

*J. M. Sullivan*

T.O. 1T-29A-1



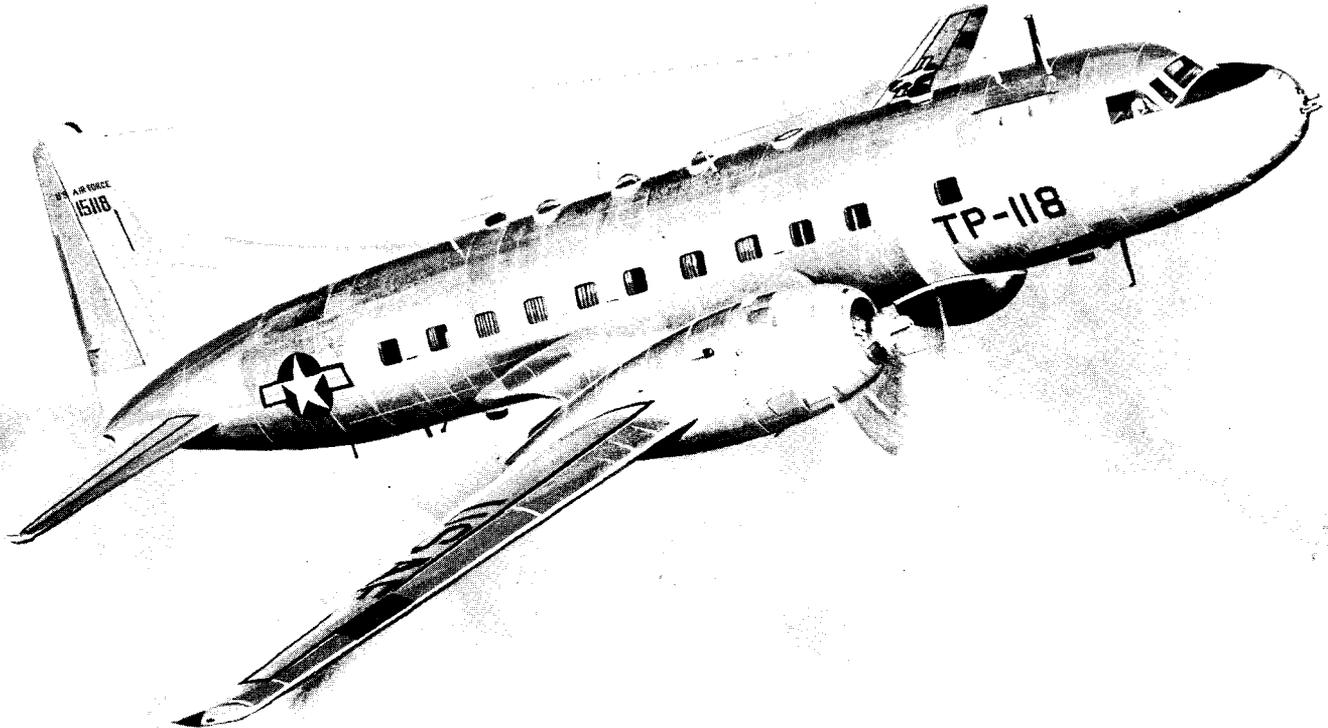
# FLIGHT MANUAL

USAF SERIES

# T-29A, B, C, & D

AIRCRAFT

CONTRACTS AF33(038)-715, F41608-69-C-2184



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C-45200

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**5 DECEMBER 1967**

CHANGE 1 - 5 JANUARY 1970

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*A . . . . .	1	*2-2A Added . . . . .	1	*3-35 - 3-36 . . . . .	1
*B Added . . . . .	1	*2-2B Blank Added . . . . .	1	*3-36A Added . . . . .	1
*C Blank Added . . . . .	1	2-3 - 2-6 . . . . .	0	*3-36B Blank Added . . . . .	1
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*ii - iii . . . . .	1	2-11 . . . . .	0	3-40 Blank . . . . .	0
iv . . . . .	0	*2-12 - 2-17 . . . . .	1	4-1 - 4-5 . . . . .	0
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1-58 - 1-59 . . . . .	0	*3-19 - 3-21 . . . . .	1	*5-9 - 5-12 . . . . .	1
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1A7-2 - 1A7-5	0		
*1A7-6	1		

**CURRENT FLIGHT CREW CHECKLISTS**

1T-29A-1CL-1  
5 DEC 1967  
CHANGE 1 - 5 JAN 1970

1T-29A-1CL-2  
5 DEC 1967

1T-29A-1CL-3  
15 JUN 1965  
CHANGE 1 - 5 JAN 1970

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<u>Current Flight Manual</u>	<u>Date</u>	<u>Changed</u>
T.O. 1T-29A-1	5 Dec 67	5 Jan 70

<u>Current Flight Crew Checklists</u>	<u>Date</u>	<u>Changed</u>
T.O. 1T-29A-1CL-1 (Pilots')	5 Dec 67	5 Jan 70
T.O. 1T-29A-1CL-2 (Navigator's)	5 Dec 67	
T.O. 1T-29A-1CL-3 (Flight Steward's)	15 Jun 65	5 Jan 70
T.O. 1T-29A-1CL-1-1 (Pilots' Scroll)	5 Dec 67	5 Jan 70

**SAFETY SUPPLEMENTS INCORPORATED IN THIS CHANGE**

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None			

**OPERATIONAL SUPPLEMENTS INCORPORATED IN THIS CHANGE**

-13	2 Aug 68	Revision Corrections	1A2-1, 1A2-2, 1A2-5, 1A2-6, 1A2-7, 2A2-1, 2A2-2, 2A2-5 thru 2A2-9, E-7
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## FOREWORD

**SCOPE** . . . This manual contains information which will provide you with a general knowledge of the aircraft, its characteristics, and specific normal and emergency operating procedures. Your flying experience is recognized; therefore, basic flight principles are avoided. This manual provides the best possible operating instructions under most circumstances, but it is a poor substitute for sound judgement. Multiple emergencies, adverse weather, terrain, or extenuating circumstances may require modification of any procedure(s) presented in this manual.

**PERMISSIBLE OPERATIONS** . . . The flight manual takes a "positive approach" and normally states only what you can do. Unusual operations or configurations which exceed the limitations as specified in this manual must be approved by the Flight Manual Manager, SAAMA (SANEAF). Clearance must be obtained from the major command before any questionable operation is attempted which is not specifically permitted in this manual.

**HOW TO BE ASSURED OF HAVING LATEST DATA** . . . You must remain constantly aware of the latest manual, checklists and status of supplements. T. O. 0-1-1-5 (supplemented monthly) and the latest flight manual or supplement status page provide a listing of the current flight manuals, checklists and supplements.

**SAFETY AND OPERATIONAL SUPPLEMENTS** . . . Safety supplements are issued as an expeditious means of reflecting safety information when hazardous or safety conditions exist. These supplements contain operational, precautionary and restrictive instructions that affect safety and safety modifications. Operational supplements are issued as an expeditious means of reflecting information when mission essential operational procedures are involved. Supplements are issued by teletype (interim) or by printed copy (formal) depending upon the urgency. Interim supplements are formalized and replaced with a new number within 30 days. If checklist pages are affected the interim supplement will be replaced within 10 days. Formal printed supplements are identified by red letters "SS" for safety supplements and black letters "OS" for operational supplements printed around the borders of the title pages. All supplements use the same numbering system; however, a safety supplement can also be identified by the "SS" preceding the number. Operational supplement numbers are preceded by a single "S". Current supplements must be complied with. A Safety and Operational Supplement Status page is furnished with each formal safety and operational supplement as well as this manual in order to help

you to be constantly aware of the status of all supplements. Since these status pages can only be as current as the associated publications, it is also necessary to refer to the appropriate index, T.O. 0-1-1-5. The title block of each supplement and title page of this manual will show the effect they have on supplements. As a further aid, a supplement summary is included in this manual following the A pages to show the disposition of each supplement incorporated in the manual as well as the replacement and rescission actions affecting those supplements. File your supplements in reverse numerical order in front of the manual; i.e., the latest supplement on top, regardless of whether it is a safety or operational supplement.

**HOW TO GET PERSONAL COPIES** . . . Each flight crew member is entitled to personal copies of the Flight Manual, Safety Supplements, Operational Supplements, and Checklists. The required quantities should be ordered before you need them to assure their prompt receipt. Check with your supply personnel - it is their job to fulfill your Technical Order requests. Basically, you must order the required quantities on the Publication Requirements Table (T.O. 0-1-1-5). Technical Orders 00-5-1 and 00-5-2 give detailed information for properly ordering these publications. Make sure a system is established at your base to deliver these publications to the flight crews immediately upon receipt.

**CHECKLISTS** . . . The flight manual contains amplified normal and emergency procedures. Checklists containing abbreviated or condensed procedures have been issued as separate technical orders. See the "A" page of this manual and the latest supplement status page for current applicable checklists. Line items in the flight manual and checklists are identical with respect to arrangement and item number. If authorized by an interim safety or operational supplement that affects a checklist, write the applicable change on the affected checklist. Within 10 days, a formal supplement will be issued with the revised checklist page attached.

**WARNINGS, CAUTIONS, AND NOTES** . . . The following definitions apply to "Warnings," "Cautions," and "Notes" found throughout the manual:

### WARNING

Operating procedures, techniques, etc., which will result in personal injury or loss of life if not carefully followed.

**CAUTION**

Operating procedures, techniques, etc., which will result in damage to equipment if not carefully followed.

**Note**

An operating procedure, technique, etc., which is considered essential to emphasize.

**DEFINITIONS . . .** The following definitions apply to the use of the words "shall," "will," "should," and "may."

**Shall and will** - Used to express that the requirements are binding and mandatory.

**Should** - Used to express a nonmandatory desire or preferred method of accomplishment and shall be construed as a nonmandatory provision.

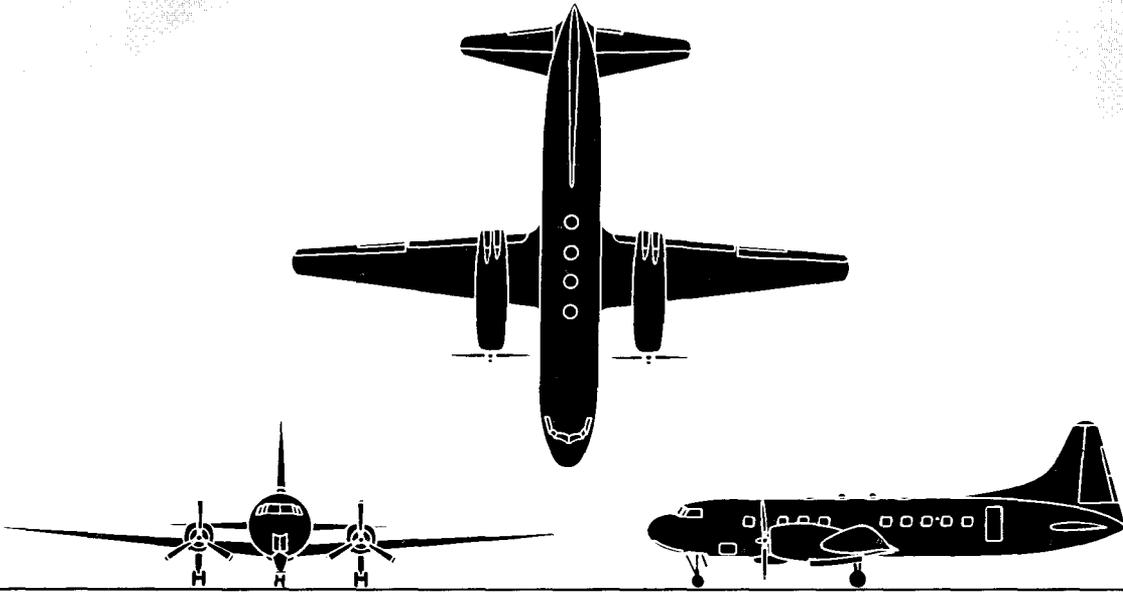
**May** - Used to express an acceptable or suggested means of accomplishment and shall be construed as a nonmandatory provision.

**YOUR RESPONSIBILITY - TO LET US KNOW . . .**

Every effort is made to keep the flight manual current. Review conferences with operating personnel and a constant review of accident and flight reports assure inclusion of the latest data in the manual. However, we cannot correct an error unless we know of its existence. In this regard, it is essential that you do your part. Comments, corrections, and questions regarding this manual or any phase of the flight manual program are welcome. These should be forwarded on AF Form 847 through your Aircrew Standardization/Evaluation channels to SAAMA (SANEAF), Kelly AFB, Texas 78241.

**AIRPLANE DESIGNATION CODE . . .** Where text or illustrations in this manual are not specifically identified for particular models, it may be assumed that such items are common to all models. Illustrations which do not show minor variations in the airplane models are labeled "Typical." Text and illustrations applicable to the different models are identified by the following code symbols:

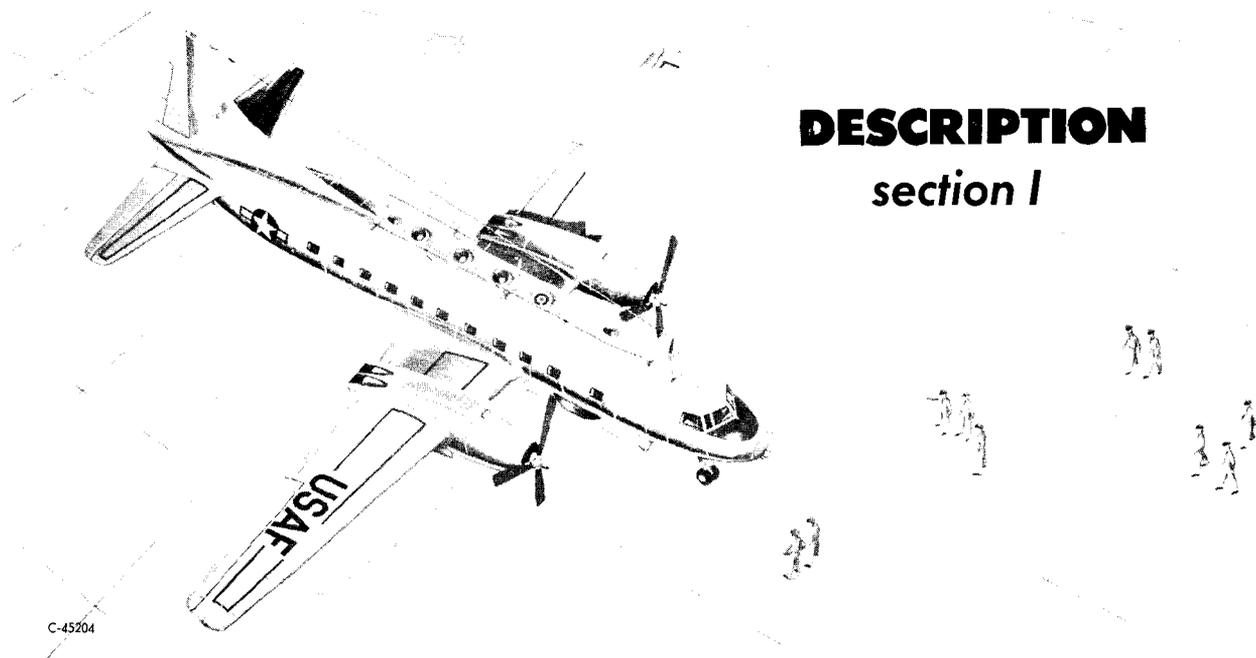
CODE	AIRPLANE MODEL
<b>A</b>	T-29A
<b>B</b>	T-29B
<b>C</b>	T-29C
<b>D</b>	T-29D



THE  
**T-29**  
AIRPLANE  
(TYPICAL)







C-45204

## DESCRIPTION

### section I

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#### THE AIRPLANE

The T-29 airplane is a transport-type, low-wing monoplane, powered by two reciprocating engines with full-feathering hydromatic propellers. Reverse pitch is available for aerodynamic braking on the ground. Periscopic sextant windows, astrodomes, antennas, and loop housings along the top of the fuselage, and a radome beneath the fuselage, identify it as a navigation and radar trainer. Within the cabin, training stations—each equipped with a seat, desk, and instrument panel—are provided for naviga-

tion students or instructors, and for radar students and instructors. A hydraulically operated entrance door, on the right side of the fuselage forward of the wing, encloses an integral stairway that unfolds into loading position as the door opens, and folds up into the fuselage as the door closes. Each unit of the retractable tricycle landing gear has dual wheels and the nose wheel unit is steerable. See the Taxi Turning Radius diagram, Section II. The basic flight crew consists of pilot, copilot, and flight engineer. Major commands may authorize operation with only a pilot and copilot when required for mission accomplishment.

# MAIN DIFFERENCES TABLE

ITEM	T-29A	T-29B	T-29C	T-29D
ENGINES	R-2800-97	R-2800-97	R-2800-99 W	R-2800-99 W
INTERPHONE	USAF COMBAT	USAF COMBAT	AN/AIC-10	AN/AIC-10
PRESSURIZED CABIN	NO	YES	YES	YES
OXYGEN CYLINDERS	2 TYPE J-1	1 TYPE G-1	1 TYPE G-1	1 TYPE G-1
ASTRODOMES	3 (FLAT WINDOW FOR PERISCOPE SEXTANT IN PLACE OF FORWARD ASTRODOME)	2 OR 3 ASTRODOMES (1 OR 2 FLAT WINDOWS FOR PERISCOPE SEXTANT IN PLACE OF ASTRODOMES)	0 OR 2 ASTRODOMES (2 OR 4 FLAT WINDOWS FOR PERISCOPE SEXTANT IN PLACE OF ASTRODOMES)	NONE
LOOP ANTENNA HOUSINGS	1 ON TOP 3 ON BOTTOM	2 ON TOP 2 ON BOTTOM	2 ON TOP 2 ON BOTTOM	2 ON TOP 2 ON BOTTOM
AUGMENTORS	OVERHANG WING TRAILING EDGE	CUT-OFF SHORT OF WING TRAILING EDGE OR "SUGAR SCOOP" EXTENSION	"SUGAR SCOOP" EXTENSION	"SUGAR SCOOP" EXTENSION
RIGHT GENERATOR AND NO. 2 ALTERNATOR	ENGINE-DRIVEN	HYDRAULIC MOTOR-DRIVEN	HYDRAULIC MOTOR-DRIVEN	HYDRAULIC MOTOR-DRIVEN
ENGINE FIRE EXTINGUISHER SYSTEM	TWO-SHOT CARBON DIOXIDE	ONE-SHOT DIBROMO-DIFLUOROMETHANE	ONE-SHOT DIBROMO-DIFLUOROMETHANE	ONE-SHOT DIBROMO-DIFLUOROMETHANE
NACELLE FLAPS	2 ON TOP COWL PANEL	2 ON TOP COWL PANEL	2 ON TOP COWL PANEL 2 ON LOWER COWL PANEL	2 ON TOP COWL PANEL 2 ON LOWER COWL PANEL
TRAINING FACILITIES	10 NAVIGATOR STUDENTS AND/OR INSTRUCTOR 4 RADAR STUDENTS AND/OR INSTRUCTOR	10 NAVIGATOR STUDENTS AND/OR INSTRUCTOR 4 RADAR STUDENTS AND/OR INSTRUCTOR	10 NAVIGATOR STUDENTS AND/OR INSTRUCTOR 4 RADAR STUDENTS AND/OR INSTRUCTOR	2 NAVIGATOR STUDENTS 2 NAV. BOMB. STUDENTS 1 NAV. INSTRUCTOR 2 BOMB. STUDENTS 1 BOMB. INSTRUCTOR

C-45205

Figure 1-1

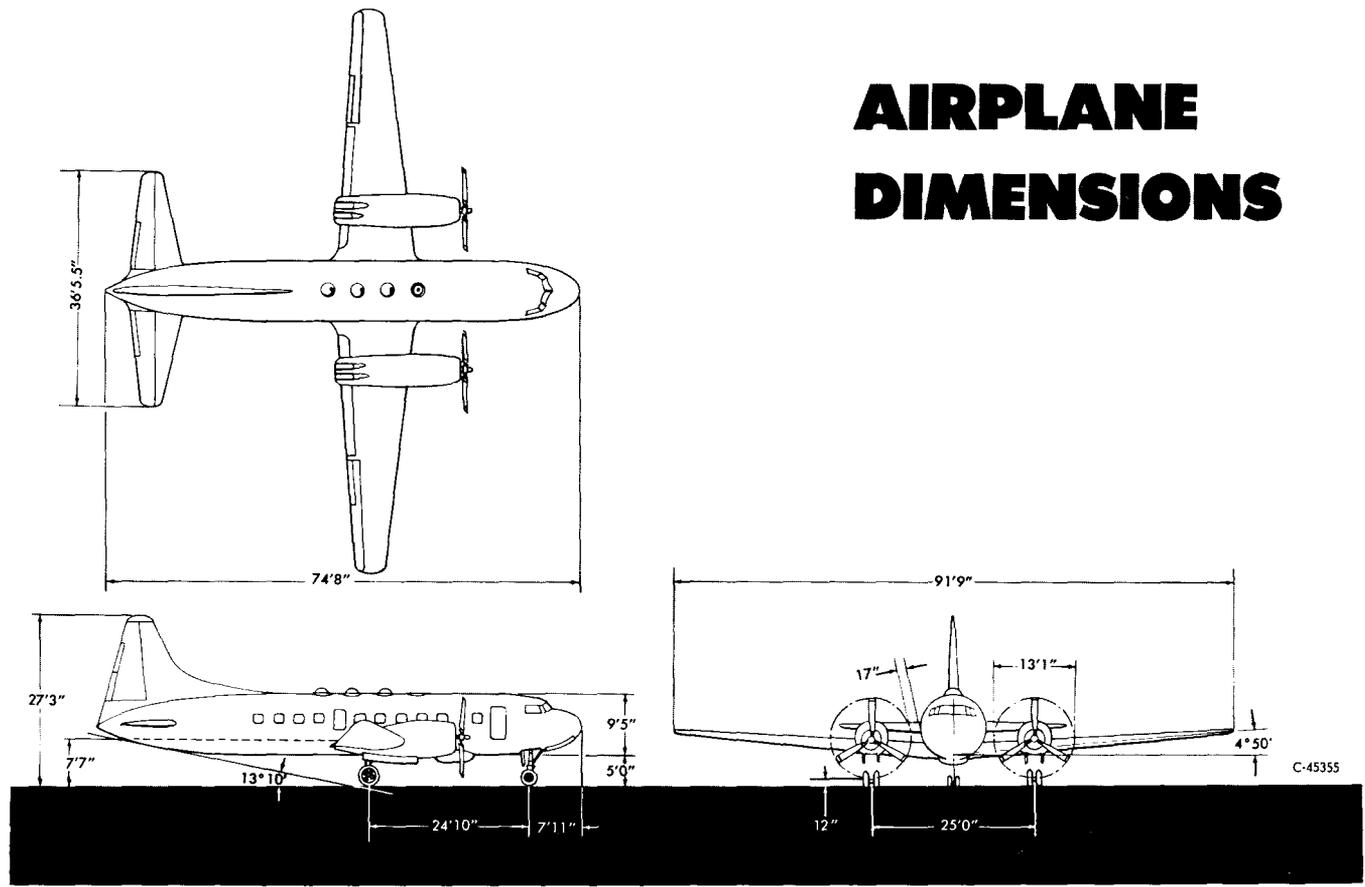


Figure 1-2

## DIMENSIONS

Wing span	91 feet, 9 inches
Length	74 feet, 8 inches
Height	27 feet, 3 inches
Tread	25 feet, 0 inches

## GROSS WEIGHT

This airplane is in the 40,000-lb. class. Refer to Section V for detailed gross weight information.

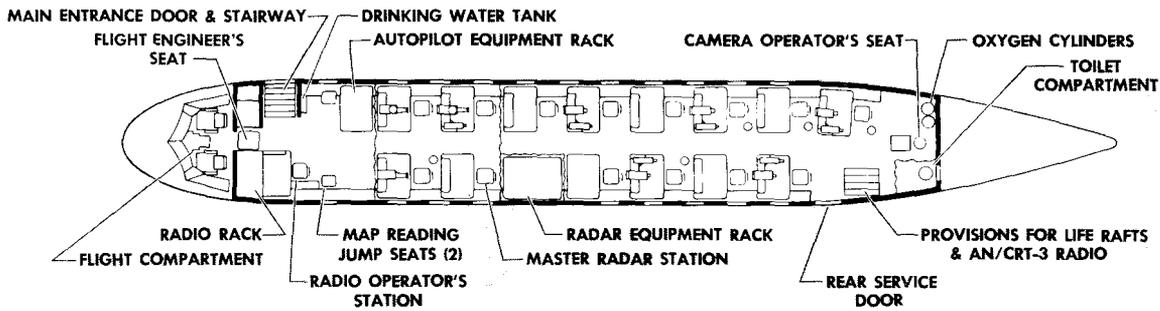
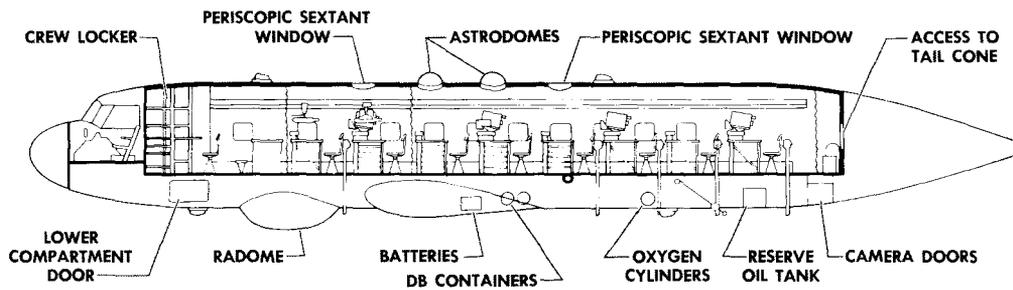
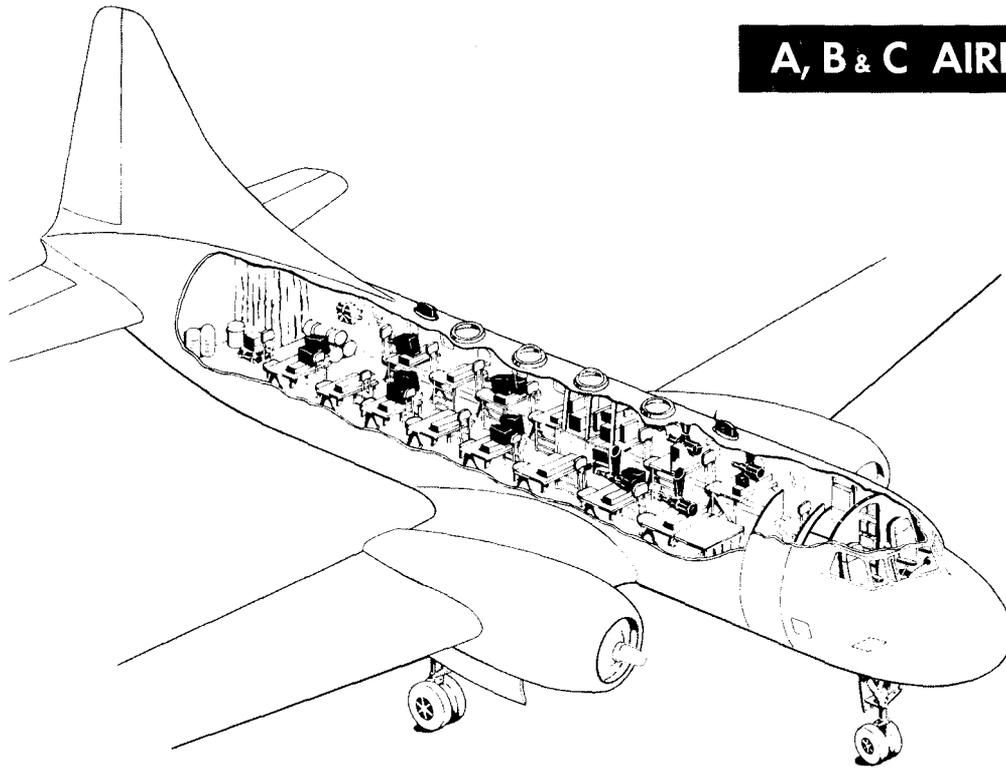
## ENGINES

The airplane is powered with two Pratt and Whitney Double Wasp, R-2800 engines. **A** and **B** airplanes are equipped with the -97 series engine and **C** and **D** airplanes are equipped with -99W series engines. The engines have integral, two-speed engine blowers and use water injection for maximum power operation. Engine exhaust augmentors are provided to increase engine cooling airflow and to augment thrust. The augmentors are large tubes that extend aft from the firewall to the wing trailing edge. Two augmentors are installed in each nacelle. Exhaust stacks carry the exhaust gases from the cylinders to the forward ends of the augmentors. Considerable

open space remains around the stacks where they terminate at the augmentors. Each augmentor functions as an ejection pump to draw cooling air across the engine and utilizes the heat energy in the exhaust gas and engine cooling air for additional thrust. Part of the engine cooling air enters muffs around the augmentors and becomes the heating air for the wing and tail anti-icing system and the heat exchanger of the cabin airconditioning system. Carburetor air is taken from an integral ram air scoop in the nacelle upper panel. Oil cooling and accessory cooling air is taken from a flush scoop in the lower surface of each nacelle. A ventilation door in the nacelle top cowl panel allows air to flow continuously through the engine accessory section. It is normally held open by a lock pin, but closes automatically and stays closed if the fire extinguishing agent is discharged. Adjustable nacelle flaps, controlled by the pilot, are provided at each nacelle to facilitate cylinder head temperature control. When the throttles, mixture control levers, or carburetor heat control levers are positioned, an anticreep device in the pedestal quadrant automatically seizes the controls and prevents reverse cable loads from moving them inadvertently. Normal operation of any of the controls instantly releases the anticreep

# GENERAL

## A, B & C AIRPLANES

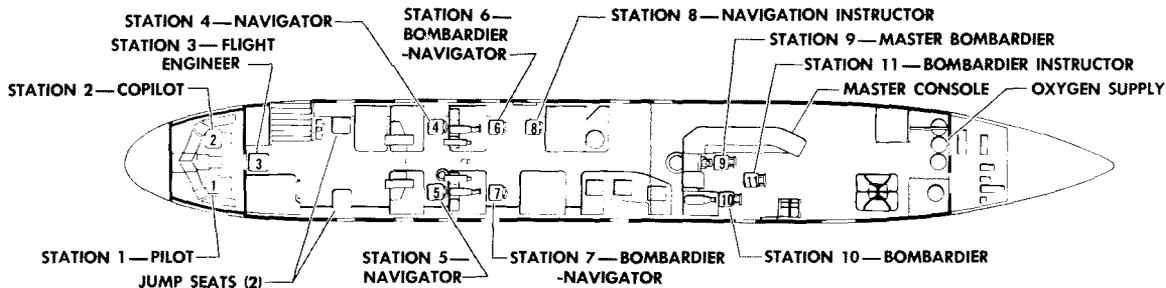
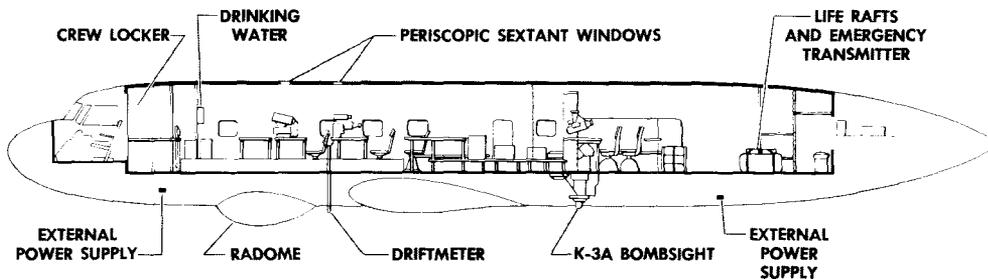
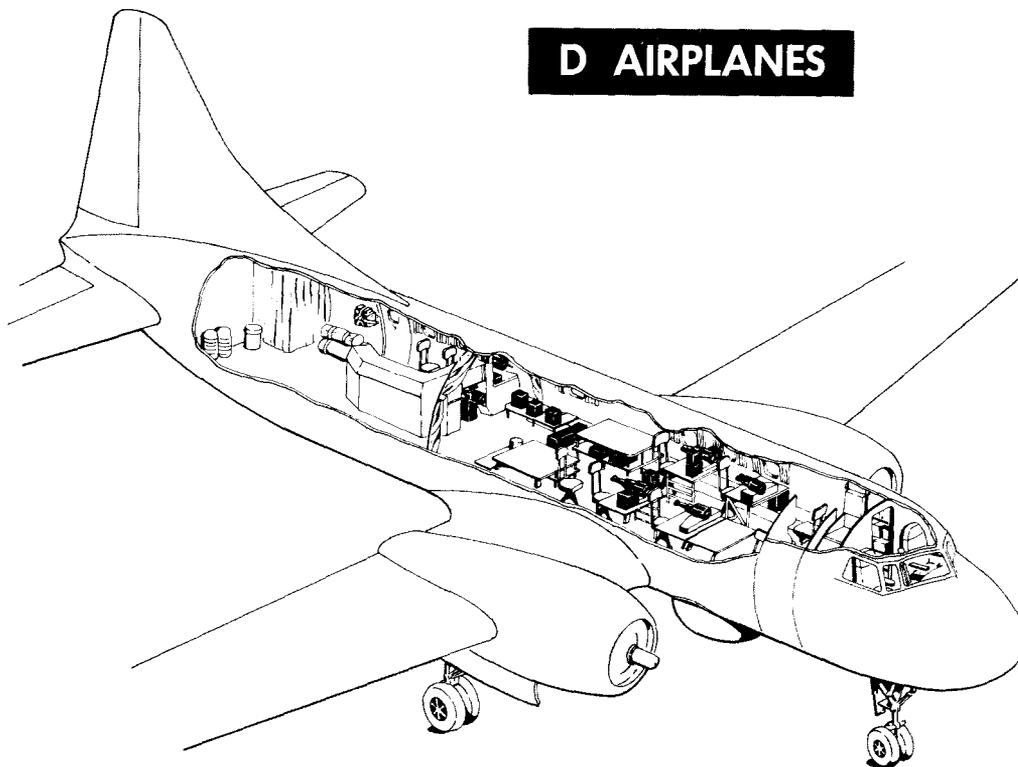


C-45206-1

Figure 1-3

# ARRANGEMENTS (TYPICAL)

## D AIRPLANES



C-45206-2

device in respect to that control and allows easy operation to the new setting, where the anticreep device again takes effect.

## ENGINE CONTROLS

### Throttles

Dual throttles 12 and 19, figure 1-10 are provided for both the pilot and the copilot on the quadrant section of the pilots' pedestal. Each throttle quadrant has a forward thrust range, OPEN; a reverse thrust range, REVERSE OPEN; and a neutral midposition, CLOSE. Each throttle quadrant is provided with a detent at the CLOSE position and with a solenoid-operated latch stop that prevents the throttle from being pulled aft into reverse thrust range unless the airplane is on the ground (left landing gear strut compressed), at which time the solenoid-operated latch stops are withdrawn. (Refer to LANDING GEAR SAFETY CIRCUIT, Section VII.) Two additional solenoid-operated latch stops prevent movement of the throttles into the full-power, reverse-thrust positions until the propeller blades have reached the full reverse pitch. The propellers are taken out of reverse by moving the throttles forward to, or beyond, the CLOSE detents.

### Mixture Control Levers

Two mixture control levers (10, figure 1-10), one for each engine, are provided on the right side of the pilots' pedestal quadrant. Each lever has three operating positions. AUTO RICH, the fully forward position, provides a rich mixture of fuel and air automatically adjusted for power, temperature, and altitude changes. In other than the idle rpm range, a leaner mixture is provided by the middle position, AUTO LEAN, which at cruise power provides a fuel-air ratio leaner than best power. IDLE CUTOFF, the fully aft position, stops the engine by stopping fuel flow at the carburetor. On **C** and **D** airplanes, the mixture control mechanism also provides adjustment for manually leaning the fuel-air mixture for cruise. Refer to CARBURETOR MIXTURES, Section VII.

### Carburetor Heat Control Levers

Two carburetor heat control levers (9, figure 1-10) on the right side of the pilots' pedestal quadrant mechanically open and close the carburetor heat doors in the nacelles. When the levers are in the COLD (fully forward) position, outside air enters the carburetors through the carburetor air inlet ducts. When the levers are in the HOT (fully aft) position, the carburetor heat doors close off the inlet ducts and all carburetor air is taken from the engine sections of the nacelles. Intermediate positions of the levers provide a mixture of hot and cold air and permit regulating carburetor air temperatures to the level desired.

## ENGINE BLOWERS

Each engine incorporates a single-stage, two-speed, geared engine blower (supercharger). In low speed, the blower ratio is 7.29 times engine speed. In high speed the ratio is 9.1 to 1 on **A** and **B** airplanes, or 8.58 to 1 on **C** and **D** airplanes. The blowers are operated in low-speed ratio for takeoff, landing,

and flights at low altitude. The high-speed ratio provides increased manifold pressure and brake horsepower capabilities for high-altitude operation. Shifting from one speed to another is accomplished by electrically controlled, hydraulically operated clutches. Each clutch is gear-driven to obtain the required speed differential. As one clutch is engaged, the other is automatically disengaged. Shifting speeds is accomplished by positioning the engine blower switch that controls a single valve and solenoid actuator to control the flow of engine oil to the hydraulically operated clutch shift valves. Refer to ENGINE BLOWERS, Section VII, for blower operation.

### Engine Blower Switches

Two engine blower switches (14, figure 1-10) control dc power to the blower shift mechanism. The switches have LOW and HIGH positions corresponding to the two speeds of the blowers.

### CAUTION

The blower shift mechanism is actuated by a dc solenoid, spring-loaded to the low ratio. If the electrical power supply is cut off while operating in high ratio, the blowers will automatically shift back to low.

## WATER INJECTION SYSTEM

A water injection system serving both engines is provided to permit an increase in maximum power for takeoff and reserve power in event of go-around, obstacle clearance, and similar emergencies. The water injection fluid, referred to as ADI (anti-detonant injection) fluid, or water, is composed of 40% distilled water and 60% methyl alcohol by volume. Rather than operate at the excessively rich mixtures required to effect internal cylinder cooling during high power operation, mixtures are leaned to approximately best power; the cooling requirements are then satisfied by the injection of water. Refer to WATER INJECTION, Section VII. A tank with a total volume of 25 US gallons, located in the right wing fillet, contains the water supply and the water pressure pump. A switch on the pedestal quadrant controls dc power to the water pump. A switch in the float-operated water quantity transmitter in the tank stops the pump when the water is used down to the three-gallon level to prevent damage to the pump by dry operation. The same switch in the tank quantity transmitter opens the power circuit from the water injection switch if the preceding use of water has left less than seven gallons in the tank. This prevents use of water injection when there is insufficient water left to complete a wet power takeoff. The release of water into inoperative engines is avoided by oil pressure operated valves in the water injection system, which prevent water flow to the water regulators if the engine oil pressure is below 30 psi. The water regulators automatically admit and meter water into the engine fuel feed valve whenever manifold pressures are above approximately 35 to 40 inches Hg. See figure 1-42 for water injection fluid specification.

# WATER INJECTION SYSTEM

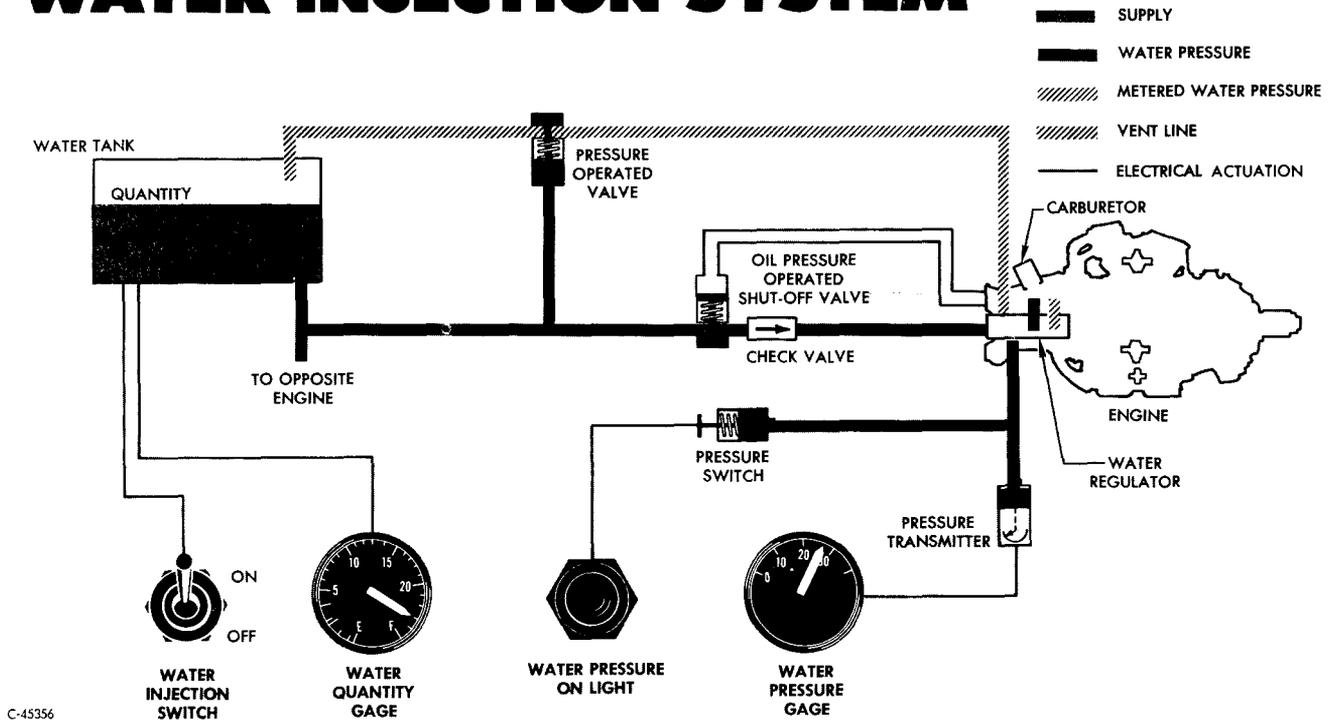


Figure 1-4

## Water Injection Fluid Specification

See figure 1-42.

## Water Injection Switch

A guarded two-position water injection switch (13, figure 1-10), located on the pilots' pedestal quadrant, is provided to control operation of the pump in the water injection system tank. The switch has ON and OFF positions. When placed in the ON position, dc power from the main bus is routed to the pump.

## Water Injection Indicators

A water quantity gage (26, figure 1-9), two green water-pressure-on indicator lights (24, figure 1-9), and two water pressure gages (22, figure 1-9) are located on the engine instrument panel. The quantity gage registers the amount of fluid in the supply tank; the water-pressure-on indicator lights illuminate when water, at 18 psi pressure or more, is available at the inlets of the water injection regulators; and the pressure gages show the pressure of the water available at the regulators. The quantity gage and the indicator lights are dc operated. The pressure gages operate on 26-volt regulated alternating current.

## ENGINE COOLING

Cooling air is drawn across the engine by the jet-pump action of exhaust gases entering the augmentors (figure 1-7). The flow of cooling air can be

increased by opening the nacelle flaps. Vanes in the aft ends of the augmentors can be positioned to restrict flow of exhaust gases and air through the augmentors. Restricting the flow increases the temperature of the augmentors and, consequently, the temperature of the heated air supplied by the augmentor muffs to the airplane's heating and anti-icing systems. Because restricting the flow through the augmentors decreases the amount of cooling air drawn across the engines, cylinder head temperatures are the controlling factor in operation of the augmentor vanes.

## Nacelle Flaps

On **A** and **B** airplanes, two nacelle flaps are installed in the top cowl panel of each nacelle. On **C** and **D** airplanes, two nacelle flaps are installed in the top cowl panel and two in the bottom cowl panel of each nacelle. The nacelle flaps are actuated by dc, reversible-motor jacks. Two switches on the overhead switch panel route current to one side or the other of the motors. Opening the nacelle flaps allows engine cooling air to vent directly from the engine section to the outside. When the nacelle flaps are closed, engine cooling air flows through the augmentor tubes along with the exhaust gases. If the cabin is being heated or if the wing and tail anti-icing system is being operated, the nacelle flaps are normally closed in order to direct a strong flow of warm air into the augmentor shrouds and muffs and

thence into the cabin heat exchanger or the wing and tail anti-icing ducts.

### Nacelle Flap Switches

Two nacelle flap switches (figure 1-8), one for each nacelle, are located on the overhead switch panel. Each switch has four positions: MID POSITION, OPEN and CLOSE; the switches are spring-loaded from the OPEN and CLOSE positions to an unmarked OFF position. The switches connect dc power to the closing side of reversible motors at the nacelle flap actuating jacks when held in the CLOSE position. When held in the OPEN position, power is supplied to the opening side of the motors. When the switches are released to OFF position, the nacelle flaps remain in the position they had reached at the time the switches were released. This allows precision control because it takes 10 seconds to move the nacelle flaps from one extreme position to the other due to reduction gearing between the motors and the jacks. When the switches are placed in MID POSITION, power is supplied to the appropriate side of the motors and the nacelle flaps open three inches on **A** and **B** airplanes, or two inches on **C** and **D** airplanes, and remain at that setting until the switches are again held in either the OPEN or CLOSE position.

### Augmentor Vanes

A vane is installed near the aft end of each augmentor. These vanes are used to raise the temperature of air in the heat collector muffers around the augmentors when required for cabin heating and/or wing and tail anti-icing. Both vanes in each nacelle are operated by a single actuator. The actuator is energized by direct current to close or trail the vanes by operation of the corresponding augmentor vane switch. Although the vanes are small compared to the cross section of the augmentor tubes, when closed they restrict the flow of air and exhaust gases sufficiently to cause considerable temperature increase in the augmentors. To protect the augmentors, thermally operated override dc circuits will turn the vanes to trail if an overheat condition develops in the heat collector muffers at the augmentors, or if the wing or tail leading edges become overheated while the augmentor vane switch circuits are armed. The vanes cannot be operated to closed or partly closed position as long as the overheat condition exists.

### Augmentor Vane Arm Switch

**B C D**  
An augmentor vane arm switch (figure 4-2) on the co-pilot's console opens and closes the dc circuit to the augmentor vane switches when wing and tail anti-icing is not in operation. The switch has ARM and OFF positions. The ARM position connects dc power to the augmentor vane switches and energizes relays that arm the overheat thermal switches in the wing and tail leading edges and disconnects dc power from the trailing side of the augmentor vane actuators. Whenever the wing and tail anti-icing system is in operation, the augmentor vane switches and the overheat safety circuits are armed regardless of the position of the augmentor vane arm switch.

### Augmentor Vane Switches

Two augmentor vane switches, located on the overhead switch panel (figure 1-8), supply dc power to either the closing or trailing sides of the augmentor vane actuators.

#### Note

On **A** airplanes, the augmentor vane switches are inoperative unless the heat anti-ice button is in PUSH ON position. On **B**, **C**, and **D** airplanes, the augmentor vane switches are inoperative unless the augmentor vane arm switch is in ARM position or the heat anti-ice button is in PUSH ON position. (Refer to AIR-CONDITIONING SYSTEM and to WING AND TAIL ANTI-ICING SYSTEM, Section IV, for additional information on the use of augmentor vanes.)

The augmentor vane switches have OFF, TRAIL, and CLOSE positions and are spring-loaded to OFF. Holding the switches in CLOSE position actuates the augmentor vanes to restrict the flow through the augmentors; holding the switches in the TRAIL position actuates the vanes to their trail positions, so that flow through the augmentors is unrestricted. Releasing the switches to the OFF position stops the vanes in the position then indicated by the augmentor vane position indicators. If the augmentor vanes have been positioned to restrict flow through the augmentors and an overheat condition occurs in the augmentors, thermal switches at the augmentors automatically operate all augmentor vanes to the trail position and the augmentor overheat warning bell rings. As long as the warning bell rings, both augmentor vane switch circuits are open and have no control over vane position.

### Augmentor Vane Position Indicators

Two augmentor vane position indicators (36, figure 1-9), one for each nacelle, are located on the engine instrument panel and indicate the position of the augmentor vanes. The indicators are calibrated in degrees with TRAIL at the fully open, or 0°, position and CLOSED at the 90° position. Degrees of intermediate positions are indicated by numerals. The remote indicators utilize 26-volt regulated alternating current. The indicators are operative, therefore, even when the augmentor vane control circuit has not been armed and even though the augmentor vane control circuit has been overridden by the augmentor overheat warning circuit.

#### Note

If an ac power failure occurs, the indicators will remain in the position indicated at the time of failure. However, the augmentor vanes will remain operative as long as dc power is available.

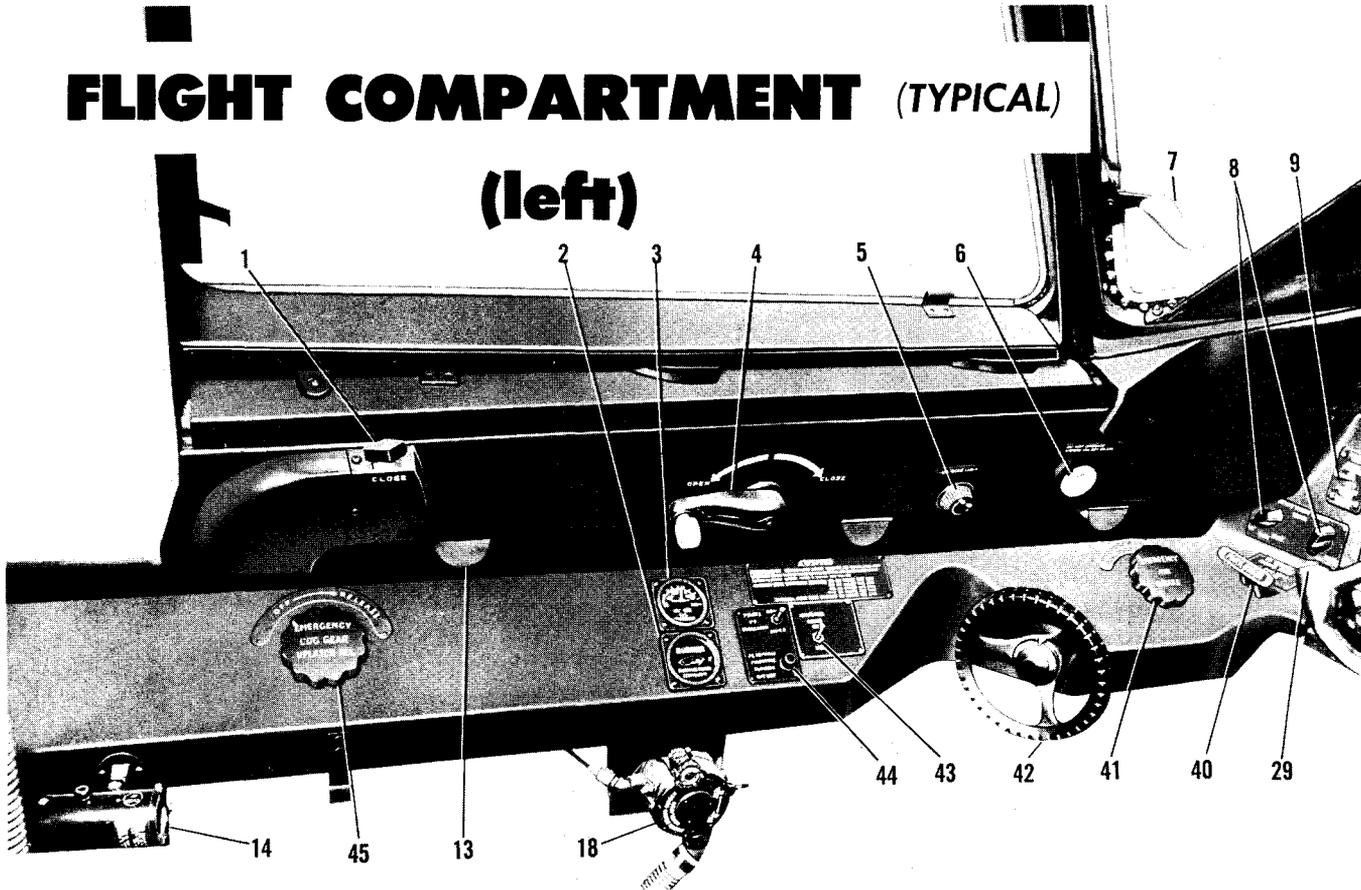
### Augmentor Overheat Warning Bell

Overheat thermal switches that turn the augmentor vanes to trail when overheat occurs also operate an



# FLIGHT COMPARTMENT (TYPICAL)

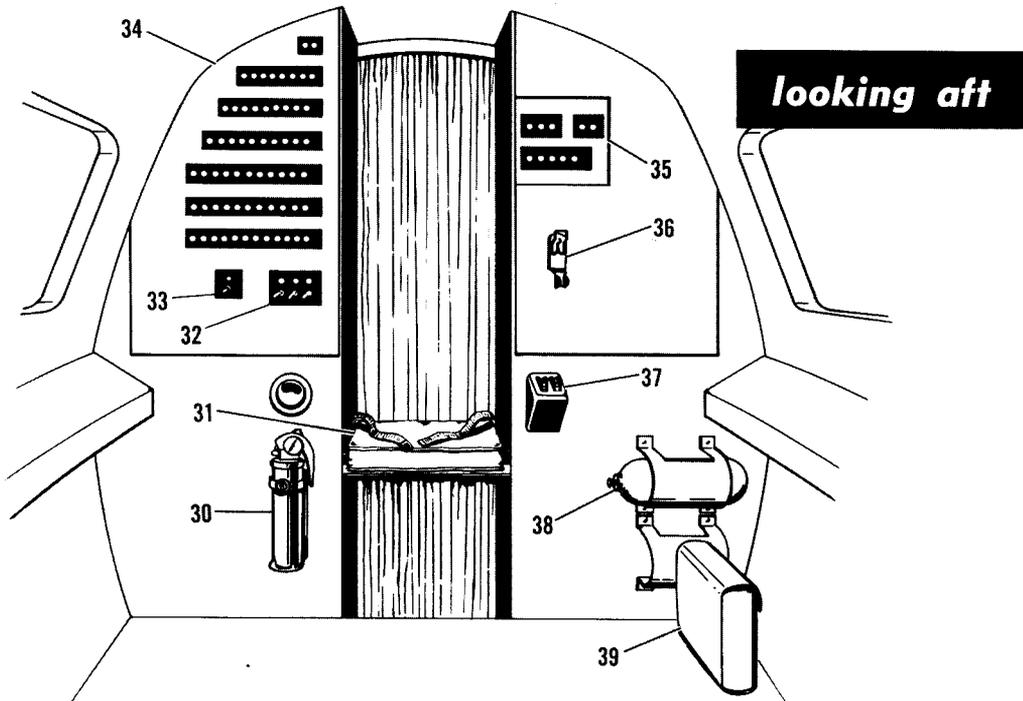
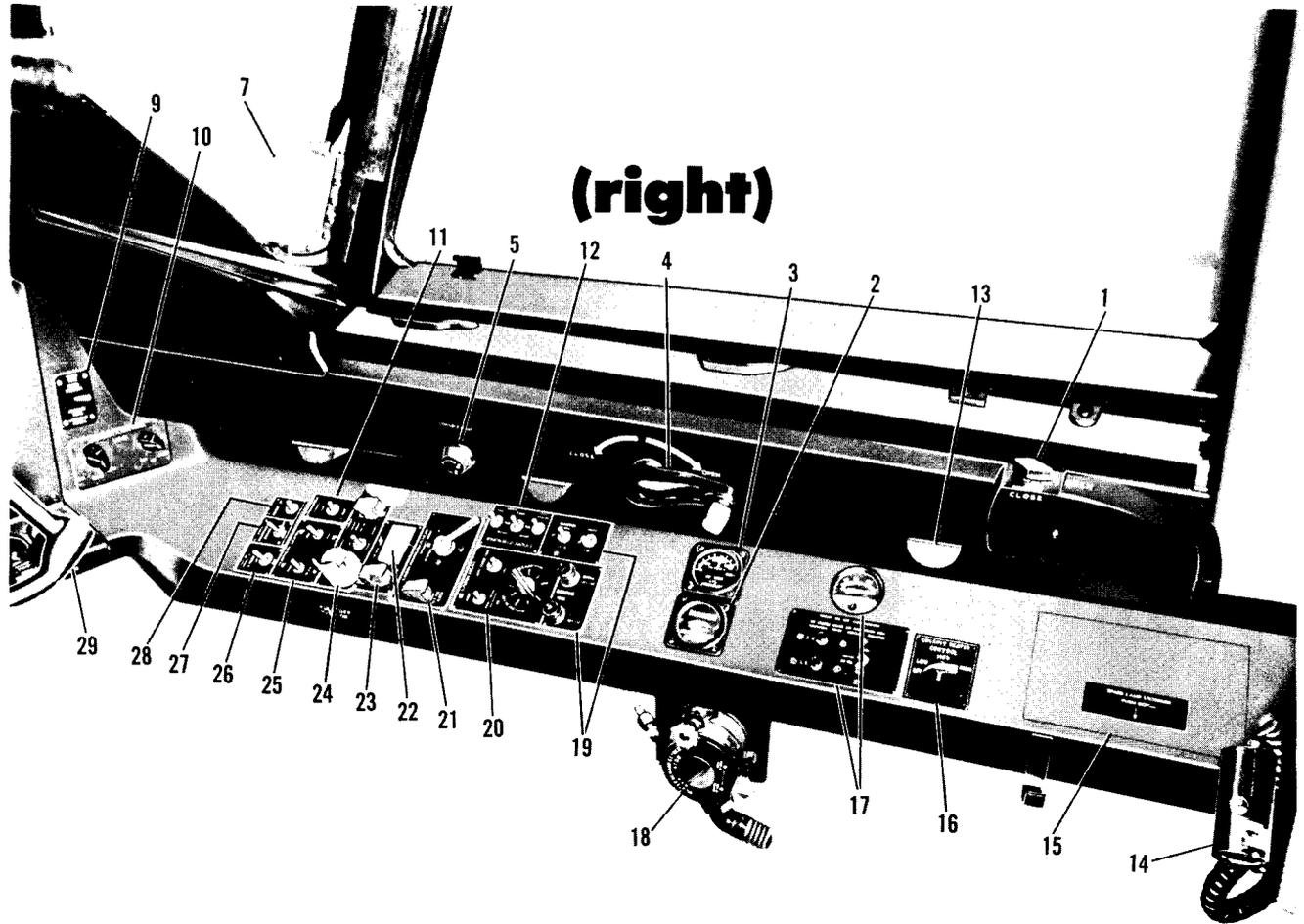
(left)



- |  |  |
|--|--|
| <ol style="list-style-type: none"> <li>1. Ventilating air outlet</li> <li>2. Oxygen flow indicator</li> <li>3. Oxygen pressure gage</li> <li>4. Side windshield crank</li> <li>5. Console lights rheostat</li> <li>6. Windshield wiper knob</li> <li>7. Direct vision windshield locking handle</li> <li>8. Pilot's flight panel red and white lights rheostats</li> <li>9. Static pressure selector switch</li> <li>10. Copilot's flight panel red and white lights rheostats</li> <li>11. Passing light switch</li> <li>12. Windshield anti-ice panel</li> <li>13. Console lights</li> <li>14. Utility spotlight <b>(A B)</b></li> <li>15. Spare lamps stowage</li> <li>16. Cockpit heater control <span style="margin-left: 20px;">LATER <b>(B C D)</b></span></li> <li>17. Propeller de-ice panel <b>(B C D)</b></li> <li>18. Oxygen regulator</li> <li>19. Reserve oil transfer and heat panels</li> <li>20. Cabin heat panel</li> <li>21. Cabin pressurization panel <b>(B C D)</b></li> <li>22. Structural overheat limit override switch</li> <li>23. Alternator-generator hydraulic system panel <b>(B C D)</b></li> <li>24. Heat anti-icing panel</li> </ol> | <ol style="list-style-type: none"> <li>25. Position light switches</li> <li>26. Wheel well and nose compt. lights switch</li> <li>27. Side windshield defrost switch <b>(A, EARLY B)</b><br/>Anti-collision light switch <span style="margin-left: 20px;">LATER <b>(B C D)</b></span></li> <li>28. Pitot heat switch</li> <li>29. Microphone and autopilot release buttons<br/>(on control wheel)</li> <li>30. Portable CB fire extinguisher</li> <li>31. Flight Engineer's seat</li> <li>32. Inverter reset switches and indicator lights <b>(A B C)</b></li> <li>33. Instrument a-c power switch and indicator light</li> <li>34. Main circuit breaker panel</li> <li>35. Auxiliary circuit breaker panel</li> <li>36. Flight Engineer's headset bracket <b>(A B)</b></li> <li>37. Autopilot turn control transfer switch<br/>and compass slaving switch</li> <li>38. Oxygen bottle</li> <li>39. Data case and flight report stowage</li> <li>40. Parking brake handle</li> <li>41. Emergency air brake knob</li> <li>42. Nose steering wheel</li> <li>43. Warning horn switch</li> <li>44. Pilot's V-2 indicator selector switch<br/>and indicator light <span style="margin-left: 20px;">LATER <b>(B C)</b></span></li> <li>45. Landing gear uplatch emergency release knob</li> </ol> |
|--|--|

C-45208-1

Figure 1-6



C-45206-2

augmentor overheat warning bell on the flight compartment ceiling. The bell rings continuously as long as an overheat condition exists in any augmentor. No cutoff switch is provided. The electrical circuit for the bell is protected by the fire detector circuit breaker on the main circuit breaker panel.

## WARNING

The fire detector circuit breaker must not be pulled out to silence the augmentor overheat warning bell. If the circuit breaker is pulled out, the fire detection system will be inoperative.

### IGNITION AND STARTING

Ignition current is provided by a separate system for each engine. Each system consists of a dual magneto, two distributors, the necessary ignition coils and relays, and two spark plugs in each cylinder. A vibrator provides ignition boost during engine starting. An ignition switch is provided for each engine. A direct-cranking starter is installed on each engine. Priming fuel is introduced to the engine through primer nozzles mounted just below the carburetor. An engine starting selector switch routes dc power from the ignition boost, prime, and start switches to the corresponding operating units at each engine during engine starting.

#### Ignition Switches

Two ignition switches (figure 1-8), one for each engine, are located on the overhead switch panel. Switch positions are: OFF, R, L, and BOTH.

#### Engine Starting Selector Switch

The engine starting selector switch, located on the overhead switch panel (figure 1-8), has LEFT, RIGHT, and OFF positions. When the left engine is to be started, the switch is placed in the LEFT position. This connects dc circuits from the ignition boost switch, prime switch, and start switch to the corresponding operating units at the left engine. When these switches are then held ON for engine starting, dc power is supplied to the operating units through the circuits previously closed by the engine starting selector switch. When the right engine is to be started, placing the engine starting selector switch in the RIGHT position allows use of the same ignition boost, prime, and start switches for starting the right engine.

#### Ignition Boost Switch

An ignition boost switch, located on the overhead switch panel (figure 1-8), is provided to afford a hot spark for engine starting. The switch has ON and OFF positions. When held to ON, the switch supplies dc power to a vibrator that produces high-voltage current. A circuit connects the vibrator to the ignition harness in each nacelle to boost the ignition voltage. Each circuit is kept open by a relay-operated switch. Only one of the relays operates at a time depending on the position of the engine starting selector switch. Moreover, the appropriate relay closes the ignition boost circuit only while the

engine start switch is held to ON. Thus, ignition boost current is supplied to the spark plugs only while the engine is being cranked by the starter.

#### Prime Switch

A two-position prime switch is located on the overhead switch panel (figure 1-8). This switch, spring-loaded to the OFF position, when held to the ON position energizes a dc, solenoid-operated prime valve for the engine selected with the engine starting selector switch. The prime valve opens, permitting fuel to bypass the carburetor and flow directly into the throat of the engine blower. To assure priming fuel flow during engine starting, the corresponding fuel boost pump must be operating. The prime switch is not operative when the engine starting selector switch is in the OFF position.

#### Start Switch

A start switch (figure 1-8), located directly below the engine starting selector switch on the overhead switch panel, has ON and OFF positions and is spring-loaded to OFF. The position of the engine starting selector switch determines which engine starter will be energized when the start switch is held to ON. Operation of the start switch supplies dc power to the selected engine starter and energizes the appropriate relay to close the ignition boost circuit from the ignition vibrator to the corresponding ignition harness.

### ENGINE INDICATORS

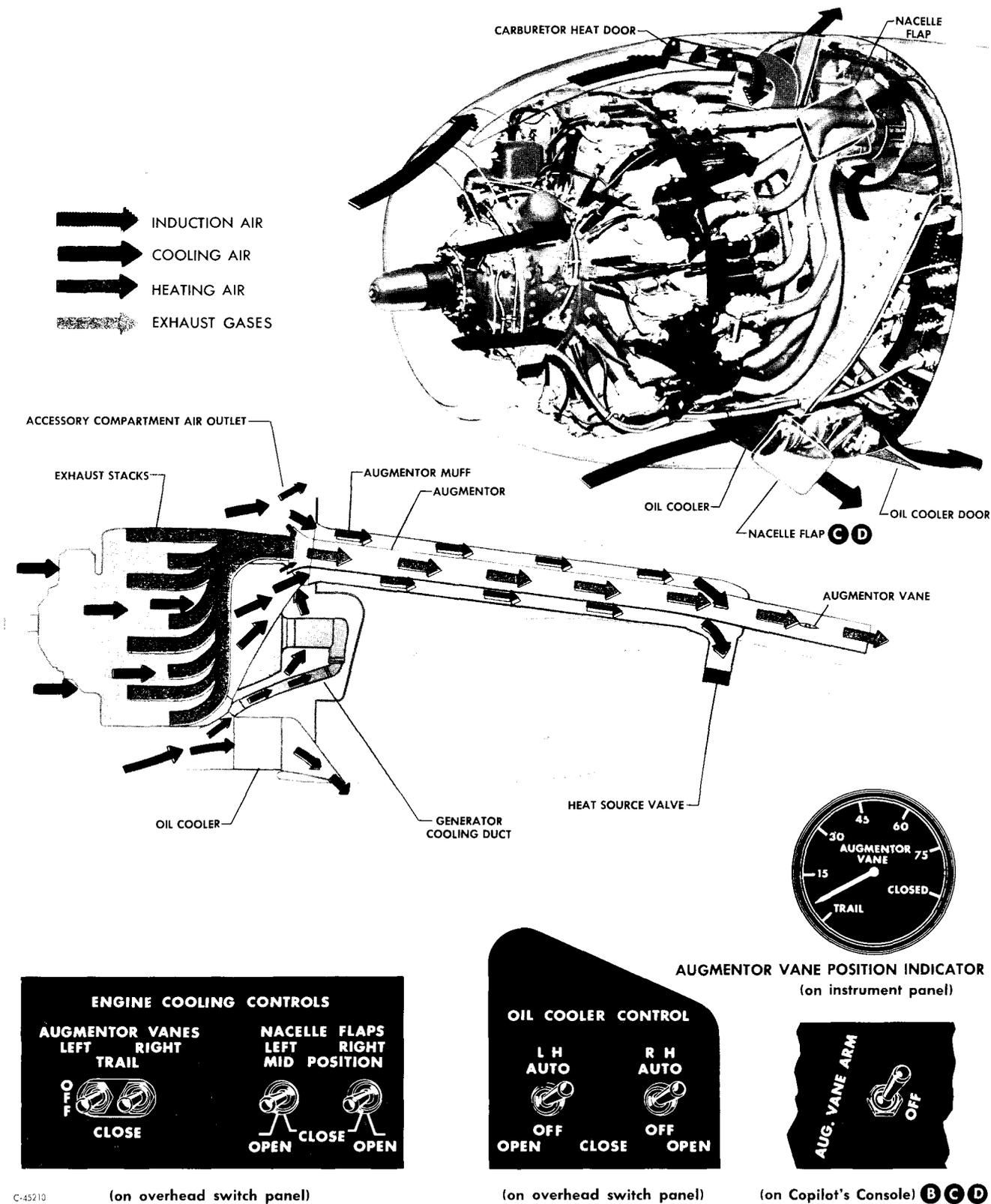
#### Manifold Pressure Gages

Two direct-reading manifold pressure gages, one for each engine, are located on the engine instrument panel (18, figure 1-9). The gages are calibrated in inches of mercury in terms of absolute pressure and measure the pressure in the induction manifold of each engine. In conjunction with the tachometers, carburetor air temperature, and pressure altitude, they give an indication of engine input power. Direct pressure lines connect the gages to the engine blower cases. When an engine is not operating, the corresponding gage indicates ambient barometric pressure.

#### Manifold Pressure Gage Line Drain Valve Buttons

Two buttons (39, figure 1-9) are provided on the engine instrument panel to operate cockpit drain valves in the left and right manifold pressure gage lines. Each button, when depressed, mechanically opens the valve in the corresponding pressure line for purging the line. The buttons are depressed for a moment or two during engine warmup with the manifold pressure several inches below field barometric pressure. This allows negative pressure in the manifold to pull foreign matter out of the gage lines into the engines, where it is discharged with the exhaust gases. If the buttons are pressed when manifold pressure equals barometric pressure, purging will not take place due to lack of suction. If the buttons are pressed inadvertently when manifold pressure exceeds cabin pressure, fuel-air mixture and any foreign matter in the lines will be blown into the flight compartment. An additional drain valve is provided in each nacelle for use of ground crew personnel during maintenance operations.

# ENGINE COOLING (TYPICAL)



C-45210

(on overhead switch panel)

(on overhead switch panel)

(on Copilot's Console) **B C D**

Figure 1-7



Figure 1-8

### Tachometers

Two tachometers (42, figure 1-9), one for each engine, are located on the engine instrument panel and indicate the rpm of each engine. Each tachometer is a remote-indicating instrument receiving power from a tachometer-generator attached to the engine accessory case, thereby operating independently of the airplane electrical system.

### Cylinder Head Temperature Gages

Two cylinder head temperature gages (20, figure 1-9), one for each engine, are located on the engine instrument panel. Each gage is connected to a bayonet-type thermocouple which is located in the hottest cylinder head of the corresponding engine. The electrical energy generated in the thermocouple is a measure of the head temperature and is indicated on the gage in degrees centigrade. Electrical power from the airplane electrical system is not required for operation of these gages.

### Carburetor Air Temperature Gages

Two carburetor air temperature gages (19, figure 1-9), one for each engine, are installed on the engine instrument panel and indicate the temperature of the air entering the carburetors. The gages are ratio-galvanometer instruments that require 28-volt dc power from the main bus and are calibrated in degrees centigrade. Each gage is connected to a resistance-type sensing bulb which is located in the duct above the carburetor coupling of the corresponding engine. If the power supply to the gages is interrupted, the pointer on each gage will fall below the low end of the scale.

### Oil Temperature Gages

Two oil temperature gages (21, figure 1-9), one for each engine, are located on the engine instrument panel. The gages indicate the temperature of the oil entering the engine in degrees centigrade. The gages are ratio-galvanometer type units which operate in

conjunction with resistance-type sensing bulbs in the engine rear cases. The instruments operate on 28-volt dc. If this power source fails, the pointers will fall below the low end of their scales.

### Oil Pressure Gages

Two oil pressure gages (38, figure 1-9), one for each engine, are located on the engine instrument panel and indicate engine oil pressure in pounds per square inch. The gages are remote-indicating Autosyn-type units which are connected to transmitters located in the engine nacelles. Each indicator and transmitter system operates from a separate 26-volt regulated ac circuit. If the power supply fails, the oil pressure gages may remain within the normal operating range, regardless of the existing oil pressure.

### Fuel Pressure Gages

Two fuel pressure gages (37, figure 1-9), one for each engine, are located on the engine instrument panel and indicate engine fuel pressure in pounds per square inch. These remote-indicating Autosyn instruments are connected to transmitters which are located in the nacelles and are similar to the oil pressure indicators. If the 26-volt regulated ac power supply fails, the gages may continue to indicate within their normal operating range, and false indications can be expected.

### Fuel Flowmeters

Two Magnesyn-type fuel flowmeters (40, figure 1-9), one for each engine, are located on the engine instrument panel. Each flowmeter is a remote-indicating unit having the transmitting unit installed in the fuel line between the carburetor and the blower case of each engine. All fuel consumed by the engine (except the primer) passes through the transmitter where the rate of flow is measured in pounds per hour. The fuel flowmeter units operate from the 26-volt regulated ac power supply.

### Fuel Pressure-Low Warning Light

A red light (27, figure 1-9), located on the engine instrument panel, will illuminate if the fuel pressure of either engine falls below 18±0.5 psi. The light operates on dc from the main bus.

### Torquemeters

Two torquemeters (41, figure 1-9), one for each engine, are located on the engine instrument panel. The torquemeters give an indication of power delivered to the propeller drive shafts. The system is essentially a method of measuring engine torque piston oil pressure and transmitting the pressure values to the indicators. The indication is in psi which refers to engine oil pressure built up in special torquemeter pressure pistons in the forward accessory section of the engine. The torquemeter transmitter is installed in the aft accessory section and is connected to the pressure pad on the front accessory case of each engine by a capillary pressure link. The transmitter and indicators are Autosyn-type remote indicating units and operate from the 26-volt regulated ac power supply.

### PROPELLERS

Each engine is equipped with a three-blade, full-feathering, reversible pitch, Hamilton Standard Hydromatic propeller. **A** airplanes have the model 23260-303 steel blade propeller; **B** **C** **D** airplanes have the model 43E60-533, modified, aluminum blade propeller. A propeller governor on each engine automatically adjusts propeller pitch to maintain constant engine speed under varying flight conditions. Governor settings are controlled from the flight compartment. Automatic and manual feathering controls are provided. Propeller pitch can be reversed after landing to produce aerodynamic braking. Feathering, unfeathering, reversing, and unreversing actions of the propeller governor are accelerated by an auxiliary feathering pump which supplies high-pressure oil to the governor, boosting the pitch change rate from approximately 8.75° per second to 14° per second. Oil from the engine oil tank sump is used for all propeller pitch changing. All propeller control electrical circuits are dc operated.

### Propeller Speed Control Levers and Governor Limit Lights

Two propeller speed control levers (figure 1-12) are provided on the pedestal quadrant to increase or decrease engine and propeller rpm by changing the propeller blade pitch. Each lever has an INCREASE RPM (forward) position and a DECREASE RPM (aft) position. The levers are spring-loaded to an unmarked OFF position midway between the two operating positions. Propeller speed is adjusted by raising or lowering a rack against the governor speeder spring. This rack is actuated by the step-motor electric head (on the governor) through the commutator switch box when one of the levers is held in either INCREASE RPM or DECREASE RPM. Propeller pitch change occurs at a rate that changes engine speed approximately 100 rpm per second. Propeller speed changes proportionately as reduction gearing keeps propeller speed at 0.45 times

engine speed. Low rpm and high rpm limit stops in the propeller governor limit the range of rpm change to predetermined settings. Two amber limit lights (figure 1-12), one for each propeller, are installed on the pilot's pedestal. When either the high rpm or low rpm stop is reached in a propeller governor, a dc circuit to the corresponding amber limit light is closed to indicate that the governor is set at either the high or low limit.

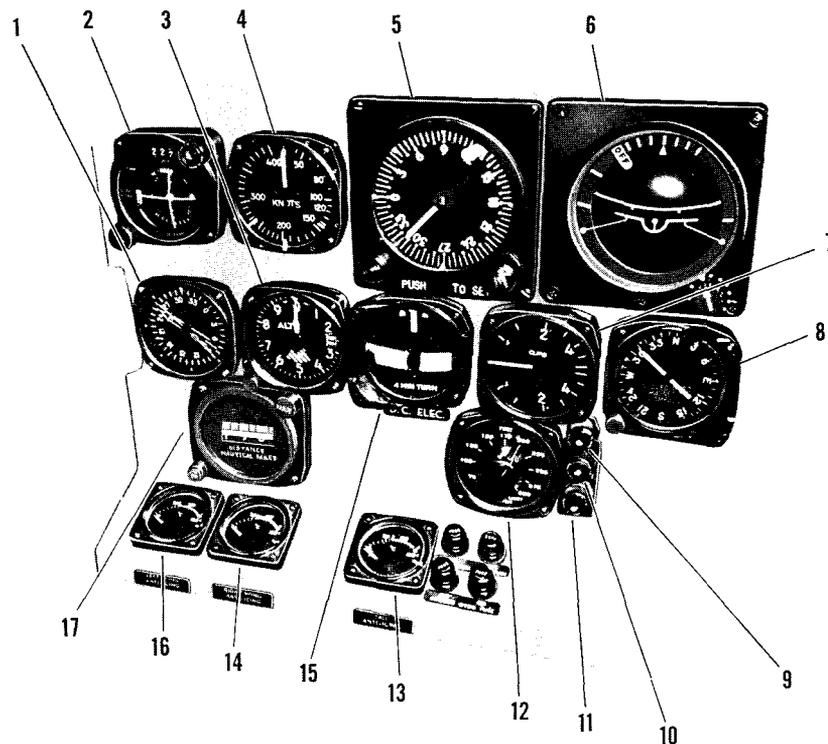
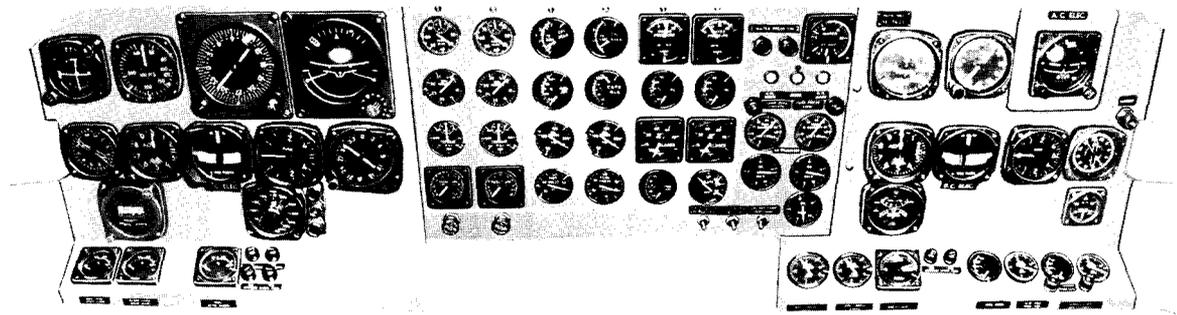
### PROPELLER PITCH REVERSAL

When the airplane is on the ground, propeller pitch may be reversed by moving the corresponding throttle aft into the reverse thrust range. Solenoid-operated latch stops prevent moving the throttle into reverse thrust range when the airplane is airborne or when the propeller pitch has not reached the full reverse pitch setting. As the throttle is moved aft into reverse thrust range, two cams on the throttle cross-shaft in the pedestal operate two micro-switches that connect direct current to the feathering pump and to the solenoid-operated valve in the propeller governor. The pump builds up pressure in the engine oil that is routed by the valve to the pitch reversing side of the piston of the pitch changing mechanism in the propeller dome. Propeller pitch changes to the full reverse thrust pitch at a rate of 14° per second. The feathering pump and solenoid-operated valve are deenergized by a propeller blade switch when the propeller reaches the full reverse angle. At this point the secondary stop in the throttle quadrant is energized, freeing the throttle for further movement aft into the REVERSE OPEN position. As the throttles are moved forward again to the CLOSE detent, high-pressure oil from the feathering pump forces the propeller piston in a positive pitch direction until the unreversing circuit is broken by the ungrounding of the propeller blade switch. This occurs a few degrees above the low pitch setting. The propeller then resumes normal governing action or operates against the low pitch stop, depending on the governor setting and engine power.

### Reverse Propeller Latch Stops and Override Indicator Handles

Two latch stops operated by one solenoid are installed in the pedestal quadrant to prevent inadvertent moving of the throttles into reverse thrust range while the airplane is airborne. The stops for the two throttles operate in unison and are spring-loaded to locking position. When the weight of the airplane compresses the main landing gear struts on landing, a switch on the left strut energizes a relay that connects direct current to the solenoid, which withdraws the latch stops. Refer to LANDING GEAR SAFETY CIRCUIT, Section VII. The throttles may then be pulled aft part way into the reverse thrust range, which closes dc circuits to the propeller pitch reversing mechanisms. Two reverse propeller override indicator handles (16, figure 1-10)—one on each side of the aft face of the pedestal quadrant—are mechanically linked to the latch stops and move in or out of the pedestal in accordance with the locking or unlocking movement of the latch stops. Two red indicator lights, one on each side of the pedestal just

# FLIGHT & ENGINE



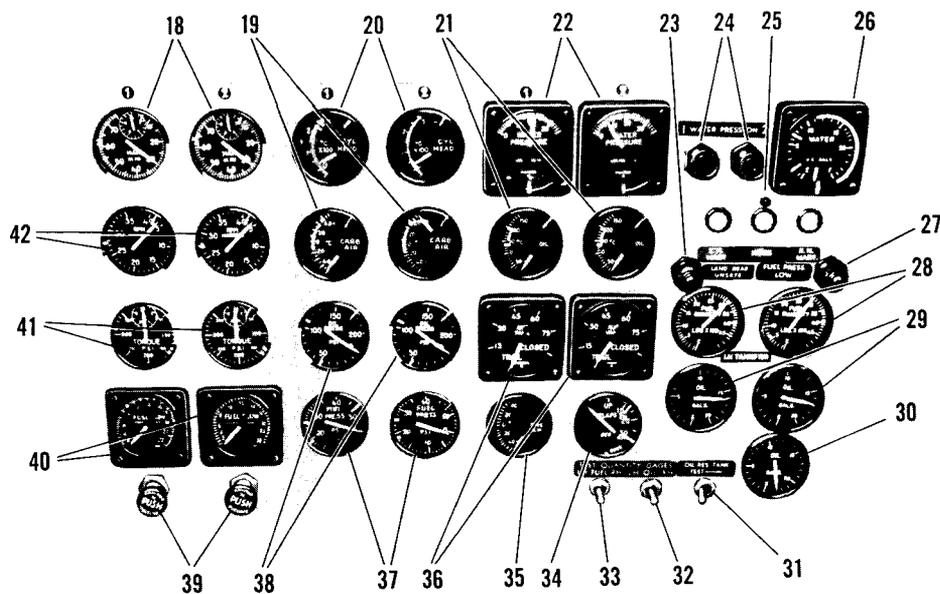
## PILOT'S INSTRUMENT PANEL

- |                                      |  |
|--------------------------------------|--|
| 1. Radio magnetic indicators         | 13. Tail anti-icing temperature gage       |
| 2. Course indicator and marker light | 14. Right wing anti-icing temperature gage |
| 3. Altimeters                        | 15. Turn and slip indicators               |
| 4. Airspeed indicator                | 16. Left wing anti-icing temperature gage  |
| 5. Heading indicator                 | 17. Tacan Range indicator                  |
| 6. Pilot's attitude indicator        | 18. Manifold pressure gages                |
| 7. Vertical velocity indicators      | 19. Carburetor air temperature gages       |
| 8. Heading indicators (slaved)       | 20. Cylinder head temperature gages        |
| 9. High altitude indicator light     | 21. Oil temperature gages                  |
| 10. Set altitude indicator light     | 22. Water pressure gages                   |
| 11. Low altitude indicator light     | 23. Landing gear unsafe warning light      |
| 12. Altitude limit switch            | 24. Water pressure on indicator lights     |

C-45212-1

Figure 1-9

# INSTRUMENT PANELS (TYPICAL)

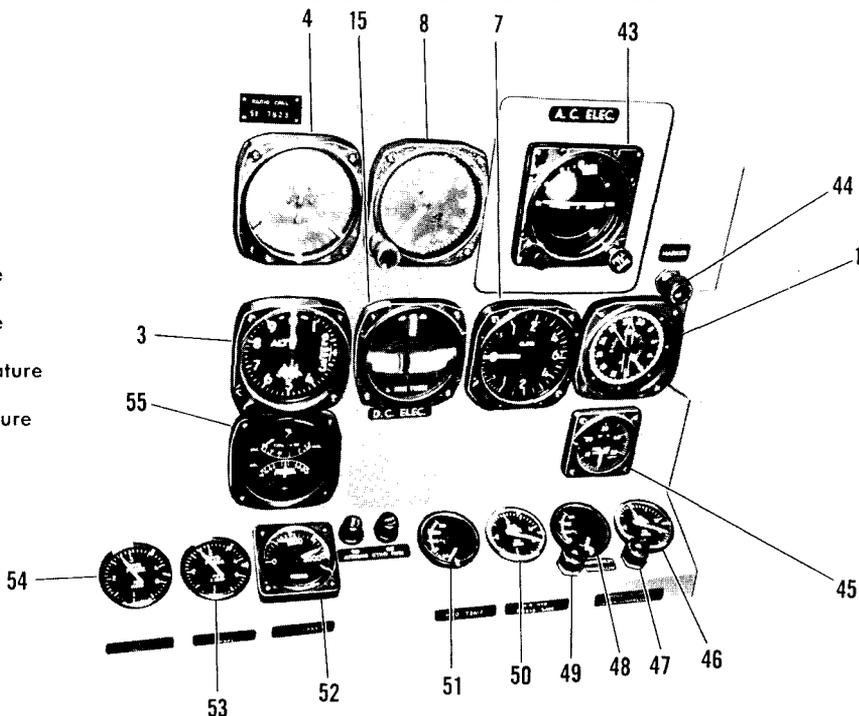


**ENGINE INSTRUMENT PANEL**

- 25. Landing gear position indicator
- 26. Water quantity gage
- 27. Fuel pressure low warning light
- 28. Fuel quantity gages
- 29. Engine oil tank quantity gages
- 30. Reserve oil tank quantity gage
- 31. Reserve oil tank quantity gage test switch
- 32. Engine oil tank quantity gages test switch
- 33. Fuel quantity gages test switch
- 34. Wing flap position indicator
- 35. Free air temperature gage
- 36. Augmentor vane position indicators
- 37. Fuel pressure gages
- 38. Oil pressure gages
- 39. Manifold pressure drain buttons
- 40. Fuel flowmeters
- 41. Torquemeters
- 42. Tachometers
- 43. Copilot's attitude indicator
- 44. Marker beacon indicator light
- 45. Cabin altimeter **(BCD)**
- 46. Cabin compressor hydraulic pressure gage **(BCD)**
- 47. Cabin compressor hydraulic pressure low warning light **(BCD)**
- 48. Cabin compressor hydraulic temperature gage **(BCD)**
- 49. Alternator-generator hydraulic pressure low warning light **(BCD)**

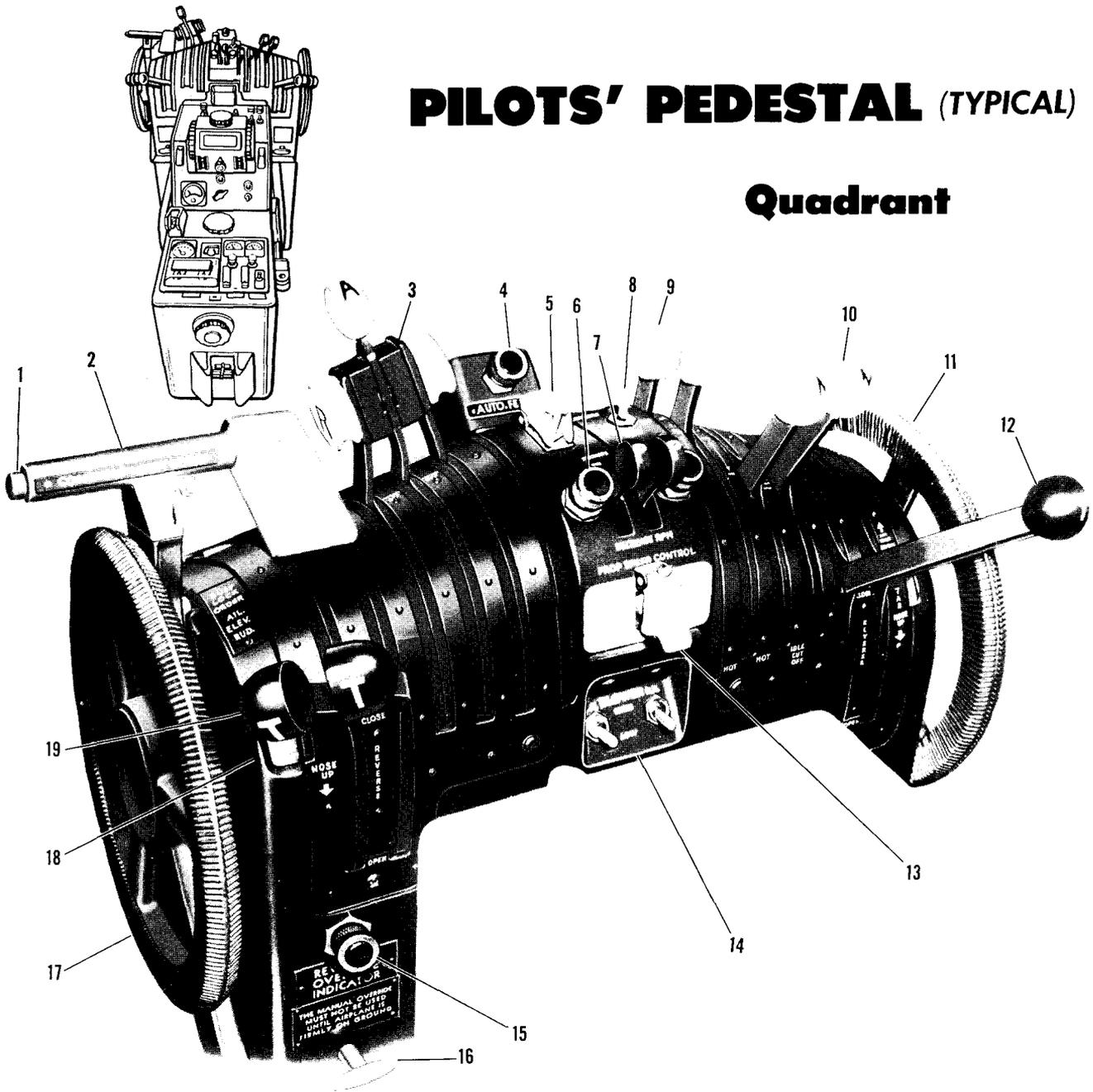
- 50. Alternator-generator hydraulic pressure gage **(BCD)**
- 51. Alternator-generator hydraulic temperature gage **(BCD)**
- 52. Emergency air pressure gage
- 53. Brake hydraulic pressure gage
- 54. Hydraulic power system pressure gage
- 55. Steering indicator (radar)

**COPILOT'S INSTRUMENT PANEL**



# PILOTS' PEDESTAL (TYPICAL)

## Quadrant



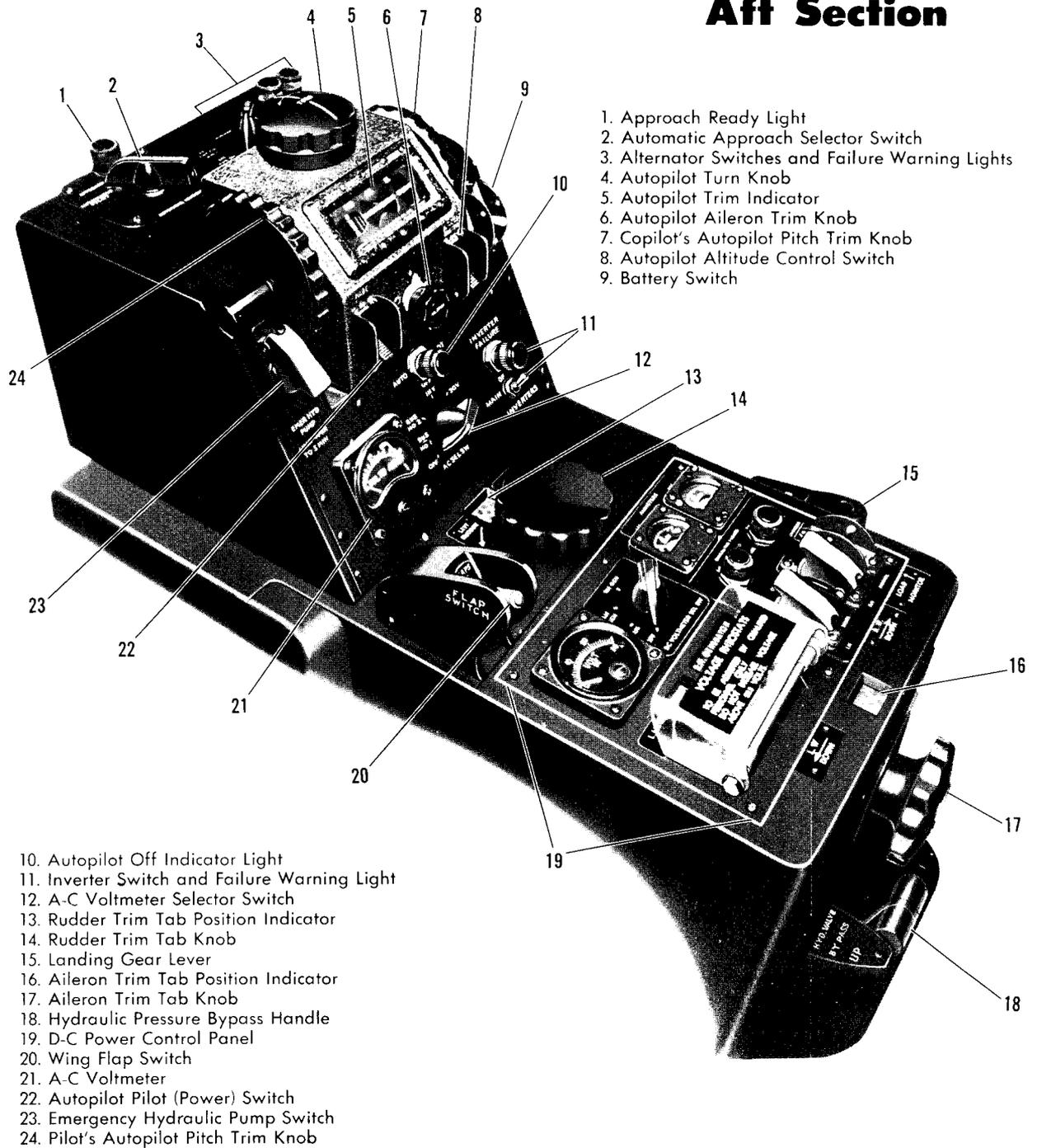
- |   |   |
|---|---|
| <ol style="list-style-type: none"> <li>1. Control surface gust lock release button</li> <li>2. Control surface gust lock handle</li> <li>3. Autopilot engage and release levers</li> <li>4. Autofeather indicator light</li> <li>5. Autofeather switch</li> <li>6. Propeller governor limit lights (2)</li> <li>7. Propeller speed control levers</li> <li>8. Autofeather test switch</li> <li>9. Carburetor heat control levers</li> <li>10. Mixture control levers</li> </ol> | <ol style="list-style-type: none"> <li>11. Copilot's elevator trim tab wheel</li> <li>12. Copilot's throttles</li> <li>13. Water injection switch</li> <li>14. Engine blower switches</li> <li>15. Reverse propeller override indicator light (some airplanes)</li> <li>16. Pilot's reverse propeller override indicator handle</li> <li>17. Pilot's elevator trim tab wheel</li> <li>18. Elevator trim tab position indicators</li> <li>19. Pilot's throttles</li> </ol> |
|---|---|

C-45213

Figure 1-10

# PILOTS' PEDESTAL (TYPICAL)

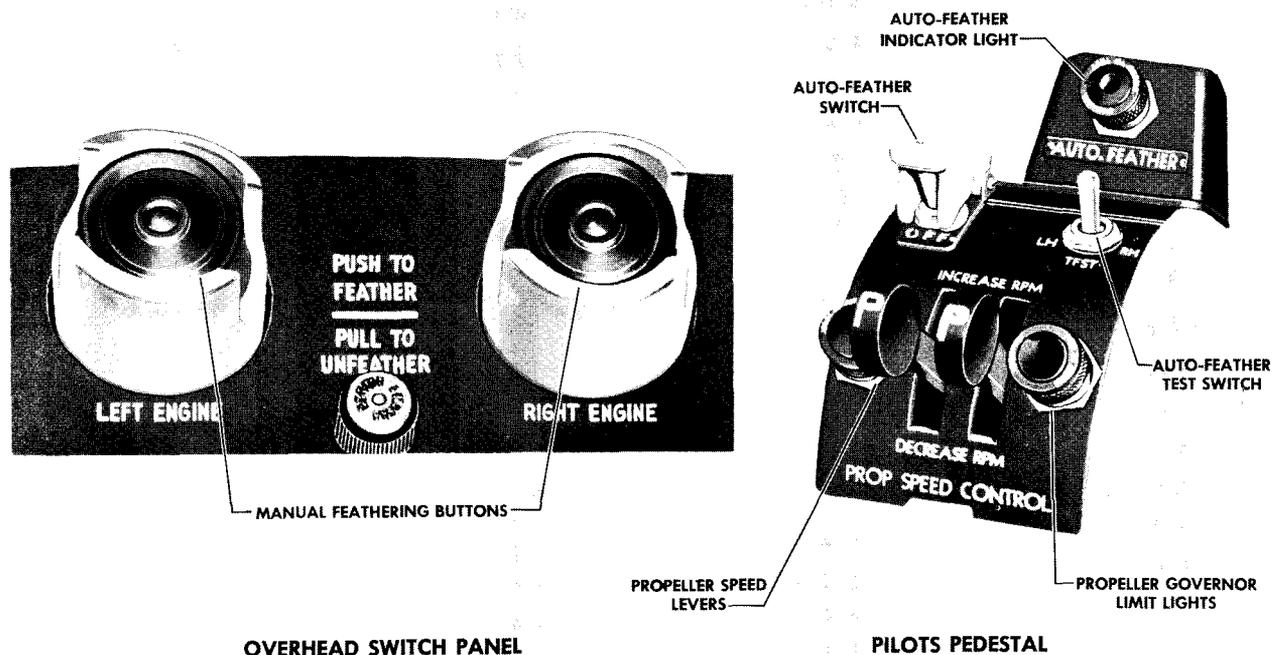
## Aft Section



C-45209

Figure 1-11

# PROPELLER CONTROLS



C-45214

Figure 1-12

above the override indicator handles, come on when the latch stops are starting to unlock. The lights operate with the handles and will glow when the handles are out and be off when the handles are in. The shafts of the handles have a red position visible only when the latch stops are in unlocked position. The red portion must be visible when the airplane is on the ground and must not be visible when the airplane is airborne. Either of the handles may be pushed in or pulled out, as required, to operate both latch stops to the desired position in event of failure of the solenoid to unlock the latches or of the spring loading to lock the latches. A secondary lock is provided at each throttle to prevent moving the throttle fully aft to REVERSE OPEN position before the blades of the corresponding propeller have reached the full reverse pitch setting. This prevents overspeeding the engine while the blades are passing through flat pitch during the change to reverse pitch. This secondary lock also prevents the inadvertent application of engine power with the throttle in the reverse range if a malfunction of the prop reversing system has left the blades in a positive thrust position. A dc energized solenoid withdraws the latch stop as soon as the propeller blade reaches the reverse pitch limit. After the throttle is aft of the second detent, it requires approximately 21 pounds throttle pressure to increase reverse power and approximately nine pounds throttle pressure to decrease reverse power. A reverse aft detent limits normal reverse power to approximately 30 in. Hg

manifold pressure. A throttle pressure of approximately 28 pounds is required to force the throttle through this aft detent position for emergency operation. Reverse power can be increased to approximately maximum power in this range. As the throttle is moved forward again to the CLOSE detent, the propeller blade switch is unreversed and the propeller returns to a positive pitch setting. The blade limit switch then opens the circuit to the solenoid and the latch stops again prevent full reverse thrust movement of the throttle.

## PROPELLER MANUAL FEATHERING SYSTEM

### Manual Feathering Buttons and Feathering Indicator Lights

Two red, push-pull type, manual feathering buttons (figure 1-12) are provided on the overhead switch panel for manual feathering and unfeathering of the propellers. The buttons are placarded "Push To Feather—Pull To Unfeather." Each button has three unmarked positions—IN, OUT, and NORMAL (half out). When feathering action is initiated, a holding circuit holds the button in until the feathering action is completed, and a red indicator light in the button glows to indicate that the propeller is feathering. When a button is pushed IN, the corresponding feathering pump is started, the governing pilot valve is hydraulically positioned and oil under boosted pressure is routed to the outboard side of the pitch changing piston to move the blades to the feathered

position. The pressure rise at the end of the feathering action causes the pressure cut-out switch on the control assembly to actuate, thus stopping operation of the feathering pump and deenergizing the pushbutton holding circuit.

After feathering has started, the feathering cycle can be stopped by pulling the button to the NORMAL (half-out) position. If this is done in flight before the propeller has stopped rotating, or on the ground before the rpm has dropped to approximately 800 rpm, the propeller blades will return to the pitch corresponding to the rpm setting of the governor. After a propeller has been completely feathered, unfeathering is accomplished by pulling the manual feathering button OUT until propeller rotation begins and then releasing the button to the NORMAL position. This simultaneously energizes the decrease pitch solenoid and the feathering pump to decrease propeller blade pitch. When the button is released after rotation starts, normal propeller governing is resumed and the blades will return to the angle dictated by the governor setting.

## WARNING

Holding the manual feathering button out longer than necessary when unfeathering may cause propeller pitch hunting or inadvertent pitch reversal if the electrical circuit is defective.

### PROPELLER AUTOFEATHERING SYSTEM

The propeller autofeather system (figure 1-13) automatically feathers the propeller of an engine in event of engine failure after sufficient power has been applied. The system is operated by automatically causing the appropriate manual feathering button to be magnetically drawn in to feathering position if engine torque pressure falls to 40 (+5) psi after the throttles have been advanced beyond a position corresponding to approximately 45 in. Hg manifold pressure (sea level). The system is powered by 28-volt dc through the autofeather switch, a torque pressure switch at each engine, and microswitches in the pedestal quadrant that close as the throttles are advanced. If torque pressure at one of the engines falls due to failure, the torque pressure switch will close and connect dc power to a solenoid and holding coil at the corresponding manual feathering button. The feathering button will be drawn in after a two- to three-second time delay and the propeller will automatically feather. A green indicator light comes on when the autofeather switch is turned to ON position and remains on until a propeller has been automatically or manually feathered or the autofeather switch has been moved to OFF. The system will not feather the second propeller if one propeller has already been feathered either auto-

matically or manually. A test system is provided for testing autofeather operation.

### Autofeather Switch and Indicator Light

A guarded autofeather switch (figure 1-12) located on the pilots' pedestal quadrant, controls dc power from the main bus to the autofeathering system in each nacelle. The switch has ON and OFF positions. In the ON position, dc power is supplied to a green indicator light, located adjacent to the switch, and to the torque pressure switches in each nacelle, thus arming both autofeathering systems. In the OFF position, both autofeathering systems are disarmed and the green indicator light will go out. The light will also go out when the autofeather switch is ON and a propeller is either automatically or manually feathered.

### Autofeather Test Switch

The autofeather test switch (figure 1-12) located on the pilots' pedestal quadrant, is provided to allow testing of the autofeather system. The switch has LH and RH positions and is spring-loaded to an unmarked OFF position. When held in LH or RH position, the switch closes a dc circuit that bypasses the corresponding throttle-operated microswitch in the autofeather system. On some **A** and **B** airplanes\*, the switch is used after the autofeather switch has been turned to ON for ground tests and the corresponding throttle has been advanced far enough to obtain 70 psi torque pressure. With the left throttle advanced to obtain 70 psi torque pressure, placing the autofeather test switch in the LH position will arm the autofeather torque pressure switch at the left engine. Retarding the throttle to a position providing less than 40 psi torque pressure while holding the autofeather test switch to LH position will then cause the autofeather system to draw in the left manual feathering button to feather position. The red light in the feather button will illuminate and the propeller will begin to feather. On other **A** and **B** airplanes\*\*, and all **C** and **D** airplanes, the autofeather system is armed without throttle movement. On these airplanes, when the engines are idling and the autofeather switch is ON, holding the test switch in the LH position will cause the left manual feathering button to be drawn in, and the left propeller will begin to feather. On all airplanes, releasing the autofeather test switch and pulling the left manual feathering button out to NORMAL position will stop the feathering action and the propeller will return to the rpm setting of the governor. The autofeather switch must then be turned to OFF and back to ON to rearm the autofeathering system for the right propeller test. After the second test the autofeather switch must again be moved to OFF and then back to ON to rearm the system prior to takeoff.

### OIL SYSTEM

Each engine has an independent oil system that incorporates an oil tank and an oil cooler in each

\*Airplanes not modified by TCTO 1T-29-554.

\*\*Airplanes modified by TCTO 1T-29-554.

# AUTO FEATHERING SYSTEM

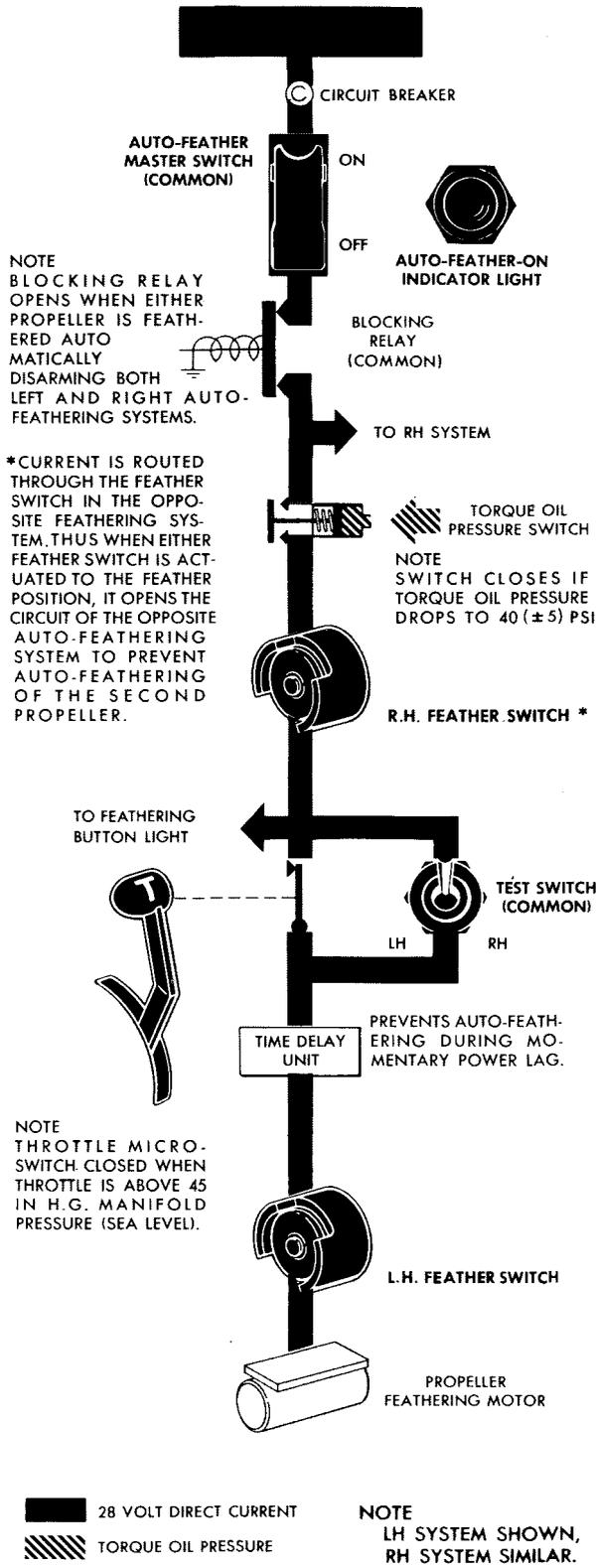


Figure 1-13

nacelle (figure 1-14). Each tank has a total usable oil capacity of approximately 22 gallons. Only 20 gallons are available for use by the engines. The remaining two gallons are reserved by a short stand-pipe for propeller feathering and reversing. A sealed hopper, installed in each tank, provides for quick warmup of the oil when the engines are operating. The hopper is attached to the bottom of the tank to the same housing to which the sump is attached. Two flap valves, installed in the housing, control flow of oil between the hopper and the tank. Oil cooling air is obtained from a flush scoop at the bottom of the nacelle. The free-flow type oil cooler incorporates a regulating valve assembly which contains a surge protection valve, a thermostatic bypass valve, and a core check valve. The surge protection valve permits the flow of oil to bypass the cooler under cold starting conditions when congealed oil would cause high pressures in the cooler. The thermostatic bypass valve bypasses oil around the cooler core when the oil is cold or when there is not enough pressure to open the surge protection valve. The core check valve prevents outlet line oil from returning to the cooler. Under normal conditions, oil flows through the oil cooler core where heat is transferred to the air that flows through the cooler. Flow of air through the cooler is regulated by an automatically operated, full-closing, oil cooler door, with selective override electrical control. The door is mounted at the oil-cooling air exit slot in each nacelle. A reserve oil tank having a usable capacity of approximately 22 gallons and equipped with heaters and a transfer pump is installed below the cabin floor opposite the rear service door. Transfer lines run from a selector valve at the reserve oil tank to the engine oil tank in each nacelle. The transfer pump and the selector valve are dc operated. The reserve oil transfer line is automatically diluted with fuel after the transfer operation, thus permitting reserve oil to transfer in cold weather operation. Refer to OIL SYSTEM, Section VII, for detailed operation.

## OIL SPECIFICATION AND GRADE

See figure 1-42.

## OIL SYSTEM CONTROLS AND INDICATORS

### Oil Cooler Control Switches

Two oil cooler control switches (figure 1-8) are located on the overhead switch panel. The switches have positions AUTO, OFF, OPEN and CLOSE. In respect to OPEN and CLOSE, the switches are spring-loaded to OFF. Each switch, when in the AUTO position, routes dc power to a thermostat in the oil return line at the engine oil tank in the corresponding nacelle. The thermostat is adjusted so that in the event oil temperature falls below or rises above preset limits it will route power to the closing or opening side of a motor which operates the oil cooler door actuating jack. If the thermostat fails to monitor oil temperature, the appropriate oil cooler control switch must be moved to the OFF and then held to the OPEN or CLOSE position, as necessary. If the switch is left in the OFF position, the oil cooler door will remain in the position to which it was last operated. Approximately 18 seconds is

required for the oil cooler door to travel from the fully closed to the fully open position, and vice versa. Oil cooler door position indicators are not provided.

### Reserve Oil Transfer Switch

The reserve oil transfer switch (figure 1-15) is located on the copilot's console. The switch has LH, OFF, and RH positions, and is spring-loaded to OFF. When held in the LH or RH position, the dc operated transfer pump and transfer selector valve are actuated to deliver reserve oil to the selected engine oil tank. The switch is released to the OFF position to stop the transfer process. Over-filling of an engine oil tank is prevented by a dc automatic cutoff switch actuated by the oil quantity indicating system, which stops the transfer pump when the main oil quantity gage reaches approximately 20 gallons. After the reserve oil transfer switch has been released to the OFF position, the transfer pump reverses and runs for approximately two minutes to scavenge oil from the transfer line. As the pump starts the reversing action, an oil transfer fuel valve at the nacelle opens and allows fuel to dilute the oil in the oil transfer line. As oil is scavenged from the line by the pump, fuel fills the line, thus assuring effective oil transfer during winter operation. The oil transfer fuel valve closes at the end of the pump reversing period.

### Reserve Oil Heat Switch and Heater Indicator Lights

A reserve oil heat switch and two reserve oil heater indicator lights (figure 1-15) are located on the copilot's console. Switch positions are HEAT and OFF. The indicator lights are placarded "INITIAL HEATER" and "MAINT. HEATER." When in HEAT position, the switch directs 115-volt unregulated ac power (Bus No. 1) to the initial heater and the maintenance heater. The lights remain illuminated as long as the heaters are energized. If oil near the wall of the tank is heated to 68°C (155°F) the heaters will be deenergized and will remain so until the boundary oil cools below that temperature, at which time the heaters will again operate. Cycling in this manner will continue as long as the switch is in the HEAT position. If oil in the center of the tank reaches a temperature above 21°C (70°F) the initial heater will be permanently shut off. It can be reactivated only by turning the switch to OFF and then turning it again to HEAT. The maintenance heater will continue to operate and cycle as before.

#### Note

When the propeller de-icing system is operating, a timer monitors power alternately for 30 seconds to each of the propellers and then off for 60 seconds. The oil heaters then operate only during the off cycle of the propeller de-icing system.

The reserve oil heat switch must be placed in HEAT position whenever the free air temperature is 21°C (70°F) or below, if oil transfer is anticipated.

### Oil Dilute Switches

Oil dilution solenoids in the nacelles are controlled by two oil dilute switches (figure 1-8) on the over-

head switch panel. The switch positions are OFF and ON. They are spring-loaded to OFF. When held to ON position, the switches connect dc power to solenoid valves in oil dilution lines connected to the fuel strainer in the nacelle. (For oil dilution management, refer to Section IX.)

### Engine Fluid-Off Handles

An oil shutoff valve is installed in each engine oil supply line at the fire wall. These valves are mechanically operated by the engine fluid-off handles (figure 1-39) on the fire control panel to shut off the flow of all oil through the fire wall, except propeller feathering oil. (Refer to ENGINE FIRE EXTINGUISHER SYSTEM, this Section.)

### Oil Quantity Gages

Three oil quantity gages (29, 30, figure 1-9), one for each oil tank, are located on the engine instrument panel. The gages read in U.S. gallons and are operated by 115-volt regulated alternating current.

#### CAUTION

If the electrical circuit to one of these gages fails, the gage continues to register the quantity indicated at the time of failure.

### Oil Quantity Gage Test Switches

Two oil quantity gage test switches (31, 32, figure 1-9) are provided on the engine instrument panel. One test switch is for the engine oil-tank quantity gages; test positions are LH and RH. The other test switch is for the reserve oil tank quantity gage; it has OFF and TEST positions. Both switches are spring-loaded to OFF. Placing either switch in a TEST position connects the calibrated circuits to ground which in effect unbalances the bridge capacitance circuit and causes the oil quantity indicator pointer to move toward zero. If a gage is functioning, its needle will move to the low end of the scale when the corresponding test switch is held to a test position. If the gage is not functioning, the needle will remain in the same position when tested.

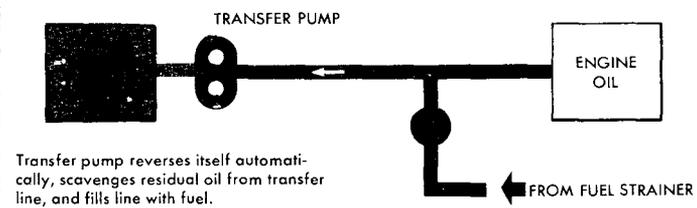
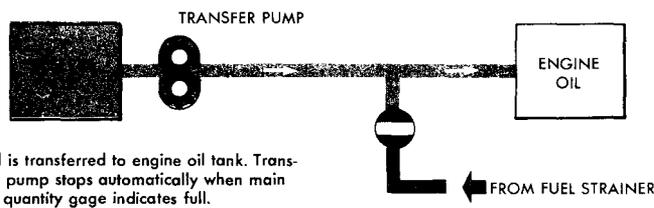
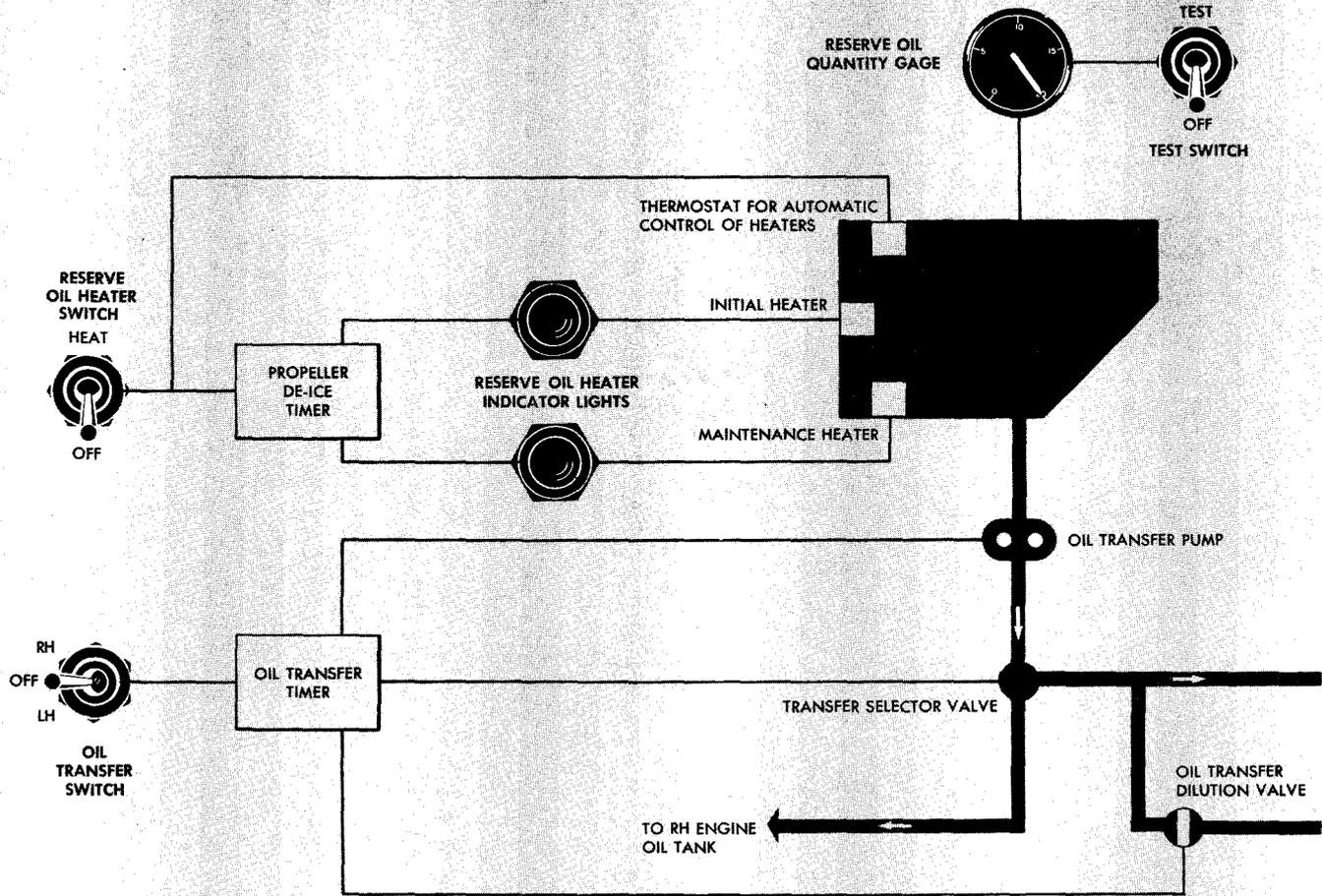
## FUEL SYSTEM

The fuel system (figure 1-17) consists of two independent integral fuel systems, one for each engine, with a crossfeed line which may be opened to allow either engine to be supplied by the opposite tank, or both engines to be supplied by either tank.

#### WARNING

Normal provisions for fuel transfer from one tank to the other are not provided. Inadvertent transfer may occur if the internal relief valve settings of the fuel booster pumps are not equal. Refer to FUEL CROSSFEED OPERATION, Section VII.

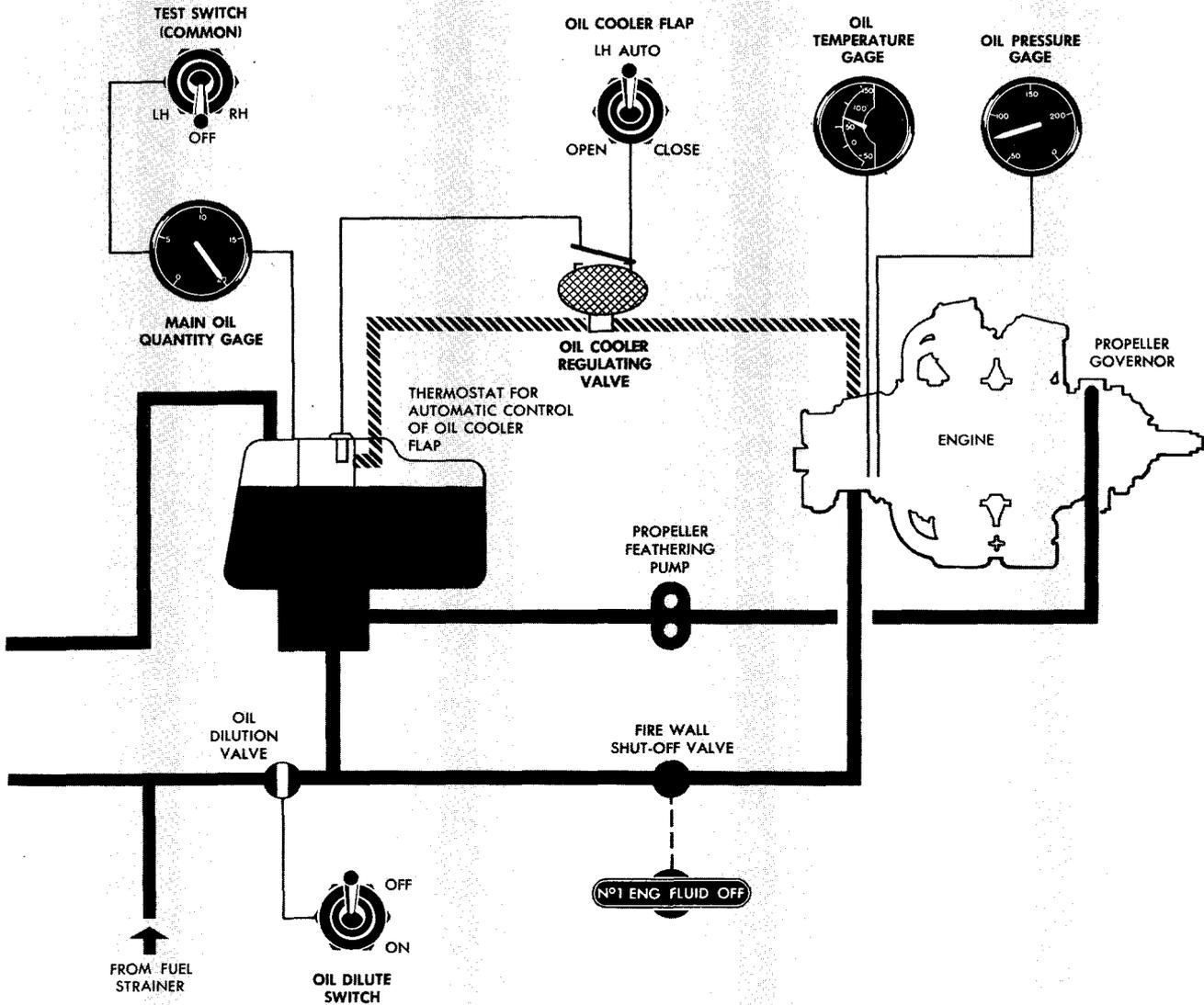
# OIL SYSTEM (reserve)



C-45216-1

Figure 1-14

# OIL SYSTEM (main)



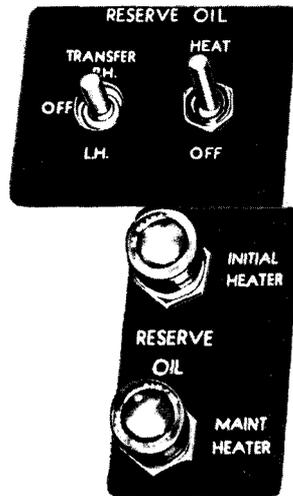
**CODE**

- ENGINE OIL SUPPLY
- ENGINE OIL RETURN
- RESERVE OIL SUPPLY
- FUEL LINE
- ELECTRICAL ACTUATION
- MECHANICAL ACTUATION

NOTE:  
LH system shown  
RH similar.

## RESERVE OIL CONTROLS

## Copilot's Console



C-45217

Figure 1-15

Each wing has two interconnected fuel-tight compartments which serve as fuel tanks. The compartments in one wing are not connected with the compartments in the other wing. A line leads forward to an electrically operated fuel booster pump in each nacelle. A crossfeed line, fitted with two valves operated mechanically and simultaneously by a crossfeed handle on the fuel control panel, crosses from one nacelle to the other and interconnects the two fuel lines downstream of the booster pumps. The booster pump on either side is thus able to help feed fuel to the opposite engine during crossfeed operation, as well as to its own engine, as required. An electrically operated main fuel shutoff valve is installed in each nacelle upstream from the booster pump. Each engine has an engine-driven fuel pump. A fuel shutoff valve operated mechanically by the corresponding engine fluid-off valve handle on the fire control panel is installed at the fire wall in each nacelle. Branch lines to the oil dilute valve, oil transfer fuel valve, and engine prime valve are provided in each nacelle. A fuel quantity gage for each tank, a fuel flowmeter, and a fuel pressure gage for each engine are provided on the engine instrument panel. A fuel quantity gage test switch and a fuel pressure-low warning light serve both sides of the fuel system.

### FUEL SPECIFICATION AND GRADE

See figure 1-42.

### FUEL SYSTEM CONTROLS AND INDICATORS

#### Fuel Shutoff Valve Switches and Indicator Lights

Two fuel shutoff valve switches (figure 1-16), one for each fuel tank shutoff valve, are located on the fuel control panel. The switches have ON and OFF positions. When a switch is placed in the ON position, the corresponding shutoff valve will open. When the switch is placed in the OFF position, the corresponding valve will close. A fuel valve indicator light, located adjacent to each switch, will

glow continuously when the corresponding valve is traveling to either of its extreme limits of travel. The light will go out when the valve has reached its fully open or fully closed position, indicating successful operation of the valve. A light which remains on indicates that the corresponding valve has stopped in an intermediate position. When both lights are out, the specific position of the fuel shutoff valves is indicated by the position of the corresponding switches only. The valves and lights are powered by the dc main bus.

#### Fuel Booster Pumps and Switches

A fuel booster pump is installed in the main fuel line in each nacelle upstream from the crossfeed line connection. The pumps are dc operated and are turned on and off by the fuel booster pump switches (figure 1-8). Fuel booster pump power is sufficient to provide normal fuel pressure at the carburetor indefinitely in event of failure of an engine-driven fuel pump. Refer to FUEL BOOSTER PUMP operation, Section VII.

#### Fuel Crossfeed Handle

A crossfeed handle (figure 1-16), located on the fuel control panel, mechanically opens and closes both fuel crossfeed valves. Turning the handle 90° clockwise opens the valves. Turning the handle counterclockwise to vertical position closes the valves.

#### Engine Fluid-Off Handles

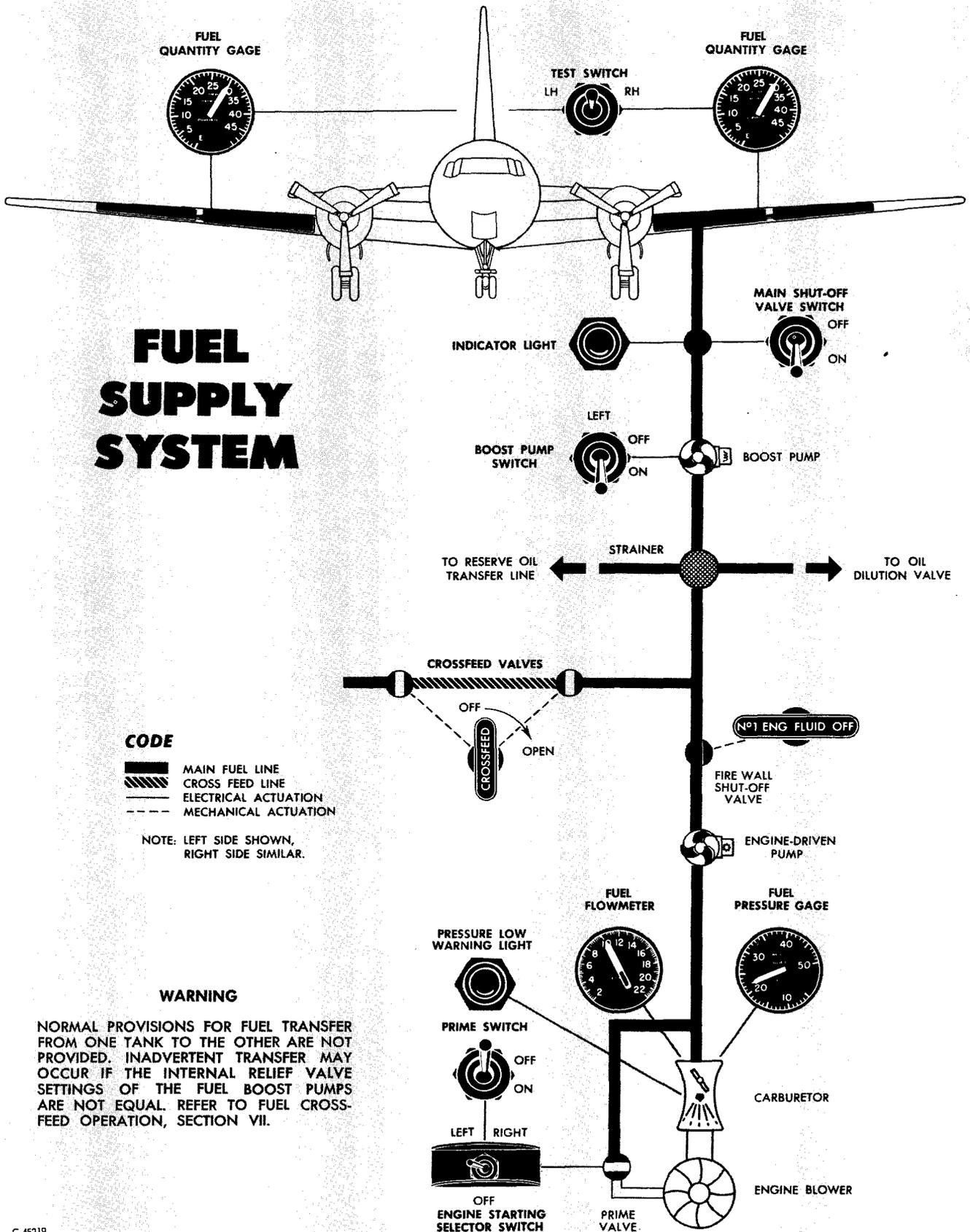
A fuel shutoff valve is installed in each engine fuel supply line at the firewall. These valves are mechanically operated by the engine fluid-off handles (see

## FUEL CONTROL PANEL



C-45218

Figure 1-16



C-45219

Figure 1-17

# FUEL QUANTITY DATA TABLE

TANK	NUMBER OF TANKS	USABLE FUEL (EACH TANK)	FULLY SERVICED (EACH TANK)
Main	2	765 Gallons (4590 Pounds)	767.5 Gallons (4605 Pounds)

NOTE: BASED ON ICAO STANDARD ATMOSPHERE:  
6.0 POUNDS PER GALLON.

C-45221

Figure 1-18

figure 1-39) on the fire control panel. (Refer to ENGINE FIRE EXTINGUISHER SYSTEM, this Section.)

### Fuel Quantity Gages

Two fuel quantity gages (28, figure 1-9) on the engine instrument panel indicate, in pounds, the quantity of fuel in the tanks. Weight of the fuel quantity is sensed at several points in each tank and these signals are balanced by bridge capacitance circuits before transmittal to the quantity gages, so that accurate fuel quantity indications, by weight, are provided regardless of changes of temperature, density, and airplane attitude. For the same reason, however, the gages will indicate that the tanks are less than full on a hot day when the tanks have actually been fully serviced, inasmuch as full gallonage will then weigh less than full gallonage weighs on a standard day. The gages operate on 115-volt regulated alternating current.

**CAUTION**

If the power circuit to one of these gages fails, the gage continues to indicate the quantity shown at the time of failure.

### Fuel Quantity Gage Test Switch

A fuel quantity gage test switch (33, figure 1-9) with LH, RH, and unmarked, spring-loaded OFF positions is located on the engine instrument panel. The switch is used to test operation of the selected fuel quantity gage. If the gage is functioning, its pointer will move to the low end of the scale when the test switch is held to the corresponding test position. If the

pointer does not move, the gage or allied circuit is faulty.

### ELECTRICAL POWER SUPPLY SYSTEM

Electrical power is supplied by three basic systems: direct current, regulated alternating current, and unregulated alternating current. Direct current (24 to 28-volt) is required to operate lights, motors, actuators, solenoids, propeller governors, fire detection and extinguisher components, and other items of electrical equipment; it is supplied to a main bus and to two nonessential equipment buses by two generators, two batteries, or an external power source. Regulated (constant frequency), single-phase, 115-volt alternating current is required to operate the flight instruments, driftmeters, autopilot, cabin temperature control, and fuel and oil quantity gages; it is supplied by two dc powered inverters. On **A**, **B**, and **C** airplanes, only one inverter operates at a time. On **D** airplanes, both inverters operate simultaneously. Regulated 26-volt alternating current is required to operate pressure gages, torquemeters, and augmentor vane position indicators; it is supplied through an inverter-powered transformer. Unregulated (variable frequency), 115-volt alternating current required for reserve oil heat, de-icing, and electronic training equipment operation is supplied through two buses by an alternator in each nacelle. A receptacle forward of the main entrance door is provided for connecting an external ac power supply.

### DC POWER SUPPLY SYSTEM

Direct current is supplied by two generators, one in each nacelle. On **A** airplanes, both generators are engine-driven. On **B**, **C**, and **D** airplanes, the

left generator is engine-driven; the right generator is driven by a hydraulic motor. Two 12-volt batteries connected in series provide a 24-volt, 88 ampere-hour source of dc power. A receptacle forward of the entrance door is provided for connecting an external dc power supply. External power must be disconnected prior to starting the right engine. When an external dc power source is not available, the batteries may be used to operate essential dc radio equipment or to start either engine. (See figure 1-19 for dc operated equipment.)

### CAUTION

When using battery power to check operation of equipment, limit operation to the absolute minimum because of the small capacity of the batteries.

A load monitoring circuit is provided to disconnect nonessential electrical equipment automatically if the output of either generator fails or is interrupted.

### DC Circuit Breakers

With four exceptions, dc circuits are protected by circuit breakers. The two circuits to the propeller feather pump motors and the two circuits to the engine starters are unprotected. Some of the circuit breakers are of the non-trip-free type which may be reset immediately after tripping. The majority of the circuit breakers are of the trip-free type which cannot be made to stay in reset position, and will not close the circuit, if held in reset position, until after the overheat device within the circuit breaker itself has cooled—usually about one minute after the circuit breaker has tripped. Circuit breakers of both types are located on the main circuit breaker panel behind the copilot's seat, on the auxiliary circuit breaker panel behind the pilot's seat, and on the radio power circuit breaker panel at the radio operator's station. See figure 1-20 for circuit breaker panel locations. Two trip-free circuit breakers (figure 4-10), on the copilot's console, protect the individual propeller de-ice control circuits. Although they are in dc circuits, these circuit breakers also respond to overload in the ac circuits that power the heating elements in the propeller blades; they cannot be made to stay in the reset position if the ac heating circuits are overloaded. The propeller de-ice and cabin dome light switches contain circuit breakers that trip the switches to OFF position in case of overload.

### Battery Switch

A side-guarded battery switch (9, figure 1-11) on the pilots' pedestal, is used to connect and disconnect the batteries to the main dc bus. The battery switch has BAT and OFF positions. A minimum battery voltage of 18 volts is required to close the battery relay connecting the battery to the bus. This relay must be closed before the generators can recharge the battery and a check should be made to ascertain that the relay is operating if the battery charge is suspected of being marginal. This may be accomplished by removing the external power source

and placing the battery switch in BAT position momentarily. If indicator lights within the cockpit illuminate, the relay has closed.

### Load Monitor Switch

A load monitor switch (figure 1-23) having NORMAL, OVERRIDE, and OFF positions, is located on the pedestal dc power control panel. In the NORMAL position the switch energizes two load monitor relays that connect dc and regulated ac nonessential buses to their corresponding power sources. If either generator becomes disconnected from the main bus, the load monitor relays automatically disconnect nonessential equipment from the bus. The equipment may be operated again by positioning the load monitor switch to OVERRIDE, which frees the relays of the monitoring effect of generator output voltage. The switch must be placed in OVERRIDE to operate the affected equipment by external power sources during ground tests. Moving the switch to the OFF position disconnects nonessential equipment. The load monitoring relays prevent overloading of one generator when the other generator is supplying less than normal voltage. Illumination of either generator failure warning light, or a sudden drop in indicated dc load, indicates that the load monitor relays have been deenergized and the affected equipment disconnected. The load monitor circuit receives power from the main dc bus and is protected by a circuit breaker on the auxiliary circuit breaker panel.

### Navigation Radio Switch

The navigation radio switch (21 and 15, figure 4-17) at the radio operator's position, is an "On-Off" master switch for the dc nonessential radio equipment bus. When both generators are operating and the load monitor switch is in NORMAL position, moving the navigation radio switch to ON position connects dc power to the nonessential navigation, communication, and training equipment. Positioning the switch to OFF allows this equipment to be disconnected without disconnecting the camera, sextant power, astrodome defrosting blowers, table lights, dome lights, and the nonessential regulated ac operated equipment, as would be the case if the load monitor switch itself had to be turned to OFF position. The navigation radio switch is turned ON for ground tests using external power. It must be ON for all normal and instrument flight in order to arm the navigation equipment circuits, among other items. On some airplanes, the navigation radio switch is located on the flight engineer's interphone panel.

### External DC Power Receptacle

An external dc power receptacle (figure 1-24) for connecting an external power source to the main dc bus is located behind a hinged door on the right side of the fuselage, just forward of the entrance door.

### Radar External DC Power Receptacle

On **A**, **B** and **C** airplanes, an external dc power receptacle (16, figure 1-42) for supplying direct current to an isolated bus for ground operation of the radar system is located on the bottom center of the fuselage, aft of the nose landing gear. On **D** airplanes, the receptacle (7A, figure 1-42) is located on the right side of the fuselage aft of the wing.

# DC POWER SUPPLY

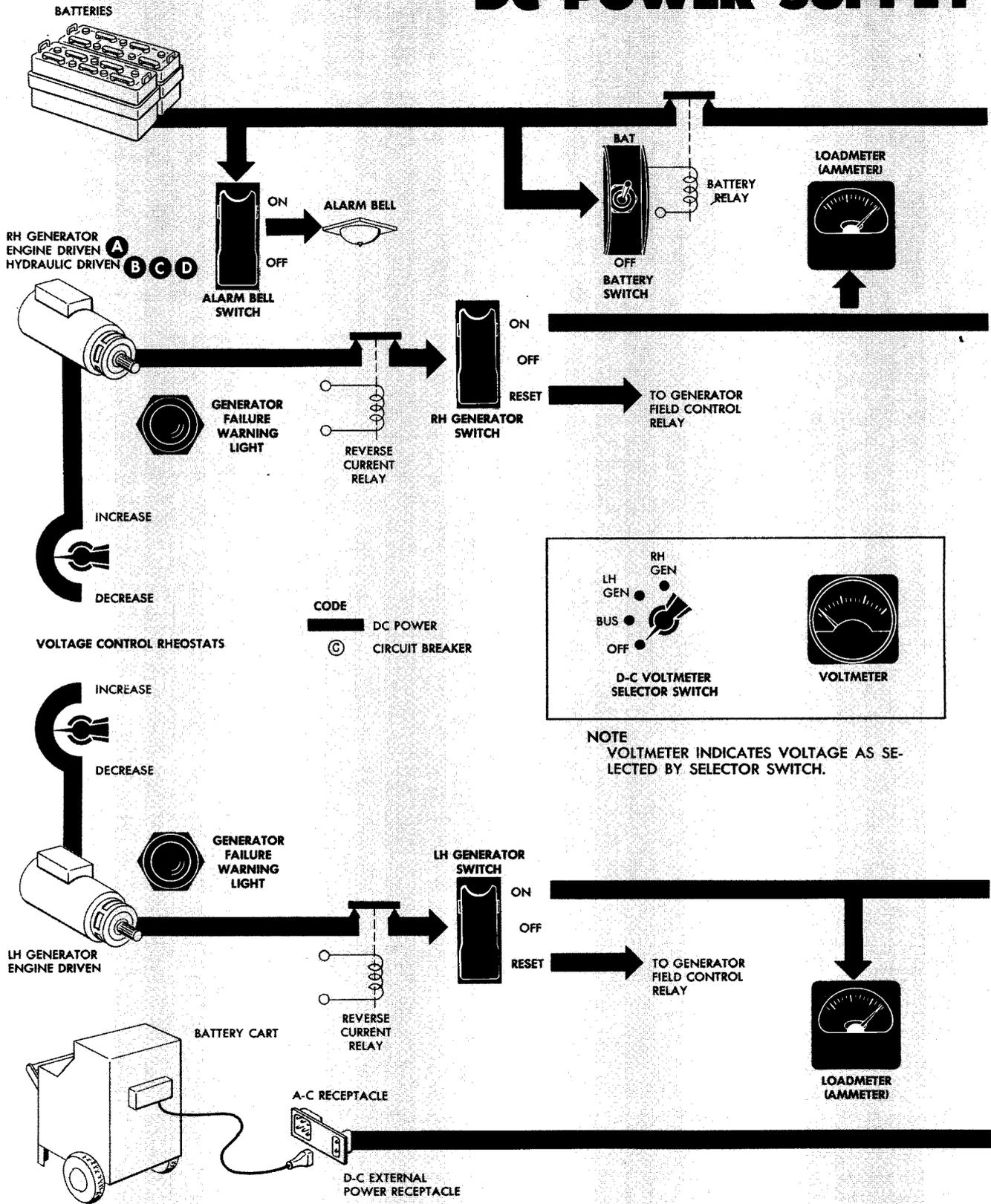
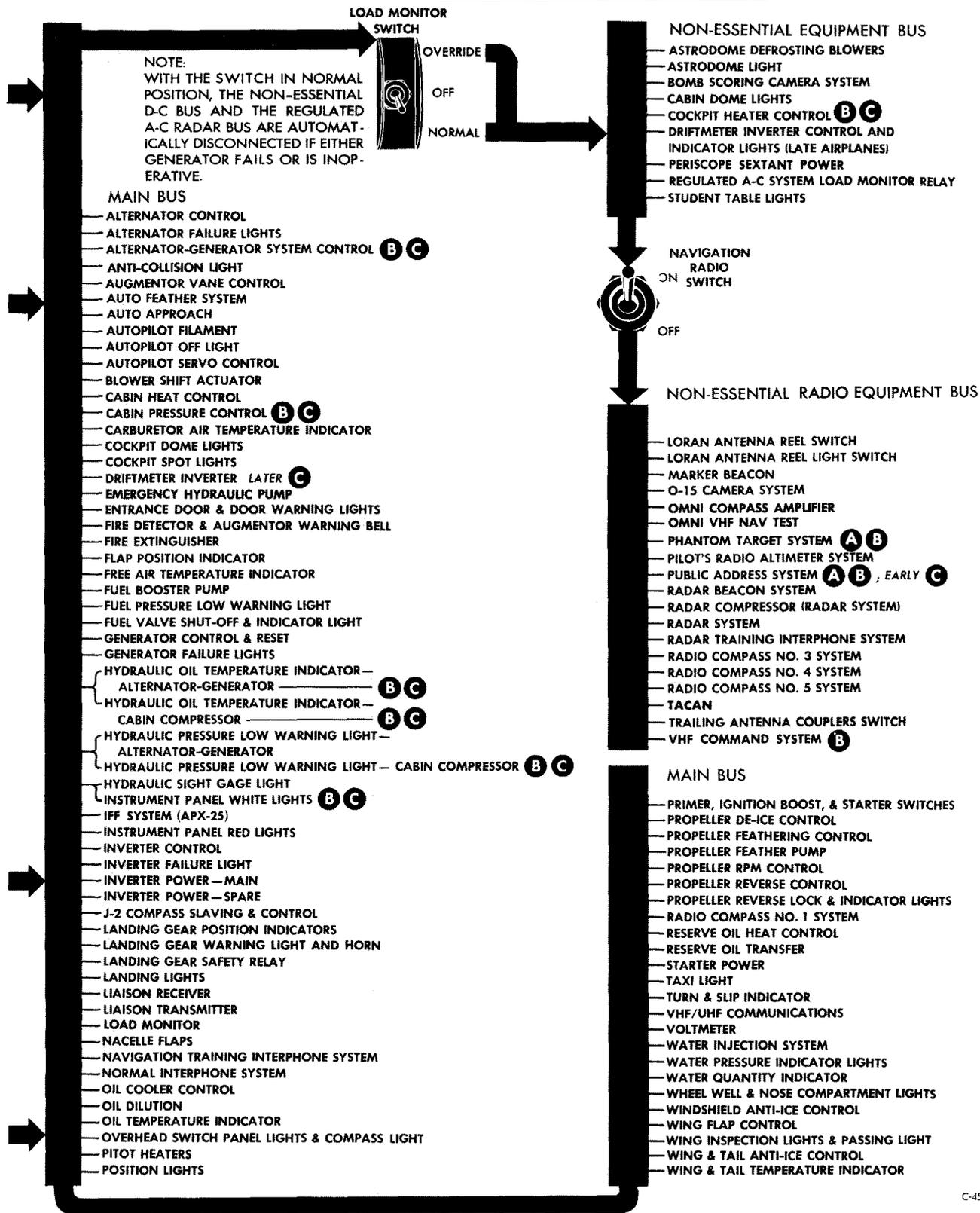


Figure 1-19 (Sheet 1 of 3)

# SYSTEMS (TYPICAL) A, B & C AIRPLANES

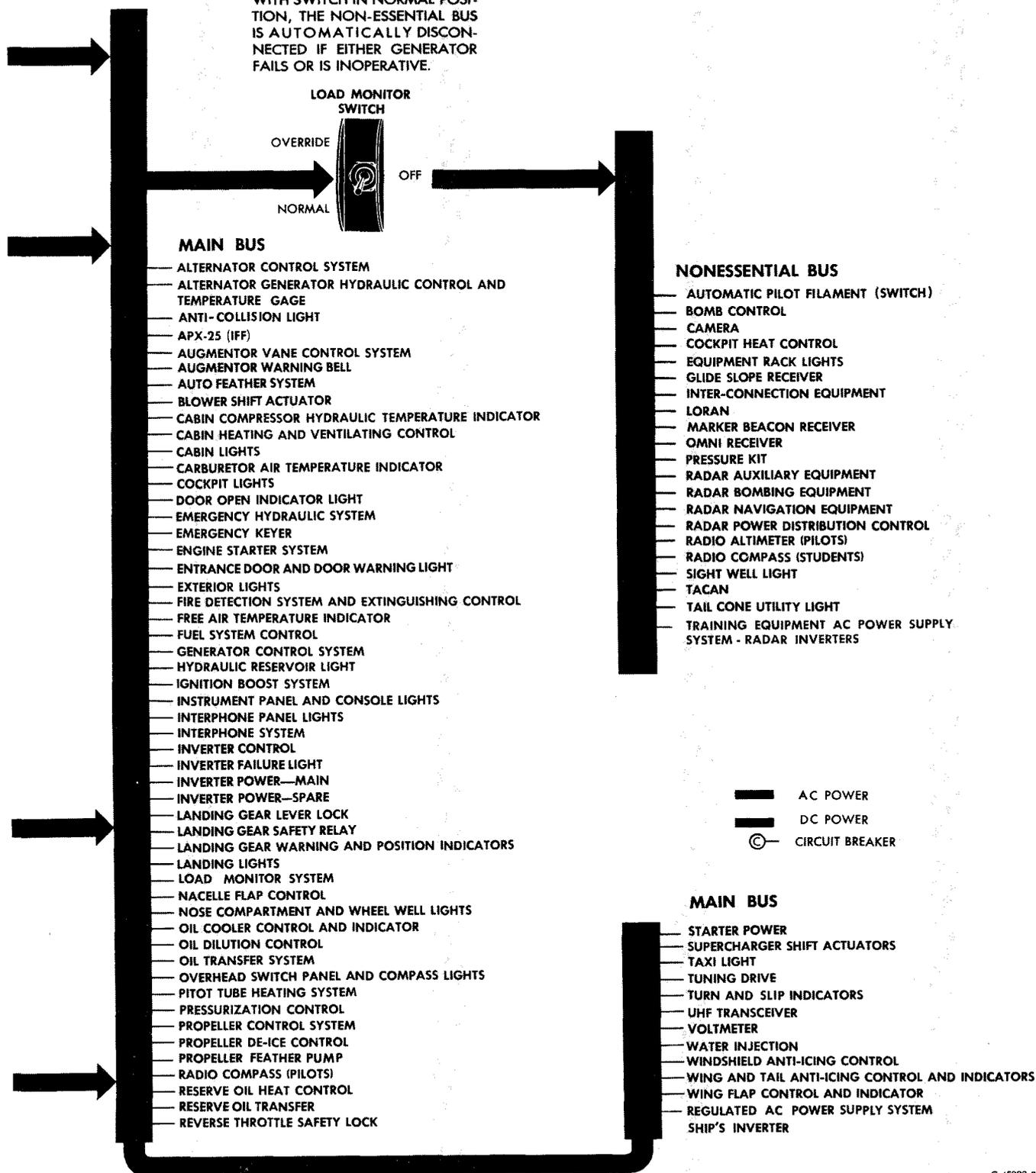


C-45222-2

Figure 1-19 (Sheet 2 of 3)

# D AIRPLANES

NOTE:  
WITH SWITCH IN NORMAL POSITION, THE NON-ESSENTIAL BUS IS AUTOMATICALLY DISCONNECTED IF EITHER GENERATOR FAILS OR IS INOPERATIVE.



C-45222-3

Figure 1-19 (Sheet 3 of 3)

### DC Voltmeter and Voltmeter Selector Switch

A dc voltmeter and selector switch (figure 1-23) is located on the dc power control panel on the pilots' pedestal. Positions of the selector switch are OFF, BUS, LH GEN, and RH GEN. When the switch is placed in the BUS position, the voltmeter will indicate the voltage of the main dc bus. When the switch is placed in either the LH GEN or RH GEN position, the voltmeter will indicate the voltage output of the selected generator provided the corresponding generator switch is OFF.

### Generator Switches

Two generator switches (figure 1-23) are located on the dc power control panel on the pilots' pedestal. The switches are guarded in ON position and have two other positions, OFF and RESET. The switches are spring-loaded from RESET to OFF position. In the OFF position, generator output is not connected to the main dc bus. In the RESET position, dc power from the dc bus is used to close the field control relay. In the ON position, generator power is connected to the main dc bus.

### Generator Voltage Control Rheostats

Each generator has two voltage control rheostats. One is located on the generator control panel below the cabin floor. It is adjusted by ground personnel. The other (figure 1-23) is located on the pedestal dc power control panel. It is also set by ground personnel, if such adjustment appears to be necessary. The pedestal voltage control rheostats are guarded by a spring-loaded plastic cover placarded with the appropriate adjustment warning. If the loadmeters show a difference of more than 10% in the total load carried by the two generators, the low loadmeter reading may be used as a standard, providing the generator voltage is not below normal (28v), while the voltage control rheostat of the opposite generator is adjusted until the readings are approximately equal. The output of either generator should not be allowed to rise above 28.5 volts. The engines must be operating at the same rpm when such adjustment is attempted. Voltage output of the two generators may not be equal after the loading equalizing adjustment has been accomplished.

#### Note

If the generator load cannot be equalized to within 10% of the total load, measures should be taken to reduce the total load. It is not desirable to discontinue operation of a generator as long as it will carry even a small part of the load.

Automatic devices in the generator voltage control system will cut out either generator automatically if output rises above approximately 32 volts, or if generator voltage is low enough to cause the current to flow from the bus to the generator.

### Generator Loadmeters (Ammeters)

The percentage of rated load carried by each generator is shown continuously on two loadmeters (figure 1-23) located on the pilots' pedestal. A reading of 1.0 indicates that the generator is operating at full rated capacity.

### Generator Failure Warning Lights

#### Note

The generator failure/overvoltage warning light provides a reliable indication only when the generator switch is in the ON position.

Two red generator failure warning lights (figure 1-23) are mounted on the dc power control panel on the pedestal. On late **B**, and all **C** and **D** airplanes, with the generator switches ON, illumination of one of the lights indicates that the corresponding generator output has been disconnected from the bus or that the generator is inoperative because of an overvoltage condition. On these airplanes the lights are placarded "Generator Failure." On **A** and early **B** airplanes, with the generator switches ON, illumination of one of the lights will indicate that the corresponding generator is inoperative because of an overvoltage condition only. On these airplanes the lights are placarded "Generator Failure Due to Over-voltage." On all airplanes, if the light remains on after the generator switch has been momentarily held in the RESET position and returned to ON, a malfunction is indicated and the generator switch must be turned to OFF.

### REGULATED AC POWER SUPPLY SYSTEM **A B C**

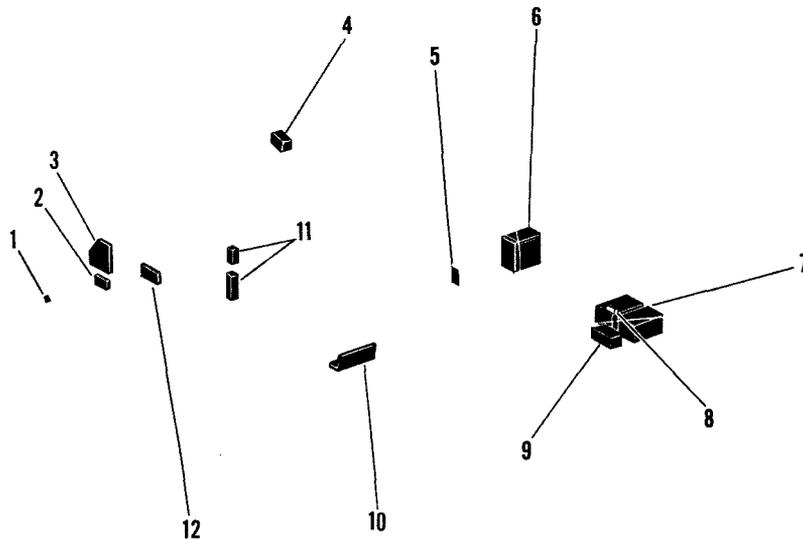
Two dc operated 2.5 KVA inverters supply single-phase, constant frequency, 115-volt alternating current to an inverter bus (figure 1-25). Only one inverter can be used at a time. Selection can be made between the main and spare inverters; however, the main inverter is normally used and the spare is selected when the main becomes inoperative. A step-down inverter-powered transformer provides 26-volt, regulated alternating current for the operation of some instruments. On **C** airplanes with Tacan installed, a separate inverter is provided to operate this radio set. Refer to TACAN, AN/ARN-21, Section IV, for operation of the Tacan inverter. (See figure 1-24 for information on equipment operated by regulated alternating current.)

### Inverter Circuit Breakers **A B C**

There are four inverter circuit breakers on the main circuit breaker panel: MAIN INVERTER CONTROL, MAIN INVERTER RESET, SPARE INVERTER RESET, and AC POWER FAILURE WARN.

# CIRCUIT BREAKER & FUSE

## A, B & C AIRPLANES



- |  |                                     |
|--|-------------------------------------|
| 1. Propeller De-ice Circuit Breakers           | 7. Battery (Ref)                    |
| 2. Fuse Box (on Forward Cabin Bulkhead)        | 8. Alarm Bell Circuit Breaker       |
| 3. Main Circuit Breaker Panel                  | 9. No. 1 Alternator Fuse Box        |
| 4. No. 2 Alternator Fuse Box                   | 10. Generator Circuit Breaker Panel |
| 5. Radar Compartment Dome Lights Breaker Panel | 11. Radio Fuse Blocks               |
| 6. Bomb Scoring Circuit Breaker Panel          | 12. Auxiliary Circuit Breaker Panel |

C-45223-1

Figure 1-20

### Inverter Power Remote Circuit Breakers **A B C**

Two remote circuit breakers are installed on the inverter control panel below the floor. They protect the circuit that furnishes dc power to operate the inverters. These circuit breakers cannot be reset directly but are controlled by the inverter reset switches on the main circuit breaker panel.

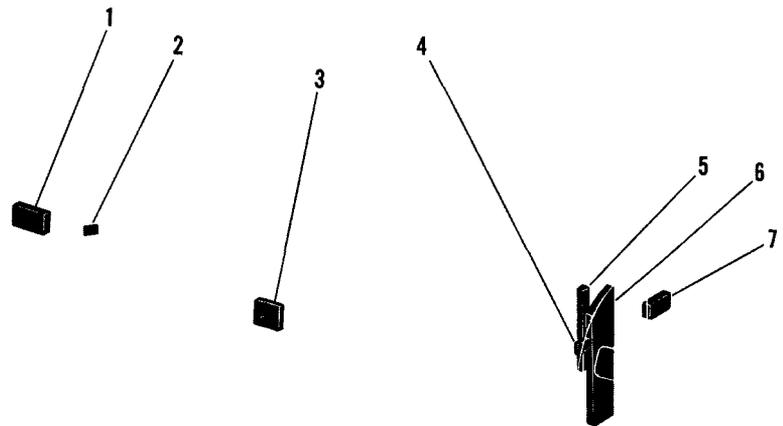
### Inverter Reset Switches and Indicator Lights **A B C**

A main inverter reset switch and a spare inverter reset switch (32, figure 1-6) are installed on the

main circuit breaker panel. Each switch has OFF and RESET positions. The switches are spring-loaded from the RESET position to an unmarked NEUTRAL mid-position. To set or to reset an inverter power remote circuit breaker, the related indicator switch is held momentarily to RESET. The OFF position is used to disconnect the inverter in the event of malfunction of the normal control. An indicator light is installed above each switch. When the light is on, the related inverter power remote circuit breaker is tripped.

# PANEL LOCATIONS (TYPICAL)

## D AIRPLANES



1. Master Bombardier Circuit Breaker Panel
2. Radar Heater Circuit Breaker Panel
3. Right Hand Power Distribution Panel
4. Crew Locker Fuse Panel
5. Radio Rack Circuit Breaker Panel
6. Main Circuit Breaker Panel
7. Auxiliary Circuit Breaker Panel

C-45223-2

### Note

The inverter reset switches must be reset after the main dc power bus is energized again after having been even momentarily deenergized.

### Inverter Switch

The inverter switch (figure 1-27), located on the regulated ac power control panel on the pilots' pedestal, has three positions: MAIN, OFF, and

**A B C**

SPARE. The switch is placed in MAIN position for normal inverter operation. If the main inverter output fails the SPARE position of the switch is used.

### Inverter Failure Warning Light

**A B C**

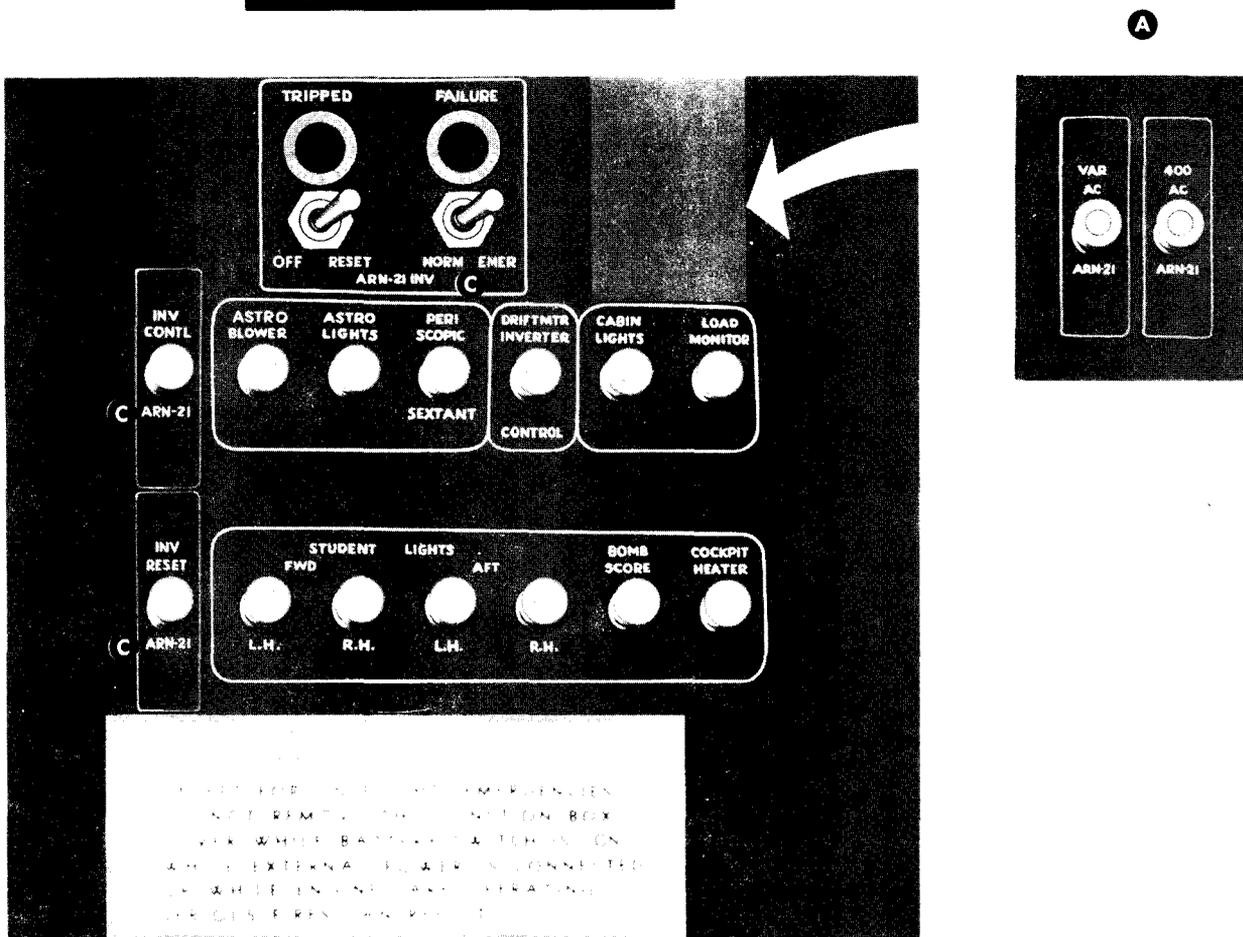
An inverter failure warning light (figure 1-27) is located adjacent to the inverter switch on the pilots' pedestal. It illuminates when the inverter which has been selected by the inverter switch becomes inoperative. The light will go out when the other





# AUXILIARY CIRCUIT BREAKER

## A, B & C AIRPLANES



C-45220-3

Figure 1-22

inverter is selected provided that inverter is operative.

**Note**

When the inverter failure warning light illuminates, the corresponding 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 on the pedestal should go out.

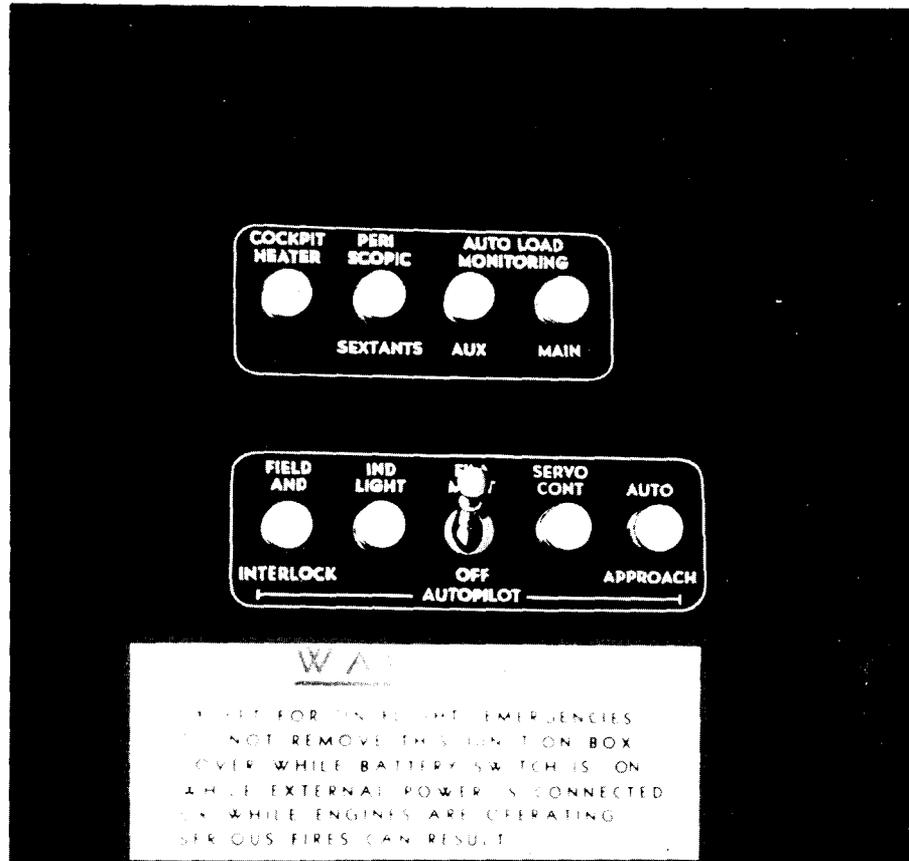
**AC Load Monitor Relay**

**A B C**

The regulated ac load monitor relay (figure 1-25) is slaved to the dc load monitor relay (figure 1-19). If

# PANELS (TYPICAL)

## D AIRPLANES



C-45220-4

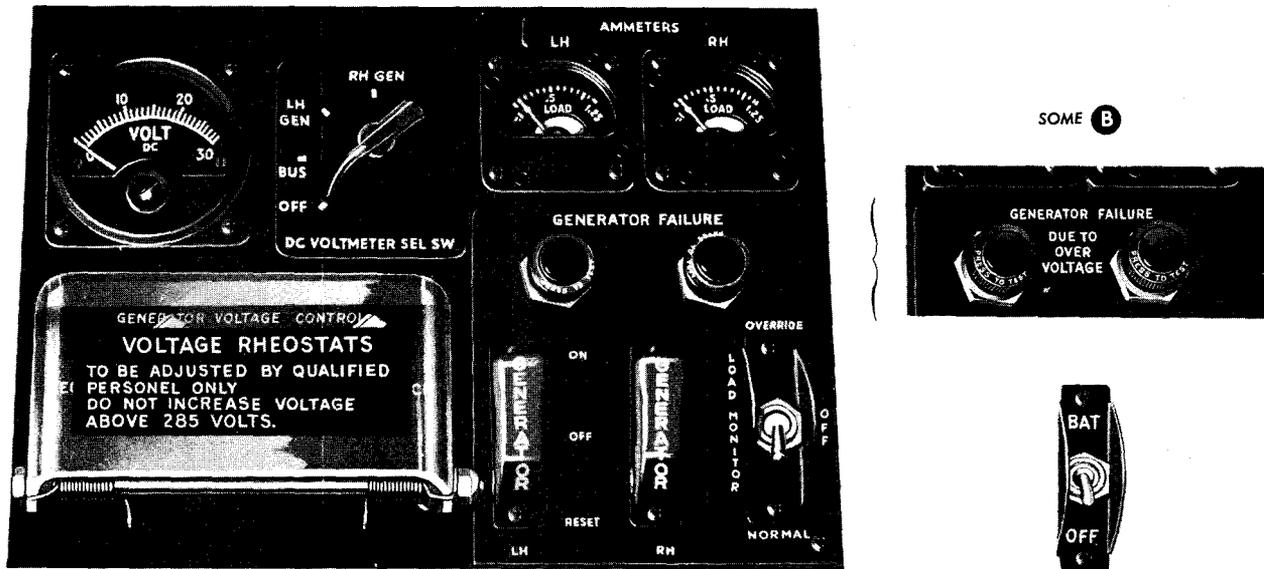
the output of either generator fails, both load monitor relays will be deenergized. The ac load monitor relay controls the power supply to the ac circuits of the radar set and camera timer. (Refer to LOAD MONITOR SWITCH, this Section.)

### AC Gyro Instrument Power Cutoff Switch **A B C**

On some airplanes, an ac gyro instrument cutoff switch is installed on the lower edge of the main circuit breaker panel (figure 1-21). The switch has

ON and OFF positions. When placed in the ON position, the attitude and directional indicators are connected, through the phase adapters, to the 115-volt regulated ac bus. When the switch is placed in the OFF position, these instruments are disconnected from the bus. The primary purpose of the switch is to disconnect the instruments from the bus when the inverters are operated for ground maintenance purposes, thus preventing undue wear on the gyros. A red indicator light, located adjacent to the switch, illuminates when the switch is in the OFF position.

# DC CONTROLS, PEDESTAL (TYPICAL)



C-45224

Figure 1-23

The light operates on direct current from the main bus.

## AC Voltmeter and AC Voltmeter Selector Switch

Bus voltages of either the regulated ac system or the unregulated ac system can be read on a voltmeter (figure 1-27) located on the regulated ac power control panel on the pilots' pedestal. The ac voltmeter selector switch (figure 1-27) is used to select the ac bus voltage to be read on the voltmeter. The switch has an OFF position and four ac bus positions; BUS NO. 1, BUS NO. 2, INV., and 26V. The two BUS positions select unregulated ac bus voltage readings; INV and 26V positions select regulated ac bus voltage readings.

## Radar External AC Power Receptacle

An external ac power receptacle for supplying regulated alternating current to an isolated bus for ground operation of the radar system is located on the bottom center of the fuselage, aft of the nose landing gear (16, figure 1-42).

## REGULATED AC POWER SUPPLY SYSTEM

Regulated 115-volt constant frequency ac power is supplied by six dc operated inverters: two 750-VA inverters supplying three-phase and single-phase current (instrument inverters); two 750-VA inverters supplying three-phase current (three-phase inverters) and two 2500-VA inverters supplying single-phase current (single-phase inverters). The instrument inverters supply current to the flight and engine instruments. The three-phase and single-phase

inverters supply current to the electronic training equipment. Each of these groups of inverters consists of a main and a spare inverter. Only one of each pair of the training equipment inverters can be used at a time. Refer to TRAINING EQUIPMENT REGULATED AC POWER SUPPLY, Section IV, for three-phase and single-phase inverter operation.

## Instrument Inverters

The main instrument inverter is powered from the essential 28-volt dc bus. The spare instrument inverter is powered from both the main and non-essential 28-volt dc buses. The main and spare instrument inverters are normally on at all times. The main instrument inverter supplies regulated alternating current to the flight and engine instruments. The spare instrument inverter supplies regulated alternating current to the autopilot, C-1 compass amplifier and RMI and, on some airplanes, the driftmeter and N-1 compass system. A step-down transformer provides 26-volt regulated alternating current for operation of some instruments. Refer to figure 1-25 for equipment operated by the instrument inverter system.

## Instrument Inverters Circuit Breakers

There are four instrument inverter circuit breakers on the main circuit breaker panel: MAIN SHIP'S INVERTER CONTROL, SPARE SHIP'S INVERTER CONTROL, MAIN SHIP'S INVERTER FAILURE WARN, and SPARE SHIP'S INVERTER FAILURE WARN. An auxiliary circuit breaker panel for the training equipment power circuits is provided at the master bombardier station. Refer to Section IV for information on the training equipment inverters.

### Instrument Inverters Switch D

The inverter switch (figure 1-27) on the regulated ac power control panel has positions MAIN, OFF, and SPARE AUTOPILOT OFF. In the MAIN position, the main instrument inverter provides three-phase and single-phase constant frequency 115-volt alternating current for flight and engine instruments, and the spare instrument inverter provides single-phase constant frequency 115-volt alternating current for the autopilot, C-1 compass amplifier and RMI, and driftmeter circuits. If the main instrument inverter output fails, the corresponding warning light will illuminate and the inverter switch must be manually placed in the SPARE position. In this position the spare instrument inverter assumes the main instrument inverter load and the autopilot, C-1 compass amplifier and RMI, and driftmeter circuits are disconnected.

### Autopilot Filament Circuit Breaker Switch D

A switch type circuit breaker is located on the auxiliary circuit breaker panel behind the pilot. The switch has FILAMENT and OFF positions. When the switch is placed in the FILAMENT position, nonessential dc power is supplied to the autopilot filaments and to the spare inverter, which in turn supplies power to the autopilot, the C-1 amplifier and RMI, and in some airplanes, to the driftmeter and N-1 compass system. Should the inverter selector switch be placed in the SPARE position, the autopilot, the C-1 amplifier and RMI, the driftmeter and N-1 compass system are automatically disconnected and the spare inverter then supplies ac power for the flight and engine instruments.

### Instrument Inverters Failure Warning Lights D

Two instrument inverter failure warning lights (figure 1-27) are installed above the instrument inverter switch on the pedestal. One light is the "Main Out" light; it illuminates when the main instrument inverter is disconnected or has failed. The other is the "Spare Out" light; it illuminates if the spare instrument inverter is disconnected or has failed.

### AC Gyro Instrument Power Cutoff Switch D

An ac gyro instrument cutoff switch (figure 1-21) is located on the lower edge of the main circuit breaker panel. The switch has ON and OFF positions. When placed in the ON position, the gyros for the attitude and directional indicators are connected to the 115-volt regulated ac bus. When placed in the OFF position, the gyros are disconnected from the bus. The switch is normally left in the ON position. It is primarily used to disconnect the gyros from the bus during ground maintenance of the airplane, when the inverters are operating, thus preventing operation and undue wear of the gyros. A red indicator light, located adjacent to the switch, will illuminate when the switch is in the OFF position. The light operates on dc power from the main bus.

### AC Voltmeter and AC Voltmeter Selector Switch D

Bus voltages of either the regulated ac system or the unregulated ac system can be read on the ac voltmeter (figure 1-27), located on the regulated ac

## EXTERNAL POWER RECEPTACLE

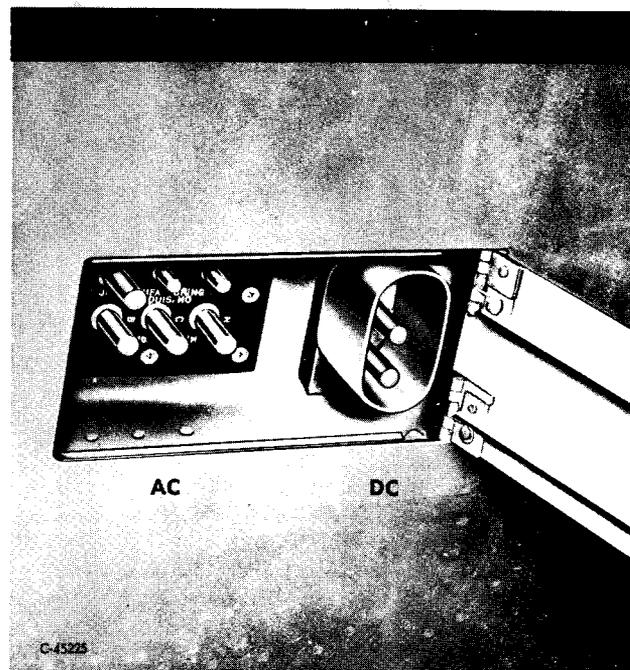
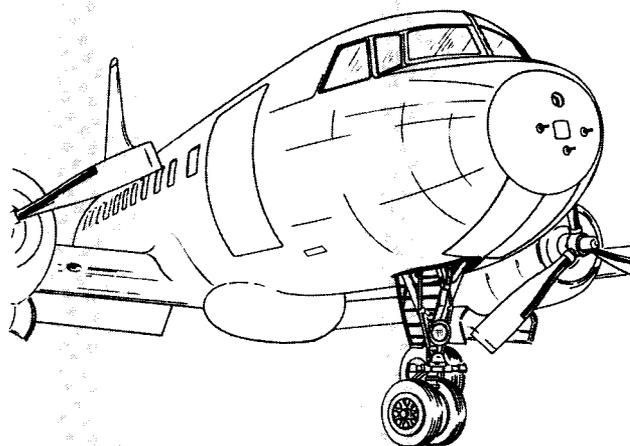


Figure 1-24

power control panel on the pilots' pedestal. The ac voltmeter selector switch (figure 1-27) is used to select the ac bus voltage to be read on the voltmeter. The switch has an OFF position and five ac bus positions: ALTRN NO. 1, ALTRN NO. 2, MAIN INV, SPARE INV, and 26V. The two ALTRN positions select unregulated ac bus voltage readings; INV and 26V positions select regulated ac bus voltage readings.

#### Note

Whenever power is supplied to bus 1 or bus 2 from either alternator or the external power source, bus voltage is read on the ac voltmeter by selecting ALTRN NO. 1 to read bus 1 voltage or ALTRN NO. 2 to read bus 2 voltage.

# REGULATED AC POWER

## A, B & C AIRPLANES

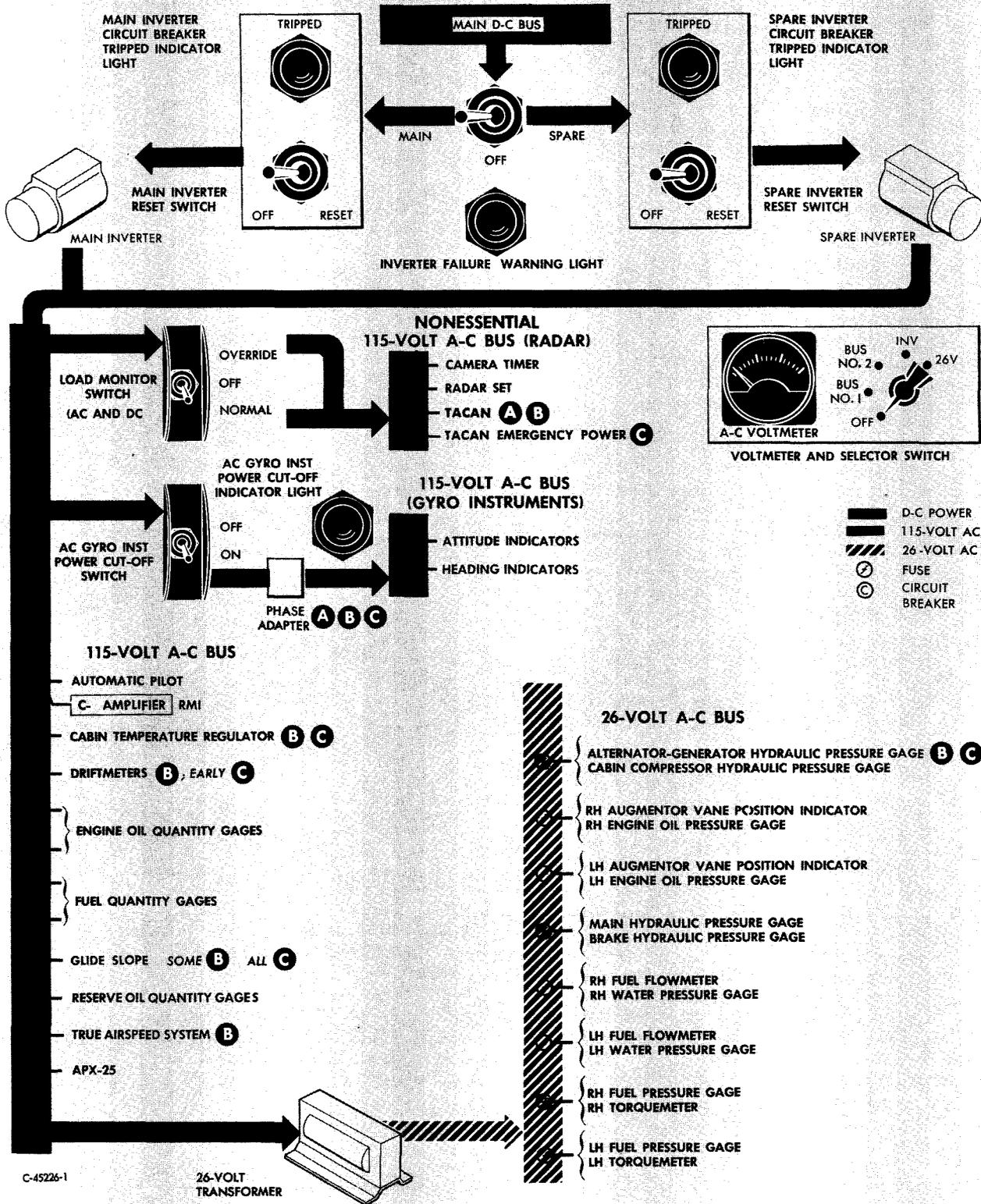
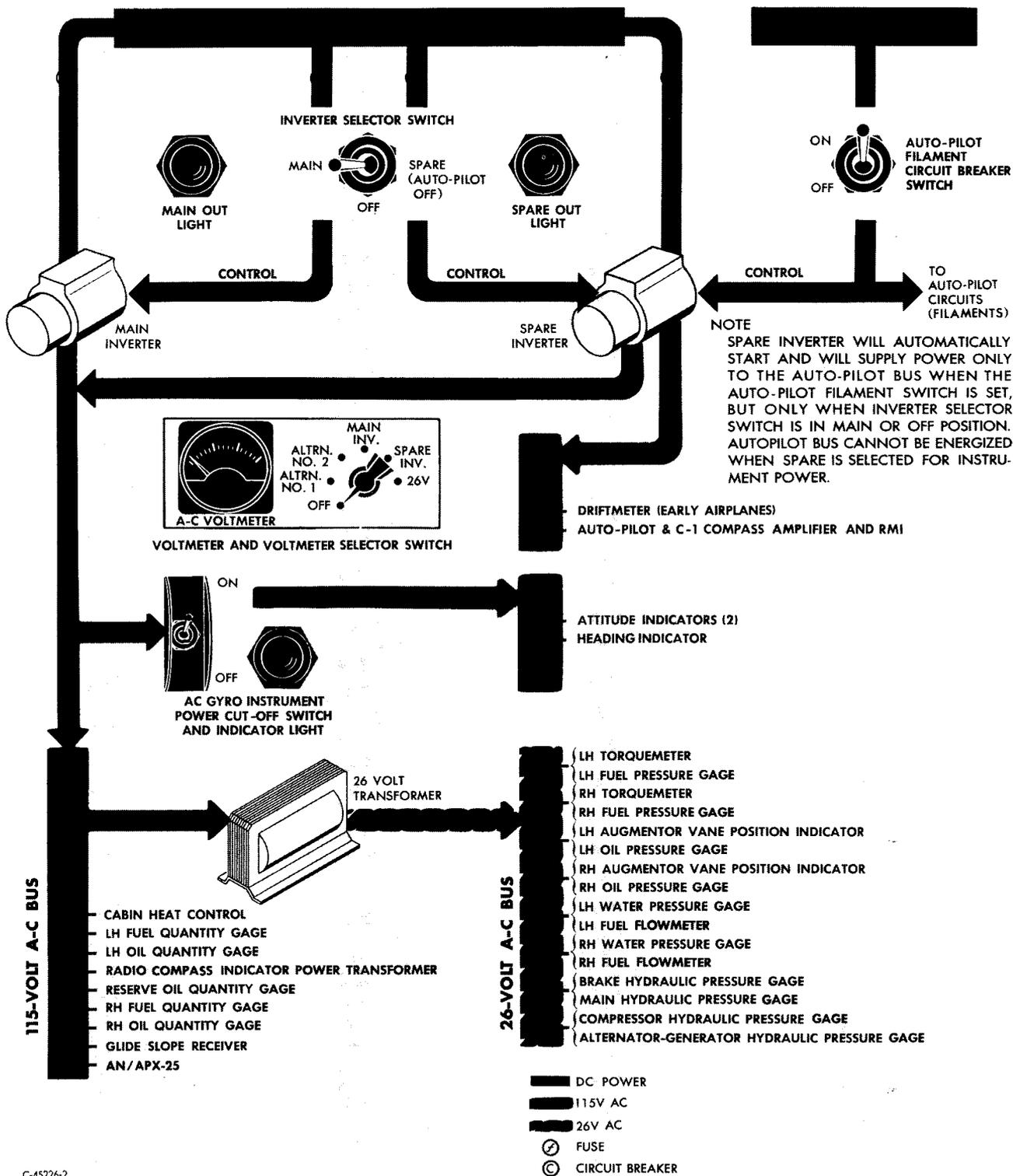


Figure 1-25

# SUPPLY SYSTEMS (TYPICAL)

## D AIRPLANES



C-45226-2

## UNREGULATED AC POWER SUPPLY SYSTEM

Two 8-KVA alternators supply 115-volt, variable frequency, single-phase alternating current to two buses. (See figure 1-26.) **A** and **B** airplanes utilize type B-1 alternators which require 28 volt dc for initial field excitation. **C** and **D** airplanes utilize type C-3 alternators which are partially self-excited but require some dc power for field excitation. One alternator, known as No. 1, is driven by the left engine; the other alternator, known as No. 2, is driven by the right engine on **A** airplanes and by a hydraulic motor in the right nacelle on **B**, **C**, and **D** airplanes. The two unregulated ac buses can be selectively powered by either alternator or by external ac power. See figure 1-26 for equipment operated by unregulated ac power.

### External AC Power Receptacle

An external ac power receptacle (figure 1-24) for supplying power to the unregulated ac buses is located on the right side of the fuselage forward of the entrance door. External power is directed to one bus or the other by positioning the alternator selector switch.

#### Note

External power can be supplied to only one of the unregulated ac buses at a time.

### Alternator Switches

Two alternator switches (3, figure 1-11), one for each alternator, are located on the unregulated ac power control panel on the pilot's pedestal. These switches connect and disconnect direct current to the fields of the alternators through the alternator voltage regulators. The switches have ON and OFF positions. When turned to ON, the alternators are excited. After approximately five minutes, they will supply normal power. On **B**, **C** and **D** airplanes, if the alternator-generator hydraulic system switch is turned to OFF, No. 2 alternator will cease to function, regardless of the No. 2 alternator switch position.

### Alternator Selector Switch

The alternator selector switch (3, figure 1-11), on the unregulated ac power control panel, is used to select the distribution of unregulated alternating current. When the switch is in the NORMAL position, the No. 1 alternator supplies No. 1 bus and the No. 2 alternator supplies No. 2 bus. Other selector switch positions are: OFF, EXT PWR ON BUS 1, EXT PWR ON BUS 2, 2 OFF - 1 ON BUS 2, 1 OFF - 2 ON BUS 1. When in the EXT PWR BUS 1 position, external ac power is connected to bus No. 1. When in the EXT PWR BUS 2 position, external ac power is connected to bus No. 2. When in the 2 OFF - 1 ON BUS 2 position, No. 2 alternator is disconnected and No. 1 alternator is connected to bus No. 2. When in the 1 OFF - 2 ON BUS 1 position, No. 1 alternator is disconnected and No. 2 alternator is connected to bus No. 1.

## Alternator Failure Warning Lights

Two red alternator failure warning lights (3, figure 1-11) are located immediately forward of the unregulated ac power control panel. Failure of an alternator causes the corresponding warning lights to illuminate. On **A** airplanes and some **B**, **C**, and **D** airplanes, the warning lights will also illuminate when the alternator switch is in the OFF position. A flashing light may sometimes be encountered when the alternator switch is first placed in ON position. This is due to normal alternator fluctuations when the alternator is first started. The lights are dc powered.

### AC Voltmeter

Bus voltage of the unregulated ac system can be read on the ac voltmeter (figure 1-27), located on the regulated ac power control panel on the pedestal. (Refer to AC VOLTMETER AND AC VOLTMETER SELECTOR SWITCH, this Section.)

### Unregulated AC Voltmeter and Voltmeter Selector Switch

An unregulated ac voltmeter and voltmeter selector switch is installed in the upper right corner of the forward side of the electrical (autopilot) equipment rack in the cabin. The selector switch has two positions - BUS NO. 1 and BUS NO. 2 - for selecting the alternator voltage to be read on the voltmeter when checking the alternator voltage regulators.

## ALTERNATOR-GENERATOR HYDRAULIC SYSTEM

**B C D**

The right generator and No. 2 alternator are driven by a hydraulic motor operated by pressure flow delivered by a pump on the right engine. (See figure 1-28.) The alternator-generator hydraulic system is not connected to the airplane's hydraulic power supply system. It has an accumulator, nitrogen pressure bottle, and accumulator pressure gage on a servicing panel in the trailing edge of the right wing. An electrically operated bypass valve is installed in the pressure line between the pump and the motor. A switch on the copilot's console supplies dc power to the pressure side of the valve actuator. When the switch is turned to OFF, direct current is supplied to the bypass side of the valve actuator. The hydraulic pump operates whenever the right engine is running. With the alternator-generator hydraulic system switch in ON position and the right engine operating at 800 to 1000 rpm, the output of the right generator will be high enough (24.5 volts) to connect it automatically to the dc bus if the generator switch is ON. The hydraulic pump then constantly supplies whatever flow pressure may be required to operate the generator drive motor at the speed necessary to put out 28 volts and enable the right generator to carry its share of the total dc load, regardless of variations in load.

**CAUTION**

In order to avoid momentarily high pressures in the alternator-generator hydraulic system, the control switch is turned ON before starting the right engine and is left ON throughout subsequent ground and flight operations except in cases of malfunction. In the event the system has been turned OFF, do not turn the system ON with the right engine running.

An amber pressure-low warning light is provided to indicate when return fluid pressure in the system is below operating limits; operation must then be discontinued. A pressure gage is provided on the copilot's flight instrument panel shelf to indicate the pressure of flow from the pump to the alternator-generator drive motor. The indicated pressure will vary widely, depending partly on engine rpm and partly on generator and alternator load. If pressure exceeds 3450 psi a relief valve will operate to route some fluid under pressure to the return manifold. A temperature gage is provided to indicate temperature of hydraulic fluid in the return line to the pump. Excessive temperature indicates a malfunction in the system. Operation of the system must then be discontinued.

**Alternator-Generator Hydraulic System Switch** B C D

A guarded ON-OFF alternator-generator hydraulic system switch (figure 4-2) is located on the copilot's console. When the switch is in the ON position, direct current is supplied through an unloading relay to the "close" side of the motor-driven actuator of the alternator-generator hydraulic system bypass valve, thus routing pressure flow from the pump directly to the hydraulic motor. In the ON position the unloading relay is not energized. The switch is kept in ON at all times as long as the right generator and No. 2 alternator are operating normally. When the switch is in the OFF position, the unloading relay is energized and then supplies direct current to the "open" side of the bypass valve actuator, allowing pressure flow from the pump to return to the manifold without operating the hydraulic drive motor. A holding circuit in the unloading relay keeps the relay energized until the ALT HYD UNLOAD circuit breaker on the main circuit breaker panel is pulled momentarily to break the holding circuit which allows the relay to unload. Prior to resetting the circuit breaker, the system switch should be placed in the ON position and the switch guard closed.

**CAUTION**

To prevent damage to the system and to prevent the possibility of fire, the switch should be turned to OFF if either the generator or alternator fails, the light illuminates, or excessive temperature is indicated.

**Note**

The alternator-generator hydraulic system switch must be placed in the ON position prior to resetting the circuit breaker to rearm the system. If the switch is left in the OFF position, the holding circuit will remain energized even though the circuit breaker is reset.

**No. 2 Engine Fluid-Off Handle** B C D

A hydraulic fluid shutoff valve is installed in the return line to the alternator-generator hydraulic pump. The valve is mechanically actuated by the No. 2 engine fluid-off handle (6, figure 1-39) on the fire control panel. (Refer to ENGINE FIRE EXTINGUISHER SYSTEM, this Section.

**Alternator-Generator Hydraulic System Pressure Gage** B C D

A pressure gage (50, figure 1-9), on the copilot's flight instrument panel shelf, indicates the hydraulic pressure in the line from the pump to the motor that runs the No. 2 alternator and the right generator. The gage is operated by 26-volt regulated alternating current.

**Alternator-Generator Hydraulic System Pressure-Low Warning Light** B C D

An amber dc operated pressure-low warning light (49, figure 1-9) illuminates whenever the return pressure drops below 69 psi. An illuminated light may indicate loss of fluid or pressurized nitrogen. If the system is operating when the light illuminates, the system should be shut down immediately by turning the alternator-generator hydraulic system switch to the OFF position.

**Alternator-Generator Hydraulic System Temperature Gage** B C D

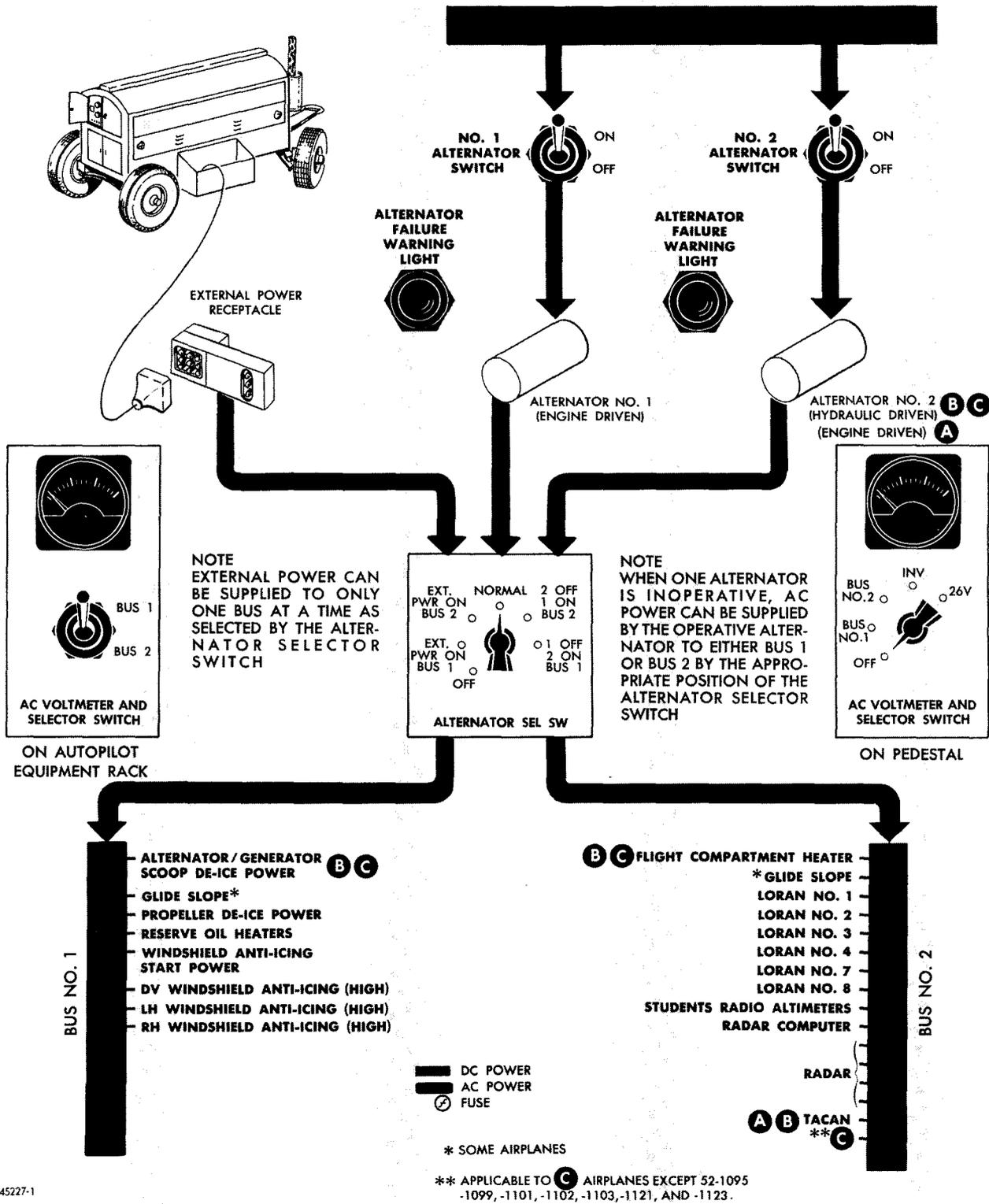
A temperature gage (51, figure 1-9) indicates the temperature of the hydraulic fluid in the return line from the hydraulic motor to the engine-driven pump in the alternator-generator hydraulic system. An operating temperature in excess of the limit marking on the gage indicates malfunction of some part of the system. The temperature gage is operated by direct current transmitted by a temperature bulb in the return manifold.

**CAUTION**

If the alternator-generator hydraulic system temperature exceeds maximum limits (figure 5-1) during ground operation, stop the right engine and investigate and correct the defect. Excessive temperatures will not occur unless there is a serious defect in the system. If excessive temperature is indicated in flight, the alternator-generator hydraulic system, right generator, and No. 2 alternator switches must be turned to OFF and electrical loads reduced as much as possible.

# UNREGULATED AC POWER

## A, B & C AIRPLANES

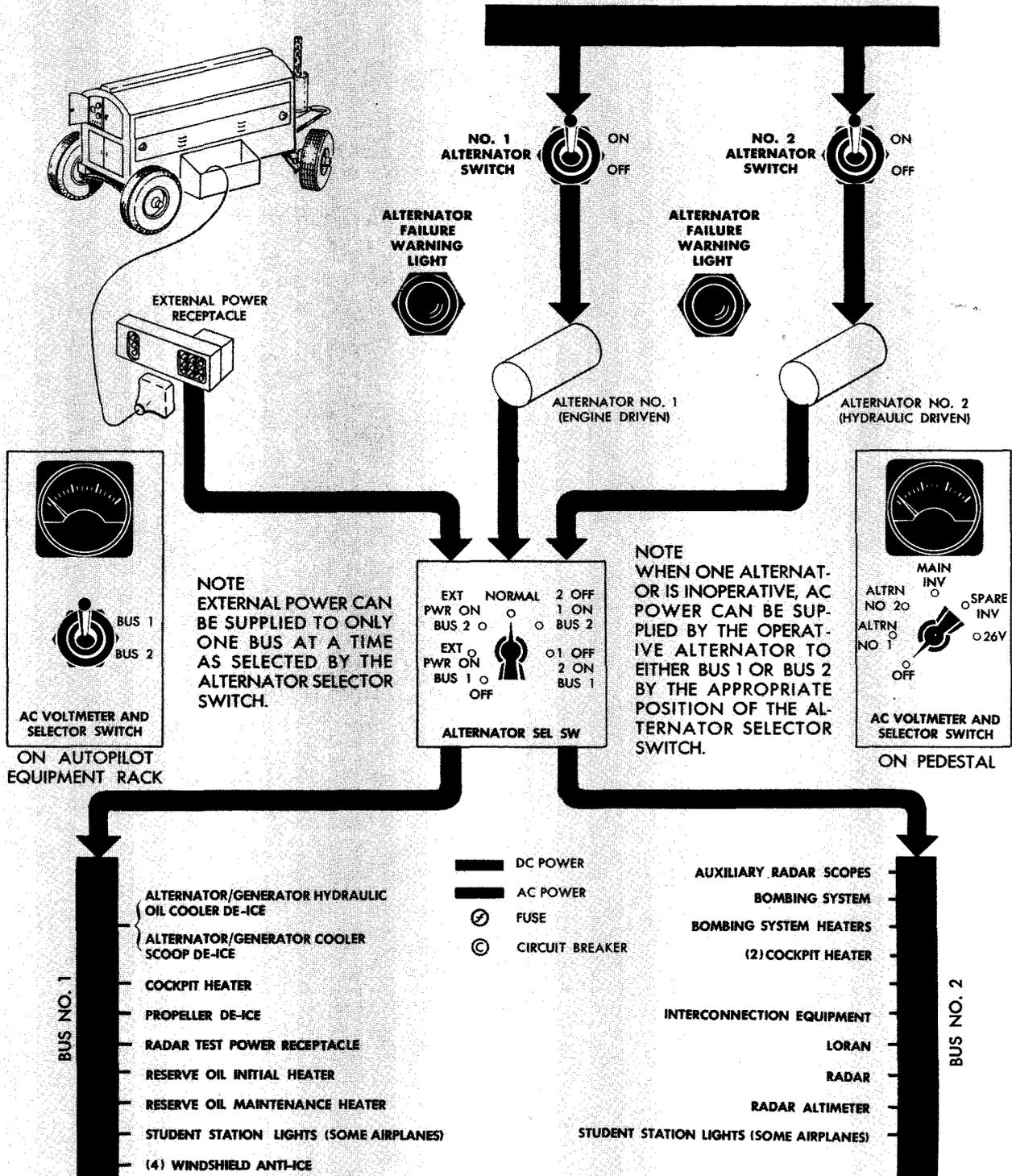


C-45227-1

Figure 1-26

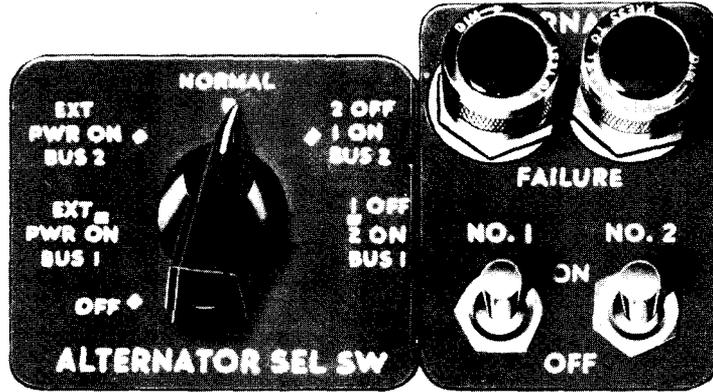
# SUPPLY SYSTEMS (TYPICAL)

## D AIRPLANES

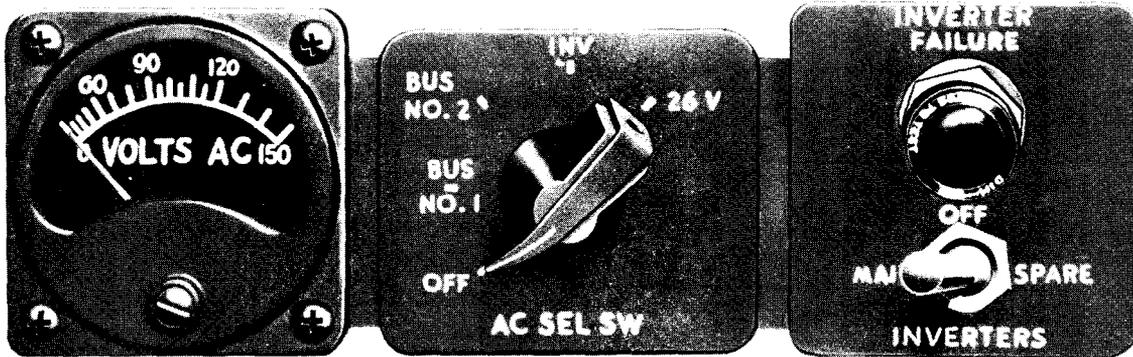


C-45227-2

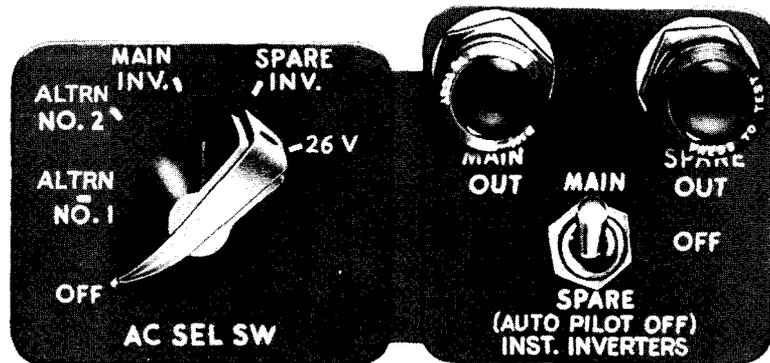
# A-C CONTROLS, PEDESTAL



A B C



D

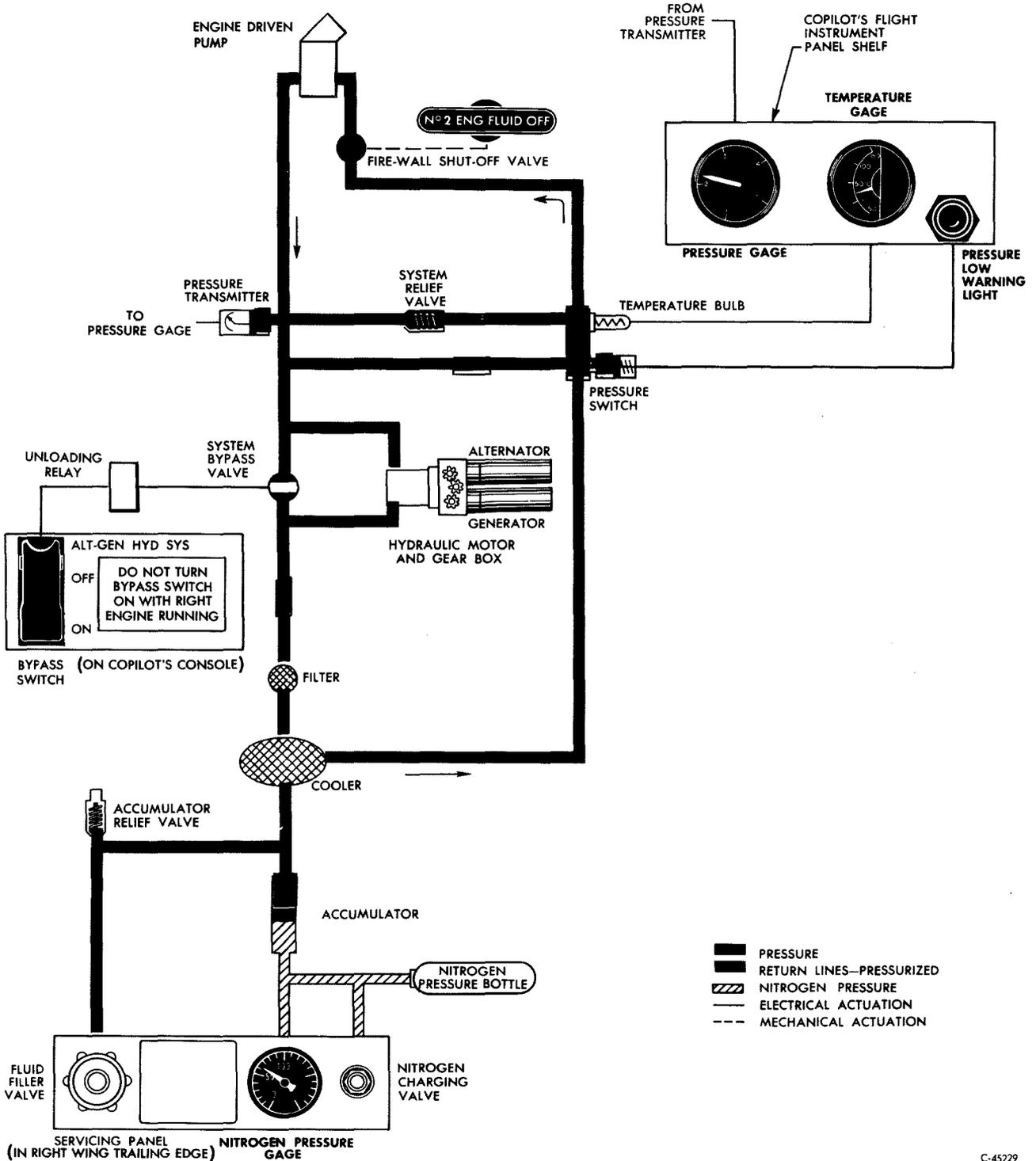


C-45228

Figure 1-27

# ALTERNATOR-GENERATOR HYDRAULIC SYSTEM

## B, C & D AIRPLANES



C-45229

Figure 1-28

### Alternator-Generator Hydraulic System Accumulator Nitrogen Pressure Gage **B C D**

A direct-reading pressure gage is provided on the alternator-generator hydraulic system servicing panel in the right wing trailing edge. The gage is used during servicing operations. It may be checked for correct pressure during preflight exterior inspection in order to assure adequate return pressure in the alternator-generator hydraulic system. If the accumulator is not properly serviced before flight, the alternator-generator hydraulic pressure-low warning light will illuminate as soon as dc power is supplied. Engine start must then be postponed until the accumulator has been serviced.

## HYDRAULIC POWER SUPPLY SYSTEM

The hydraulic power supply system (figure 1-31) is a semi-open center type system with manual depressurization. Two engine-driven, variable displacement hydraulic pumps maintain a constant pressure of approximately 3000 psi. The entire system may be operated under full pressure when required, or all of the system except the brakes and accumulator can be relieved of pressure when operated in bypass status. Operation of either of the engine-driven pumps will provide pressure to the brakes and accumulator, giving unlimited brake operation at all times when fluid is available in the normal supply system. An accumulator is provided to store pressure for brake or system operation. An electrically operated emergency hydraulic pump provides pressure for the entire system in an emergency and a pneumatic system provides limited emergency brake operation. The emergency hydraulic pump may also be used to provide hydraulic pressure for ground operation when the engines are not running. The hydraulic reservoir is provided with a sight gage and filler fitting. Test stand connections for ground operation and checking of the system are provided on a panel at the aft side of the nose landing gear well. The accumulator air pressure gage is also located on this panel. The accumulator must be charged with air on the ground to assure reserve pressure in the system. See figure 1-31 for hydraulically operated equipment. See figure 1-42 for hydraulic fluid specification.

### Hydraulic Reservoir and Sight Gage

The hydraulic reservoir is installed in a housing located above the floor level aft of the radio rack. A sight gage (figure 1-30) on the reservoir can be read through a window in the aft side of the housing. Sight calibrations are: FULL - FLIGHT LEVEL, FULL - GROUND LEVEL GEAR DOWN, REFILL - GROUND LEVEL, and EMERG. The reservoir has a fluid capacity of 6.2 U. S. gallons, of which 1.3 gallons are reserved for use with the emergency hydraulic pump.

### Hydraulic Pressure Bypass Handle

A hydraulic pressure bypass handle (figure 1-29), on the aft face of the pilot's pedestal, mechanically operates a bypass valve in the pressure supply line of the system. When the bypass handle is in the BYPASS (UP) position, the system is depressurized except for the pressure accumulator where pressure

is maintained by the pumps at approximately 3000 psi to provide adequate pressure for brake operation. When the bypass handle is placed in the PRESS. (DWN) position, the output of the variable displacement pumps is directed toward all components of the hydraulic system.

### Emergency Hydraulic Pump Switch

The emergency hydraulic pump switch (23, figure 1-11) controls dc power to a motor-operated pump which furnishes an alternate source of hydraulic pressure for operation of the system within the operating time limit of the pump motor. The switch has ON and OFF positions and is guarded in OFF position. The pump can be used for operating the system on the ground when the engines are not running and test stand hydraulic pressure is not available. Under this condition, the pressure bypass handle must be in the PRESS. (DWN) position, so that fluid pressure from the emergency pump can be directed to all lines of the system. If, due to a line failure, the normal supply of hydraulic fluid in the system and reservoir has been exhausted, use of the emergency pump is limited to the 1.3-gallon reserve fluid supply in the reservoir. With this reserve fluid, if the hydraulic pressure bypass handle is in BYPASS (UP) position, the wing flaps can be lowered, the accumulator can be charged, and brakes can be applied approximately 12 to 15 times.

#### CAUTION

- In case of complete hydraulic failure, the 1.3 gallons of reserve hydraulic fluid may not be available.
- Do not operate the emergency hydraulic pump continuously for longer than five minutes without allowing it to cool for one-half hour.

### Emergency Hydraulic Pump Reset Switch and Indicator Light

An emergency hydraulic pump circuit breaker reset switch and indicator light are located on the main circuit breaker panel behind the copilot's seat (figure 1-21). If the emergency pump draws an excessive amount of dc power, a remote control circuit breaker trips, stopping the pump and illuminating the indicator light. The reset switch must then be held momentarily to the RESET position to reset the circuit breakers and start the pump.

### Engine Fluid-Off Handles

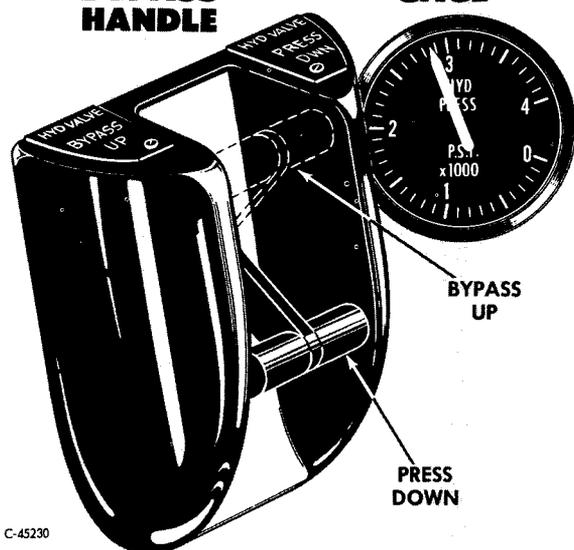
A hydraulic fluid shutoff valve is installed in the hydraulic supply line at the firewall in each nacelle. The valves are mechanically actuated by the engine fluid-off handles (3 and 6, figure 1-39) on the fire control panel. (Refer to ENGINE FIRE EXTINGUISHER SYSTEM, this Section.)

### Hydraulic Pressure Gage

The hydraulic pressure gage (54, figure 1-9) is located on the copilot's flight instrument panel shelf. The gage is connected to a pressure transmitter powered by 26-volt regulated alternating current.

## HYDRAULIC PRESSURE BYPASS HANDLE

## HYDRAULIC PRESSURE GAGE



C-45230

Figure 1-29

On early **A** airplanes, the gage is a direct-reading pressure gage. When the pressure bypass handle is in the PRESS. (DWN) position, the hydraulic pressure gage indicates the pressure throughout the hydraulic system; when the handle is in the BYPASS (UP) position, the pressure gage should read zero.

### Brake Hydraulic Pressure Gage

The brake hydraulic pressure gage (53, figure 1-9) indicates the pressure isolated in the accumulator when the hydraulic pressure bypass handle is in BYPASS (UP) position. It indicates the pressure in the entire hydraulic system when the handle is in PRESS. (DWN) position. The gage is powered through a pressure transmitter by 26-volt regulated alternating current. On early **A** airplanes, the gage is a direct-reading pressure gage.

### Hydraulic Accumulator Air Pressure Gage

The hydraulic accumulator air pressure gage in the nose wheel well indicates the air pressure in the hydraulic accumulator when there is no hydraulic pressure trapped in the accumulator system. The accumulator is charged on the ground to 1000 psi. Refer to figure 1-43, Temperature Correction Table.

#### Note

With engines inoperative, intermittent operation of the brakes when the system is in bypass will drain the accumulator hydraulic charge.

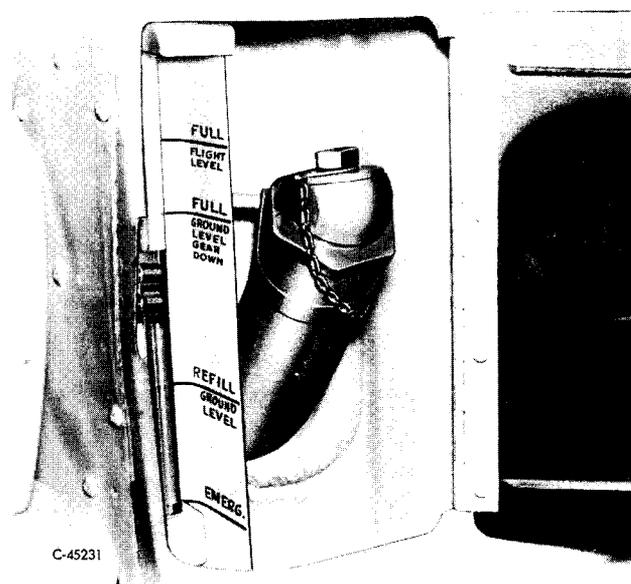
## FLIGHT CONTROL SYSTEM

The primary flight control surfaces are mechanically operated by conventional dual wheels and pedals. Conventional trim tabs on the ailerons, rudder, and right elevator are mechanically operated by controls on the pilots' pedestal. The aileron trim tabs also act as servo tabs to aid in reducing the control force on the ailerons. The elevator trim tab acts as a nose up servo. Rudder and elevator control forces are reduced by the boosting action of automatically operated flight tabs. The flight tabs are independent of the trim tabs. Tension regulators limit the range of cable tension variations in the principal control systems despite temperature changes. The aileron and rudder control cables are interconnected to improve lateral stability during low-speed flight. This interconnection is accomplished by use of springs and can be overridden when necessary to cross-control the airplane. Curtain seals installed between the trailing edges of the stabilizers and the leading edges of the rudder and elevators increase control efficiency by preventing air flow through the slots between the control surfaces and the stabilizers.

### RUDDER AND ELEVATOR FLIGHT TABS

Automatically operated flight tabs are incorporated in the trailing edges of the rudder and the left elevator. When the elevators or rudder are operated in flight, the control force applied by the pilot against the air load on the main control surface creates a reverse torque in the flight tab operating linkage and causes the flight tab to deflect in a direction opposite to the deflection of the main control surface. This

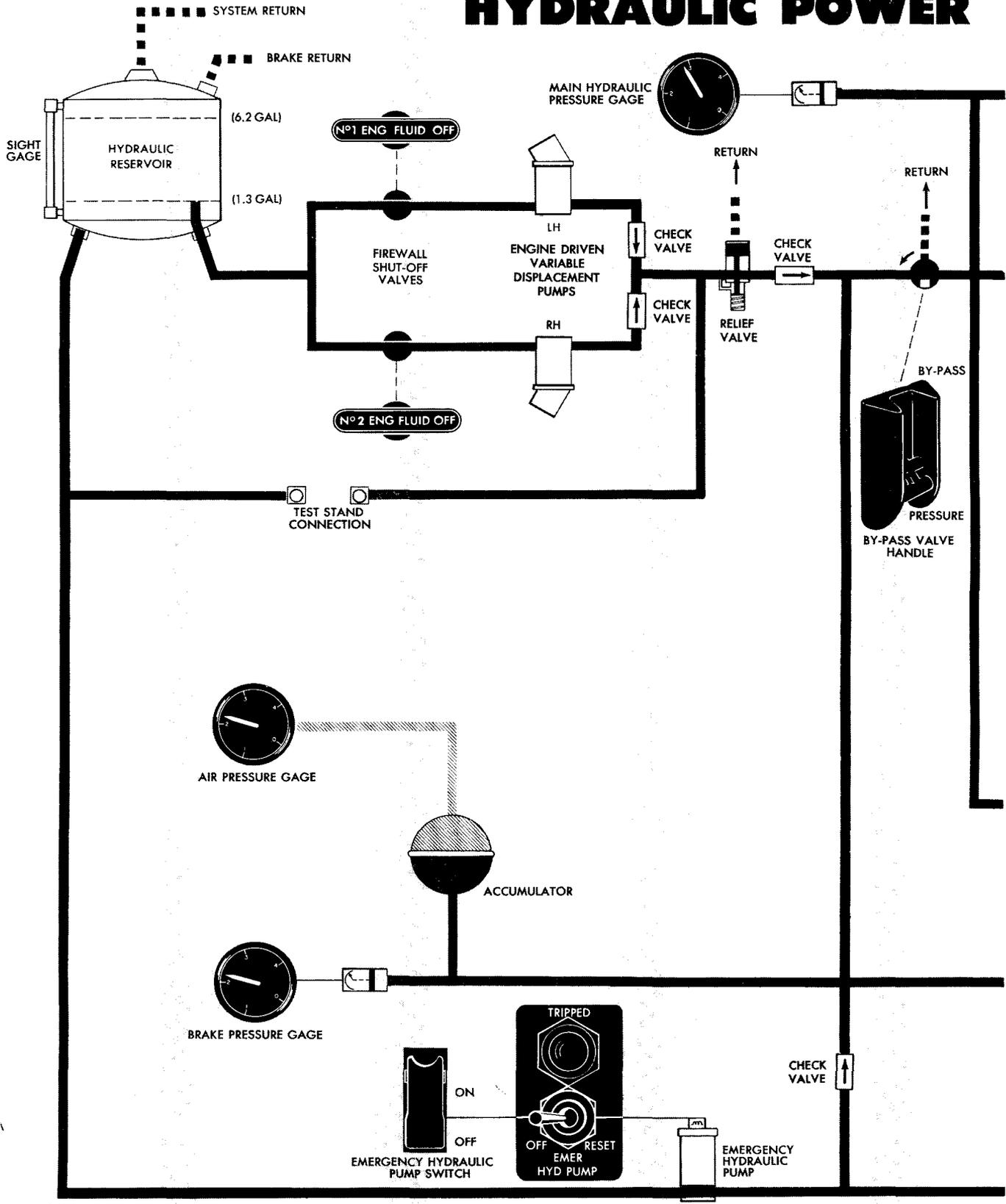
## HYDRAULIC RESERVOIR SIGHT GAGE



C-45231

Figure 1-30

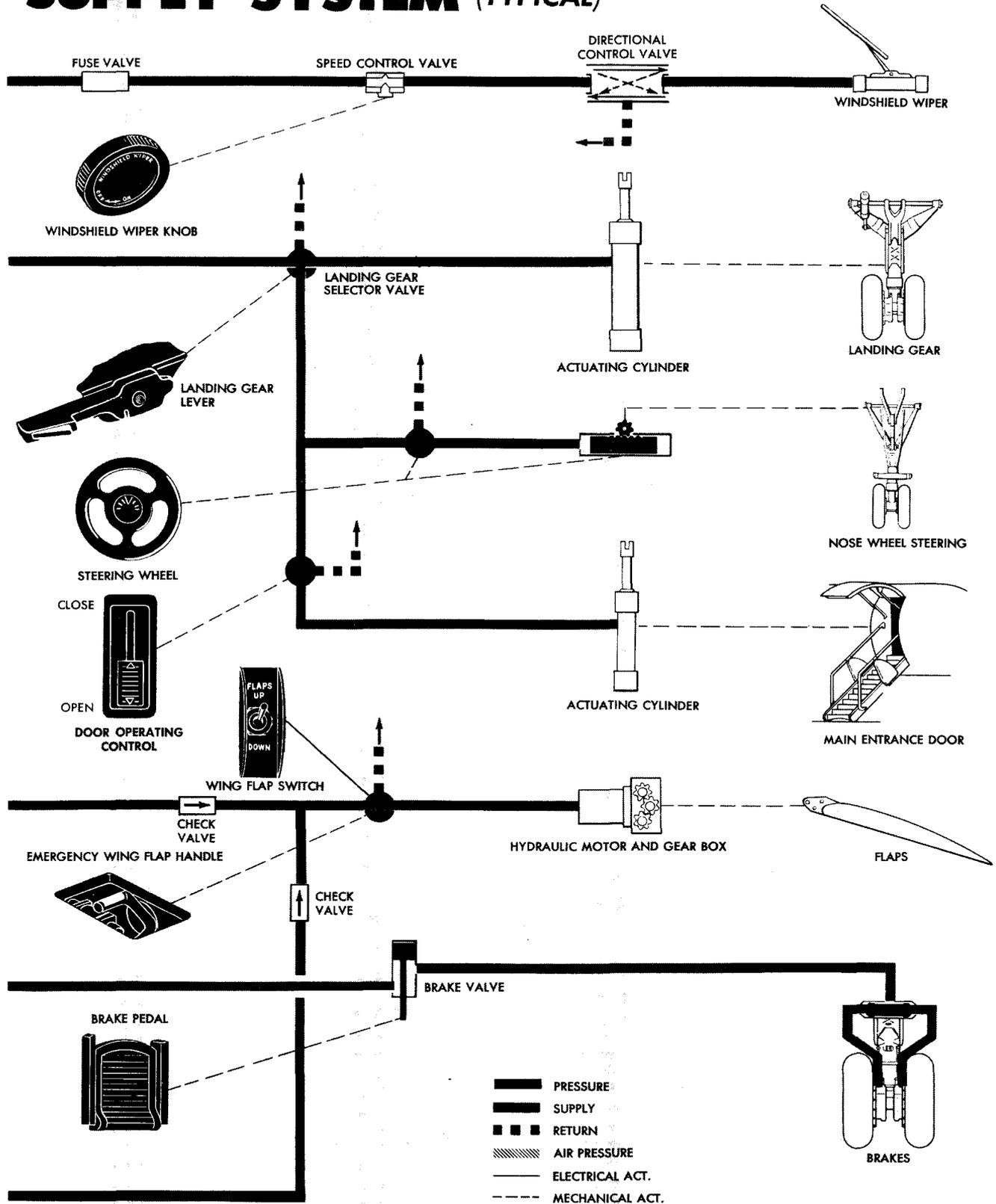
# HYDRAULIC POWER



C-45232-1

Figure 1-31

# SUPPLY SYSTEM (TYPICAL)



C-45232-2

partly cancels the force applied by the main surface air load and assists the pilot in moving the main surface in the desired direction.

**FLIGHT CONTROL SYSTEM CONTROLS AND INDICATORS**

**Control Wheels and Columns**

Each control wheel incorporates a dome floodlight button, a microphone button, and an autopilot release button (29, figure 1-6). The static position of the control columns is "nose-down" (forward), due to a bob weight on an arm that projects forward from the lower right end of the control yoke. As airspeed builds up during takeoff the columns move aft to a position corresponding approximately to neutral elevator position (depending on trim tab settings and center of gravity factors.) On landing, as airspeed decreases, the control columns again move forward to the static "nose-down" position.

**Aileron Trim Tab Knob and Position Indicator**

The aileron trim tab knob (17, figure 1-11) is located on the aft face of the pilots' pedestal. The aileron trim tab position indicator (16, figure 1-11) is located on the pedestal directly above the knob.

**Rudder Trim Tab Knob and Position Indicator**

The rudder trim tab knob (14, figure 1-11) is located on the pilots' pedestal. The rudder trim tab position indicator is on the pedestal in front of the knob.

**Elevator Trim Tab Wheels and Position Indicators**

The elevator trim tab wheels (11 and 17, figure 1-10) are located on each side of the pilots' pedestal. The elevator trim tab position indicators (18, figure 1-10) are on the pedestal inboard of the wheels.

**Rudder Pedal Adjustment Cranks**

A crank for rudder pedal fore-and-aft adjustment is provided under the instrument panel shelf above each pair of pedals.

**CONTROL SURFACE GUST LOCK SYSTEM**

A system of cables and lock pins operated by a handle on the left side of the pilot's pedestal quadrant section is provided for locking the main control surfaces in neutral position and blocking the throttles when the airplane is parked.

**Control Surface Gust Lock Handle**

A control surface gust lock handle (figure 1-32), located on the pilots' pedestal quadrant, is provided to lock the control surfaces in neutral when the airplane is parked. When the handle is forward it is in the UNLOCKED position. A latch operated by a push button in the left end of the handle prevents inadvertent movement of the lock handle. To lock the controls the handle is eased back until a pointer on the side of the handle shaft is opposite the word "Ailerons" marked on the quadrant. Careful turning of the control wheel is then required to line up the hole in the stop plate at the ailerons with the gust lock pin. Attempts to force the gust lock handle aft to the ELEVATOR or RUDDER positions before the AILERON (and, subsequently, the ELEVATOR) position has been locked will damage the stop plates. Locking the elevators and rudder requires similar "hunting" with the control column and the rudder pedals in order to seat the corresponding lock pin in the stop plate holes. When the handle has been brought aft in this manner to LOCKED position, a projection on the handle prevents forward movement of the throttles. A latch operated by a push button in the left end of the handle is pressed in when moving the locking handle. The handle is spring-loaded to the UNLOCKED (forward) position.

**WING FLAP SYSTEM**

The two Fowler-type wing flaps are operated synchronously to the same setting by a hydraulic motor. Power for operating the motor is supplied by the main hydraulic system. Normal control of the wing flap system is provided by the main dc power supply

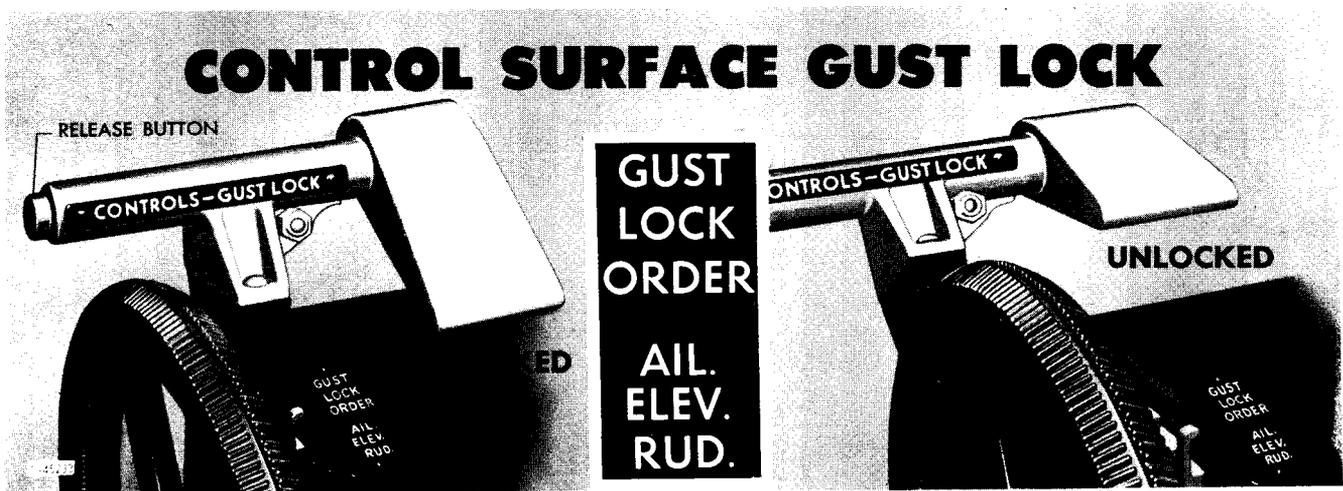


Figure 1-32

system. A switch on the pilots' pedestal is provided for wing flap management. A wing flap position indicator indicates flap position in degrees down. Hydraulic power is supplied to a solenoid-operated selector valve by the hydraulic power supply system. The selector valve routes hydraulic pressure either to the forward or reverse side of a hydraulic motor at the wing flap drive gear box. The wing flap drive tubes are connected to stub shafts that protrude from the left and right sides of the gear box. Two limit switches operated by arms on a shaft that protrudes from the forward side of the gear box open the control circuit when the wing flaps have reached the down or up limit. The same shaft operates the wing flap position transmitter. The wing flap selector valve solenoid is provided with a handle for manual emergency operation of the solenoid in event of electrical failure. Full extension or retraction of the wing flaps requires approximately 20 seconds. In down position the flaps are at an angle of 39° below the wing chord line.

## WING FLAP SYSTEM CONTROLS AND INDICATORS

### Wing Flap Switch

A guarded wing flap switch (20, figure 1-11), located on the pilots' pedestal, has positions — UP and DOWN — and is spring-loaded to an unmarked OFF position. When the switch is held to either of the operating positions, the solenoid-operated selector valve directs hydraulic pressure to the corresponding side of the hydraulic motor which operates the wing flaps. The flaps can be stopped at any intermediate position by releasing the wing flap switch to OFF. Power for the wing flap control switch and solenoid-operated selector valve is supplied from the dc power supply system.

### Wing Flap Position Indicator

A remote indicating wing flap position indicator (34, figure 1-9) is located on the engine instrument panel and indicates flap position in degrees of flap extension. The indicator is calibrated in increments of 5°. With the wing flaps fully down, the total deflection measured at the outboard flap is 39°. The indicator operates from 28-volt direct current.

### Emergency Wing Flap Handle

The emergency wing flap handle (figure 1-33) is attached to the wing flap selector valve and is accessible through a door in the floor at student position No. 11 on the left side of the cabin on **A**, **B**, and **C** airplanes, or through a door in the floor under the radar equipment rack on the left side of the cabin on **D** airplanes. In the event of electrical failure of the wing flap control circuit the handle can be moved to FLAPS UP or FLAPS DOWN position to operate the wing flaps to the desired setting. The flaps stop when the handle is released to the NEUTRAL position.

### CAUTION

Inasmuch as 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. Continuing to operate the wing flap drive motor after the wing flaps have reached the up or down limit stops would impose undue torque stresses on the wing flap drive mechanism.

## LANDING GEAR SYSTEM

The airplane is equipped with a retractable, tricycle-type landing gear. The main landing gear consists of dual wheels mounted on a hydraulic-pneumatic shock strut at each engine nacelle. The nose landing gear consists of co-rotating dual wheels, mounted on a similar shock strut of smaller dimensions, on the fuselage center line at the airplane nose. The steerable nose landing gear retracts into the nose wheel well. The main landing gear retracts into the engine nacelles. The nose wheel doors close over the wheel well opening after the nose gear has been extended but the main gear doors remain open while the gear is extended. Landing gear extension and retraction is accomplished by direction of hydraulic fluid pressure originating in the hydraulic power supply system to actuating cylinders linked to the shock struts. Mechanical latches retain the gear in either the up or down position to permit the hydraulic system to be depressurized after operation of the gear. In the event the hydraulic system becomes inoperative, the landing gear may be extended by "free fall" by placing the landing gear lever in the DOWN position, which mechanically releases the gear uplock, or through application of emergency air pressure to the landing gear uplock latches. Landing gear positions are shown at three indicators on the engine instrument panel. A warning horn signals the pilot if the landing gear is not locked down when the throttles are retarded for a landing approach. A microswitch-operated solenoid lock prevents movement of the landing gear lever to UP position while the weight of the airplane is on the landing gear. The microswitch is attached to the torsion links of the left main gear and actuates as the strut becomes extended. A small window in the flight compartment floor, aft of the pedestal, permits observation of the nose gear down-latch. The nose gear torque arms are provided with a quick-disconnect pin to facilitate ground handling of the airplane. Retraction time for the landing gear is less than five seconds; extension time is approximately 13 seconds.

## LANDING GEAR SYSTEM CONTROLS AND INDICATORS

### Landing Gear Lever

The landing gear lever (15, figure 1-11), located on the pilot's pedestal, has UP and DOWN positions. The lever is cable-connected to the main gear and nose gear uplatches and to the landing gear hydraulic selector valve. The landing gear lever latch (figure 1-34) in the upper end of the lever must be released to unlock the locking shaft before the lever can be moved from DOWN or UP position. If the locking shaft binds or fails, it can be unlocked by pulling out

# WING FLAP CONTROLS & POSITION INDICATOR

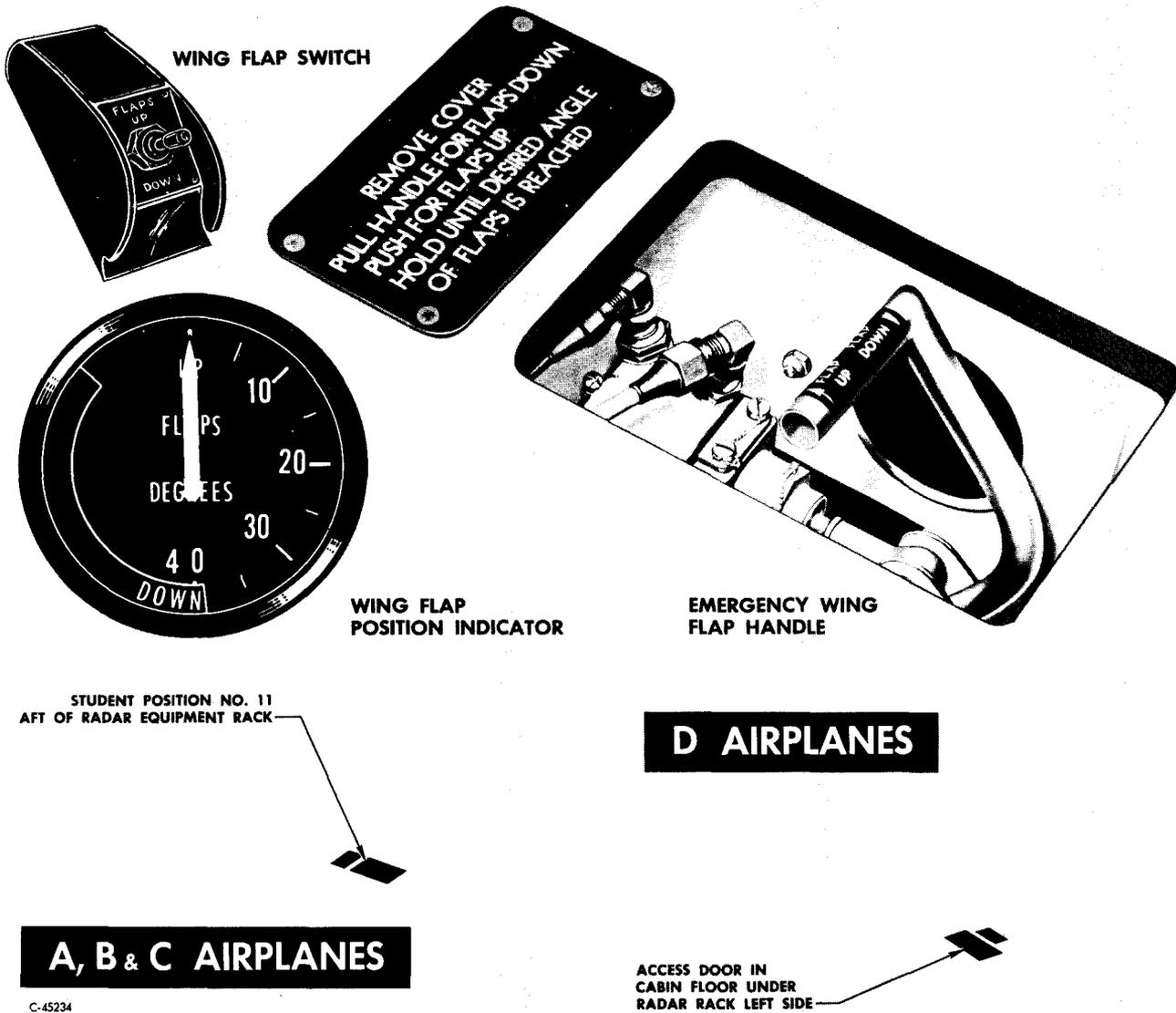


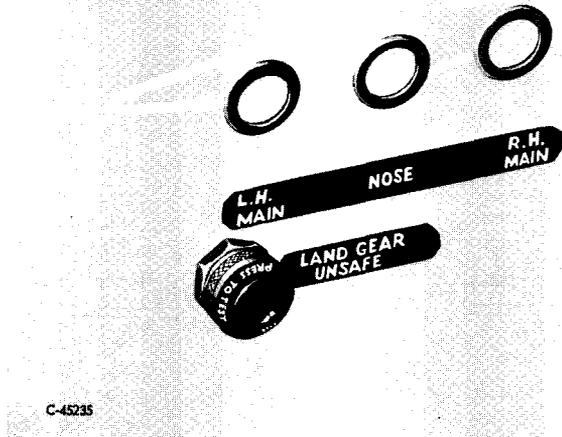
Figure 1-33

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. The lever itself is spring-loaded to UP or DOWN over center of travel so that it cannot creep if unintentionally released. In addition, a spring-loaded down-lock inside the pedestal locks the landing gear in the DOWN position as long

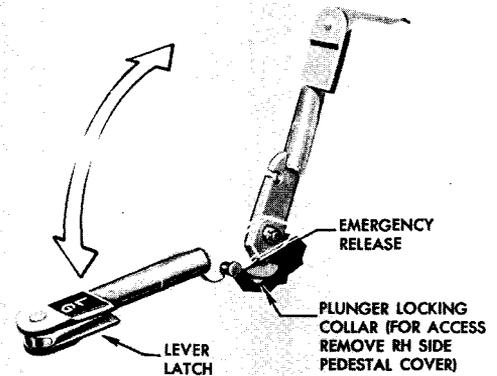
as the landing gear supports the weight of the airplane. This down-lock is released by a solenoid if the airplane is jacked up or as soon as it is airborne during takeoff. Refer to LANDING GEAR SAFETY CIRCUIT, Section VII. A lever release button (figure 1-34) in the side of the pedestal is provided to be operated manually in place of the solenoid should the latter fail to release the landing gear lever down-lock after takeoff.

# LANDING GEAR CONTROLS & INDICATORS

## POSITION INDICATORS



## LANDING GEAR LEVER



## WARNING HORN SWITCH

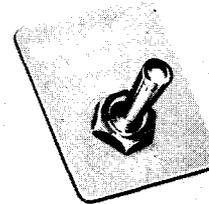


Figure 1-34

### Note

In an aborted takeoff the landing gear lever can be moved to UP position before the weight of the airplane is off the gear if the lever release button in the side of the pedestal is pushed in at the same time.

### Emergency Landing Gear Up-Latch Release Knob

The emergency landing gear up-latch release knob (45, figure 1-6, and figure 1-36), located on the pilot's console, has OFF and RELEASE positions. It is normally safety-wired to OFF. Should any of the up-latches fail to release the gear for extension, rotating the knob clockwise toward the RELEASE position directs compressed air from the emergency air bottle to the up-latch release cylinders. The hydraulic bypass handle should be in the BYPASS position to relieve system pressure and thus preclude binding of the landing gear up latches when the emergency air system is used.

### Landing Gear Ground Safety Locks

Pin-type ground safety locks (figure 1-35) are provided for both units of the main gear and for the nose gear. The pins are flagged with instructions to remove them before flight. They are then stowed in the flight compartment.

### Landing Gear Position Indicators

Three landing gear position indicators (25, figure 1-9), one for each gear, are located on the engine instrument panel. Each indicator has three electrically controlled tabs. There is an up-and-locked tab, placarded "UP", an unlocked or in-transit tab (heavy diagonal lines), and a down-and-locked tab (wheel). The landing gear position indicators are dc operated.

### Landing Gear Unsafe Warning Light

A landing gear unsafe red warning light (23, figure 1-9), is located on the engine instrument panel below the gear position indicators. The light will illuminate when any one gear is not up-and-locked or down-and-locked, depending on the position of the landing gear lever. The light illuminates when the gear is in transit or if throttles are retarded to a position corresponding to approximately 16 to 20 inches Hg manifold pressure while the landing gear is not down-and-locked. The light is powered by the dc main bus and is controlled by the landing gear limit switches.

### Landing Gear Warning Horn and Cutoff Switch

A landing gear warning horn is installed on the underside of the pilots' console. The warning horn blows if the throttles are retarded to a position corresponding to approximately 16 to 20 in. Hg manifold pres-



C-45236

Figure 1-35

sure at 5000 feet pressure altitude and engine RPM 2100 while the landing gear is not down and locked. The horn can be silenced by momentarily holding the warning horn cut-off switch (figure 1-34), on the pilots' console, in OFF position. The switch is spring-loaded to ON, but will not reactivate the horn until the system has been rearmed by moving the throttles forward past a position corresponding to approximately 16 to 20 in. Hg manifold pressure. The horn is powered by the dc main bus. Each throttle is connected to the warning horn through separate, independent circuits.

## STEERING SYSTEM

The nose gear is equipped with a steering unit that is operated by hydraulic fluid from the landing gear "down" hydraulic line. Thus, the steering unit is operative only when the landing gear lever is in DOWN position. A centering cam on the nose gear shock strut returns the nose wheels to centered position when the weight of the airplane is off the gear and the strut is not compressed. Therefore, the nose wheels are always in centered position when the gear is being extended or retracted. A quick-disconnect pin in the nose gear torque arm joint provides a means of freeing the nose wheels from the steering unit for ground handling purposes.

## NOSE STEERING WHEEL

The steering wheel (42, figure 1-6) is on the pilots' console. The turning limit of the nose wheels is approximately  $63^\circ$  either side of center. The steering wheel ratio is 4 to 1. When turning force is not being applied to the steering wheel, the steering control valve returns to neutral and the nose wheels are free to caster. A white index mark on the hub and outer rim of the steering wheel and a white index mark on the pilots' console fairing are provided to ascertain centering of the nose wheel. When the index marks are aligned, the nose wheel is centered.

## TURN INDICATOR

A turn indicator on the hub of the steering wheel indicates the amount and direction of turn of the nose wheels. The turn indicator is calibrated in degrees from zero to  $60^\circ$  in both directions from the centered position.

## BRAKE SYSTEM

Each wheel of the main landing gear is equipped with a spot-type, single-disc, self-adjusting brake. The brakes are normally operated by hydraulic pressure. An emergency air bottle provides pressure for operation of the brakes when hydraulic power is not

available. A shuttle lockout and fuse valve is installed in the hydraulic brake system in order to provide emergency air operation of the brakes in case of pressure loss or line breakage. Operation of the valve is automatic. As long as the hydraulic system is in operation, fluid is free to travel through the valve. When emergency air is applied to the valve, the shuttle moves to close off the hydraulic ports allowing air to actuate the brakes. A break in the hydraulic line downstream will also cause the shuttle to move, thereby acting as a fuse closing off the hydraulic ports and eliminating further loss of hydraulic fluid. A fuse reaction time of approximately two seconds allows 10 to 20 cubic inches of hydraulic fluid to escape before fuse piston locks out.

### HYDRAULIC BRAKE SYSTEM

Hydraulic pressure from the hydraulic power supply system is metered to the brakes through the power brake valves operated by the brake pedals in the cockpit. The power brake valves reduce main hydraulic system pressure to the maximum brake operating pressure of approximately 1000 psi. (See figure 1-31.) When the hydraulic pressure bypass handle is in the PRESS. (DWN) position, sustained hydraulic pressure is available to the brake valves, and the brakes can be operated without limitation. When the hydraulic pressure bypass handle is in the BYPASS (UP) position, and with the emergency hydraulic pump and the engine-driven pumps not operating, only the pressure in the hydraulic system accumulator and the brake lines is available to the brake valves. The brakes can be operated approximately 12 to 15 times before the pressure is dissipated. If either engine-driven pump is operating, brakes can be operated without limitation. When the pressure bypass handle is in the BYPASS (UP) position and the emergency hydraulic pump is operating, but the engine-driven pumps are not operating the brakes can be continuously operated during the five-minute period that the emergency pump can be continuously operated.

### Brake Pedals

Conventional toe-operated brake pedals are incorporated in the rudder pedals.

### Parking Brake Handle

The parking brake handle (40, figure 1-6) is located on the pilots' console. The brakes must be applied by depressing the brake pedals before setting the parking brake handle.

### Brake Hydraulic Pressure Gage

A pressure gage (53, figure 1-9), located on the shelf of the copilot's flight instrument panel, indicates the pressure of hydraulic fluid trapped in the accumulator and brake system lines when the hydraulic pressure bypass handle is in the BYPASS (UP) position. For additional information on this gage, refer to HYDRAULIC POWER SUPPLY SYSTEM, this Section.

### EMERGENCY AIR BRAKE SYSTEM

The emergency air brake system provides air pressure for wheel braking in the event that the hydraulic brake system is inoperative and reverse thrust is not available. Compressed air is metered into the brake hydraulic lines between the brake valves and the brake cylinders. The short section of tubing immediately preceding the brake discs must be intact for the air system to function properly. Although the system will allow varying degrees of braking pressure, the sensitivity of the system makes it difficult to achieve this effect. The system does not provide for differential braking. When the emergency air cylinder is fully charged, approximately eight air brake applications can be made. Refer to EMERGENCY AIR BRAKE OPERATION, Section III.

### Emergency Air Brake Knob

The emergency air brake knob (41, figure 1-6), located on the pilots' console, has OFF, HOLD, and ON positions. The knob releases and controls compressed air from the emergency air cylinder for emergency braking in the event of hydraulic brake failure. Placing the knob in the ON position opens the air valve to introduce compressed air into the brake hydraulic lines. Placing the knob in the HOLD position, after first placing it in ON, will hold the air pressure in the brake lines. In the OFF position, the emergency air line from the cylinder is closed and air pressure is released overboard from the hydraulic brake lines. The air brake knob is safety-wired in the OFF position.

### Note

Hydraulic brake operation will not be reliable after emergency air brake operation until the brake hydraulic lines have been bled to remove all air.

### EMERGENCY AIR SYSTEM

An emergency air system (figure 1-36) is provided for emergency operation of the brakes and release of the landing gear up-latches. Air pressure is supplied by a compressed air cylinder mounted in the nose wheel well.

### Emergency Air Pressure Gage

A direct-reading air pressure gage (52, figure 1-9), located on the copilot's instrument panel skirt, indicates the pressure in the emergency air cylinder. See figure 1-43, Temperature Correction Table, for correct gage readings at specific temperatures.

### INSTRUMENTS

Instruments required for flight and navigation of the airplane, and for monitoring the operation of the engines and systems, are located on the instrument panel and instrument panel skirts (figure 1-9), the pilot's and copilot's consoles (figure 1-6), and the pedestal (figure 1-11). The pilot's and copilot's flight instruments are grouped on individual panels on each side of the engine instruments. All flight instruments are electrically operated with the exception of the airspeed indicators, altimeters, and vertical velocity indicators, which operate from the

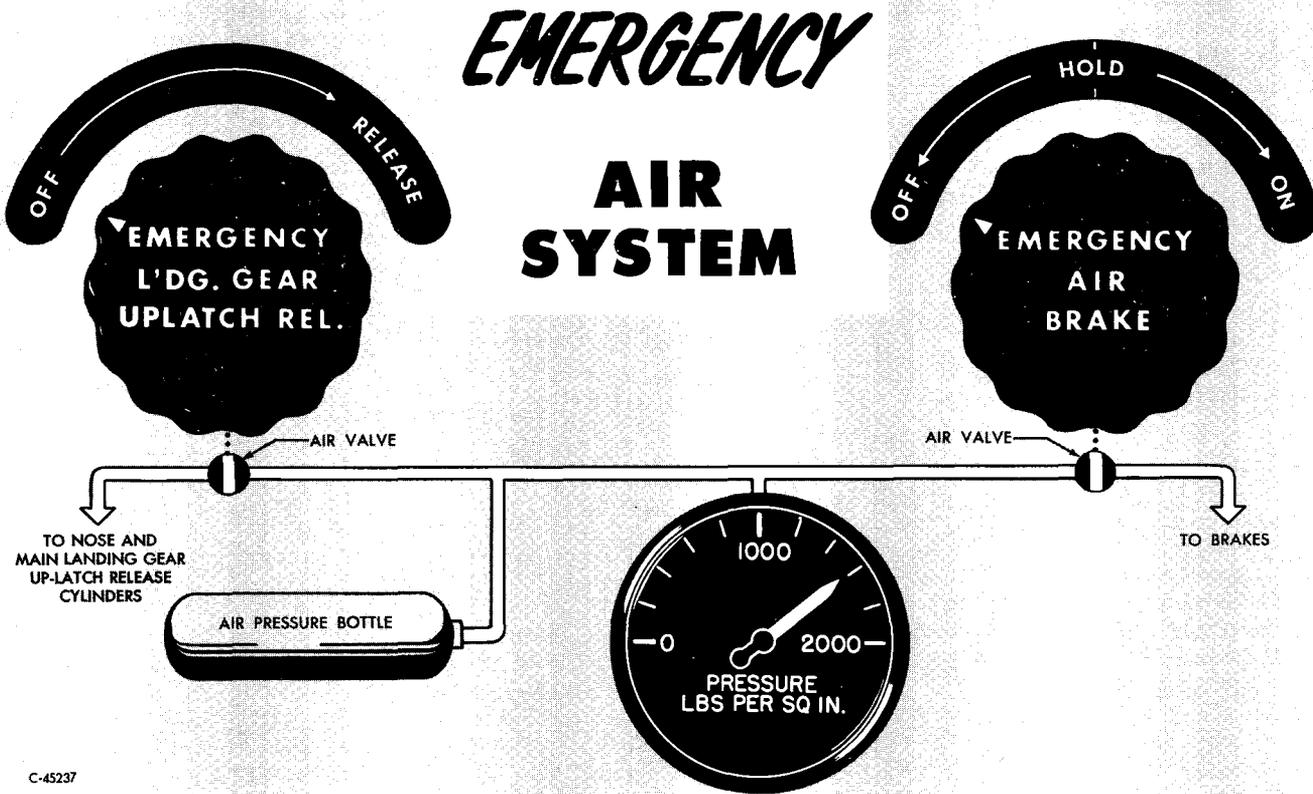


Figure 1-36

pitot-static system. Electrical power for these instruments is supplied by the 115-volt regulated ac bus, through phase adapters, and by the 28-volt dc bus.

#### Note

On some airplanes, a switch is provided to disconnect the gyro instruments from the 115-volt regulated ac bus. Refer to AC GYRO INSTRUMENT POWER CUTOFF SWITCH, this Section.

#### PILOT'S FLIGHT INSTRUMENTS

The pilot's and copilot's flight instrument panels (figure 1-9) are both provided with airspeed indicators, attitude indicators, autopilot heading indicators, radio magnetic indicators, altimeters, turn-and-slip indicators, and vertical velocity indicators. In addition, the pilot's flight instrument panel is provided with a course indicator, a directional indicator, a radio altimeter on **A** and **B** airplanes and some **C** and **D** airplanes, a radio altimeter altitude limit switch, altitude limit lights, and a TACAN range indicator. A steering indicator, used in conjunction with the radar training equipment, is located on the copilot's flight instrument panel. A magnetic (standby) compass (6, figure 1-5) is located in the windshield "V".

#### Copilot's Attitude Indicator

The copilot's instrument panel is equipped with a J-8 attitude indicator to provide a visual indication of aircraft attitude. The gyro motor of this instrument is powered by 115-volt regulated alternating current from the inverter. If power fails during operation, an attitude warning flap will appear.

#### WARNING

The attitude warning flap is an indication of insufficient electrical power only. It does not appear with malfunctions of other components within the instrument.

Forces acting on the erection mechanism of the attitude indicator during a normal turn may cause errors to be noted in pitch and/or bank up to five degrees upon return to level flight. The erection mechanism will begin to correct these errors once true gravitational forces are sensed. A caging knob at the lower right corner of the instrument allows manual erection of the gyro axis to the vertical position in relation to the instrument case. A pitch trim knob is also included to adjust the miniature aircraft in relation to the horizon bar.

**WARNING**

A pitch error in the indications of the J-8 attitude indicator will result from accelerations or decelerations. This error will appear as a climb after acceleration and a descent after deceleration. The amount of these errors depends on the duration and rate of deceleration and acceleration. This error will be most noticeable at the time the airplane rotates after the takeoff run. At this time, a climb indication error of about one and a half bar widths will normally be noticed. The erection system will automatically remove the error once acceleration ceases.

**CAUTION**

To avoid damage to the instrument, do not pull caging knob violently. If it is necessary to cage the gyro to correct errors, the aircraft must be in straight and level flight to align the gyro axis with the true vertical.

**Pilot's Attitude Indicator**

On some airplanes, a type J-8 attitude indicator is installed on the pilot's flight instrument panel. On other airplanes, a type MM series attitude indicator is installed on the pilot's flight instrument panel (6, figure 1-9). The MM series attitude indicator is similar in appearance and operation to the J-8 except that the MM series indicator incorporates an automatic erection system that maintains the gyro rotor in the erect position at all times regardless of the attitude of the airplane. A single knob at the lower corner of the instrument provides manual adjustment of the horizon bar. A power failure warning flag will show if the power supply is interrupted. The normal erection time is approximately 2-1/2 minutes after power has been applied.

**WARNING**

The attitude warning flag will not appear with a slight electrical power reduction or failure of other components within the system. Failure of certain components can result in erroneous or complete loss of pitch and bank presentations without a visible flag.

**PILOTS' PITOT-STATIC SYSTEM**

The pilot's and copilot's pitot-static systems (figures 1-37 and 1-38) are independent, and each receives

pitot pressure from a separate pitot tube installed on the nose of the fuselage. Static pressures from a pair of external static ports located on the sides of the fuselage, and from the alternate static port inside of the dorsal fin, are available for the pilot's and copilot's flight instruments. The pilots' pitot-static system is independent of the pitot-static system that serves the training flight instruments in the cabin.

**Note**

Erratic operation of the copilot's instruments may be due to a leak in the static-pressure line to the automatic pilot amplifier.

**Static Pressure Selector Valves**

A static pressure selector valve (9, figure 1-6) is installed on each of the auxiliary panels outboard of the pilots' and copilot's flight instrument panels. The valves are used to select static pressure from either the normal static source (two side ports) or the alternate static source (dorsal fin port) for the flight instruments on the corresponding flight instrument panels. At cruising airspeed, the altimeter reading will be approximately the same for either static source. As speed is reduced, the altimeters will read progressively lower when the alternate (dorsal fin) port is used, until at minimum airspeeds, the reading is approximately 50 feet lower than the normal reading.

**EMERGENCY EQUIPMENT****FIRE DETECTION AND EXTINGUISHER SYSTEMS**

A fire detection system warns of fire in the nacelles and in the area of the reserve oil tank below the floor opposite the rear service door. A fixed fire extinguisher system is provided for extinguishing a nacelle fire. See figure 1-39 for fire detection and extinguishing zones.

**WARNING**

The fire detector circuit breaker must not be pulled out to silence the augmentor overheat warning bell. If the circuit breaker is pulled out, the fire detection system is inoperative.

**FIRE DETECTION SYSTEM**

A thermocouple-type fire detection system detects fires in the engine sections (zone 1), engine accessory sections (zone 2), main landing gear wells (zone 3), and in the reserve oil tank area. On some **A** airplanes, and on early **B** airplanes, one fire detection circuit is provided in each nacelle, and the entire system is tested by depressing a fire detection circuit test button on the fire control panel. Later **B** airplanes, and all **C** and **D** airplanes have two fire detection circuits installed in each nacelle. On these airplanes, the entire fire detec-

tion system is tested by alternately placing a fire detection circuit test switch on the fire control panel in the left and right positions. In the presence of fire, any of the thermocouples will generate sufficient current to actuate its detection and warning circuits and cause the corresponding fire warning light on the fire control panel to illuminate. Operating the test button or switch simulates a fire in the protected areas.

#### Note

If the fire warning lights do not illuminate within 15 seconds after actuating the test switch, the fire detection system is defective.

#### Fire Detection Circuit Test Switch

On **A** airplanes, and on early **B** airplanes, a push-button switch is provided on the fire control panel (4, figure 1-39) to test the operation of all components and circuits of the fire detection system simultaneously. Depressing the button will cause the three warning lights on the fire control panel to illuminate. On later **B** airplanes, and on **C** and **D** airplanes, a toggle switch (5, figure 1-39) is provided to test all components and circuits of the fire detection system. On these airplanes, the switch has three positions: DET. "A" L & R NAC & FUS OIL (toggle left position), DET. "B" L & R NAC (toggle right position), corresponding to the two detector circuits, and an unmarked OFF position to which the toggle is spring-loaded.

#### Fire Warning Lights

Three fire warning lights (figure 1-39), on the fire control panel, are marked: "NO. 1 ENGINE," "NO. 2 ENGINE," and "FUS OIL TANK." Illumination of one of the warning lights indicates that at least one thermocouple in the corresponding area has sensed the sudden increase of heat characteristic of flame. The gradual heat increase normal to engine operation usually does not energize detector thermocouples. A warning light that has illuminated to indicate fire, will go out when fire is no longer present in the area.

### WARNING

If the detection circuit is broken by fire damage, the corresponding warning light will go out before the fire is out.

#### ENGINE FIRE EXTINGUISHER SYSTEM **A**

A two-shot, carbon dioxide (CO<sub>2</sub>), fixed fire extinguisher system is provided to combat fire in the nacelles. CO<sub>2</sub> is stored in three main supply cylinders and three reserve supply cylinders. The supply to be discharged is determined by use of a selector switch on the fire control panel. Two fire extinguisher switches guarded by engine fluid-off handles are provided, one for each nacelle. Operation of an engine fluid-off handle closes valves in the fuel, oil, and hydraulic fluid supply lines at the firewall and releases the related fire extinguisher switch

to mid-position, which automatically selects the discharge route to that nacelle. The fire extinguisher switch can then be operated to the ON position to discharge the selected CO<sub>2</sub> supply. Discharge outlets are provided in the engine section (zone 1), the engine accessory section (zone 2), and the main landing gear well (zone 3) in each nacelle. The ventilation door in the engine top cowl panel automatically closes and the corresponding CO<sub>2</sub> supply indicator disc in the fuselage skin forward of the left wing is ruptured when CO<sub>2</sub> is discharged. The supply selector, route selector, and discharge circuits are dc powered to actuate relays and solenoid valves.

### WARNING

The fixed fire extinguisher system will not put out a fire in the reserve oil tank area. Portable fire extinguishers must be used in this area. A small panel in the floor under the table at student station No. 18 is provided for access.

#### CO<sub>2</sub> Selector Switch **A**

The CO<sub>2</sub> selector switch (figure 1-39) is installed in the upper center of the fire control panel. The switch has positions MAIN and RESERVE. The switch position selected determines the bank of CO<sub>2</sub> bottles, main or reserve, which will be discharged when either of the fire extinguisher switches are actuated. Selection is made through a dc circuit.

#### CO<sub>2</sub> Supply Indicator Discs **A**

Two red discs, one each for the main and reserve CO<sub>2</sub> supplies, are installed in the fuselage skin forward of the left wing leading edge. These discs are ruptured when CO<sub>2</sub> vents overboard automatically to relieve unsafe pressure conditions caused by high temperature in the cylinders. Ruptured or missing discs indicate that the supply of CO<sub>2</sub> has been depleted. Two yellow discs, one each for the main and reserve CO<sub>2</sub> supplies, are installed next to the red discs in the fuselage skin forward of the left wing leading edge. These discs rupture when CO<sub>2</sub> is discharged during normal operation of the fire extinguisher system, indicating that the supply of CO<sub>2</sub> has been depleted.

#### Fire Extinguisher Switches **A**

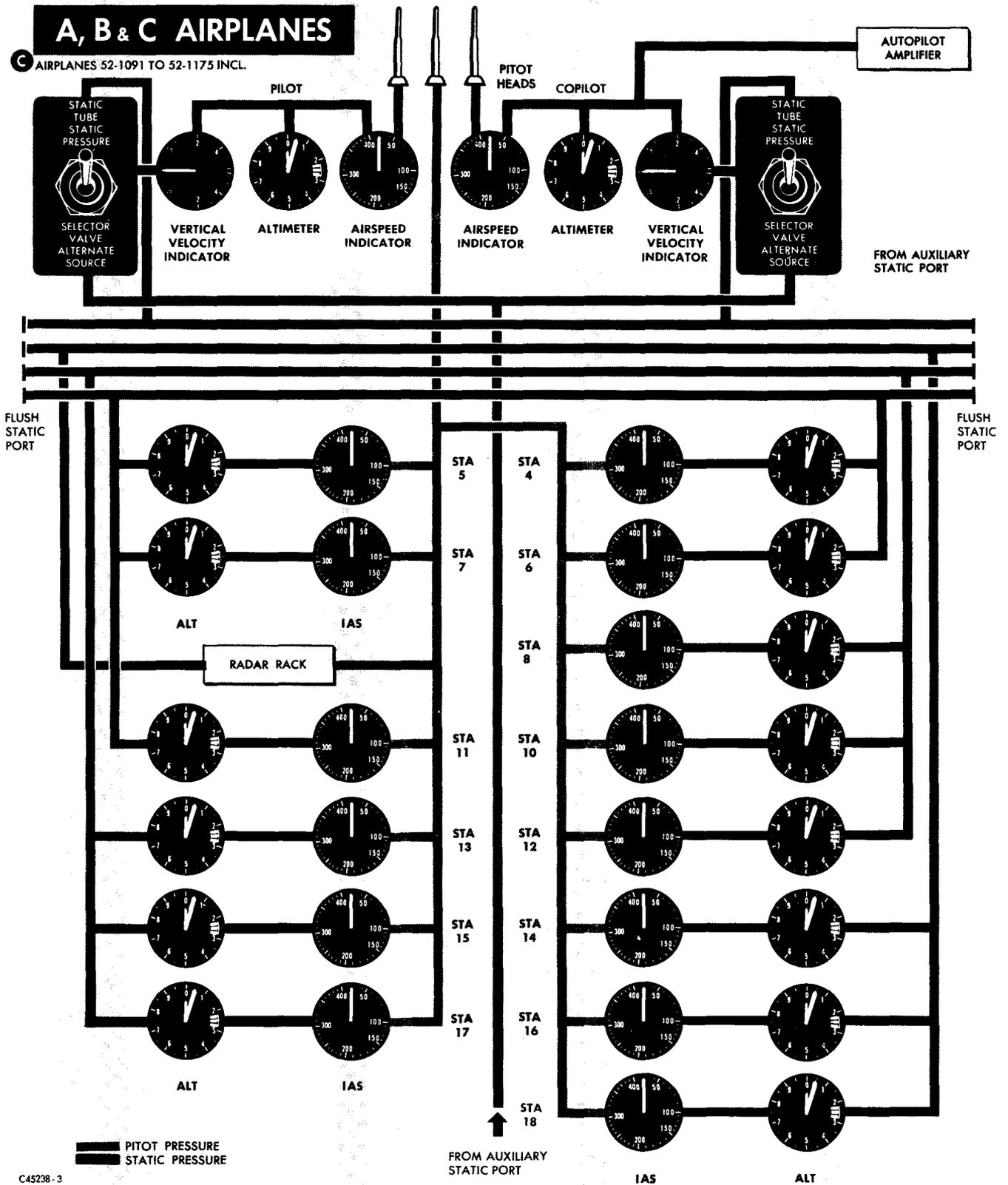
Two guarded fire extinguisher switches (figure 1-39), one for each nacelle, are located on the fire control panel. The switches are so placed on the panel that it is necessary to pull out the corresponding engine fluid-off handle before the fire extinguisher switch guard can be lifted.

#### Note

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

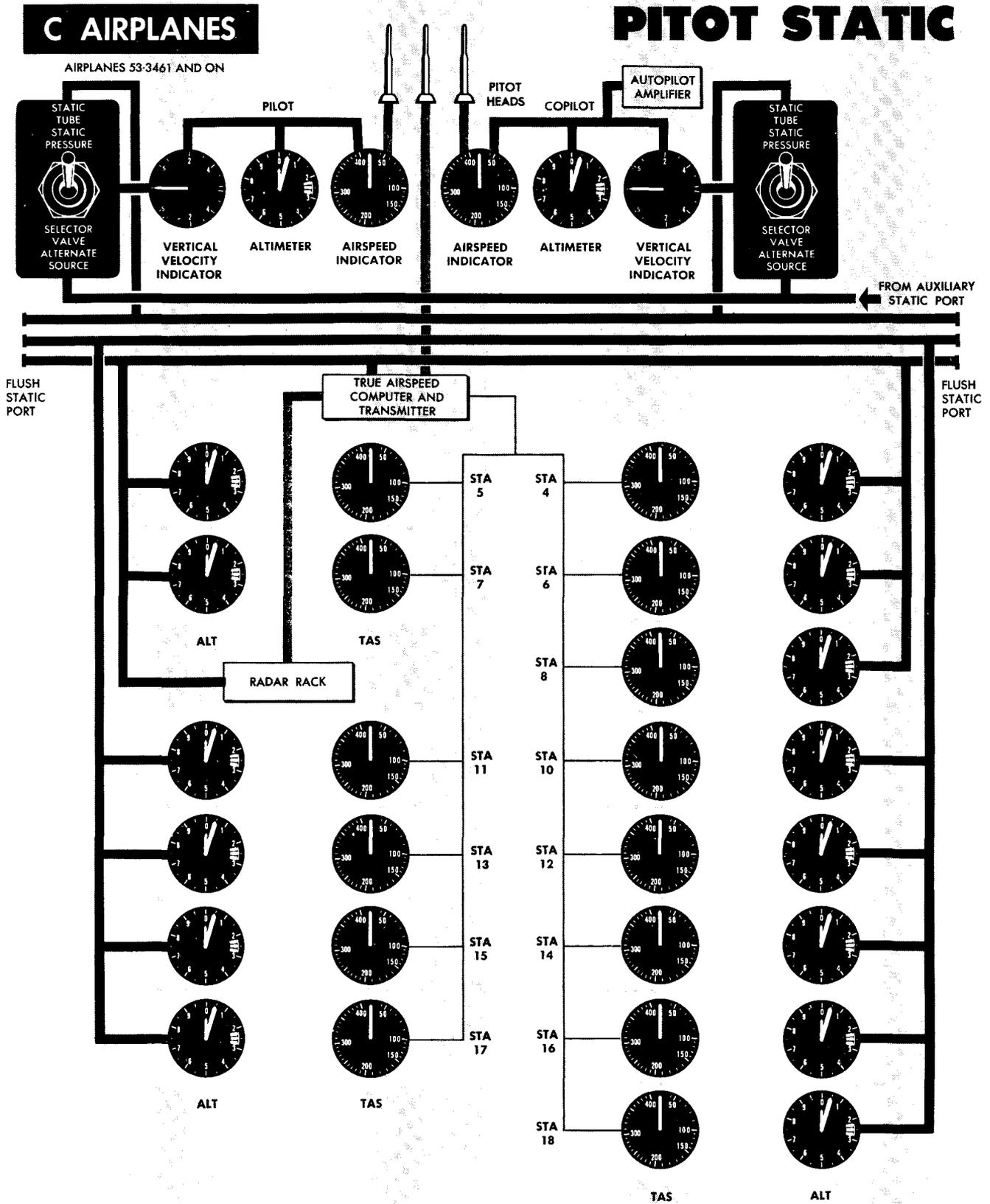
When the guard is lifted, the spring-loaded fire extinguisher switch automatically releases from its

# PITOT STATIC SYSTEM



C45238 - 3

Figure 1-37

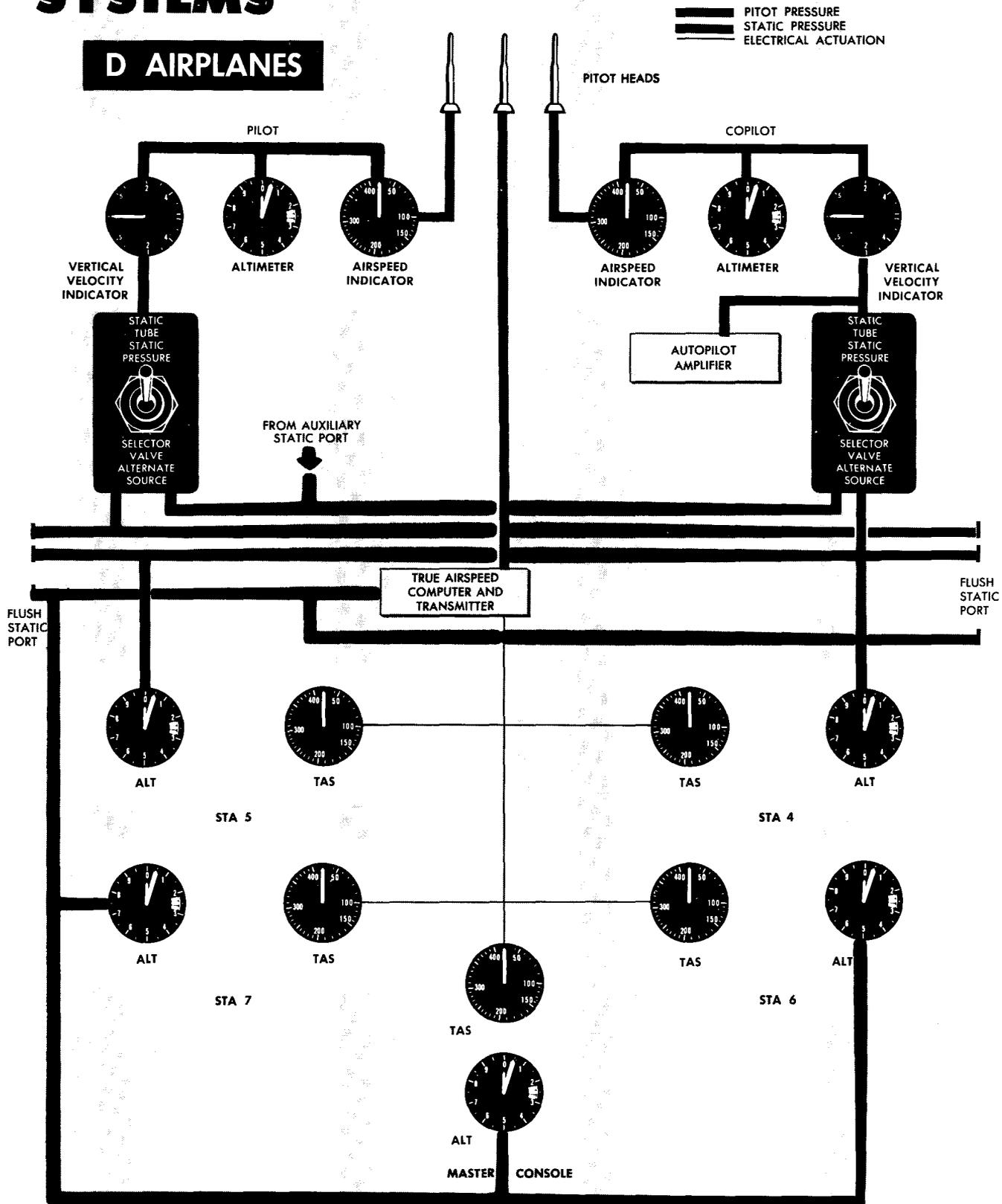


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Figure 1-38

# SYSTEMS

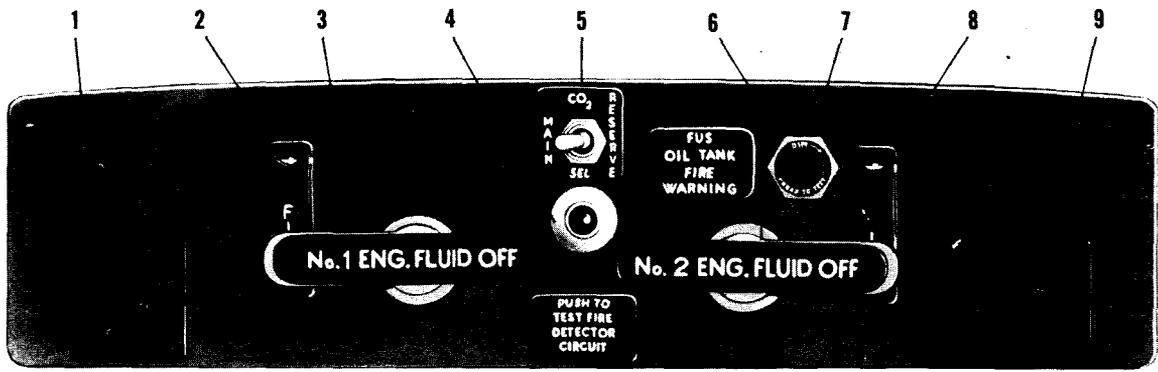
## D AIRPLANES



45238-2

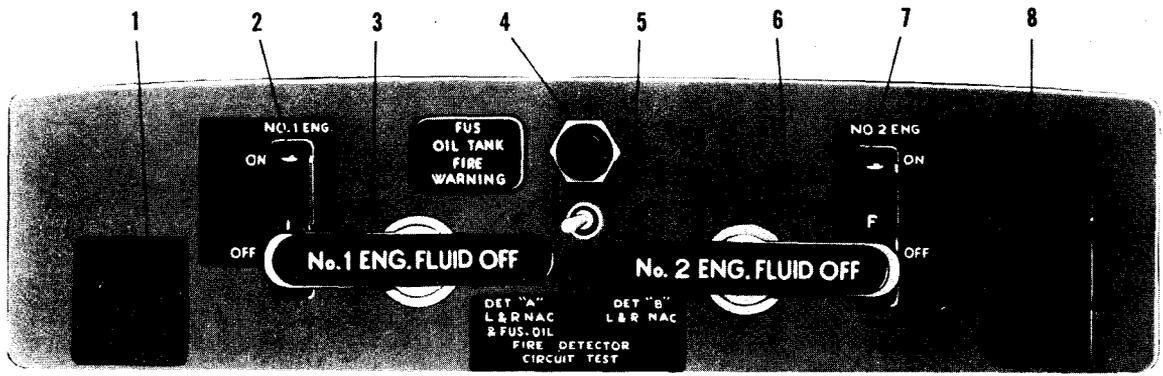
# FIRE CONTROL PANELS

## A AIRPLANES



- |  |   |
|--|---|
| 1. Left Nacelle Fire Warning Light               | 6. No. 2 Engine Fluid Off Handle                  |
| 2. Left Nacelle CO <sub>2</sub> Discharge Switch | 7. Reserve Oil Tank Area Fire Warning Light       |
| 3. No. 1 Engine Fluid Off Handle                 | 8. Right Nacelle CO <sub>2</sub> Discharge Switch |
| 4. Detection System Test Button                  | 9. Right Nacelle Fire Warning Light               |
| 5. CO <sub>2</sub> Selector Switch               |   |

## B, C & D AIRPLANES



- |   |                                      |
|---|--------------------------------------|
| 1. No. 1 Engine Fire Warning Light                | 5. Fire Detector Circuit Test Switch |
| 2. No. 1 Engine Fire Switch                       | 6. No. 2 Engine Fluid-Off Handle     |
| 3. No. 1 Engine Fluid-Off Handle                  | 7. No. 2 Engine Fire Switch          |
| 4. Fuselage (Reserve) Oil Tank Fire Warning Light | 8. No. 2 Engine Fire Warning Light   |

### FIRE DETECTION AND EXTINGUISHER ZONES

- DETECTION ONLY
- DETECTION AND EXTINGUISHING

NOTE: CARBURETOR (IN ZONE 1) IS ALSO PROTECTED BY EXTINGUISHING AGENT.

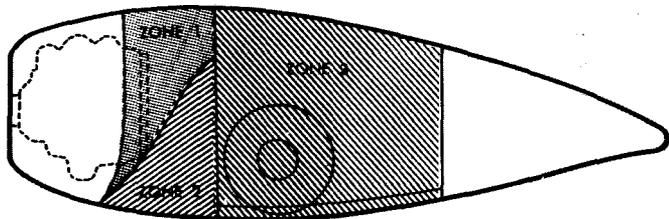


Figure 1-39

OFF position to an unmarked CENTER position. Centering of the fire extinguisher switch opens a directional valve to the area controlled by the fire switch. Discharge of the selected CO<sub>2</sub> supply is accomplished by pushing the fire extinguisher switch upward to the ON position.

#### ENGINE FIRE EXTINGUISHER SYSTEM B C D

A fixed, one-shot, dibromodifluoromethane (DB) fire extinguisher system is provided for combatting one fire in an engine nacelle. Two DB containers, located in the left wing fillet, are connected by tubing to discharge points located in the following areas in each nacelle: accessory section, carburetor, alternator and generator, oil cooler, and main landing gear well. The pressure of the extinguishing agent is also used to close the ventilation door (figure 1-7) in the engine top cowl panel. The two DB containers, pressurized with nitrogen, are discharged simultaneously and completely in approximately three seconds. The discharge circuits are powered by direct current.

### WARNING

Prolonged exposure (five minutes or more) to high concentrations of dibromodifluoromethane (DB) or its decomposition products can cause pronounced eye and nose irritation and should be avoided. It is safer to use than previous fire extinguishing agents such as carbon tetrachloride or methylbromide. However, especially in confined spaces, 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.

#### Note

Some aircraft may utilize bromochloromethane (CB) as the engine fire extinguisher agent instead of dibromodifluoromethane (DB). Prolonged exposure to CB should be avoided for the same reasons as DB.

#### Engine Fluid-Off Handles

Two engine fluid-off handles (figure 1-39), one for each engine, are provided on the fire control panel for the purpose of shutting off the flow of fuel, oil, and hydraulic fluid to either engine area in the event of fire. When one of these handles is pulled full out, shutoff valves stop all fluid flow except propeller feathering oil, forward through the fire wall. The shutoff valves can be re-opened by pushing the handle forward to its normal position.

#### Fire Extinguisher Switches B C D

Two guarded fire extinguisher switches (figure 1-39), one for each nacelle, are provided on the fire control panel. The switches are so placed on the panel that it is necessary to pull out the corresponding engine

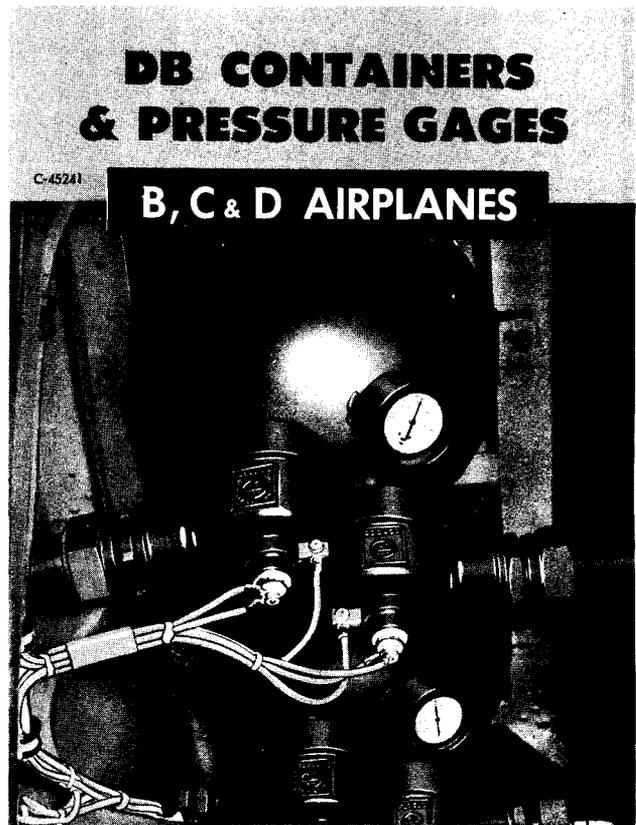


Figure 1-40

fluid-off handle before a fire extinguisher switch can be operated to discharge the fire extinguisher system.

#### Note

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

After the switch guard is lifted, the fire extinguisher switch can be moved from its normal OFF position to the ON position to completely discharge the fire extinguisher agent into the corresponding nacelle.

#### DB Container Pressure Gages B C D

Two pressure gages on the dibromodifluoromethane containers (figure 1-40) register the pressure within the containers. The gages are accessible through an access door in the lower surface of the fillet between the left wing trailing edge and the fuselage.

#### Note

The containers are charged in accordance with figure 1-42. At lower temperatures the gage pressure is reduced and at higher temperatures the gage pressure will read higher. To determine that the DB bottles are properly charged, correct the gage pressure reading by adding or subtracting 1 psi per 1° F above or below 70° F.

### PORTABLE FIRE EXTINGUISHERS

A one-quart CB portable fire extinguisher (1, figure 3-9) is located aft of the copilot's seat. Two one-quart CB portable fire extinguishers (1, figure 3-9) are located in the cabin. A pressure gage on each extinguisher indicates the nitrogen and CB pressure in the extinguisher. See figure 1-42 for servicing information.

### WARNING

Prolonged exposure (five minutes or more) to high concentrations (pronounced irritation of eye and nose) of bromochloromethane (CB) or its decomposition products 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, especially in confined spaces, 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.

### ALARM BELL

One alarm bell is located in the cabin (4, figure 3-9). A guarded alarm bell ON-OFF switch is located on the overhead switch panel. The alarm bell circuit is connected directly to the batteries, and the bell can be sounded even though the battery switch is in OFF position and there is no other dc power on the airplane. On **D** airplanes, sounding the alarm bell will also illuminate the cabin white lights, and they will remain on until all electrical power is disconnected. The alarm bell circuit breaker is located above the battery in the battery elevator compartment.

### FIRST AID KITS

On **A**, **B**, and **C** airplanes, five first aid kits are normally provided (2, figure 3-9). Four kits are located along the right side of the cabin below the hat rack, and one kit is located above the crew locker. On **D** airplanes, four first aid kits are provided. One kit is stowed on the forward face of the aft cabin bulkhead and three kits are installed in the training compartment.

### FLASHLIGHTS

Flashlights (9, figure 3-9) are installed at the main entrance door, rear service door, bailout door, and at each emergency exit. The flashlights may be removed from their holders and operated manually.

### LIFE RAFTS

**A**, **B**, and **C** airplanes, equipped for overwater flight, are provided with a 20-man pneumatic life raft (6, figure 3-9) which is stowed on the floor aft of the rear service door. **D** airplanes, equipped for overwater flight, are provided with two pneumatic life rafts which are stowed on the floor aft of the rear service door and are secured to the floor with straps. Each raft accommodates six men.

### PARACHUTE STOWAGE

Parachute stowage is provided at all student and instructor positions in the cabin, either beneath the tables or outboard of the seats. Parachute stowage for the pilots and the flight engineer is provided in racks aft of the copilot's seat.

### EMERGENCY EXITS

The emergency exits (figure 3-5) are the flight compartment side windows, three escape hatches in the right cabin wall and one in the left cabin wall, the rear service door, and the astrodomes. **D** airplanes have only one escape hatch in the right cabin wall and have no astrodomes. On late **B** airplanes, and on **C** and **D** airplanes, a secondary bailout door in the right cabin wall replaces one of the escape hatches. The escape hatches are released inward by pulling down on the handle in the upper portion of the hatch. The bailout door can be jettisoned by pulling up on the release handle located just aft of the door, and then pushing the door out. The rear service door is jettisoned by turning its handle to OPEN position and pulling up on the jettison handle located just forward of the door. The astrodomes are released inward by pulling down on the "T" handles, removing the rubber retaining seal around the base of the dome, and then pulling down on the upper handle.

### Note

A safety strap is provided at the rear service door and should be snapped in place across the opening before the door is jettisoned. The purpose of the strap is to assure that personnel bail out from a low crouch to avoid striking the stabilizer.

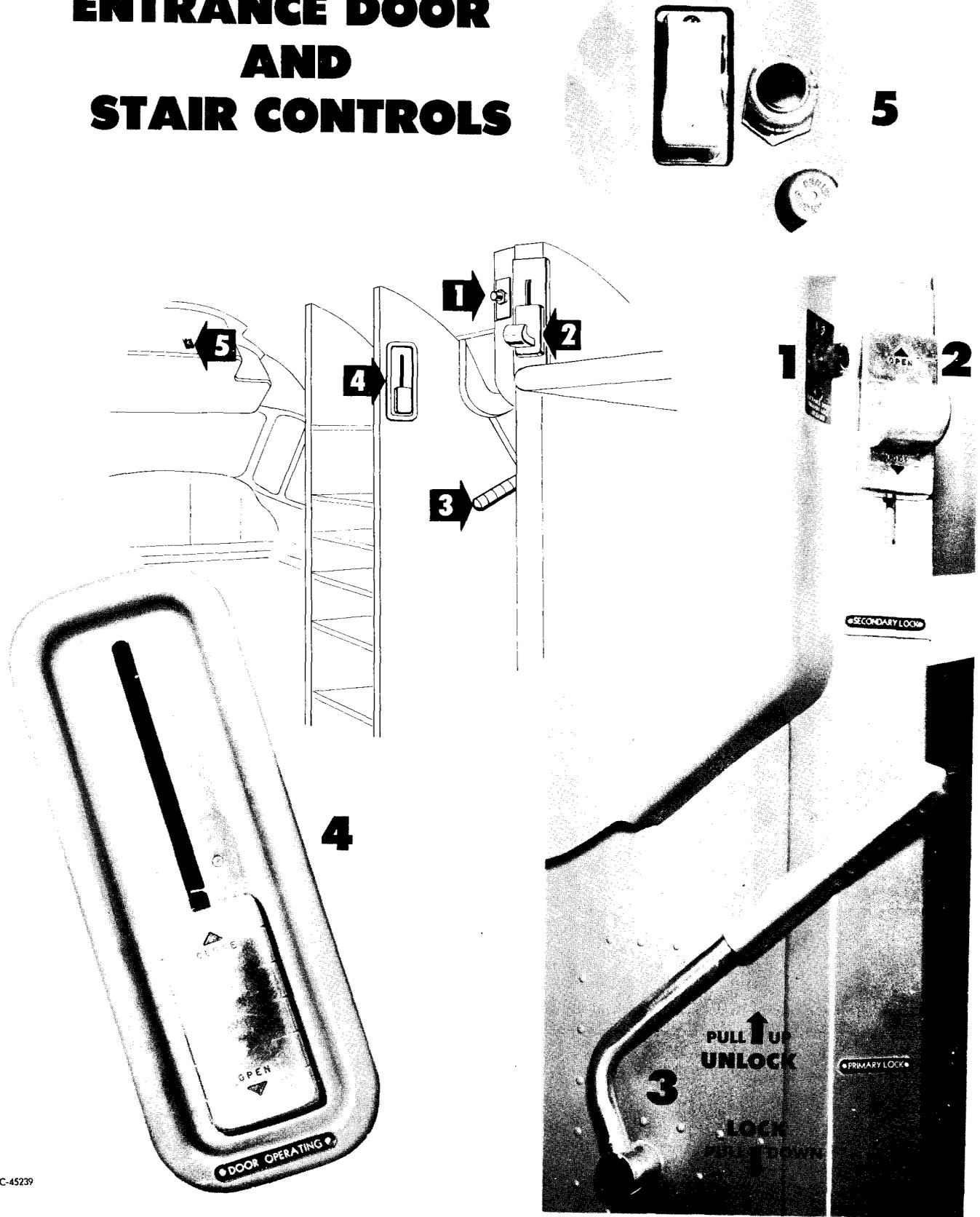
### ESCAPE ROPE

An emergency escape rope (7, figure 3-9) is provided for emergency ground evacuation of personnel and when used is installed in the center bayonet receptacles in the fore and aft side of the rear service door frame. The rope may be stowed in the overhead rack at student station No. 18 on **A**, **B** and some **C** airplanes, or adjacent to the rear service door on some **C** and all **D** airplanes.

### ENTRANCE DOOR AND STAIR SYSTEM

The entrance door and stair (figure 1-41), in the right side of the fuselage forward of the wing, are normally extended and retracted hydraulically. The hydraulic units that operate the door and stair are controlled by a selector valve that is mechanically linked to the door operating handle located on the entry forward bulkhead. An air cylinder and a hydraulic cylinder comprise the actuating components. Hydraulic pressure for operation of the door and stair is supplied from the landing gear "down" hydraulic line and the door and stair can be operated hydraulically only when the landing gear lever is in down position.

# ENTRANCE DOOR AND STAIR CONTROLS

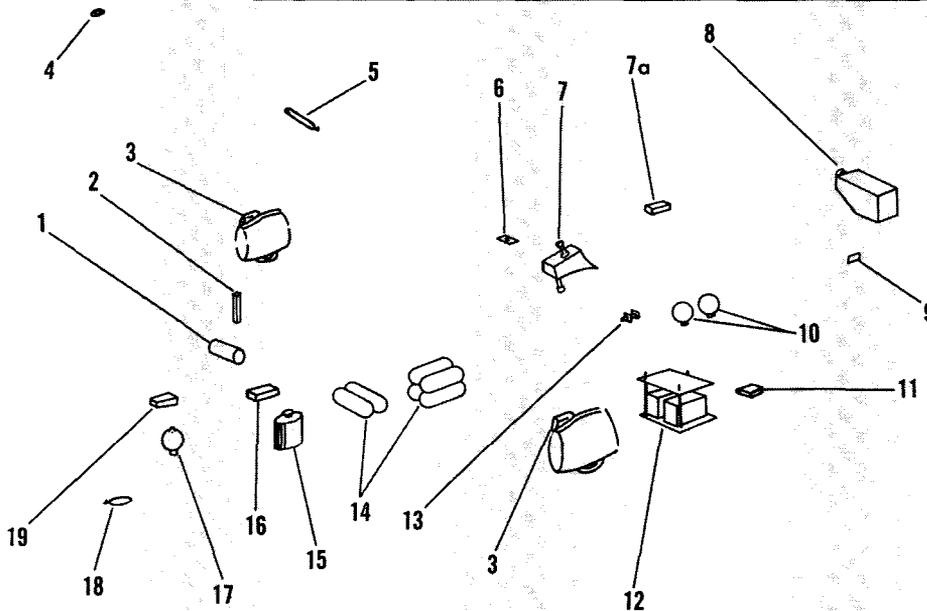


C-45239

Figure 1-41

# SERVICING DIAGRAM

SERVICE FLUID	USAF SPECIFICATION	NATO SYMBOL
Fuel	Recommended MIL-G-5572 Grade 115/145	F-22
	Alternate MIL-G-5572 Grade 100/130	F-18
When Fuel Grade 100/130 Is Used—Engine Power Must Be Restricted As Shown In Section V.		
Oil	MIL-L-22851 Type II	O-128
Hydraulic Fluid	MIL-H-5606	H-515
Water Injection Fluid	60 ± 5% Alcohol and 40 ± 5% Water* by Volume	S-738
	Alcohol, Above -30°F (-34°C) MIL-A-6091 ASG Alcohol, Above -50°F (-45°C) O-M-232 (Grade A)	S-747
*Includes 2/3 of 1% (of Water Volume) of Oil, MIL-C-4339		
Fire Extinguishing Agent (Carbon Dioxide) <b>A</b>	Federal Specification BB-C-101	None
Fire Extinguishing Agent <b>B C D</b> (Dibromodifluoromethane)	MIL-D-4540	None
Breathing Oxygen	MIL-O-27210	None



- 1. Drinking water tank
- 2. Paper cup dispenser
- 3. Engine oil tanks (2)
- 4. Fuel tank filler caps (2)
- 5. Alternator-generator hydraulic system servicing panel **B C D**
- 6. Cabin pressurization compressor sump **B C D**
- 7. Water injection tank
- 7a. External radar power receptacle **D**
- 8. Reserve oil tank
- 9. Oxygen system filler valve **B C D**
- 10. DB Fire extinguishing agent containers
- 11. Dehydrator container (for marker beacon antennas)
- 12. Batteries
- 13. Dehydrator container (for radar pressure system)
- 14. CO<sub>2</sub> fire extinguisher supply cylinders **A**
- 15. Hydraulic reservoir
- 16. External radar power receptacle **A B C**
- 17. Hydraulic accumulator
- 18. Emergency air bottle
- 19. External power receptacle

C-45242

Figure 1-42

# TEMPERATURE CORRECTION TABLE

STABILIZED TEMPERATURES		PSI AT VARIOUS TEMPERATURES					
°C	°F	DB ENGINE FIRE EXTINGUISHER		OXYGEN SYSTEM	EMERGENCY AIR SYSTEM	MAIN HYDRAULIC ACCUMULATOR	A-20 PORTABLE FIRE EXTINGUISHER
		MIN.	MAX.	TOLERANCE ±25	TOLERANCE <sup>+0</sup> <sub>-550</sub>	TOLERANCE ±20	TOLERANCE <sup>+25</sup> <sub>-0</sub>
71	160			497	2450	1202	187
65	150			489	2400	1180	183
60	140			481	2350	1158	179
55	130			473	2300	1135	175
49	120			465	2250	1113	171
43	110	440	505	457	2200	1091	167
38	100	425	490	449	2150	1068	162
32	90	410	475	441	2100	1046	158
26	80	400	465	433	2050	1023	154
21	70	390	455	425	2000	1000	150
16	60	380	445	417	1950	977	146
10	50	370	435	409	1900	955	141
5	40	360	425	401	1850	932	137
-1	30	350	415	393	1800	910	133
-7	20	340	405	385	1750	887	129
-12	10		395	377	1700	865	124
-18	0		385	369	1650	842	120
-24	-10			361	1600	819	116
-29	-20			353	1550	796	112
-34	-30			345	1500	773	108
-40	-40			337	1450	750	103
-45	-50			329	1400	728	99
-51	-60			321	1350	705	95
-54	-65			313	1300	694	93

The above table illustrates pressure changes in some pressurized systems at various stabilized ambient temperatures. System pressures should correspond to the pressure indicated in the table for any given ambient temperature with allowance for the tolerance given for each system. The tolerances given are based on a 70°F stabilized temperature.

The figures are theoretical and for all practical purposes when used in servicing and inspection, the numbers may be rounded out to the nearest 5 psi. In checking accumulator and air bottle pressures on the airplane, consideration must be given to variations of temperature within and surrounding certain components of the airplane. Cockpit temperatures of an airplane setting in the sun may be as much as 20°F higher than the FAT.

C-45600

Figure 1-43

## ENTRANCE DOOR AND STAIR SYSTEM CONTROLS AND INDICATORS

### Entrance Door Operating Handle

An entrance door and stair operating handle (4, figure 1-41) is provided on the entry forward bulkhead. The handle, which slides vertically on a slotted panel, has two placarded positions: OPEN (down), and CLOSE (up), and a NEUTRAL unmarked position provided with a detent. The handle is mechanically connected to the entrance door hydraulic selector valve. When the handle is moved to OPEN position, it turns the valve and routes hydraulic pressure to the door-opening port of the door and stair actuating cylinder installed in the entry aft bulkhead. Fluid in the upper part of the cylinder then bleeds off at a predetermined rate through a restrictor valve and returns to the return manifold. Variations in extension (or closure) speeds may be controlled by intermediate positions of the operating handle. The door and stair open or close in approximately five seconds when the handle is placed in fully OPEN or CLOSE position. The operating handle is normally left in OPEN position while the door is open and is held in CLOSE position to close the door and stair; it is then placed in the NEUTRAL detent until the next operation. When the handle is in NEUTRAL, hydraulic pressure in the actuating cylinder is relieved.

### Primary Lock Lever

The primary lock lever (3, figure 1-41), on the entry aft bulkhead, mechanically operates the primary latches that hold the door closed.

### Secondary Lock Control

A sliding secondary lock control (2, figure 1-41), on the entry aft bulkhead, mechanically operates pins that slide into the primary latches to hold them in locked position. The secondary lock control has two positions: LOCK and OPEN.

### Entrance Door Unlatch Switch

The entrance door unlatch switch (5, figure 1-41), on the overhead switch panel, has ON and OFF positions. It is spring-loaded and guarded to OFF. When the switch is OFF, two spring-loaded lock pins prevent inadvertent withdrawal of the primary latches from the locked position. When the switch is held to ON, two dc solenoids withdraw the lock pins and the green door-unlocked indicator light illuminates to indicate that latches can be opened. The lock pins reseal automatically when the door is again closed and latched.

### Exterior Secondary Lock Handle

An exterior secondary lock handle (figure 2-1), located in a recess in the skin below the entrance door, is pulled to release the secondary lock pins from the primary latches when opening the door from the outside.

### Exterior Primary Lock Handles

The two primary latches can be engaged or released from the outside (even when mechanically and electrically locked from the inside) by means of two handles (figure 2-1) on the exterior latch plates.

### Door-Unlocked Indicator Light

A green door-unlocked indicator light (1, figure 1-41), located adjacent to the secondary lock control, illuminates when the solenoid lock pins are withdrawn from the latches by operation of the entrance door unlatch switch. When this light is on, the door can be unlocked and opened from the inside. The light circuit is powered by direct current.

### Entrance Door-Open Warning Light

On **A** airplanes, the entrance door-open warning light (5, figure 1-41) on the overhead switch panel is operated by microswitches at the entrance door. On **B**, **C**, and **D** airplanes, the warning light is operated by microswitches at the entrance door, rear service door, and lower forward compartment doors. On some **B** airplanes, and all **C** and **D** airplanes, the light is also operated by a microswitch at the bailout door handle. If any of these doors is not closed and latched, the light will illuminate. The door-open warning light circuit is powered by direct current.

### CAUTION

The bailout door switch is actuated by the release handle. It is possible to have a door-safe indication (light out) with the door not fully closed.

## FLIGHT COMPARTMENT SEATS

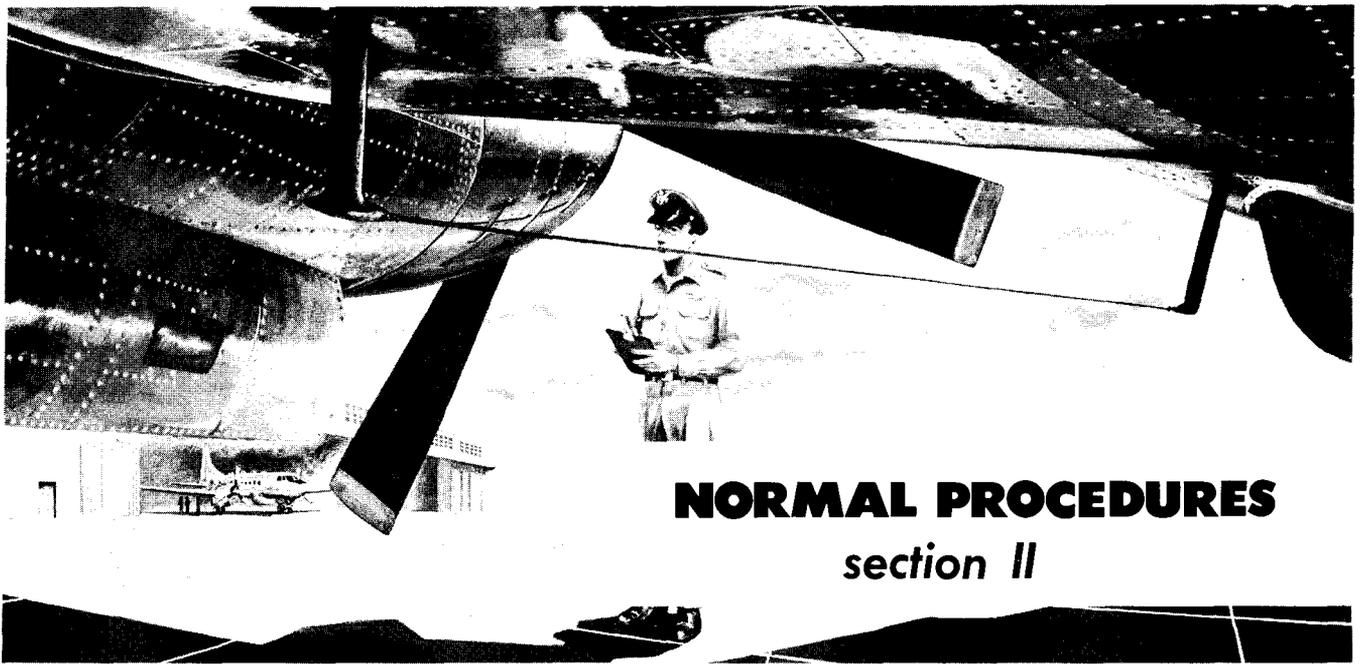
### PILOTS' SEATS

The pilot's and copilot's seats are mounted on tracks. A small handle, below the forward edge of each seat, is pulled up to release the seat for fore and aft adjustment; when the seat is in the desired position, the handle is released to lock the seat in place. A lever on the outboard side of each seat is pulled up to release the seat for vertical adjustment; releasing the lever locks the seat in the desired position. A small thumb lever, on the outboard rear support tube of each seat, is pressed down to release the seat-back for tilt adjustment; releasing the lever locks the seat-back in the desired degree of tilt. Both armrests of each seat can be moved upward to stowed positions. Safety belts are furnished for both seats; shoulder harnesses are not provided.

### AUXILIARY EQUIPMENT

Section IV of this manual contains information on the following auxiliary equipment: air-conditioning, defrosting, anti-icing and de-icing, communications and associated electronic equipment, lighting, oxygen, automatic pilot, and miscellaneous equipment.





## NORMAL PROCEDURES

### section II

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## PREPARATION FOR FLIGHT

### FLIGHT PLANNING

Refer to the Appendix to determine the fuel quantity, power plant settings, airspeed, etc., necessary to complete the proposed mission.

### WEIGHT AND BALANCE

Check takeoff and anticipated landing gross weight and balance data. Check that weight of fuel and alternate load items are suited to the proposed flight. Refer to WEIGHT LIMITATIONS, Section V. For detailed information, refer to the Handbook Weight and Balance Data, T. O. 1-1B-40, and to the Load Adjuster applicable to this airplane. Check that the weight and balance clearance form is completed.

### TAKEOFF AND LANDING DATA CARDS

Completion of the takeoff and landing data card is required for all flights, except that when making touch-and-go landings, the TOLD card is only required for the initial takeoff. Fill out the TOLD card using the operating data in the Appendix or precomputed data. Acceleration time/distance check data must be computed only when refusal speed is less than takeoff speed. The TOLD card is contained in the Pilot's Abbreviated Checklist.

### CHECKLISTS

The Flight Manual contains only amplified checklists; the abbreviated checklists have been issued as a separate technical order, T. O. 1T-29A-1CL-1. It contains normal procedures, emergency procedures, and performance data for use by a basic crew of pilot, copilot, and flight engineer. A minimum crew of two, pilot and copilot, may be used if authorized by the major command as essential for mission accomplishment. Refer to CHECKLISTS in the FLIGHT MANUAL Foreword.

#### Note

- The term "climatic" as used in the checklists indicates equipment operation or settings which may be necessary for other than daylight VFR conditions. This includes IFR, night, cold weather, tropic, and desert conditions. The equipment operation or setting will vary depending on the prevailing conditions. In practice, the response to climatic items will be the required switch or control position.
- THRU-FLIGHT checklist. The thru flight checklist may be accomplished when the airplane is assigned missions which require intermediate stops by the same flight crew and no maintenance is performed during these stops. Thru-flight checklist items are indicated by an asterisk (\*). These items must be accomplished during an intermediate stop or after completion
- of engine runup by a qualified crew member. The remaining items may be accomplished at the discretion of the pilot. All items under BEFORE TAKEOFF and subsequent checks must be accomplished for all flights.
- TRAFFIC PATTERN checklist. When remaining in a closed traffic pattern, the landing crew briefing should be accomplished prior to takeoff, and only those items indicated by the symbol ▲ need be accomplished. These items constitute the TRAFFIC PATTERN checklist and when performed eliminate the requirement for the DESCENT checklist Phases I and II.
- The pilot is responsible for accomplishment of all checklists in the same sequence they are presented in this section. Accomplishment of each item will be indicated by the proper response. If no response is given for a particular item, stop and demand a response before continuing. Capital letters indicate the crew member making the response. Lower case letters indicate the crew member assisting in the check. Certain portions of the After Takeoff and Descent checklists may be accomplished silently (shaded area) by the flight engineer at the discretion of the pilot. The nomenclature (P), (CP), and (FE) used hereafter will refer to pilot, copilot, and flight engineer. The flight engineer will read the checklist, and perform such duties as indicated, as well as those directed by the pilot. The duties of the flight engineer will be performed by the copilot or as directed by the pilot when a minimum crew of two is used. Upon completion of each checklist, the flight engineer will advise the pilot that the checklist called for has been completed.
- HQ USAF (AFOMORO) letter, 28 Oct 69, "Utilization of Flight Engineer (A435XO)" names all aircraft that require a Flight Engineer (A435XO) as a crew member. T-29/C-131 aircraft are not listed as Flight Engineer aircraft but will now be authorized a Flight Mechanic (A431XO/1). Since the words Flight Engineer or the letters "FE" now occur throughout the entire flight manual, no attempt will be made to change over to Flight Mechanic or FM until the next revision of the flight manual.
- Coordinated checks. Certain items in the checklists that are accomplished by the copilot or flight engineer require coordination with the pilot. These items are indicated by a circle around the number of the item (e. g., ①).

**APPROACHING AIRPLANE**

Check that the wheel chocks are in place. Ensure that gear safety pins are installed by observing the red flags attached to the pins.

**ENTRANCE**

See figure 2-1.

**PREFLIGHT CHECKS**

It shall be the responsibility of the pilot to ensure that an interior and exterior inspection, as outlined, and a preflight inspection, as required by the Manual of Scheduled Inspection and Maintenance Requirements have been performed. It shall also be the responsibility of the pilot to ensure that each crew member has accomplished his individual inspection requirement as outlined in this Section and in Section VIII.

1

2

3

4

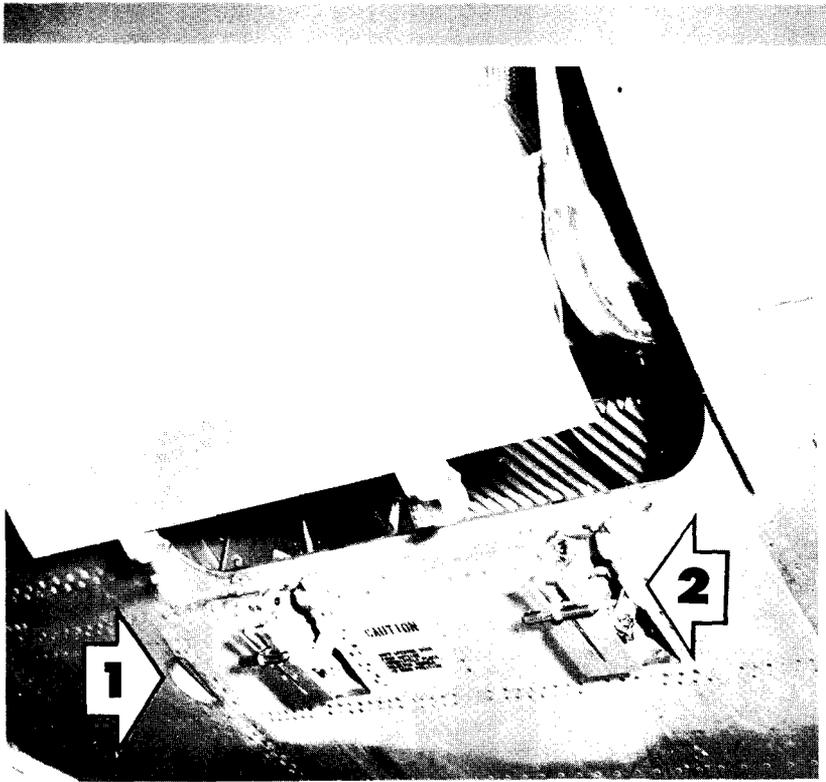
5

6

7

8

9



# OPENING ENTRANCE DOOR FROM OUTSIDE

**1** Pull exterior secondary lock handle to release the secondary lock pins if locked from inside

**2** Pull out and down on exterior primary lock handles to release door

**3** Lift door and grasp bottom step; then pull stair out and down

**NOTE:** Be sure the door-operating handle is moved to OPEN position.....

C-45244



Figure 2-1

**Note**

- The basic flight crew consists of pilot, copilot, and flight engineer. Major commands may authorize operation with only a pilot and copilot when required for the command mission accomplishment.
- The aircrew visual inspection procedures outlined in this section are predicated on the assumption that maintenance personnel have completed all the requirements of the Manual of Scheduled Inspection Requirements for preflight. Therefore, duplicate inspections and operational checks of systems by aircrew members have been eliminated, except for certain items required in the interest of flying safety.

**INTERIOR INSPECTION**

1. Form 781 — Checked.  
Check the forms for accuracy and for condition of airplane. Check that the airplane has been serviced as required for the mission.
2. Fuel Controls — Normal
3. Alarm Bell — Checked.
4. Ignition — Off.
5. Battery (Propellers Clear) — Checked and as required. Place the battery switch to BAT and check for a minimum of 18 volts; then place the battery switch OFF unless needed for further checks.

**CAUTION**

The battery switch must be in the OFF position whenever a dc external power source is connected to the airplane. This is to prevent damage to the battery from possible abnormal voltages of the external power source.

6. External Power — As required.  
If external power is to be connected, ensure that both propellers are clear; then request that external power be connected. If unregulated ac power is required for preflight of training compartment equipment, request the ground crew to connect the external ac power.
7. Alternator Selector — As required.  
If external power is required for anti-icing and de-icing equipment preflight, place the selector switch in the EXT PWR ON BUS 1 position. If external power is required for training compartment equipment preflight, place the selector switch in EXT PWR ON BUS 2 position.

8. Load Monitor — Override.
9. Gear Lever — Down and Locked.  
Check that the landing gear lever is in the DOWN position, that the landing gear lever solenoid lock plunger is out and flush with the pedestal, that the three landing gear position indicators show gear down, and that the unsafe warning light is out. Press-to-test the bulb.
10. Hydraulic Bypass — Down.
11. Trim Tabs — Zero.

**Note**

If the airplane has just undergone inspection or if work has been accomplished on any of the control surfaces or mechanism, ensure that the trim tab controls have been connected properly. The trim tabs operate in the opposite direction from the desired control surface movement.

12. Nacelle Flaps — Climatic.  
Normally the nacelle flaps are open.

**CAUTION**

During cold weather operation at temperatures below +2°C (35°F), do not operate nacelle flaps until preheat has been applied or engine is operating and oil temperature reaches 40°C. This will preclude damage to the operating mechanisms.

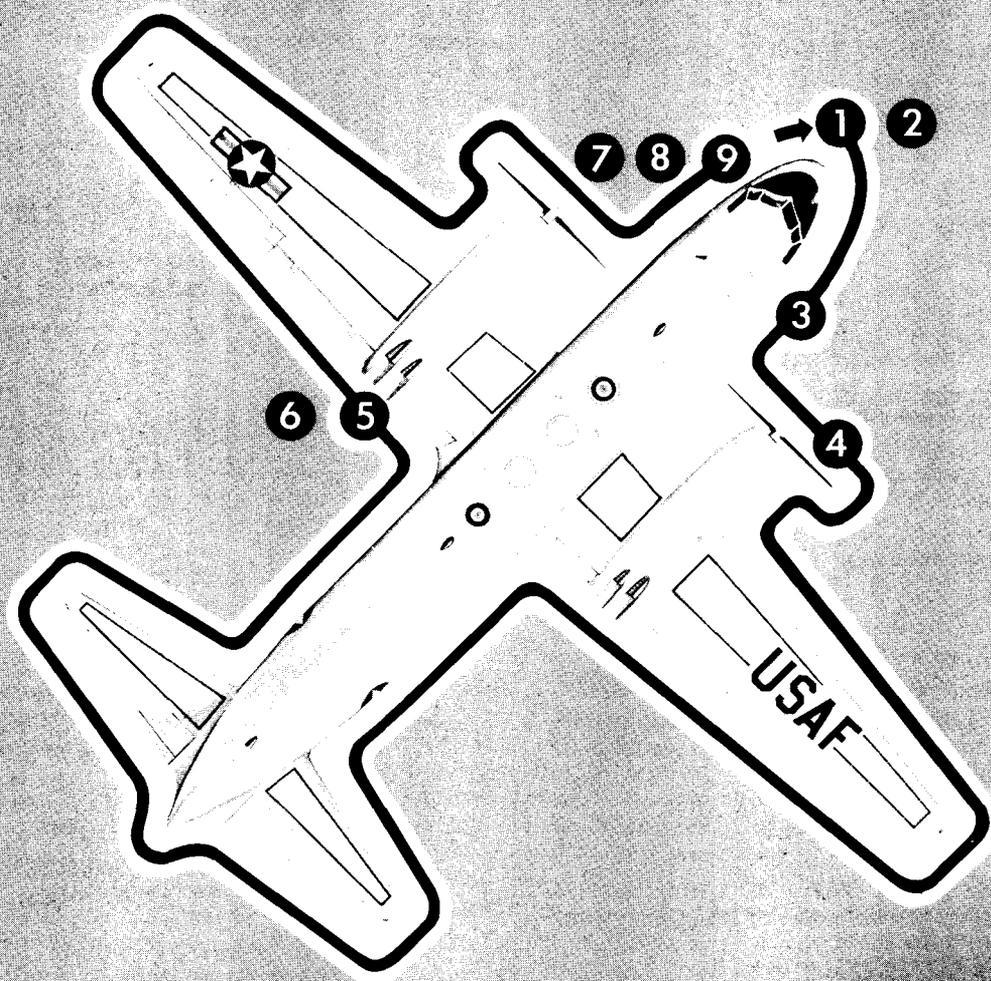
13. Oil Coolers — Auto.
14. Emergency Air Pressure — Checked.  
Check that the emergency air system is charged to the proper pressure. See Temperature Correction Table, figure 1-43.
15. Static Selectors — Static and Safetied.
16. Pitot Heat — Climatic.  
Pitot heat will be checked externally by an assisting crew member. Place the pitot heat switch in the ON position and check that the pitot heads are heating. This may be accomplished by allowing the covers to warm briefly, then removing and checking covers. Care must be exercised to prevent burning the covers.

**CABIN****Note**

While checking the items listed below, check that doors and escape hatches are closed. Check for indications of insecure or defective installations and the general appearance of the airplane.

# EXTERIOR INSPECTION DIAGRAM

(TYPICAL)



C-45245

Figure 2-2

1. Latitude Correction Knob – Off. **ⓐ** **ⓑ**
2. Ballast or Overwater Equipment – Checked. If overwater equipment is required, check that sufficient equipment is aboard and secured.
3. Galley Equipment – Checked. Check the galley for cleanliness, stowage of equipment, and all switches OFF.
4. Battery and External Power – As required. Unless electrical power is further required, turn battery switch off or disconnect external power.

## EXTERIOR INSPECTION

Perform the following checks in accordance with figure 2-2.

### Note

While checking the items listed below, check that doors and inspection plates are closed, check for fluid leaks, indications of defective or insecure installations, and the general over-all appearance of the airplane. Check that external aircraft ground wires are removed and secured. Check for accumulation of ice, snow, and frost; see Section IX, Cold Weather Procedures.

1. Pitot Covers — Removed.
2. Nose Gear Pin — Removed.
3. Static Ports — Clear.
4. Right Main Gear Pin — Removed.
5. Left Main Gear Pin — Removed.
6. Landing Gear Safety Switch — Checked.
7. Static Ports — Clear.
8. Crew and Passenger Briefing, Personal Equipment — Checked.

**Note**

Brief the crew as necessary for mission accomplishment. Check personal and survival equipment as required. The pilot may appoint a crew member to brief the passengers at a more appropriate time. Refer to Section VIII or T. O. 1T-29A-1CL-1 for passenger briefing checklist.

9. Flight Controls — Checked.  
Check flight controls for freedom and correct direction of travel. Visual observation of all control surfaces must be made to accomplish this.

**BEFORE STARTING ENGINES**

1. Aircraft Inspection Form 781 — Completed.  
(P) Sign exceptional release if not previously signed.
2. Publications — Checked. (P-CP)  
Check that required flight information publications are current and available.
- \*3. Gear Pins and Pitot Covers - Stowed. (FE)
- \*4. Safety Belts — Fastened. (P-CP)
5. Smoke/Oxygen Masks — Checked. (ALL)  
Set oxygen regulator to 100%.
- \*6. Battery — As required. (FE)  
If external power is available place the battery switch OFF. If external power is not available, place the battery switch in the BAT position for starting and perform electrical checks after the engine is started.
- \*7. External Power — On. (CP)

- \*8. Circuit Breakers — Checked. (P-CP-FE)  
Check all circuit breakers on the main, auxiliary, and radio circuit breaker panels. Place the main and spare inverter and the emergency hydraulic pump reset switches in the RESET and then ON position. On **A**, **B**, and **C**, airplanes, check that the three indicator lights are out. On **D** airplanes, check that the indicator light is out. On all airplanes, check that ac gyro power switch is ON.

- \*9. Generators — As required. (FE)  
For normal starts, the left generator should be ON and right generator OFF.

- \*10. Inverters — Checked and Main. (FE)
  - a. Inverter selector switch — SPARE.  
Check voltage for 115 ( $\pm 2.5$ ) volts.
  - b. Place voltmeter selector in 26V position and check for voltage indication.
  - c. Inverter selector switch — MAIN.  
Check voltage for 115 ( $\pm 2.5$ ) volts.

**Note**

- Voltage may deviate slightly from normal until the inverter has reached normal operating temperature.
- For a battery start, delay the inverter check and keep the inverter switches OFF until one generator is operating.

- \*11. Command Radio — On. (CP)  
Tune to tower or ground control frequency. For a battery start, leave the radio off until one generator is operating.
12. Throttles — Set. (P)  
The throttle should be positioned to give 800 to 1000 rpm.
13. Autopilot — OFF. (P)
14. Propellers — High Lights. (P)  
Place the propeller speed control levers in the INC RPM position momentarily and observe that the amber lights remain illuminated.
- \*15. Carburetor Heat — Cold. (P)
16. Mixtures — Off. (P)
17. Water Injection — OFF. (P)
18. Blowers — Low. (P)
19. Alternator Selector — Normal. (P)

- 20. Alternators – Off. (P)
- 21. Reverse Override – Out. (P)
- \*22. Hydraulic Pressure – Checked (2000 psi minimum). (CP)
- \*23. Parking Brake – Reset. (P)
- 24. Fire Detector – Checked. (CP)

**Note**

If the fire warning lights do not illuminate within 15 seconds after actuating the test switch of either system, the fire detection system is defective.

**WARNING**

Fire detection system defects must be corrected before the airplane is released for flight. A defective fire detection system could endanger the airplane and personnel aboard in the event of fire.

- 25. Pilot's Console – Checked. (P)
  - a. Emergency landing gear uplatch release knobs – Safetied OFF.
  - b. V-2 indicators selector switch – E-4, late **B**, all **C**

**Note**

E-4 selects N-1 on those aircraft modified with the N-1 compass system.

- c. Windshield wiper – OFF.
- d. Emergency air brake knob – Safetied OFF.
- 26. Augmentor Vanes – Checked and Trail. (CP-fe) On **A** airplanes, push in the heat anti-icing button and check operation of vanes by holding the left and right vane switches in the CLOSE position and observing the corresponding indication of augmentor vane position indicators. Hold the switches in the TRAIL position until vanes begin to trail. Then pull out the heat anti-icing button and the vanes should trail. On **B**, **C**, **D** airplanes, place the augmentor vane arm switch in the ARM position. Hold left and right augmentor vane switches in the CLOSE position and observe the augmentor vane position indicators. Hold the switches in the TRAIL position until the vanes begin to trail, then release the switches. Place the arm switch to OFF, and

the vanes will again begin to trail. Push the heat anti-icing button in and the vanes will stop. Pull the button out and the vanes will move to trail.

**Note**

**D**

Place the cabin heat and vent switch to NORMAL prior to accomplishing this check. After completing augmentor vane check, place the cabin heat and vent switch to SHUTOFF position.

- \*27. Copilot's Console – Checked. (CP)
  - a. Pitot heat switch – OFF.
  - b. Light switches – As required.
  - c. Alternator-generator hydraulic system switch – ON. **B** **C** **D**

**CAUTION**

**B** **C** **D**

In order to avoid momentary high pressures in the alternator-generator hydraulic system, the control switch is turned ON before starting the right engine and is left ON throughout subsequent ground and flight operations except in case of emergency. In the event the system has been turned OFF, do not turn the system ON with the right engine running.

- d. Structural overheat limit override switch – Normal.
- e. Cabin heat and vent switch – SHUTOFF.

**CAUTION**

The heat source valves must be closed before starting the engines to prevent the possibility of combustible fumes entering the heat source valve ducting. Placing the cabin heat and vent switch in the SHUTOFF position will not always ensure this. 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. Therefore, if the heat source valves have been manually operated, they must be manually closed before engine start. Refer to Section IV.

- f. Cabin pressure switch – AUTO. **B** **C** **D**

- g. Cabin pressure manual dump valve — NORMAL. **B C D**
  - h. Cabin heat selector switch — Climatic.
  - i. Windshield anti-ice switches — OFF.
  - j. Reserve oil heat switch — OFF.
  - k. Propeller de-ice switch — OFF.
- \*28. Fuel, Oil, and Water Quantity — Checked. (CP)

**Note**

Test fuel and oil quantity gages prior to the first flight of the day.

- \*29. Seat Belt and No Smoking Signs — On. (FE)
- \*30. Engine Instruments — Checked. (P-CP)  
Check that the manifold pressure gages read alike and correspond with field barometric pressure; use reading obtained for engine runup power check. Check cylinder head temperature gage for approximate priming requirements.
- \*31. Passenger Briefing — Completed. (P)
- \*32. Before Starting Engines Checklist — Completed. (FE)

**STARTING ENGINES**

The pilot may designate the flight engineer to start the engines.

- \*1. Rear Service Door — Closed. (FE)

**WARNING**

Wind, prop, or jet blast on the rear service door causes the scissors and door to close so fast when latches are released, that unless extreme caution is exercised, injury to the hands, fingers, or feet may result.

- \*2. Props and Fire Guard — Clear and Posted. (P-CP) Determine that all loose material, ground equipment, and personnel are at a safe distance from the airplane. Check that ground fire-fighting equipment is available and that a fire guard is posted. The ground observer signals that engine area is clear to start. Turn on wing inspection lights if desired.
- \*3. Left Engine — Start. (P)

- a. Fuel boost pump switch for left engine — On (check pressure).
- b. Engine starter selector switch — LH
- c. Start switch — ON.

**CAUTION**

- The start switch must not be held to ON for more than one minute. If a start is not obtained, wait one minute, then attempt another start. If the second start is not successful, wait five minutes to allow the starter to cool before attempting further starting.
- To conserve battery power when starting with the airplane's batteries, do not exceed 30 seconds of continuous cranking.
- Discontinue the starting procedure if any indication of hydraulic lock is noted while turning the propeller through continuously.
- d. Ignition switch for left engine — BOTH after 15 blades.

**Note**

- A count of 15 blades will ensure adequate engine pre-oiling when making a cold start. If the engine is started within one hour after shutdown, a count of six blades is sufficient to detect hydraulic lock.
- Hold the ignition boost switch to the ON position immediately after placing the ignition switch to BOTH.
- e. Prime switch (toggle intermittently) — ON as required. Hold the prime switch in the ON position intermittently if the engine is warm (on one second and off two seconds). If the engine is cold, hold the switch ON continuously. Holding the prime switch in the ON position after the engine fires has been found to give the most satisfactory start.

**CAUTION**

Overpriming must be guarded against to prevent scuffed cylinders due to the inevitable dilution of the oil film on the cylinder walls by fuel that condenses on them during the priming. Overpriming may also lead to excessive torching immediately after engine start.

- f. Throttle — 800 to 1000 rpm.  
The initial rpm surge which occurs during the engine start should not be allowed to exceed 1000 rpm. When the engine is running smoothly at 800 to 1000 rpm on prime alone, release the start switch and the ignition boost switch to the OFF position.

**CAUTION**

Rapid movement of the throttle during engine start can damage the carburetor.

- g. Oil pressure - Checked.  
Check for positive rise in oil pressure within 30 seconds after the engine starts.

**CAUTION**

If oil pressure does not indicate a positive rise within 30 seconds after engine start, stop the engine and investigate.

**Note**

- Indicated oil pressure may lag actual oil pressure by as much as 30 seconds dependent on the temperature. Indicated oil pressure response will be slower as the temperature of the oil is decreased, but actual oil pressure response will be nearly as rapid as on a standard day if oil dilution was properly accomplished.
- If oil temperature was below 40°C before engine start, engine oil pressure may start abnormally high. Reduce engine speed, if necessary, to prevent excessive pressures until oil warms up. Pressure should stabilize within the allowable range during engine warmup.

- h. Mixture control — Climatic.

**Note**

With the engine running smoothly at 800 to 1000 rpm on prime alone, ease the mixture control lever slowly out of IDLE CUT OFF. Release the prime switch to the OFF position when the rpm starts to drop.

**CAUTION**

If the engine stops, immediately return the mixture control lever to IDLE CUT OFF and continue cranking and priming for a second start.

- i. Throttle — 1000 rpm.  
After the engine is running smoothly, adjust the throttle to maintain approximately 1000 rpm.
- j. Fuel boost pump switch — OFF.  
Check that engine fuel pressure remains within normal limits after the fuel boost pump switch has been turned to OFF.
- \*4. External Power — Removed and Clear. (CP)
- \*5. Battery — On. (CP)
- \*6. Door — Closed. (Designated)  
Refer to figure 2-3.

**WARNING**

Due to the hazard of the rotating propeller, the main entrance door will be closed prior to starting the right engine.

- \*7. Hydraulic Pressure Gage — Checked. (CP)  
As the main entrance door closes, a drop in pressure without a corresponding rise will indicate that the left hydraulic pump is inoperative.
- \*8. Door Warning Light — Out. (FE)  
The door-open warning light should be out. Depress the light to ensure that the bulb will illuminate. Test the door solenoid lock by actuating the entrance door unlatch switch. While holding this switch in the ON position, check that the green indicator light above the door secondary lock handle is illuminated. This indicates pilot control of the door unlocking mechanism.
- \*9. Engine Analyzer — On. (FE)
- \*10. Fire Guard — Posted. (CP)
- \*11. Right Engine — Start. (CP)  
Repeat the starting procedure for the right engine.
- \*12. Engine Start Selector — OFF. (FE)
- \*13. Right Generator — ON. (FE)
- \*14. Cabin Compressor and AG System — Checked. (CP) **B C D**  
Check that the pressure-low warning lights operate and go out and that the hydraulic temperatures and pressures are within limits.
- \*15. Starting Engines Checklist — Completed. (FE)

**ENGINE GROUND OPERATION****CAUTION**

Since scuffed pistons have resulted from applying power too quickly after starting cold engines, care should be exercised not to exceed 1100 rpm until oil temperature has warmed up to 40°C.

**Note**

- To prevent and combat lead or other fouling accumulations on the spark plugs and in the combustion chamber, make a periodic run-up of the engine during prolonged periods of ground idling. This run-up is accomplished by placing the mixture in AUTO RICH and setting the throttle at 35 in Hg. Move the mixture to AUTO LEAN, allow the cylinder head temperature to reach 160°C, and hold for 30 seconds. (Adjust nacelle flaps if required to obtain desired CHT.) The engine should be run-up in this matter at 10-minute intervals.
- Manifold pressures greater than field barometric pressure are required for momentary accessory checks. Since engine cooling and the indications of engine cooling are least effective during ground operation, the duration and power for these checks should be held to the absolute minimum required.
- Experience has shown the desired position of mixture control during ground operation at or below 1500 rpm is dependent on carburetor setting and density altitude. Normally, auto lean is used for ground operation at or below 1500 rpm to prevent spark plug fouling. At higher density altitudes, manual leaning may be required; at lower density altitudes, AUTO RICH may be required.

**BEFORE TAXIING**

- \*1. Cabin Heat and Vent Switch — Normal. (CP)
- \*2. Fire Detection System — Checked. (CP)
- \*3. IFF/SIF — Standby. (CP)
- \*4. Radios — As required. (CP-p)  
Turn navigation radios ON to permit proper warm-up.
- 5. Interphone — Checked. (P-CP)
- \*6. Alarm Bell — Checked. (P) **A B C**  
Alarm bell check is not required when a public address system is installed.

- 7. Carburetor Heat — Checked. (FE)  
Place the carburetor heat control levers in the full HOT position until a rise in CAT is noted, then return the levers to COLD and note a decrease in temperature. After levers are placed to COLD, approximately two minutes are required for temperature to stabilize.

- \*8. Radio Call — Completed. (CP)
- \*9. Altimeter and Clocks — Set. (P-CP)

**WARNING**

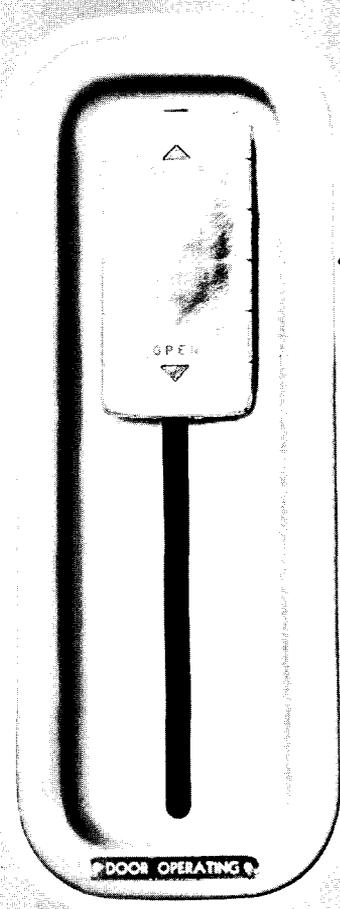
It is possible to misset the altimeter by 10,000 feet and still have the correct indication on the barometric scale. This happens when the barometric set knob is continuously rotated after the barometric scale is out of view. The knob can be rotated until eventually the numbers will reappear in the Kollsman window from the opposite side. If the correct altimeter setting is then established, the altimeter will read approximately 10,000 feet in error. To avoid the possibility of this error, pay particular attention to the ten-thousand foot pointer when setting the altimeter.

- \*10. Flight Instruments — Set. (P-CP)
  - a. Magnetic compass (standby) — Checked.  
Check that the magnetic compass indicates approximately the airplane heading.
  - b. Heading Indicators — Caged and set.
  - c. Attitude indicators — Caged and set.  
Check the MM series indicator for proper erection and cage the J-8 indicator. Align MM series attitude indicator horizon bar 3° above miniature airplane. Set J-8 or B1A attitude indicator miniature airplane approximately 1-1/2 bar widths below the 90° indices.

**WARNING**

- To avoid the possibility of a takeoff with the J-8 attitude indicator erected in the inverted position, the instrument must be caged prior to takeoff to ensure proper erection.
- To avoid damage to the instrument, do not pull the erection knob violently.
- \*11. Ignition Grounding — Checked. (FE)  
Accomplish an ignition switch check at 800

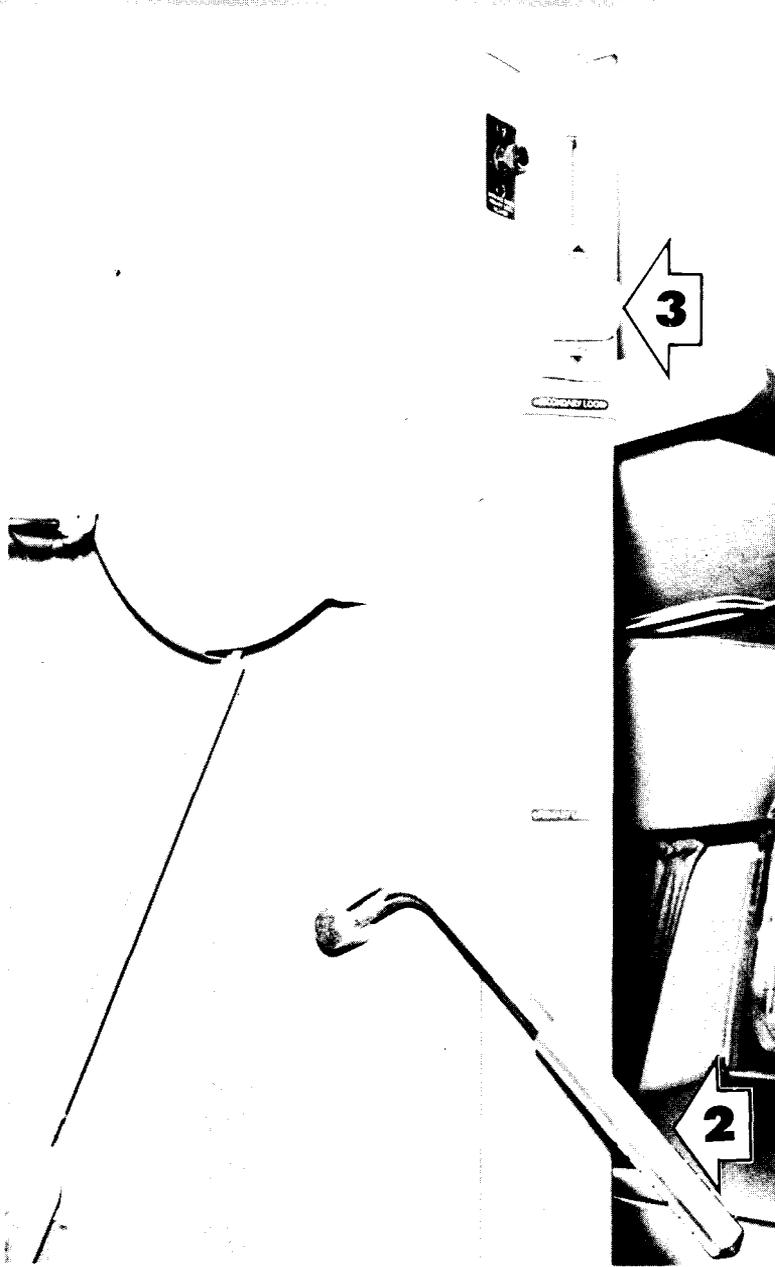
# CLOSING ENTRANCE DOOR FROM INSIDE (TYPICAL)



Move the door-operating handle to the CLOSE position **1**

Move primary lock lever down to LOCK position after door is closed **2**

Move secondary lock handle to the LOCK position **3**



C-45246

Figure 2-3

to 1000 rpm. Switch the ignition switch from BOTH to L, to R, to OFF momentarily, and then back to BOTH. Proper connection of ignition leads will be indicated by a slight reduction of rpm when operating on each magneto and by complete cutting out of the engine in the OFF position.

### WARNING

If the engine does not cease firing when the ignition switch is in the OFF position, the magneto ground wire is open. In this case, personnel must be warned to keep clear of the propeller after the engine is shut down until the defect has been corrected.

### CAUTION

Perform this check as rapidly as possible to prevent severe backfiring when the switch is turned on again.

#### Note

The ignition switch check may be accomplished using the engine analyzer by observing L-1 and L-2 circuits for grounding when ignition switch is in the R position, and R-1 and R-2 circuits for grounding when ignition switch is in the L position.

- \*12. Chocks – Removed. (P-CP)
- \*13. Before Taxiing Checklist – Completed. (FE)

## TAXIING

### POWER REQUIREMENTS

Depending on the type and condition of the ramp and the gross weight of the airplane, power requirements to initiate the roll are normally 1000 to 1500 rpm. Advance both throttles evenly and do not try to turn the nose wheel before the airplane is in motion. After starting the roll, taxi with the engines at 800 to 1000 rpm to keep generators in operation.

### PASSENGER CONSIDERATION

Smooth taxiing is a must for passenger safety and comfort. The pilot and copilot will devote their full attention to taxiing and controlling the airplane. Avoid overcontrolling the airplane. If a swaying motion can be felt in the cockpit, the sway is greatly amplified in the cabin. Avoid high speed turns and "jerky" fast stops. For added safety, use all available lights when taxiing at night.

### STEERING

Directional control during taxiing is normally accomplished by means of the steerable nose wheel. Differential thrust is ineffective, and differential braking is not normally recommended as it induces excessive brake wear. Avoid overuse of the brakes and exer-

cise extreme care when applying the inside brake on a turn. Differential braking can be used to steer the airplane in the event of an emergency. The minimum turning diameter required to keep all wheels on the runway when using only nose wheel steering is approximately 60 feet. The minimum turning diameter for wing tip clearance is approximately 125 feet. See figure 2-4.

### CAUTION

Avoid sharp turns when taxiing at high speeds in order to prevent damage to the nose gear and to prevent excessive wear on the tires.

### AIRCRAFT BACKING USING REVERSE THRUST

Move both throttles aft into reverse thrust range until the aircraft begins movement backward. Then one throttle may be moved to the forward thrust idle range. To stop the aircraft, the throttle(s) in reverse thrust range will be returned to the forward thrust range and power applied to stop backward movement. Use brakes to stop aircraft when forward movement begins.

### CAUTION

- If reverse taxiing is necessary, avoid high power operation, sharp brake applications, and rough or rutted runways to prevent pitching the airplane on its tail.
- Do not use reverse for taxiing until the propellers have been exercised several times to circulate warm oil in the propeller dome.
- Do not taxi in reverse for long periods. To do so will cause excessive heat inside the nacelles. Keep nacelle flaps closed to ensure adequate engine cooling while taxiing in reverse.

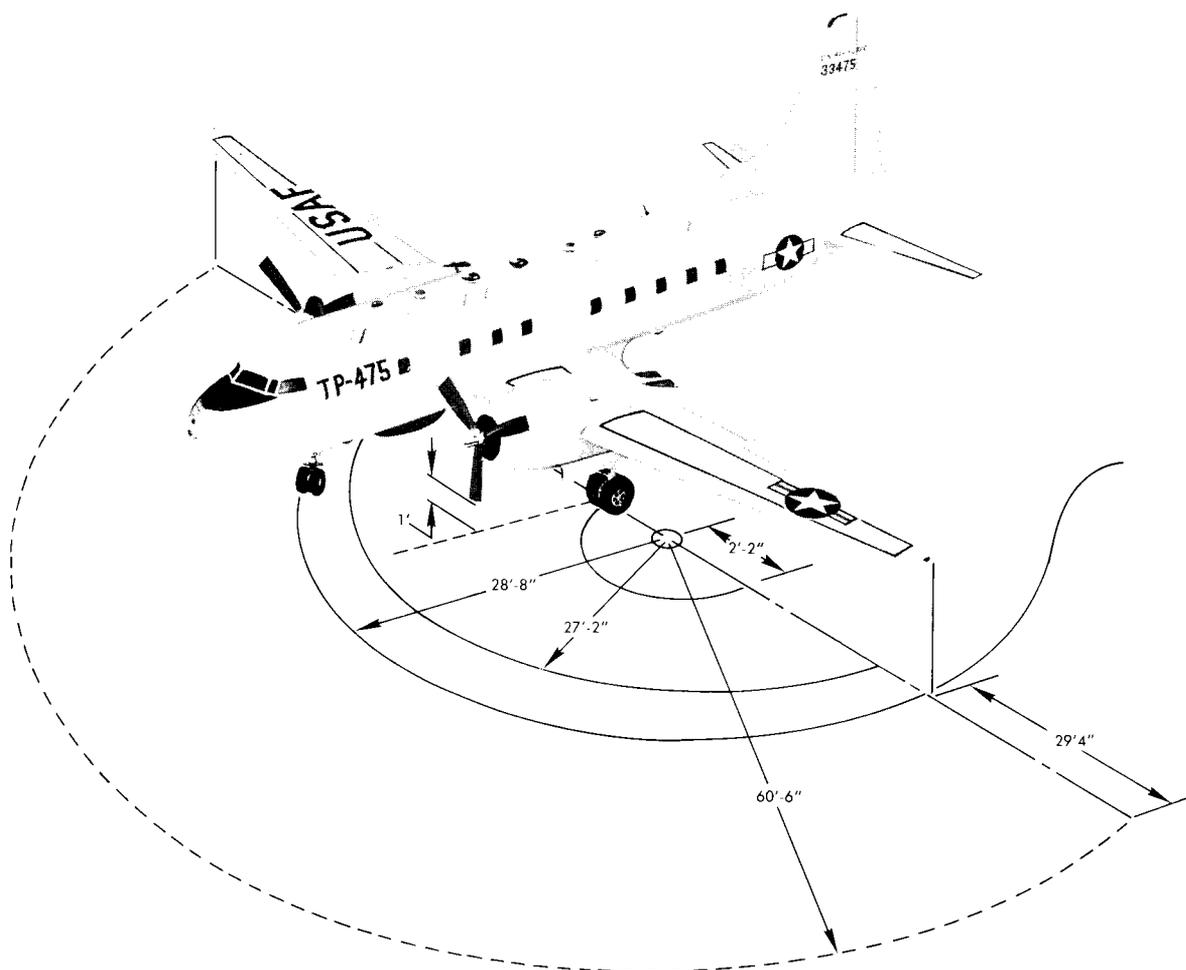
### DURING TAXIING

- \*1. Brakes – Checked. (P)  
Check the brakes immediately after the airplane begins to roll from the parking area at the start of taxiing. Make periodic checks of brake effectiveness during taxiing. The copilot will check main hydraulic pressure and brake hydraulic pressure periodically while taxiing.

#### Note

Brakes will be checked immediately after aircraft movement, but the taxiing checklist may be delayed until clear of congested area.

# TAXI TURNING RADIUS (TYPICAL)



C-45248

Figure 2-4

- \*2. Turn-Slip and Heading Indicators – Checked. (P-CP)  
Check turn-and-slip and heading indicators for proper turn indications while executing turns in taxiing.
  - \*3. Taxiing Checklist – Completed. (FE)
  - \*4. Mixtures – Auto Rich. (P)
  - \*5. RPM – 1500. (P)
  - 6. Generators – Checked. (FE)
    - a. Check each generator for required bus voltage (28 to 28.5) with the opposite generator switch OFF.
    - b. Check that the generators divide the load equally within 10% of the total load. If the generators do not divide the load as specified, the generator voltage control rheostats should be readjusted.
- ENGINE RUNUP**
- \*1. Nose Wheel and Parking Brake – Centered and Set. (P)
  - 2. Manifold Pressure Lines – Drained. (P)
  - \*3. Engine Temperatures and Pressures – Within Limits. (P)

**WARNING**

The airplane should not be flown with one generator inoperative.

- \*7. Propellers – Exercised. (P)
- a. Propeller speed control levers — LOW LIGHTS (decrease rpm). Hold the propeller speed control levers in the DEC RPM position until the governor limit lights go out and then come on again. Tachometers should indicate 1200 ( $\pm 50$ ) rpm.
  - b. Propeller speed control levers — HIGH LIGHTS (increase rpm). Hold the propeller speed control levers in the INC RPM position until the governor limit lights go out and then come on again. Tachometers should indicate approximately 1500 rpm.

**CAUTION**

In cold weather, repeat the propeller pitch change several times to circulate warm engine oil through the governing system. In warm weather, one or two cycles is sufficient.

**Note**

During repeat cycles, it is not necessary to go from low to high limits. Allow three seconds for stabilization at each end of cycle. After last cycle, return to high lights.

8. Propeller Blade Switches – Checked. (FE) (Perform one at a time.) With the engine operating at 1500 rpm and the propellers in the full increase rpm condition, pull the feathering button out firmly and hold until rpm stabilizes between 1150 and 1300 rpm and check the loadmeter for an increase; then immediately release the feathering button to normal and check the loadmeter for a decrease. Check that the rpm returns to 1500 and the loadmeter returns to normal. If the rpm does not stabilize or continues to decrease while holding the feathering button out, a propeller malfunction is indicated.

**CAUTION**

To avoid overloading the engine sump, do not repeat this check more than three times on one engine until the engine has

operated for at least two minutes following a test.

**Note**

During cold weather operation, (35°F or below) this check should be delayed until after engine runup is completed to allow additional engine oil warm-up time. **A**

9. Propellers Reverse – Checked. (P-fe)

**Note**

- During cold weather operation, (35°F or below) this check should be delayed until after engine runup is completed to allow additional engine oil warm-up time. **A**

- Perform a reverse check on one propeller at a time with the opposite engine operating at approximately 1500 rpm. This procedure assures generator power on the main bus and prevents excessive drain on battery power.

- Check the area ahead of the airplane to avoid "blasting" ground personnel and equipment.

- a. Pull the throttle back through the throttle closed detent into the reverse operating range. Watch for a dc loadmeter increase as the feathering pump starts and an rpm increase as the propeller passes through flat pitch. Watch for a dc loadmeter decrease when the feathering pump stops.

**Note**

A solenoid lock prevents the application of high power until after the propeller blades have reached full reverse pitch.

**CAUTION**

If loadmeter does not decrease it indicates that the feather pump is still running. Disconnect the dc power supply to stop the pump.

**CAUTION**

- Limit the use of high power settings with the propeller in reverse pitch to short intervals to avoid overheating vital engine accessories. Critical temperatures are not detected by the normal engine instrumentation. Reverse pitch tests should be conducted within a range not to exceed field barometric pressure.
- b. Return the throttle to the normal operating range. Watch for a dc loadmeter indication when the feathering pump starts and stops.

**Note**

- Watch for an increase, a decrease, then an increase of approximately 200 to 300 rpm when returning the throttle to the normal operating range. This surge will occur as the blades pass through flat pitch and indicates that the propeller has returned to forward thrust operation.
- If it cannot be determined that the propeller blades have returned to forward thrust, toggle the propeller lever toward decrease rpm. Check the tachometer for a decrease in rpm. This indicates that the propellers are out of reverse. If the propellers are still in reverse, depress the manual feathering button and observe the tachometer. Pull the feathering button out to the NORMAL position when the rpm decreases after the blades pass through flat pitch. The rpm will stabilize if the blades remain in forward thrust.

\*10 Load Monitor — Normal. (FE)

\*11. Alternators — On. (FE)

**Note**

While accomplishing items 12 through 18, retain 1500 rpm on engine not being checked. This procedure assures 115 volts unregulated ac power to the number 2 bus for check of equipment.

\*12. Engine Power — Checked. (P -fe)

**Note**

This item may be deleted as a thru-flight item if an ignition analyzer is utilized to check ignition wave patterns. An ignition analyzer check should be performed at 1700 rpm or above to obtain a more reliable presentation of spark plug performance.

Advance the throttle until the manifold pressure indicates field barometric pressure. On **A** airplanes the rpm of each engine should be 2050 ( $\pm 50$ ). On **B** airplanes the rpm of the left engine should be 2050 ( $\pm 50$ ) and the rpm of the

right engine should be 2000 ( $\pm 50$ ). On **C** and **D** airplanes the rpm of the left engine should be 2100( $\pm 50$ ) and the rpm of the right engine should be 2050( $\pm 50$ ). Normally, the left engine will be checked first.

**Note**

When making the power check, approximately two rpm should be added for each knot of headwind.

- \*13. Alternator — Checked. (FE)  
With no load on the alternator, observe alternator output voltage. The voltage must be stable, 115 ( $\pm 5$ ) volts.

**WARNING**

The airplane should not be flown with one alternator inoperative.

- \* **(14)** Ignition System — Checked. (FE)

**Note**

This item may be deleted as a thru-flight check item if an ignition analyzer is utilized to check ignition wave patterns. An ignition analyzer check should be performed at 1700 rpm or above to obtain a more reliable presentation of spark plug performance.

With the engine operating at field barometric pressure:

- a. Place ignition switch to R, note rpm drop; then to BOTH momentarily to allow rpm to stabilize.
- b. Place ignition switch to L, note rpm drop; then back to BOTH.

**Note**

Maximum permissible drop-off is 65 rpm (normal is 25 rpm). The difference between left and right should not exceed 40 rpm. Operation on a single magneto must not exceed 60 seconds.

- c. Normally the flight engineer will make the ignition check. The maximum drop must be reported to the pilot (i. e. right 40, left 30).

15. Blower — Checked. (P)  
With the engine operating at field barometric pressure:

- a. Blower switch of engine being checked — HIGH. Manifold pressure should increase 1-1/2 to 2 in. Hg. Observe fluctuation of engine oil pressure.
- b. Blower switch of engine being checked — LOW. Manifold pressure

should decrease to the original indication. Leave the blower switch in the LOW position for takeoff.

**WARNING**

The airplane should not be flown, unless the blowers will shift properly.

**Note**

If erratic changes in manifold pressure or other indications of improper clutch or selector valve operations appear, repeat cycle of shifting after first idling at 1000 rpm for two minutes to allow heat to dissipate. Refer to Section VII for additional information on engine blower shift operation.

16. Water Injection System — Checked. (P)

- a. Water injection switch — ON.
- b. Water indicator lights — ON.

**Note**

Water pressure causes derichment (decrease in fuel flow).

- c. Advance the throttle to obtain 800 pounds fuel (manifold pressure of 35 to 40 in. Hg).

**Note**

At this throttle setting, the water pressure is slightly greater than that specified for takeoff.

- d. Without retarding the throttle, turn the water injection switch OFF. Fuel flow will increase and the water injection indicator lights will go out.
- e. If the water injection system is inoperative on one or both engines, refer to the Appendix for dry takeoff performance.

17. Autofeather System — Checked. (P-fe)

- a. Autofeather switch — ON (green light on). (P)
- b. Retard throttle slowly until feather button red light comes on, torque pressure 35 to 45 psi. (P)
- c. Autofeather test switch — Hold to LH. (P)

After two to three seconds, the left manual feathering button will pull in. The pilot releases the test switch to OFF after a 200 rpm drop and the flight mechanic pulls out the left manual feathering button to the NORMAL position. Feather action will stop and rpm will return to the original setting. The green light will be out.

- d. Autofeather switch — OFF. (P)

**CAUTION**

Leaving the autofeather switch ON after the test would leave the system disarmed and inoperative. The switch must be turned OFF after each test. It is turned ON again just prior to takeoff.

**Note**

The test of the autofeather system is not complete until it is observed that the red lights in the two manual feathering buttons go out as the throttles are advanced beyond approximately 25 in. Hg manifold pressure (45 psi torque pressure). As the throttles are retarded, the lights will come on again at approximately 20 in. Hg manifold pressure. If either (or both) of the lights fail to go out as the throttles are advanced, malfunction of the autofeather torque pressure switch is indicated. Takeoff should then be postponed until the defect has been corrected. Takeoff performance data in the Appendix is based on autofeathering within a maximum of three seconds after engine failure.

- \*18. Propeller Manual Feather — Checked. (FE)

**Note**

Reduce power to 1500 to 1700 rpm prior to accomplishing the thru-flight manual feather check.

**CAUTION**

During cold weather, repeat the manual feathering system check until satisfactory operation is obtained if the RPM drop is very slow or sluggish. Otherwise, overspeeding may occur during takeoff. To avoid overloading the engine sump, do not repeat this check or autofeathering system test more than three times on one engine until the engine has operated for at least two minutes.

- \*19. Remaining Engine — Checked. (Repeat Steps 12 to 18 "Engine Power" through "Propeller Manual Feather")
- 20. Propeller blade switch and propeller reverse — Checked. (If delayed because of cold weather) **A**
- \*21. Navigation Radios — Checked and Set. (P-cp)

**Note**

For thru-flights, complete checks are not required; however, assure that radios are tuned to proper frequencies.

- a. VOR, TACAN, and ILS.
  - (1) RMI bearing pointers (VOR and TACAN) — Check for approximate bearing.
  - (2) Course deviation indicator (VOR and TACAN) — Set bearing shown under RMI bearing pointers in course window, and CDI should center.
  - (3) Course deviation indicator and glide-slope indicator (ILS) — Check for proper displacement of the CDI and GSI. Both warning "OFF" flags should be hidden.
  - (4) DME — With the Tacan selector switch in the T/R position, read distance in nautical miles to station.

**WARNING**

Before using the CDI or RMI for navigational purposes, assure that the instrument selector switch is in the desired position (TACAN or VOR/ILS).

- b. ADF.
  - Check the radio compass bearing pointers for approximate station bearing.
  - Check the set in ANT, ADF, and LOOP positions.
- c. HF communication — Checked, if required.
- d. VHF communications — Checked.
- e. UHF communications — Checked.
- \*22. Engine Runup Checklist — Completed. (FE)

**BEFORE TAKEOFF**

- 1. Circuit Breakers — Checked. (FE)

- 2. Carburetor Heat — Climatic. (FE)

**Note**

Normally all takeoffs are made with the heat control levers in the full COLD position, except when CAT, is  $-10^{\circ}$  to  $+15^{\circ}\text{C}$  and weather conditions are conducive to carburetor icing; carburetor heat may be used on takeoff to aid in the vaporization of fuel and to improve carburetor performance.

**CAUTION**

- Special precautions should be taken to maintain the carburetor air temperature above the critical icing range of  $-10^{\circ}$  to  $+15^{\circ}\text{C}$  while staying below the maximum allowable temperature for low blower operation. Use caution when using carburetor heat for takeoff. Temperatures will increase rapidly as maximum power is applied.
- If carburetor heat is used for takeoff, the CAT that will be maintained must have been utilized in determining the performance data. The higher CAT's seriously reduce engine torque values, which in turn affect maximum allowable takeoff weight, desired flaps, critical field length, takeoff ground run, refusal speed, and landing data.
- 3. Autofeather — ON. (P)
  - Check that the green arming light and both red feather button lights are on.

**CAUTION**

If the switch has been left in the ON position, place it in the OFF, then in the ON position to rearm the autofeathering system. Failure to do this will result in the system remaining inoperative.

- 4. Propellers — High Lights. (P)
  - Hold the left and right propeller speed control levers in the INC RPM position and observe that the indicator lights remain illuminated as an indication that the propellers are in low pitch.
- 5. Blowers — Low. (P)
- 6. Trim Tabs — Set. (P)
  - The elevator trim tab is normally set for approximately 2-1/2 to 3 units of nose-up trim. Rudder and aileron are set at zero.

- ⑦ Wing Flaps — Set For Takeoff. (FE)  
Set wing flaps as computed for takeoff under the existing conditions.
8. Fuel Boost Pumps — On. (FE)
- ⑨ Anti-Icing and De-Icing Equipment — Climatic. (CP)
- a. Heat anti-ice button.— Climatic.

**Note**

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

- b. Cabin heat — Climatic.
- c. Windshield anti-ice switches — START for **A**, **B**, early **C**; D.V. START and WINDSHIELD — BOTH MAIN LOW for late **C** and all **D**.
- d. Propeller de-ice switches — Climatic.
- e. Side windshield defrosting handles — Climatic.
- f. Reserve oil heat — Climatic.

**Note**

The reserve oil heat switch must be placed in HEAT position whenever the free air temperature is 21°C (70°F) or below if oil transfer is anticipated.

10. Flight Controls — Checked. (P)  
Check that the gust control lock is fully forward and move all controls to check for freedom of movement.
11. Safety Belt — Fastened. (P-CP-FE)
12. Crew Briefing — Completed. (P)  
The pilot will brief the copilot and other crew members to assure that they know their duties during takeoff. The following items will be covered:
- a. The required performance data from the takeoff and landing data card.
- b. Pattern (or IFR route) to be followed in case an immediate landing is necessary after becoming airborne.
- c. Air traffic control clearance and route to be followed after normal departure.

The following standard items shall also be covered by a crew making its first flight together:

- a. If emergency occurs before refusal speed is attained, the takeoff will be discontinued. Any crew member may call, "Abort," up to refusal speed. The pilot will initiate the abort.
- b. In case of an emergency, the copilot and flight engineer will accomplish the necessary procedures at the pilot's command.

13. Before Takeoff Checklist — Completed. (FE)

**LINEUP**

1. Nacelle Flaps — Mid-Position. (FE)
2. Windows — Locked. (P-CP)
3. Anti-Collision Light — On (Position Lights Steady) (CP)
4. Pitot Heat — Climatic. (CP)
5. Mixtures — Auto Rich. (CP)
6. Water Injection — As required. (CP)  
If a wet takeoff is being made, check water pressure and pressure indicator lights.

**WARNING**

- A Minimum of nine gallons is required to ensure a safe takeoff. Sloshing of the ADI fluid in the tank can actuate the shut-off switch with as much as six gallons remaining.
- In the event of a water injection system failure before reaching refusal speed, the takeoff should be aborted.

- ⑦ IFF/SIF — Set. (CP)
8. Attitude and Heading Indicators — Checked. (P-CP)
- a. Cross-check that all heading indicators and magnetic compass indicate airplane heading.
- b. Recheck attitude indicators for proper indication.
9. Lineup Checklist — Completed. (FE)

**TAKEOFF****NORMAL TAKEOFF**

The takeoff charts in the Appendix are based on setting maximum power before releasing the brakes; however, releasing the brakes at field barometric

pressure (in. Hg MAP) and advancing the throttles smoothly to maximum power results in nominal difference in performance.

#### Note

If a rolling takeoff is to be accomplished, allow the aircraft to continue to roll when taxiing onto the runway, and smoothly advance the throttles. Use nose wheel steering to control the aircraft direction, avoiding skids and skips, excessive speeds, and use of brakes during the turn onto the runway.

The pilot advances the throttles smoothly to approximately 45 in. Hg; then the copilot advances the throttles to the limiting manifold pressure. Check that the two red manual feathering button lights go out as manifold pressure indicates approximately 25 in. Hg.

#### WARNING

If one or both of the red lights in the manual feathering buttons fail to go out when the throttles have been advanced beyond the position corresponding to approximately 25 in. Hg manifold pressure, the takeoff must be postponed until the trouble has been corrected. If takeoff should be attempted with one or both of the red lights on and the autofeather switch in the ON position, one propeller will autofeather as soon as the throttles have been advanced beyond the 45 in. HG manifold pressure position.

#### CAUTION

Increasing aircoop ram pressure resulting from the increase in airspeed during the takeoff roll usually results in a manifold pressure rise of approximately two inches. Make the necessary throttle adjustments to avoid exceeding maximum manifold pressure.

Maintain directional control with nose wheel steering until the rudder becomes effective at approximately 60 KIAS. The control column may be held forward until 70 to 80 KIAS to provide traction for the nose wheel. At 80 KIAS, apply back pressure on the control column to level the airplane. (The nose of the airplane should be raised slightly at this time to a point where the nose wheel strut is extended but the wheels are still on the runway.) Maintain this attitude to approximately 10 knots below takeoff speed. Then smoothly but steadily increase back pressure on the control column to rotate the nose to a climb attitude just as takeoff speed is reached. Avoid abrupt changes in attitude which create a sinking sensation in the cabin. Be prepared to reduce power and abort the takeoff if a malfunction occurs before reaching refusal speed. Normally the pilot should

not release the throttles until the decision to continue to takeoff or abort has been made.

#### TAKEOFF WITHOUT WATER INJECTION

A takeoff without water injection (dry maximum power) is accomplished in the same manner as takeoff with wet rated power except that increased takeoff distances and decreased single-engine performance will result with the lower power developed by the engines. Gross weight must be limited to maintain the desired performance. Refer to Section V and the Appendix.

#### MINIMUM RUN TAKEOFF

From the charts in the Appendix, compute maximum takeoff weight, flap setting, critical field length, takeoff speed, and single-engine rate-of-climb. Use maximum flap extension for the density altitude, power, and gross weight. Obtain maximum power before releasing the brakes and starting the takeoff run.

#### CROSS-WIND TAKEOFF

In light-to-moderate cross-winds, use normal takeoff techniques. In extreme cross-winds, hold the nose wheel on the ground slightly longer than normal in order to maintain directional control and break from the ground cleanly. Use cross-controlling as necessary. See Appendix I, Takeoff and Landing Crosswind Chart.

#### OBSTACLE CLEARANCE

Use minimum run takeoff procedure. Break ground at takeoff speed and climb at that speed until clear of all immediate obstacles. Do not attempt to force the airplane off the runway. After the obstacle is cleared, proceed with normal takeoff.

#### AFTER TAKEOFF—CLIMB

#### Note

For typical takeoff and initial climb procedures, see figure 2-5.

#### CAUTION

- If vibration is noticed on takeoff, brake wheels lightly after takeoff to preclude possible damage to the nacelle or uplocks from loose tread or unbalanced wheels.
- Due to the pronounced nose-high attitude of the airplane when taking off with a 0° flap setting, there is apt to be a feeling of being airborne before all wheels are clear of the runway. Make certain that the airplane is definitely airborne before applying brakes.

▲ 1. Landing Gear — Up. (CP)

When definitely airborne, the copilot will retract the landing gear on command of the pilot. The landing gear unsafe light will remain illuminated while the gear is in transit then will go out as the position indicators show gear up.

**WARNING**

Do not recycle the landing gear when an up and locked malfunction occurs. Recycling the landing gear when unknown mechanical defects exist could result in the gear jamming in the up position. Place the landing gear in the down and locked position and prepare for landing.

**Note**

- If the up and locked malfunction is identified and the possibility of the gear jamming in the up position does not exist, a recycle of the landing gear may be made.
- Retract landing gear immediately after takeoff before reaching landing gear retraction speed limitation to avoid excessive stress to the landing gear actuating mechanism. Refer to LANDING GEAR RETRACTION SPEED LIMITATIONS, Section V.

▲ 2. Wing Flaps — Up. (FE)

At a safe altitude and flap retraction speed (1.2 stall speed-clean, minimum), the flight engineer will retract the wing flaps on command of the pilot.

▲ 3. Power — Set. (CP-fe)

After reaching a safe altitude and climb airspeed, the copilot will set power. In high density traffic areas, the flight engineer may make the power reduction from METO to climb power.

▲ 4. Autofeather — Off. (FE)

Check that the green arming light goes out.

▲ 5. Water Injection — Off. (FE)

Place the water injection switch in the OFF position and check that the two green water-pressure-on indicator lights go out. Check for increased fuel flow indications.

**Note**

Water will continue to flow at climb power. Water injection should be turned off to conserve water.

- ▲ 6. Reverse Override Handles — In. (FE)  
Check that the override handles are in. If the red portion of the shaft is visible, push the handle in. The indicator light should go out.

**WARNING**

If, due to malfunction of the electrical circuit, the override handles will not remain in after takeoff, the propeller reverse lock circuit breaker should be pulled out to assure that the throttle quadrant stops will be effective during the flight. Manually operate the reverse override handles after landing.

- ▲ 7. Landing Lights — As required. (FE)

8. Hydraulic Bypass — Up. (FE)

**Note**

If one or more of the landing gears is not up and locked, the gear will extend as the hydraulic bypass handle is raised to UP position. Gear extension will be indicated by illumination of the red in-transit light. A jar may also be apparent as the gear is snapped down by the slipstream. Do not place the bypass handle in the DOWN position until the landing gear is extended.

**WARNING**

Do not recycle the landing gear when an up and locked malfunction occurs. Recycling the landing gear when unknown mechanical defects exist could result in the gear jamming in the up position. Slow the airplane to 130 KIAS (maximum), place the landing gear in the down and locked position, and prepare for landing.

- ▲ 9. Fuel Boost Pumps — As required. (FE)  
Place the fuel boost pump switches in the OFF position one at a time after reaching a safe altitude. Check for a fuel pressure fluctuation when the switches are turned OFF. Pressure should then stabilize within normal limits. During climb, fuel boost pumps should be turned on above 10,000 feet. After reaching cruise altitude, continued use of boost pumps may be required to prevent fluctuating fuel pressures. Boost pumps may be turned off if stable fuel pressure can be maintained without their use. Turn on fuel boost at any time fuel pressure fluctuates within normal range or if pressure warning light flickers.

**WARNING**

Do not turn pumps on if fuel pressure drops below limits and the engines continue to operate normally.

- 10. Engines and Wings – Checked. (Designated)
- 11. Seat Belt and No Smoking Signs – As required. (FE)
- 12. Engine Analyzer – Checked. (FE)
- 13. After Takeoff-Climb Checklist – Completed. (FE)

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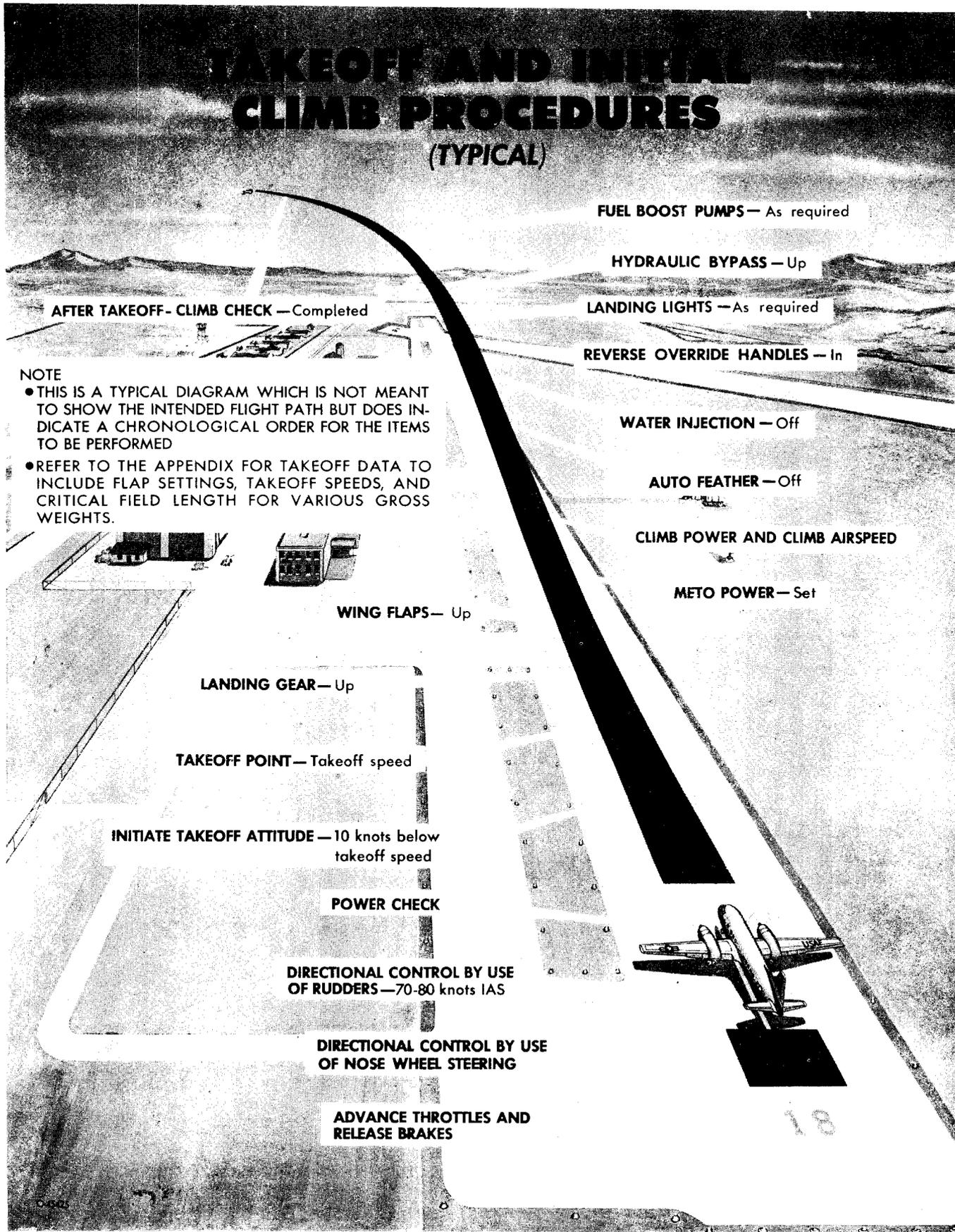


Figure 2-5

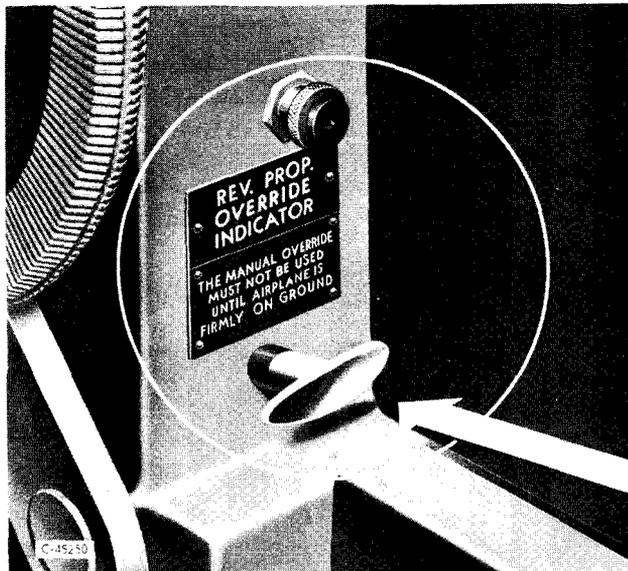


Figure 2-6

### CLIMB

Climb speed with wing flaps retracted is 140 KIAS. Adjust nacelle flaps to the MID-POSITION or less to maintain desired cylinder head temperatures. With this procedure, you will be able to obtain the results set forth in the climb charts in the Appendix.

### CRUISE

The nacelle flaps should be kept as nearly closed as possible in normal flight to reduce air drag. Nacelle flaps should not be opened beyond the mid-position because of the excessive drag and reduced cooling encountered. Cylinder head temperatures should be maintained at 200°C during normal cruise flight operation. Flight operations at cylinder head temperatures below this may have a minor beneficial effect on the service life of the engine and its components. However, reducing cylinder head temperatures during cruise flight by opening the nacelle flaps will seriously reduce the service life of the exhaust system, augmentor tubes, and muffler installation. Refer to Section VII for proper management of mixture, fuel boost pumps, and spark plug defouling procedures.

### FLIGHT CHARACTERISTICS

Refer to Section VI, FLIGHT CHARACTERISTICS.

### DESCENT

For best approach speeds at various gross weights and altitudes, refer to the Appendix. In making a normal descent from cruising altitude, reduce pow-

er as required to maintain desired airspeed and rate of descent. Phase I of the descent checklist may be accomplished as required during descent. Phase II must be completed prior to entering the downwind leg of the traffic pattern.

### CAUTION

Avoid prolonged use of high rpm with low manifold pressure. Maintain 1 in. Hg manifold pressure for each 100 rpm. If the nature of flying conditions in descent requires a large reduction in power, reduce rpm as well as manifold pressure. It is important to cushion the high inertia loads on the master rod bearings which occur at conditions of high rpm and low manifold pressure.

On **B**, **C**, and **D** airplanes, turn the cabin pressurization manual dump valve handle to DUMP if the cabin pressure relief valve fails to open below 8000 feet altitude.

### PHASE I

1. Crew and Passenger Briefing — Completed. (P)
  - a. Crew briefing:
    - (1) Altimeter setting.
    - (2) Weather conditions.
    - (3) Type and plan of approach.
    - (4) Missed approach procedures.
    - (5) Landing and go-around performance data.
      - (a) Determine approach and landing flap settings.
      - (b) Check landing ground roll distance.
      - (c) Obtain airspeeds for landing and go-around.
  - b. Passenger briefing:
    - (1) Arrival time.
    - (2) General weather conditions.
2. Trailing Antenna — In. (Designated)
3. Hydraulic Fluid — Checked. (FE)
4. Hydraulic Bypass — Down. (FE)
5. Hydraulic and Air Pressure — Checked. (FE)
6. Blowers — Low. (FE)
 

Engine blowers may be shifted from HIGH to LOW position during descent with mixture

control levers in the AUTO LEAN or AUTO RICH position.

- ⑦. Fuel Controls — Normal. (FE)

**Note**

Coordination is required only when the fuel controls are in other than the normal positions.

8. Circuit Breakers — Checked. (FE)  
 9. Engine Analyzer — Checked. (FE)  
 10. Phase I Descent Checklist — Completed. (FE)

**PHASE II**

1. Seat Belt and No Smoking Signs — On. (FE)  
 2. Fuel Boost Pumps — On. (FE)  
 3. Augmentor Vanes — Climatic. (FE)

**CAUTION**

If augmentor vanes are used during descent, care should be used to prevent exceeding desired cylinder head temperature in the event of an increase in power.

4. Mixtures — Auto Rich. (FE)  
 5. Carburetor Heat — Climatic. (FE-cp)  
 Check that the carburetor heat control levers are in the COLD position unless icing conditions require the application of heat. If the flight engineer's seat is not modified to slide forward, the copilot will perform this check.

**CAUTION**

If carburetor heat is being used and a go-around is necessary, carburetor air temperature must not be allowed to exceed maximum limits.

6. Descent Checklist — Completed. (FE)

**BEFORE LANDING**

**Note**

The BEFORE LANDING check may be performed before, but normally not later than the points indicated on figure 2-7.

1. Propellers — RPM 2400. (FE-cp)  
 If the flight engineer's seat is not modified to slide forward, the copilot will set the RPM.

- ②. Wing Flaps — Approach Setting. (FE)  
 Extend the wing flaps to the appropriate angle for the approach depending on field length and gross weight factors. Refer to the Appendix for landing charts and conditions.

- ③. Landing Lights — As required. (FE)

- ④. Landing Gear — Down and Locked. (CP)  
 Check the three position indicators. Check that the landing gear unsafe warning light is out, press-to-test the bulb. Check that the main and brake hydraulic pressures and the emergency air pressure are within limits. Check that the landing gear handle is down and locked. Check that the index marks on the nose steering wheel are aligned with the index mark on the pilot's console fairing.

**CAUTION**

Do not lower the landing gear at speeds in excess of the airspeed limit. The gear actuating mechanism and supporting structure are not designed for the airloads that would be imposed if the gear were lowered at a greater airspeed.

**Note**

If the throttles are retarded to a low power setting before the landing gear has been lowered, the gear unsafe warning horn will sound.

- ⑤. Water Injection — As required. (FE)

**CAUTION**

Do not turn on water injection switch if water quantity is not sufficient to ensure an adequate supply of water for a go-around. A minimum of nine gallons is required to ensure a safe go-around.

6. Before Landing Checklist — Completed. (FE)

**LANDING**

**CAUTION**

In the event of engine failure during approach or landing, adequate single-engine performance is assured only if the airplane is operated in accordance with the performance charts in the Appendix.

# NORMAL LANDING PATTERN

## (TYPICAL)

**BASE LEG**

RPM—2400

WING FLAPS—APPROACH SETTING

LANDING GEAR—DOWN AND LOCKED

WATER INJECTION— AS REQUIRED

IAS—1.4 STALL SPEED (MINIMUM)

BEFORE LANDING CHECK COMPLETE

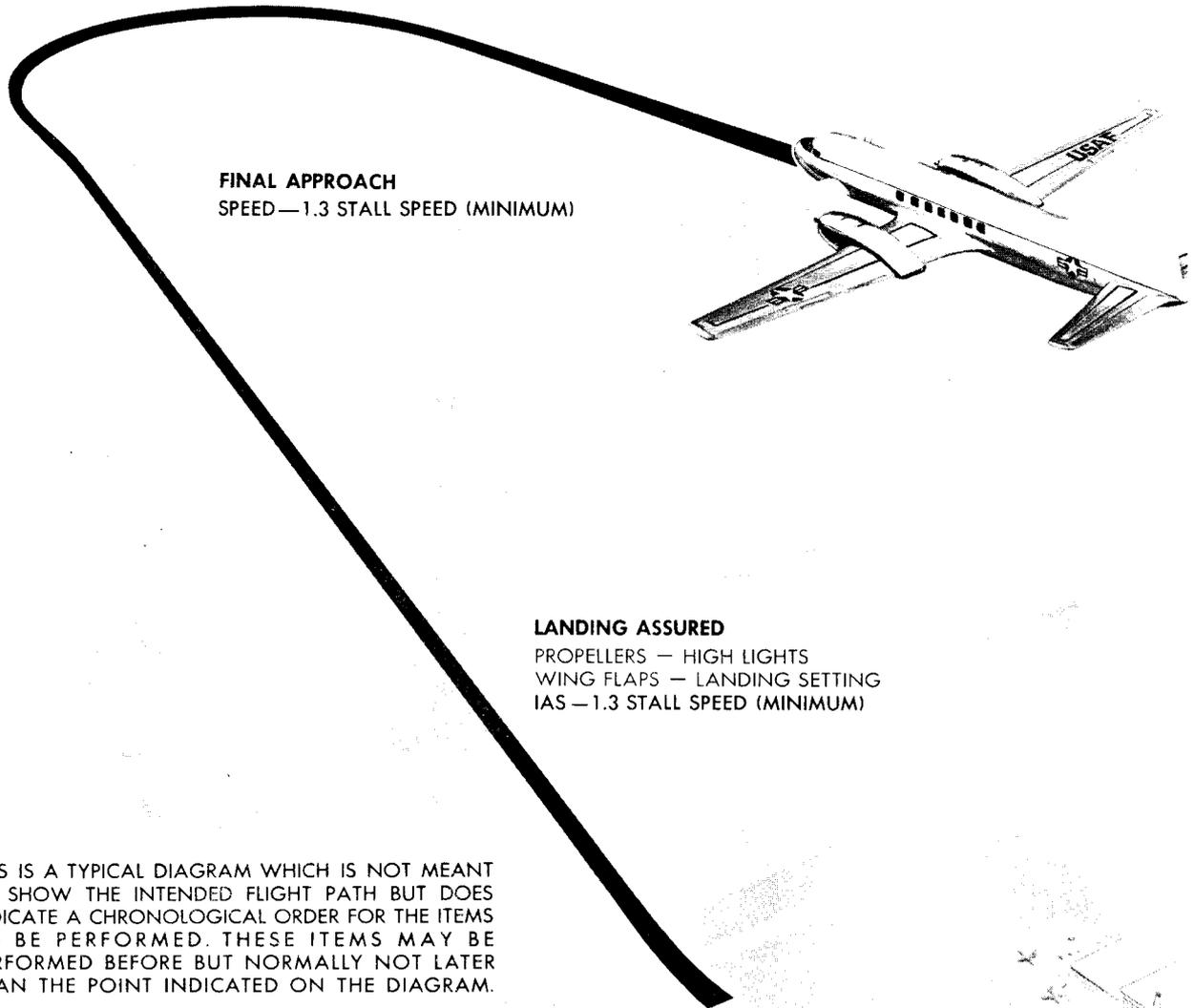
**DESCENDING**

ACCOMPLISH THE DESCENT CHECK LIST BEFORE ENTERING THE DOWNWIND LEG OF LANDING PATTERN.

**PATTERN ALTITUDE—DOWNWIND**

WING FLAPS—AS REQUIRED

IAS—1.4 STALL SPEED (MINIMUM)

**NOTE**

- 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 APPENDIX FOR FLAP SETTINGS AND AIRSPEEDS AT VARIOUS GROSS WEIGHTS.

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Figure 2-7

For a typical normal landing pattern, see figure 2-7. Power effects on the airplane at low speeds are important in landing operations. Cutting the power at low airspeeds results in abrupt deceleration due to the large increase in drag caused by windmilling propellers and extended flaps. To maintain lift in this condition, speed must be maintained. The only way to keep speed is to nose down the airplane. Hence, the result of cutting power during the landing operation is a drastic increase in the rate of descent. Safer and better controlled landings can be made by maintaining some power during the landing flare until the airplane touches down. After touchdown, the wing flaps should be retracted to allow the weight of the airplane to rest on the wheels for more positive braking effect. The throttles may then be pulled back into the reverse thrust range for aerodynamic braking.

#### Note

Landing distances shown in the charts in the Appendix are based on the techniques described here, with the exception that the effect of aerodynamic braking by use of propeller reverse thrust is not reflected in the chart data. Efficient use of reverse thrust will shorten the landing roll appreciably.

#### NORMAL LANDING

After the final approach configuration has been established, gradually reduce airspeed to 1.3 stall speed (minimum) for flap setting. When the landing is assured:

- ①. Propellers — High Lights. (FE-cp)  
Hold the left and right propeller speed control levers in the INC RPM position until the governor limit indicator lights illuminate. If the flight engineer's seat is not modified to slide forward, the copilot will set the High Lights.
- ②. Wing Flaps — Final Setting. (FE)  
Extend the wing flaps to the appropriate angle for the landing depending on field length and gross weight factors.
3. Landing Checklist — Completed. (FE)

Start the flare at 1.3 stall speed and reduce power throughout the flare. Fly the airplane to touchdown with a small amount of power; do not stall it. After touchdown, close the throttles and start retracting the wing flaps.

#### Note

In the event of an electrical malfunction, the reverse override handles will not pop out automatically, they must be pulled out manually before the throttles can be pulled into the reverse range.

Use nose wheel steering for directional control during reverse thrust braking. When reverse thrust is used, some control surface buffet may occur. For proper coordinated action at this point, the copilot should hold forward pressure on the control column and at the pilot's direction, hold the reverse override handle out while the pilot controls steering with his left hand and reverse thrust with his right. Braking action from reverse thrust is greatest at high speeds.

When the airplane has lost most of its forward speed (below 50 knots) the pilot moves the throttles to the normal power-off detent while applying the brakes lightly.

#### Note

A secondary solenoid-actuated stop on the throttle prevents power application in reverse thrust range if the corresponding propeller fails to reach approximately full-reverse pitch.

#### CAUTION

When brakes are used on landing, they normally should not be applied during the initial high-speed roll. If brakes are used excessively, as in performing a short field or brakes only landing, or steering with brakes, it is recommended that a minimum of 15 minutes elapse between landings if the landing gear remains extended, and a minimum of 30 minutes elapse between landings if the landing gear is retracted. This is to allow sufficient time for cooling. In a normal landing, utilizing reverse thrust and no brakes until after the airplane has lost nearly all its forward motion, brake use will not be excessive and a cooling period is not required.

#### MINIMUM RUN LANDING

Use the same procedure as for normal landing except touch down sooner by closing the throttles more rapidly than normal in the last portion of the flare over the runway. Brakes may be applied over a greater portion of the landing roll. Retract the wing flaps immediately after contact to permit the airplane to settle more rapidly on the gear to increase braking effectiveness. Use reverse thrust as effectively as possible.

#### CROSS-WIND LANDING

Landings and takeoffs have been made in 90° crosswinds of 25 knots with no unusual or dangerous characteristics. Refer to the Appendix for Takeoff and Landing Cross-Wind Chart.

**Technique for Cross-Wind Landing**

After the turn to final approach is made, prior to beginning roundout, lower the upwind wing and apply opposite rudder to counteract drift and maintain a straight track down the center of the runway.

**CAUTION**

Cross control pressures required to maintain a straight-line track over the runway are greater than for most airplanes due to the spring tension on the rudder-aileron interconnect.

Maintain the wing-low attitude throughout the flare. Maintain pressure on the upwind aileron after the gear touches the ground.

**Note**

If conditions warrant, a combination of cross control and crab can be employed during the approach phase but all crab must be eliminated prior to touchdown.

**CAUTION**

If the airplane is crabbed or drifting at the moment of ground contact, excessive stresses may be imposed on the landing gear.

Retract wing flaps immediately upon touchdown. Use rudder for directional control until nose wheel touches down, then use nose wheel steering for directional control. Hold the upwind aileron pressure until airplane has completed landing roll.

**ZERO WING FLAP LANDING**

For a zero wing flap landing, maintain approximately 1.3 stall speed on the approach keeping a slight amount of power on the engines. Too much power will result in a pronounced nose-high attitude which must be avoided. Close the throttles after the landing flare, and decelerate normally, using reverse thrust.

**HIGH GROSS WEIGHT LANDING**

Refer to Section V for landing gear limitations. If higher landing weights are unavoidable, a reduced rate of sinking speed and minimum use of brake should be attempted.

**CAUTION**

In the event of engine failure during an approach or landing at high gross weights or high altitude fields, adequate single-engine performance is assured only if the airplane is operated in accordance

with the performance charts in the Appendix.

**LANDING ON SLIPPERY RUNWAYS**

Prior to landing on a slippery runway, determine the stopping distance factor using the latest runway condition reading. Multiply the dry runway ground roll by the stopping distance factor to determine the ground roll on the slippery runway. Refer to the Stopping Capability Chart in the Appendix.

**Note**

If no RCR is available, use 12 for wet runways and 5 for icy runways.

When landing on wet or icy runways, the maintenance of directional control calls for a combined use of nose wheel steering, cautious application of brakes, and careful use of power. When reversing propeller pitch on an icy runway, the power must be applied evenly to prevent unbalanced thrust on one engine from causing the airplane to slide sideways. The nose wheel alone will not hold the airplane in a straight line and power will have to be balanced whether in reverse or normal pitch. Rudder control will still be effective during the initial portion of the landing roll and reversing phase. Reverse thrust is highly effective in reducing ground roll after landings; however, with light snow or standing water on the runway, caution must be exercised to prevent visibility loss by snow or water blown forward. Turn on windshield wiper before using reverse thrust. Apply reverse thrust immediately after touchdown, reducing power as speed is lost. With proper use of reverse thrust, forward visibility can be maintained in all but very fluffy snow.

**WARNING**

- If airplane has a visible accumulation of ice, approach speed should be 1.4 stall speed (minimum) and touchdown speed should be 1.3 stall speed (minimum).
- Use minimum braking when landing on an icy runway. Brakes will be ineffective during initial landing roll.

**TOUCH-AND-GO LANDING**

Use the normal landing procedures prior to and including touchdown. After touchdown, the pilot will maintain directional control with the rudder.

**Note**

During touch-and-go landings, sufficient airspeed should be maintained at all times to permit directional control with the rudder. The flight engineer adjusts the wing flaps to the appropriate takeoff

flap setting. In the absence of a flight engineer, the copilot will actuate the wing flaps. Simultaneously, the copilot sets the elevator trim to 2-1/2° nose up and places the autofeather switch in the ON position after which he will call for the pilot to advance the throttles toward maximum power. Normal takeoff procedures will then be used to complete the takeoff.

## GO-AROUND

In the event of a go-around, advance the propellers and throttles to maximum power. Establish a climbing attitude and simultaneously call for gear up and wing flaps to approach setting.

### CAUTION

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

Adjust airspeed to best climb speed for flap setting and complete normal takeoff and climb procedures. Compensate for out-of-trim condition by use of control pressures until you can readjust trim tab settings. For typical go-around procedures, see figure 2-8.

## AFTER LANDING

1. IFF/SIF – Off/Standby. (CP)  
Turn IFF/SIF off as soon after landing as possible. This will eliminate signals which would interfere with the radar control of airborne airplanes. If another takeoff is anticipated without engine shutdown, turn IFF/SIF to STANDBY.
2. Anti-Collision Light and Position Lights – As required. (CP)
3. Landing Lights – As Required (FE)
4. Anti-Ice and De-Ice – Off. (CP)
5. Nacelle Flaps – Open. (FE)
6. Fuel Boost Pumps – OFF. (FE)
7. Augmentor Vanes – Trail. (FE)
8. Unnecessary Radios – Off. (CP)
9. Water Injection – Off. (FE)
10. Alternators – As required. (FE)  
If final landing, turn alternator OFF. If another takeoff is anticipated without engine

shutdown, alternators may be left on.

11. Trim Tabs – Zero. (FE)
12. Wing Flaps – Up. (FE)
13. Load Monitor – Override. (FE)
14. Flight Controls – As required. (P)  
Pull the control gust lock handle back slowly while turning the aileron control wheel to lineup lock pin. After the aileron is locked, continue pulling the handle while moving the elevator to line-up lock pin. After the elevator is locked, continue pulling while moving the rudder pedals to line-up lock pin. Pull the handle until the projection in the left end of the handle snaps out in place.

### CAUTION

Attempts to force the gust lock handle aft before the aileron and elevator positions have been locked will damage the stop plates. Locking the controls requires "hunting" to seat the corresponding control lock pin in the stop plate holes.

If another takeoff is anticipated, the gust lock system does not have to be engaged.

15. After Landing Checklist – Completed. (FE)

## ENGINE SHUTDOWN

1. Nose Wheel and Parking Brake – Centered and Set. (P)
2. Window – Open. (CP)
3. Throttles – RPM 1000. (P)  
Maintain 1000 rpm for 30 seconds to scavenge the oil sump.
4. Ignition Grounding – Checked. (FE)
5. Copilot Console – Set. (CP)
6. Right Mixture – Off. (CP)

### Note

- If a check of the right engine hydraulic pump is desired, shut down the left engine and perform a hydraulic pump check by operating the wing flaps and observing the hydraulic pressure gage. Normally, this will be accomplished after the last flight of the day.



Figure 2-8

**Note**

- During intermediate stops, both engines may be shut down simultaneously unless a check of a specific hydraulic pump is required.
- 7. Right Ignition — Off. (CP)  
After the engine stops rotating, place right engine ignition switch to OFF.
- 8. Wing Flaps — 25°. (FE)
- ⑨ Main Entrance Door — Open. (Designated)

**WARNING**

Do not open the main entrance door until the right engine has been shut down and the propeller has stopped turning.

- 10. Left Mixture — Off. (CP)
- 11. Left Ignition — Off. (CP)
- 12. Radios — Off. (CP)
- 13. Engine Analyzer — Off. (FE)
- 14. Inverters — OFF. (FE)
- 15. Chocks — In Place. (P-CP)
- 15A. Fasten Seat Belt Sign — Off (FE)
- 16. Battery — As required. (CP)

**Note**

Off unless battery power is needed.

- 17. Engine Shutdown Checklist — Completed. (FE)

**BEFORE LEAVING AIRPLANE****Note**

During an enroute stop if a flight crew member remains with the airplane, the Before Leaving Airplane Checklist may be omitted.

- 1. Lights — As required. (ALL)
- 2. Parking Brakes — As required. (P)  
When the wheel chocks are in place, the pilot releases the parking brakes unless it is otherwise required to leave them set.

**Note**

If parking brakes are required, the hydraulic pressure bypass handle should be placed in the UP position after the parking brakes are set. This prevents dissipation of pressure in the brake system. With a fully charged accumulator, the parking brakes will hold approximately 12 hours.

- 3. Oil Dilution — As required. (FE)

**Note**

Oil dilution need not be accomplished at this time, although the pilot should ensure that oil dilution will be accomplished for cold weather operation; refer to Section IX.

- 4. Form 781 — Completed. (P)

**CAUTION**

In addition to the established requirements for reporting any system defects or unusual and excessive operations, the flight crew will also make entries on Form 781 to indicate when any limits in the Flight Manual have been exceeded.

- 5. Battery Switch — OFF. (FE)
- 6. Gear Pins and Pitot Covers — In Place. (FE)
- 7. Before Leaving Airplane Checklist — Completed. (FE)

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# EMERGENCY PROCEDURES

## section III

C-45254

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## INTRODUCTION

This Section contains what experience has shown to be the best procedures in meeting various emergencies that may be encountered. Each emergency presents a different problem, but a thorough knowledge of the procedures contained in this Section will enable a pilot to better cope with any emergencies he may encounter. The pilot, as soon as practical after encountering an emergency and after completing initial corrective action, shall establish communications with the ground station which he is monitoring at the time. There has been a tendency in the past, on the part of the pilot, to minimize certain disorders that could become serious. This practice is not consistent with safety as there may be insufficient time later to alert the agencies that can help. Once an emergency call has been channeled to Air Rescue Service and other agencies, a very diligent and constant check on the subsequent progress of the flight is maintained. Include a complete description of the trouble in the original message. This enables rescue agencies to make early preparations and computations in connection with their responsibilities. Place emphasis on accurate position reporting. Keep the ground station notified at all times of any changes or developments in the emergency, as well as informing them of action taken.

### Note

- Although many inflight emergencies require immediate corrective action, frequently difficulties are compounded by the tempo of the pilot's commands and hurried execution by the crew. It is essential that the pilot carefully analyze the difficulty prior to taking corrective action.
- The urgency of certain emergencies requires immediate and instinctive action by the crew member. These checklist items are in bold print and will be memorized by the crew member. During an emergency, the pilot will call out the bold print items and the applicable crew member will take the necessary action. Following completion of the bold print items, the remaining portion of the checklist will be completed in its entirety, time permitting.
- All odors not identifiable by the flight crew shall be considered toxic. Immediately go to 100 percent oxygen, properly ventilate the aircraft, and land as soon as practicable. Do not take off when unidentified odors are detected.

## GROUND OPERATIONS

### HYDRAULIC SYSTEM FAILURE

1. HYDRAULIC BYPASS — UP. (FE)
2. EMERGENCY HYDRAULIC PUMP — ON. (FE)

3. Brakes — As required. (P)  
Bring the airplane to a complete stop, as nose wheel steering will not be available without hydraulic pressure.

### Note

If the above procedure fails to stop the aircraft, an emergency stop may be made by using the emergency air brake system.

4. Shut Down Both Engines. (CP)
5. Gear Pins — Installed. (FE)

### ENGINE FIRE

If an induction or exhaust system fire develops during engine start, discontinue prime, open the throttle, and continue cranking to blow out the fire. If the fire persists or any other type of engine fire exists, stop the airplane, alert the tower, and proceed as follows:

1. MIXTURE — OFF. (CP)
2. FLUID HANDLE — PULL OUT. (CP)
3. FUEL VALVE — OFF. (FE)
4. FUEL BOOST PUMP — OFF. (FE)
5. HEAT AND VENT — SHUTOFF. (CP)
6. FIRE EXTINGUISHER — ON (IF FIRE EXISTS). (CP)

### WARNING

- If adequate ground fire fighting equipment is not available, operate the airplane fire extinguisher as soon as the engine stops.
- Prolonged exposure (five minutes or more) to high concentrations (pronounced irritation of the eyes and nose) of dibromodifluoromethane (DB) or its decomposition products should be avoided. It is safer to use than previous fire extinguishing agents (carbon tetrachloride, methylbromide); however, especially in confined spaces, 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.

### Note

Some aircraft may utilize bromochloromethane (CB) as the engine fire extinguisher agent instead of dibromodifluoromethane (DB). Prolonged exposure to CB should be avoided for the same reasons as DB.

7. Ignition — OFF. (FE)
8. Shut Down Other Engine. (P)

If an induction or exhaust system fire occurs while the engine is running, advance the throttle and attempt to blow the fire out. If the fire persists, use the procedure outlined above.

### FUEL PRESSURE DROP

Do not continue to taxi or continue a takeoff run if fuel pressure drops below operating limits and the engine continues to operate normally. Stop the airplane and shut down the affected engine immediately. Continuing a takeoff run under this condition might result in an otherwise avoidable engine fire. Shut down the affected engine as follows:

1. Mixture – Off. (CP)
2. Fluid Handle – Pull Out. (CP)
3. Fuel Valve – Off. (FE)
4. Fuel Boost Pump – Off. (FE)
- 4A. Oil Coolers – Off. (FE)
5. Heat and Vent – Shutoff. (CP)
6. Fire Extinguisher – On (If Fire Exists). (CP)
7. Ignition – Off. (FE)
8. Shut Down Other Engine. (P)

### WARNING

- To prevent a possible igniting spark from electrical equipment, do not turn other electrical switches ON or OFF until the defective fuel system has been found to be free of fuel leaks. It is important to leave the battery switch ON to have direct current to discharge the engine fire extinguisher agent if required.
- Request the ground crew to stand by with fire fighting equipment until the danger of fire has been eliminated.

## TAKEOFF

### TAKEOFF ABORTED

- a. Hold airplane straight with nose wheel steering. (P)

#### Note

Nose wheel steering is normally effective with reverse thrust on one engine and the other engine inoperative. However, with full reverse power, brakes may be necessary to assist in maintaining directional control. The amount that nose wheel steering effectiveness is reduced is determined by the runway surface condition. Holding the control column forward will increase steering effectiveness.

### WARNING

When operating under single-engine conditions, the airplane has a tendency to veer in the direction of the good engine when reverse thrust is applied. Care must be exercised on wet or icy runways.

- b. Reverse override handles – Pull out. (CP)

#### Note

- To prevent the handles from inadvertently returning to the IN position on rough or bumpy terrain, hold the handles out until the propellers are reversed.
  - The handles operate in unison. Pulling either handle operates both handles.
- c. Throttles, both engines – REVERSE. (P)
  - d. Brakes – As required. (P)
  - e. Wing flaps – UP. (FE)

#### Note

The case may arise when brakes and reversed propellers will not stop the airplane on the remaining portion of the runway. Should ground conditions or obstructions beyond the end of the runway warrant it, retraction of the landing gear may be essential to prevent crew injury or more serious airplane damage. Refer to LANDING GEAR SYSTEM EMERGENCY OPERATION, this Section, for procedure to retract the landing gear before the airplane is airborne.

### EMERGENCY DURING TAKEOFF (CONTINUED FLIGHT IMPOSSIBLE)

If an emergency occurs soon after breaking ground at very low altitude and it is determined that continued flight is impossible, prepare for a crash landing by accomplishing the following steps upon command of the pilot.

1. POWER – AS REQUIRED. (P)  
Adjust power as necessary to maintain optimum directional control.
2. GEAR – AS REQUIRED. (CP)  
Retract or lower the landing gear as necessary, depending on terrain. The pilot must use his judgment in determining whether to extend or retract the gear, keeping in mind the landing gear will absorb a considerable amount of the initial shock.
3. WARN CREW. (CP)  
Warn the crew and cabin occupants with one long ring of the alarm bell.
4. FLUID HANDLES – PULL OUT. (CP)  
Pull both engine fluid off handles out just prior to contact.
5. BATTERY SWITCH – OFF. (FE)  
Place the battery switch to the OFF position just prior to contact.

6. Land Straight Ahead, Change Direction Only To Miss Major Obstructions.

### ENGINE FAILURE DURING TAKEOFF (CONTINUED FLIGHT POSSIBLE)

If continued takeoff is elected after engine failure occurs, maximum power and directional control must be maintained. The following items will be accomplished upon command of the pilot:

- a. Landing gear lever — UP (after takeoff). (CP)
- b. Flaps — As required for weight and speed. (FE)  
Leave wing flaps at takeoff setting. Hold takeoff speed until obstacles have been cleared. Then, using flap management, increase airspeed to 1.2 stall speed minimum for clean configuration while retracting wing flaps approximately 1° for every knot increase in airspeed.
- c. Shut down engine — Accomplish steps under ENGINE FAILURE INFLIGHT, this section, with exception of Step 1 if propeller has automatically feathered.

#### Note

The autofeather switch will normally be ON for takeoff and the propeller of the failed engine will automatically feather. This will be indicated when the red light in the propeller manual feathering button for the failed engine comes on, and approximately two seconds later the feathering button automatically moves into the feathering position. The red light in the manual feathering button for the failed engine will stay on until the propeller is feathered and the button pops out. The green autofeather indicator on the pedestal will go out at the completion of the autofeather cycle.

### WARNING

The autofeather system will operate only when power loss is the emergency condition encountered. The autofeather system does not protect nor operate when the emergency is an overspeeding propeller, engine fire, etc.

### CAUTION

Observe the dc loadmeters for indications when the pump motor starts and stops. If the pump does not stop when the propeller feathers and the feather button does not return automatically to the NORMAL position, pull the button out to the NORMAL position to stop the cycle and prevent damage to the pump and motor.

## INFLIGHT

### SINGLE ENGINE OPERATION

During single-engine operation, added attention must be given to single-engine emergency operating procedures in order to minimize the possibility of compounding an emergency. The pilot should continue to direct his primary attention to flying the airplane. The copilot, assisted by the other crew members, should actually perform the necessary emergency procedures, when ordered to do so by the pilot. It is important to remember the information outlined in the following paragraphs.

#### Performance

Pilots must be continually aware that single-engine absolute and service ceilings, as well as single-engine go-around capabilities, are significantly reduced under high ambient temperature conditions. The performance reduction is of particular concern when operating over, or from, high ground elevations.

#### Maintaining Controlled Flight

Maintaining control of the airplane, including required drag reduction, during all emergency procedures is axiomatic to all airplane flight operations and is vital during single-engine maneuvers at low altitudes. Gear retraction on go-around, one engine inoperative, is a normal requirement and is imperative while operating at above standard temperatures or at high ground elevations. Flap management is also important to drag reduction and must receive proper consideration.

#### Reduction of Electrical Load

Reduction of the electrical load to minimize the possibility of failure of the remaining generator during single-engine operations, must not be overlooked. Reduction of the load prior to engine shutdown during practice maneuvers is a major safety precautionary measure. Electrical loads should be reduced to less than the normal rated capacity of the remaining generator before engine power adjustments for practice engine shutdown are made.

#### Electrical Power Loss

Complete loss of dc power as a result of failed or nonoperating generators can be a contributing factor in compounding an emergency. Pilots must be familiar with the airplane systems and instruments so that, under the stress of an emergency, erroneous or unreliable indications from monitoring instruments will not result in pilot actions which compound the emergency. It is to be particularly noted that the landing gear position indicators are unreliable in the event of dc power loss.

#### Landing

During landings with one engine inoperative, the gear and flaps should not be extended until the final stages of the approach; however, the exact point for gear extension must be left to the discretion of the pilot and will be based upon airplane and flight conditions.

**MINIMUM AIRSPEED FOR WING FLAP SETTINGS**

(WINGS LEVEL)	WING FLAP SETTINGS				
	24°	20°	12°	6°	0°
TAKE - OFF WEIGHT IN POUNDS	AIRSPEED KNOTS IAS				
34,000	103	103	103	107	112
35,000	103	103	105	108	113
36,000	103	103	106	110	115
37,000	103	103	107	111	116
38,000	103	104	109	113	117
39,000	103	105	110	114	119
40,000	104	106	111	116	121
41,000	105	108	112	117	122
42,000	107	109	114	118	123
43,000	108	110	115	120	125
44,000	109	111	116	121	126
45,000	110	112	117	122	127
46,000	112	114	119	124	129

# SINGLE ENGINE

**WARNING**

RETRACT FLAPS AS FAST AS ACCELERATION WILL PERMIT BUT TO NO LESS A SETTING THAN GIVEN ABOVE FOR ANY AIRSPEED-GROSS WEIGHT COMBINATION. SERIOUS LOSS OF ALTITUDE MAY RESULT.

C-45257-1

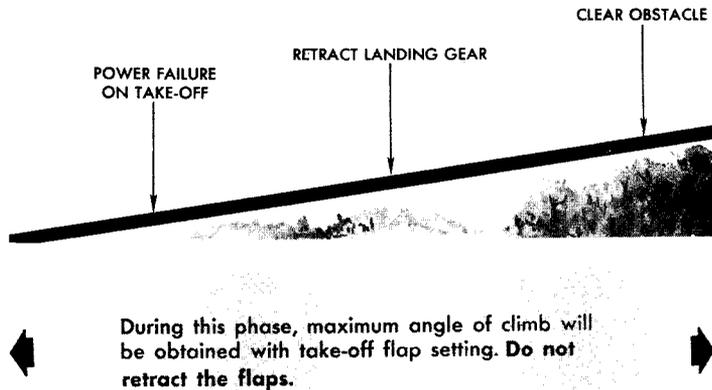


Figure 3-1

**Flight Characteristics Under Single-Engine Operation**

During low-speed single-engine flight, keep the wing on the inoperative engine side approximately 3° high, using a minimum amount of rudder. For single-engine climb out/go around, it is absolutely essential that proper flap management be used while maintaining airspeed at or above 1.2 stall speed for the flap setting. This will prevent entering the pre-stall buffet area.

**WARNING**

A stall warning in the form of buffeting will occur if airspeed is allowed to get too low. If a turn is entered, increase air speed in proportion to the angle of bank to compensate for loss of lift. Rate of climb will be severely reduced while flying in the buffet range.

A climb speed of 1.2 stall speed will result in the best angle of climb gradient. Single-engine climb speeds in excess of 1.2 stall speed will reduce the angle of climb gradient and should be avoided when obstacle clearance is critical.

**Directional Stability**

Because of high directional stability it may be difficult to determine immediately which engine has failed. To avoid confusion, observe the torque pressure gages and fuel flowmeters rather than depend entirely on the feel of the airplane.

**ENGINE FAILURE**

Maintain controlled flight. Hold the airplane straight and level, terrain permitting, and determine which engine has failed by observing the torquemeter and fuel flowmeters.

**Engine Shutdown**

1. PROPELLER — FEATHER. (CP)