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FLIGHT MANUAL

USAF SERIES C-47, A, B, D, HC-47, C-117A, B, C
NAVY MODELS R4D-1, C-47H, C-47J,
TC-47K AIRCRAFT



MODELS REDESIGNATED IN ACCORDANCE WITH
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SEE WEEKLY INDEX, T. O. 0-1-1A,
FOR CURRENT STATUS OF SAFETY
OF FLIGHT SUPPLEMENT.

COMMANDERS ARE RESPONSIBLE FOR BRINGING THIS
TECHNICAL PUBLICATION TO THE ATTENTION OF ALL
AIR FORCE PERSONNEL CLEARED FOR OPERATION OF
AFFECTED AIRCRAFT



PUBLISHED UNDER AUTHORITY OF THE SECRETARY OF THE AIR FORCE
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15 MARCH 1963

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<i>Page No.</i>	<i>Issue</i>	<i>Page No.</i>	<i>Issue</i>
Title	Original	9-1 thru 9-8	Original
A	Original	A1-1	Original
i thru iv	Original	A1-2 Blank	Original
1-1 thru 1-45	Original	A1-3 thru A1-17	Original
1-46 Blank	Original	A1-18 Blank	Original
2-1 thru 2-19	Original	A2-1 thru A2-20	Original
2-20 Blank	Original	A3-1 thru A3-19	Original
3-1 thru 3-30	Original	A3-20 Blank	Original
4-1 thru 4-41	Original	A4-1 thru A4-43	Original
4-42 Blank	Original	A4-44 Blank	Original
5-1 thru 5-8	Original	A5-1 thru A5-22	Original
6-1 thru 6-2	Original	A6-1 thru A6-11	Original
7-1 thru 7-11	Original	A6-12 Blank	Original
7-12 Blank	Original	A7-1 thru A7-5	Original
8-1 thru 8-7	Original	A7-6 Blank	Original
8-8 Blank	Original	X-1 thru X-11	Original
		X-12 Blank	Original

CURRENT FLIGHT CREW CHECKLISTS

T. O. IC-47-CL-1-1	-	15 March 1963
T. O. IC-47-CL-1-2	-	15 March 1963
T. O. IC-47-CL-1-3	-	15 March 1963
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**TABLE OF CONTENTS**

	<i>Page</i>
	<i>Introduction</i> <i>1</i>
SECTION I	<i>Description</i> <i>1-1</i>
SECTION II	<i>Normal Procedures</i> <i>2-1</i>
SECTION III	<i>Emergency Procedures</i> <i>3-1</i>
SECTION IV	<i>Description and Operation of Auxiliary Equipment</i> <i>4-1</i>
SECTION V	<i>Operating Limitations</i> <i>5-1</i>
SECTION VI	<i>Flight Characteristics</i> <i>6-1</i>
SECTION VII	<i>Systems Operation</i> <i>7-1</i>
SECTION VIII	<i>Crew Duties</i> <i>8-1</i>
SECTION IX	<i>All-Weather Operation</i> <i>9-1</i>
APPENDIX	<i>Performance Data</i> <i>A-1</i>
INDEX	<i>Alphabetical Index</i> <i>X-1</i>

INTRODUCTION

SCOPE. This manual contains the necessary instructions for safe and efficient operation of the C-47, C-117 and R4D. These instructions provide you with a general knowledge of the airplane, its characteristics, and specific and emergency operating procedures. Your flying experience is recognized, and therefore, basic flight principles are avoided.

SOUND JUDGEMENT. Instructions in this manual are for a crew inexperienced in the operation of this airplane. 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, etc., may require modification of the procedures.

PERMISSIBLE OPERATIONS. The Flight Manual takes a "positive approach" and normally states only what you can do. Unusual operations or configurations (such as asymmetrical loading) are prohibited unless specifically covered herein. Clearance must be obtained from Service Engineering Division (WRNEO), Warner Robins Air Material Area, Robins Air Force Base, Georgia, before any questionable operation is attempted which is not specifically permitted in this manual.

STANDARDIZATION AND ARRANGEMENT. Standardization assures that the scope and arrangement of all flight manuals are identical. The manual is divided into ten fairly independent sections to simplify reading it straight through or using it as a reference manual. The first three sections must be read thoroughly and fully understood before attempting to fly the airplane. The remaining sections provide important information for safe and efficient mission accomplishment.

SAFETY OF FLIGHT SUPPLEMENTS. Information involving safety will be promptly forwarded to you by Safety of Flight Supplements. Supplements covering loss of life will get to you in 48 hours by T W X, and those concerning serious damage to equipment within 10 days by mail. The current status of each Safety of Flight Supplement affecting your airplane can be determined by referring to the Weekly Index of Safety of Flight Supplements (T. O. 0-1-1A). The title page of the Flight Manual and the title block of each Safety of Flight Supplement should also be checked to determine the effect they may have on existing supplements. You must remain constantly aware of the status of all supplements -

current supplements must be complied with, but there is no point in restricting your operation by complying with a replaced or rescinded supplement.

CHECKLIST. The Flight Manual contains only amplified checklists. Abbreviated checklists have been issued as separate technical orders - see the back of the title page for T. O. numbers and date of your latest checklist. Line items in the Flight Manual and checklists are identical with respect to arrangement and item number. Whenever a Safety of Flight Supplement affects the abbreviated checklist, write in the applicable change on the affected checklist page. As soon as possible, a new checklist page, incorporating the supplement will be issued. This will keep hand-written entries of Safety of Flight Supplement information in your checklist to a minimum.

HOW TO GET PERSONAL COPIES. Each flight crew member is entitled to personal copies of the Flight Manual, Safety of Flight 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. 0-3-1). 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.

FLIGHT MANUAL AND CHECKLIST BINDERS. Loose leaf binders and sectionalized tabs are available for use with your manual. These are obtained through local purchase procedures and are listed in the Federal Supply Schedule (FSC Group 75, Office Supplies, Part 1). Binders are also available for carrying your abbreviated checklist. These binders contain plastic envelopes into which individual checklist pages are inserted. They are available in three capacities and are obtained through normal Air Force supply under the following stock list numbers: 7510-766-4268, -4269, and -4270 for 15, 25, and 40 envelope binders respectively. Check with your supply personnel for assistance in securing these items.

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.

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 test 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 welcomed. These should be forwarded through your Command Headquarters, in accordance with T. O.

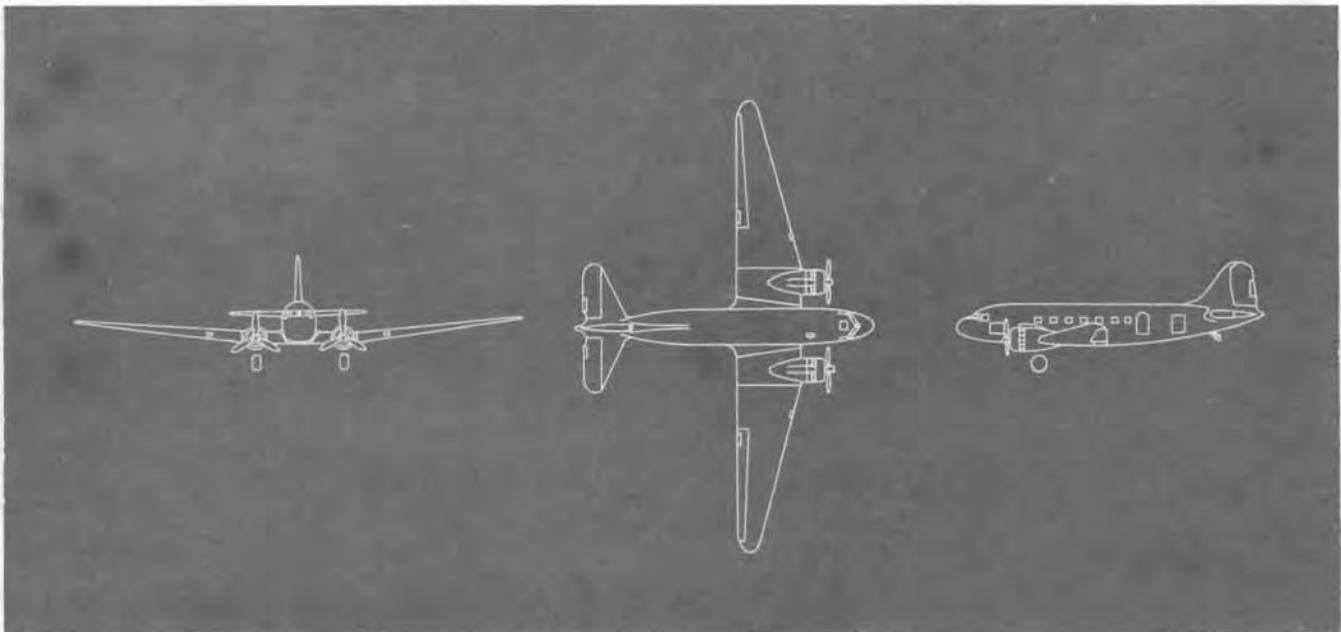
00-5-1, to Warner Robins Air Material Area (WRNEO, Robins Air Force Base, Georgia.

AIRCRAFT SERIES DESIGNATION. The C-47, C-47A, C-47B, C-47D and SC-47 aircraft will be referred to in this manual as C-47 SERIES AIRCRAFT, and the C-117A, C-117B, and C-117C Aircraft will be referred to as C-117 SERIES AIRCRAFT. The R4D-1, R4D-5, R4D-6, and R4D-7 aircraft will be designated as R4D SERIES AIRCRAFT. Information common to all series will not carry a designation, except differences which are common to specific aircraft.

NOTE

Aircraft with the R-1830-92 engine installed were designated C-47, C-47A, SC-47, R4D-1, or R4D-5. Aircraft with the R-1830-90C engine installed were designated C-47B, C-117A, or R4D-6. Aircraft with the R-1830-90D engine installed were designated C-47D, C-117B, or R4D-7. The SC-47 is a C-47 modified for long range missions. Coverage of the VC-47 (personnel transport) aircraft in this manual, as a result of varied modifications, will consist only of installations that are common to the C-47 SERIES AIRCRAFT.

The Aircraft



SECTION I DESCRIPTION

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TABLE OF CONTENTS

The Aircraft.....	1-1
Engine.....	1-3
Propellers.....	1-14
JATO System (if Installed).....	1-18
Oil System.....	1-18
Fuel System.....	1-18
Electrical Power Supply System.....	1-24
Hydraulic Power Supply System.....	1-25
Flight Control System.....	1-33
Wing Flaps.....	1-37
Landing Gear System.....	1-37
Skis (if Installed).....	1-40
Brake System.....	1-40
Instruments.....	1-41
Emergency Equipment.....	1-41
Pilots' Seats.....	1-44
Auxiliary Equipment.....	1-44

THE AIRCRAFT.

The C-47, C-47A, C-47B, C-47D, SC-47, C-117A, C-117B, C-117C, R4D-1, R4D-5, R4D-6, and R4D-7 aircraft, manufactured by the Douglas Aircraft Company, Inc., are twin-engine, low-wing monoplanes, equipped with a retractable main landing gear. The C-47 series and R4D series aircraft are designed for use as cargo, ambulance or troop transports, while the C-117 series aircraft are personnel transports. The SC-47 is a C-47 series aircraft modified by Land Air, Cheyenne, Wyoming, for long range missions. Some aircraft have provisions for carrying propellers and releasable parachute packs on the underside of the fuselage.

MAIN DIFFERENCES TABLE.

The main differences table shows both the C-47 and C-117 series aircraft for cumulative comparison.

AIRCRAFT DIMENSIONS.

The principal dimensions of the aircraft are:

Span	95 feet
Length	64 feet 5½ inches
Height	16 feet 11 inches

AIRCRAFT GROSS WEIGHT

The design gross weight is 26,000 pounds; however, the maximum permissible weight of the aircraft can vary within broad limits, depending on certain weight controlling criteria. For more detailed weight information, see Operational Weight Limitations, Section V.

INTERIOR ARRANGEMENT.

The C-47 series and R4D series aircraft are designed to carry various loads. Folding benches for 27 or 28

MAIN DIFFERENCES TABLE

ITEM	C-47, C-47A	C-47B, C-47D	SC-47	C-117A, C-117B	R4D-1, R4D-5	R4D-6	R4D-7
ENGINE	R-1830-92	R-1830-90C, C-47B R-1830-90D, C-47D	R-1830-90D	R-1830-90C, C-117A R-1830-90D, C-117B	R-1830-92	R-1830-90C	R-1830-90D
ASTRODOME	YES	SOME	YES	NO			
CARGO DOORS	YES	SOME	YES	NO			
AIRLINER SEATS	NO	SOME	NO	YES			
MAIN CABIN EMERGENCY EXIT	2	2	2	3			
CARGO SPACE HEATER	NO	NO	SOME	NO			
APP	SOME	SOME	SOME	SOME			
BUFFET	NO	NO	NO	YES			
NAVIGATOR'S STATION	YES	YES	YES	NO			
FUEL TANKS	4	4	8	4			
SKIS	SOME	SOME	SOME	NO			
ALARM AND WARNING SYSTEM	YES	YES	YES	NO			
STEWARD'S SEAT	NO	NO	NO	YES			
PARA PACK PROVISIONS	YES	YES	YES	NO			
PARATROOP PROVISIONS	YES	YES	YES	NO			
JATO	YES	YES	YES	NO			

passengers are installed along both sides of the main cabin compartment. When used as an ambulance transport, 15 to 24 litters (depending on litter arrangement) can be installed. Loading provisions permit transport of a variety of cargo (figure 1-1).

On C-117 series aircraft, the main cabin is equipped with 21 adjustable reclining passenger seats and one folding seat for the flight steward. The passenger seats are arranged in seven rows of three seats each, with double seats on the left side of the aisle and single seats on the right. A buffet is installed at the rear of the main cabin on the left side just aft of the passenger entrance door and a lavatory compartment is located aft of the main cabin (figure 1-1).

FLIGHT CREW (C-47 AND R4D SERIES AIRCRAFT)

Accommodations are provided for a crew of five: pilot, co-pilot, radio operator, loadmaster, navigator, and flight mechanic (figure 1-1).

FLIGHT CREW (C-117 SERIES AIRCRAFT).

Accommodations are provided for a crew of four: pilot, co-pilot, radio operator, and steward (figure 1-1). A folding seat is also provided on some aircraft, aft of and between the pilot and co-pilot, for a flight examiner.

ENGINE.

The aircraft is powered by a two 14-cylinder, twin-row, radial, air cooled Pratt and Whitney R-1830-90C, R-1830-90D, or R-1830-92 engines. The R-1830-90D or R-1830-92 engine incorporates a single speed integral supercharger, and the R-1830-90C engine incorporates a single-stage 2-speed integral supercharger. On some aircraft, with the R-1830-90C engine installed, the high blower has been made inoperative. An injection type carburetor and a direct-cranking starter, or a combination electric-inertia, direct cranking starter is installed.

MAGNETIC CHIP DETECTOR (R4D SERIES AIRCRAFT).

A magnetic chip detector system, for the engine main oil sump plug, is provided to warn of internal engine failure. The magnetic chip detector warning lights are mounted on the right side of the main instrument panel. 28-volt dc power is supplied through circuit breakers on the radio circuit breaker panel.

SUPERCHARGERS.

On aircraft with the R-1830-90D or R-1830-92 engine installed, and integral single-speed supercharger with an impeller gear ratio of 7.15 to 1, is provided. On aircraft with the R-1830-90C engine installed, a

single-stage, 2-speed supercharger with a low blower ratio of 7.15 to 1 and a high blower ratio of 8.47 to 1, is provided. The high gear ratio allows the engine to maintain higher power at greater altitudes than would be possible with only the low ratio. On some aircraft, the high blower has been made inoperative.

Supercharger Handle (Some Aircraft).

On some aircraft with the R-1830-90C engine installed, a 2-position supercharger handle, mechanically connected to a hydraulic control valve, is located below the side window, to the left of the pilot's seat (1, figure 1-2 and 4, figure 1-8). The handle has the following positions: LOW BLOWER and HI BLOWER. When the handle is moved to the HI BLOWER position, hydraulic fluid pressure from the main hydraulic system actuates a small hydraulic cylinder located on the rear crankcase of each engine. The actuating cylinder positions an engine oil selector valve, which directs engine oil under pressure to the high blower clutch to shift the clutch into the high ratio position. When the handle is moved to the LOW BLOWER position, the hydraulic fluid pressure actuates the hydraulic cylinders, moving the engine oil selector valves to direct engine oil under pressure to shift the low blower clutches into the low ratio position.

High Blower Indicator Lights (Some Aircraft).

Two 28-volt d-c high blower indicator lights are located immediately forward of the supercharger control valve handle (2 and 3, figure 1-2). These push-to-test lights, placarded L.H. MOTOR and R.H. MOTOR, will illuminate when the supercharger control valve handle is placed in the HI BLOWER position and the hydraulic actuating cylinder positions the engine oil selector valve into high blower. Failure of one or both of these lights to illuminate when the control valve handles are in the HI BLOWER position, is an indication that the supercharger control hydraulic system is not functioning properly.

THROTTLE LEVERS AND FRICTION LOCK.

Two throttle levers, mounted on the control pedestal (3, figure 1-10), are connected by a cable system to the throttle control on each carburetor. The throttles are mechanically operated and equipped with a friction-type lock to prevent creeping of the controls (6, figure 1-10). The placarded throttle positions are CLOSE and OPEN. The throttle range between these positions is used for the desired power setting.

MIXTURE CONTROL LEVERS AND THUMB LATCH LOCK.

Two mixture control levers, mounted on the upper right side of the control pedestal (4, figure 1-10) are

GENERAL ARRANGEMENT DIAGRAM TYPICAL

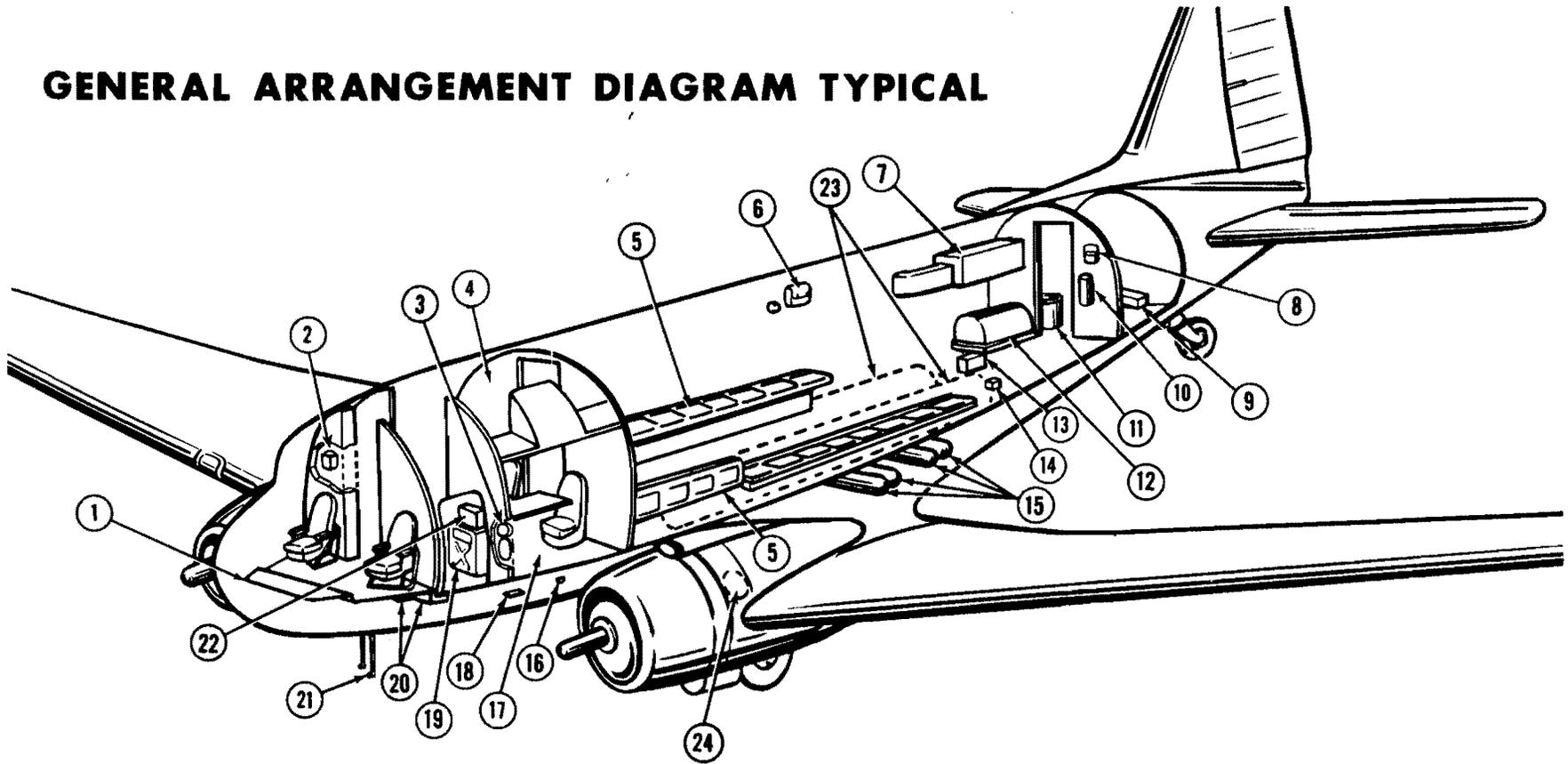
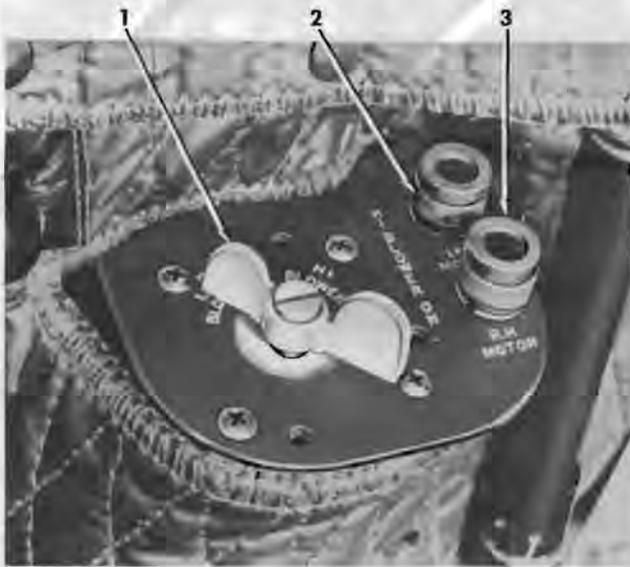


Figure 1-1

- | | |
|-----------------------------------|--------------------------------------|
| 1. PILOTS COMPARTMENT | 13. PARAPACK CONTROL JUNCTION BOX |
| 2. HYDRAULIC PRESSURE ACCUMULATOR | 14. LOW PRES. SYS. OXY. FILLER VALVE |
| 3. PORTABLE OXYGEN CYL. | 15. LOW PRES. SYS. OXY. TANKS |
| 4. RADIO OPERATORS COMP. | 16. ALTERNATE STATIC SOURCE |
| 5. FOLDING TROOP SEATS | 17. NAVIGATORS COMPARTMENT |
| 6. LITTER HANGER | 18. EXTERNAL POWER RECEPTACLE |
| 7. SPACE HEATER | 19. MAIN ELECTRICAL JUNCTION BOX |
| 8. MISC. STOWAGE | 20. BATTERIES |
| 9. ENG. COVER STOWAGE | 21. PITOT STATIC TUBE |
| 10. SURFACE CONTROL LOCKS STOWED | 22. POWER SYSTEMS JUNCTION BOX |
| 11. TOILET | 23. L.R. FUEL TANKS |
| 12. A.P.P. | 24. C.B. CONTAINER |



SUPERCHARGER HANDLE AND HIGH BLOWER INDICATOR LIGHTS



1. SUPERCHARGER HANDLE
2. HIGH BLOWER INDICATOR LIGHTS (LH)
3. HIGH BLOWER INDICATOR LIGHTS (RH)

Figure 1-2

connected by a cable system to the mixture control on each carburetor. The mixture control levers have the following positions: IDLE CUT-OFF, AUTO-LEAN, and AUTO-RICH. The IDLE CUT-OFF position cuts off all fuel flow to the engine, except for priming. The AUTO-LEAN position automatically provides the fuel air ratio required for cruise operation with normal cylinder head temperature. The AUTO-RICH position provides a richer fuel-air ratio for the higher power settings. Each mixture control lever is equipped with a thumb-latch lock which mechanically releases the lever when depressed.

CARBURETOR AIR SYSTEMS.

One of three types of carburetor air induction systems is installed in the aircraft: ram, ram-filtered, or ram-nonram filtered.

RAM-TYPE CARBURETOR AIR SYSTEM.

The ram-type carburetor air system (figure 1-3) provides two ways of supplying air to the carburetor. A small duct, located on the top forward edge of the engine accessory cowling, routes cold ram air directly to the carburetor throat, or, ram air flows

inside the cowling past the exhaust collector ring and is preheated prior to entering the carburetor throat. The source of air supply is determined by the position of the carburetor air preheat door in the carburetor air intake throat.

Carburetor Air Control Levers and Friction Lock Lever.

Two carburetor air control levers, one for each engine, mounted on the right side of the control pedestal (4, figure 1-10), mechanically control the movement of their respective preheat door in the carburetor air intake throat. The control levers have HOT and COLD placarded positions. In the HOT position, the carburetor air preheat door shuts off the ram air flow to allow the preheated air to flow from inside the cowling past the exhaust collector ring and into the carburetor. In the COLD position, the preheat door shuts off the preheated air flow and allows ram air to flow from the scoop to the carburetor (figure 1-3). Intermediate positions are used to regulate the carburetor air temperature as required. A friction-type lock lever is installed adjacent to the carburetor air preheat control levers for locking them in any desired position.

RAM FILTERED-TYPE CARBURETOR AIR SYSTEM.

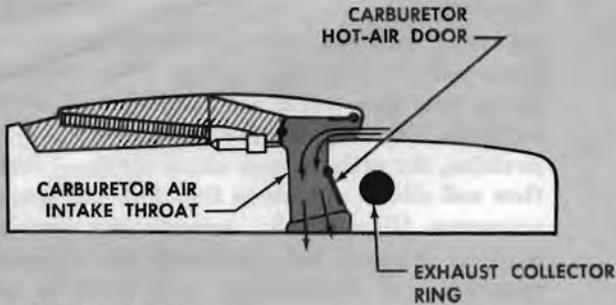
The ram filtered-type carburetor air system (figure 1-3) provides two ways of supplying air to the carburetor. Cold ram air is routed through a detachable filter duct unit, mounted on top of the nacelle, and directed down into the throat of the carburetor, or ram air flows inside the cowling past the exhaust collector ring and is preheated prior to entering the carburetor throat. The source of air supply is determined by the position of the carburetor air preheat door in the carburetor air intake throat.

Carburetor Air Control Levers and Friction Lock Lever.

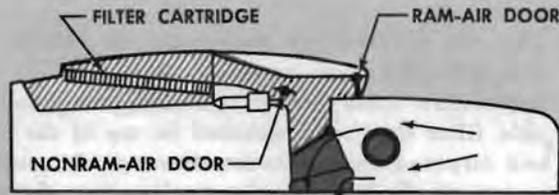
Two carburetor air control levers, one for each engine, mounted on the right side of the control pedestal (4, figure 1-10), mechanically operate the movement of their respective preheat door in the carburetor air intake throat. The control levers are placarded HOT and COLD. In the HOT position, the carburetor preheat door shuts off the ram air flow to allow the preheated air to flow from inside the cowling past the exhaust collector ring and into the carburetor. In the COLD position, the preheat door shuts off the preheated air flow and allows filtered ram air to flow from the scoop to the carburetor (figure 1-3). Intermediate positions are used to regulate the carburetor air temperature as required. A friction-type lock lever is installed adjacent to the carburetor air preheat control levers for locking them in any desired position.

CARBURETOR AIR SYSTEMS

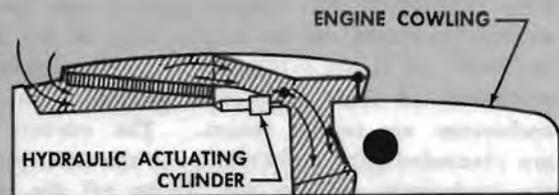
RAM-NONRAM TYPE CARBURETOR AIR SYSTEM



RAM AIRFLOW
 Nonram-air door closed. Hot-air door closed. Direct unfiltered air to carburetor.



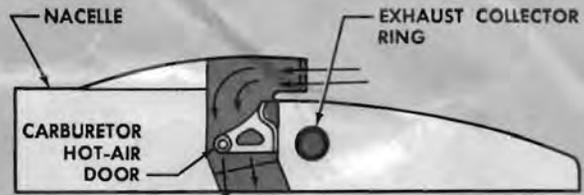
HOT AIRFLOW
 Ram-air door closed. Nonram air shut off by hot air door in open position. Hot air to carburetor.



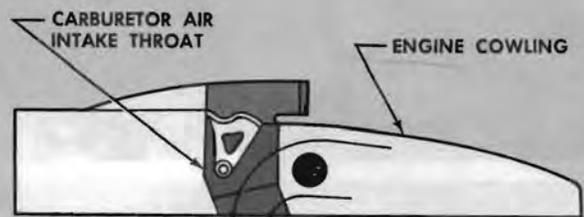
NONRAM FILTERED AIRFLOW
 Ram-air door closed. Hot-air door closed. Nonram filtered air to carburetor.

- RAM AIR
- NONRAM AIR
- HOT AIR

RAM-TYPE CARBURETOR AIR SYSTEM

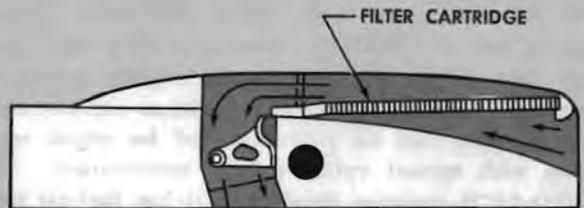


RAM AIRFLOW
 Carburetor hot-air door closed. Direct ram air to carburetor.



HOT AIRFLOW
 Carburetor hot-air door open. Ram air shut off by hot-air door in open position. Hot air to carburetor.

RAM FILTERED-TYPE CARBURETOR AIR SYSTEM



RAM FILTERED AIRFLOW
 Carburetor hot-air door closed. Direct filtered ram air to carburetor.



HOT AIRFLOW
 Carburetor hot-air door open. Filtered ram air shut off by hot-air door in open position. Hot air to carburetor.

Figure 1-3

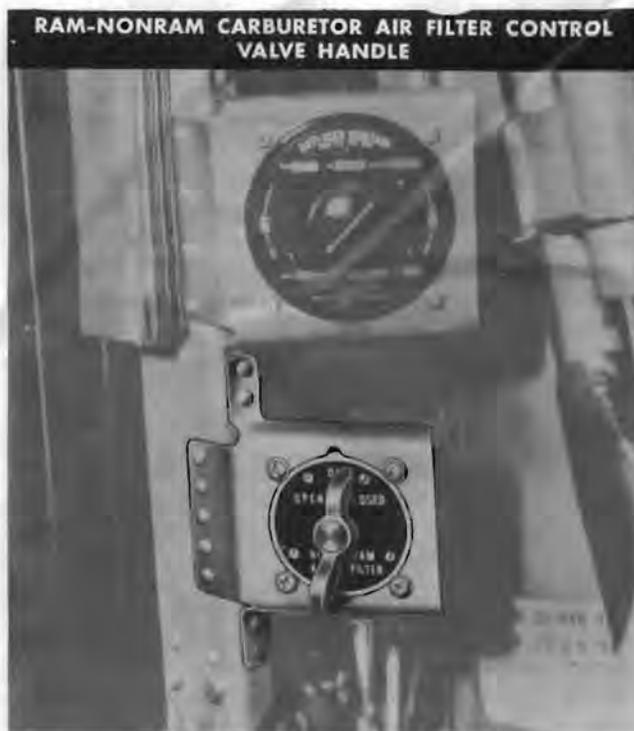


Figure 1-4

RAM-NONRAM FILTERED-TYPE CARBURETOR AIR SYSTEM.

The ram-nonram filtered-type carburetor air system (figure 1-3) provides three ways of supplying air to the carburetor. An air scoop fairing extending from the leading edge of the engine accessory cowl on top of the nacelle has two openings. Cold ram air flows through the front scoop opening directly down into the carburetor throat. Cold nonram air is drawn through the aft opening of the fairing and flows through a filter unit down into the carburetor throat. Preheated air flows from inside the engine cowl past the exhaust collector ring and into the carburetor throat. The source of air supply is determined by the position of the ram, nonram, and carburetor preheat door in the carburetor air intake throat. On some aircraft, the positioning of the induction valve door and the aft door, is controlled electrically by switches located in the cockpit. On other aircraft, the induction valve door is controlled manually by levers located in the cockpit, while the floating aft door is positioned automatically by the pressure differential within the scoop.

Carburetor Air Control Levers and Friction Lock Lever.

Two carburetor air control levers, one for each engine, mounted on the right side of the control pedestal (4, figure 1-10), mechanically control the



1. CARBURETOR AIR CONTROL FRICTION LOCK LEVER.
2. CARBURETOR AIR CONTROL LEVERS.

Figure 1-5

movement of their respective preheat door in the carburetor air intake throat. The control levers have HOT and COLD placarded positions. In the HOT position, the carburetor air preheat door shuts off the ram and nonram air flow to allow the preheated air to flow from inside the cowl, past the exhaust collector ring, and into the carburetor. In the COLD position, the preheat door shuts off the flow of preheated air and allows ram or nonram filtered air to flow from the scoop to the carburetor. Intermediate positions are used to regulate the carburetor air temperature as required. A friction-type lock lever is installed adjacent to the carburetor air preheat control levers for locking them in any desired position.

Air Filter Control Handle.

The ram-nonram carburetor air filter control handle, located on the bulkhead aft of the pilot's seat (figure 1-4), mechanically controls a hydraulic valve that directs the flow of hydraulic pressure for the operation of the ram door and the nonram door in each

carburetor airscoop. On some aircraft, this control handle has OPEN (nonram), CLOSED (ram), and OFF positions. On other aircraft, the positions are: FILTERED (nonram), UNFILTERED (ram), and LOCKED. In the OPEN or FILTERED position, the ram door shuts off the ram air flow and the nonram door is opened to allow nonram filtered air to flow to the carburetor, provided the preheat control lever is in the COLD position. In the CLOSED or UNFILTERED position, the nonram door shuts off the nonram filtered air flow and the ram door is opened to permit ram air to flow to the carburetor, provided the preheat control lever is in the COLD position (figure 1-3). When the air filter control handle is placed in a desired position, sufficient time must be allowed for hydraulic actuation before the air filter control handle is returned to OFF or LOCKED to relieve the system pressure. The doors will remain in this position until the control handle is used to select another position.

Carburetor Air Temperature Indicators.

A 28-volt d-c dual carburetor air temperature indicator, graduated in degrees centigrade from -50° to $+150^{\circ}$, is mounted on the main instrument panel (15, figure 1-11, 23, figure 1-12).

Carburetor Air Control Selector Switches (Some Aircraft).

Two rotary, 5-position carburetor air control selector switches, one for each carburetor, are located on the left side of the cockpit immediately aft of the main instrument panel. Each switch has the following positions: HOT AIR, OFF, FULL COLD, FILTER, and FULL COLD. The HOT AIR position of the switch energizes a 28-volt d-c motor which, through a cam and cable system, closes the aft (nonram) door and the induction valve (forward) door to shut off the ram air supply admitting preheated air to the carburetor (figure 1-3). The FULL COLD positions of the switch energizes the motor to close the aft (non-ram) door and the induction valve door to shut off the preheated air supply, admitting ram airflow to the carburetor. The FILTER position of the switch energizes the motor to position the induction valve door to shut off the flow of ram and preheated air, and open the aft (non-ram) door to supply filtered non-ram air to the carburetor. The OFF position opens the circuit to deenergize the motor. The electrical circuit for the motor incorporates micro and limit switches which automatically shut off the motor when the doors are properly positioned for the selected airflow.

COWL FLAPS.

Hydraulically operated cowl flaps are attached to the aft edge of the engine cowling. On aircraft with the ram or ram-nonram air induction system, the center flap of the top segment is stationary. On aircraft with the ram filtered air induction system, the three flaps in the top segment are fixed. A hydraulic actuating cylinder, installed on the lower part of the engine cowling, is connected to each movable cowl flap by a series of tie rods and operating levers. Movement of the cowl flaps is controlled by the cowl flap hydraulic controls in the cockpit.

COWL FLAP HANDLES.

Two cowl flap handles attached to the hydraulic valves are located on the side of the fuselage to the right and forward of the co-pilot's seat (14, figure 1-7 and 24, figure 1-9), and have CLOSE, OFF, TRAIL, OFF, and OPEN positions. In the CLOSE position, hydraulic fluid pressure is directed to one side of the actuating cylinder and the cowl flaps move toward the closed position. In the OPEN position, hydraulic pressure is directed to the other side of the actuating cylinder and the cowl flaps move toward the open position. In the OFF position, the hydraulic pressure is trapped in the actuating cylinder to hold the cowl flaps in any desired position. In the TRAIL position, both sides of the actuating cylinder are unpressurized, allowing the cowl flaps to move in either direction, depending on the balance of the air loads on the cowl flaps.



In any position other than OFF, system pressure may be lost if leakage occurs in the cowl flap hydraulic system.

IGNITION SYSTEM.

The ignition system consists of two magnetos, installed in the rear accessory section of each engine, which distribute the current to the spark plugs through ignition switches, wiring, and a high tension ignition harness.

Ignition Switches.

The ignition switch unit is located above the vee of the windshield (6, figure 1-6) and incorporates a master ON-OFF switch and an ignition switch for each engine. Each engine ignition switch has four positions: OFF, L, R, and BOTH. The master ON-OFF switch grounds out all four magnetos (both magnetos of each engine) when in the OFF position. The ON position leaves the control of the magnetos to each engine ignition switch. When the engine ignition switch is positioned to L, the left magneto

provides ignition for the rear spark plugs and the right magneto is grounded. When the engine ignition switch is positioned to R, the right magneto provides ignition for the front spark plugs and the left magneto is grounded. When the engine ignition switch is positioned to OFF, both magnetos for that engine are grounded and both front and rear spark plugs will not fire. When the ignition switch is in the BOTH position, both magnetos for that engine are able to generate current for the ignition system and all spark plugs can fire.

PRIMING SYSTEM.

The priming system functions as an aid in starting the engines by injecting fuel from a primer line into the upper eight cylinders.

Primer Switch (C-47 and C-117 Series Aircraft).

A 3-position, 28-volt d-c engine primer switch, mounted on the electrical control panel (15, figure 1-13), is a momentary-type switch spring loaded to the OFF position. The RIGHT (down) position of the switch energizes the right engine primer solenoid valve to direct fuel under pressure to the right engine for priming. The LEFT (up) position energizes the left engine primer solenoid valve to direct fuel under pressure to the left engine for priming. The OFF position opens the engine primer circuit. Priming fuel pressure is provided by the booster pumps (if installed) when the booster pump is ON or by manually operating the hand wobble pump (if installed).

HAND PRIMER HANDLE.

On some aircraft, a hand primer is installed on the co-pilot's side of the cockpit. The handle of the primer is turned to the left to UNLOCK, then pushed in and pulled out to pump the fuel to the engine. The handle of the primer is pushed in, then turned to the right to LOCK. The valve handle for selecting the LEFT or RIGHT engine is adjacent to the hand primer.

Oil Dilution and Primer Switches (Some Aircraft).

Two 3-position, 28-volt d-c oil dilution and primer switches, one for each engine, are mounted on the electrical control panel (20, figure 1-14). These switches are the momentary-type, spring loaded to the OFF position. When either switch is placed in the ENGINE PRIMER (down) position, the respective engine primer solenoid valve is energized to direct fuel under pressure to the engine for priming. When either switch is held in the OIL DILUTION (up) position, a 28-volt d-c circuit energizes the oil

dilution solenoid, and fuel is introduced into the engine oil inlet line for dilution of the engine oil to aid in cold weather starting. Priming fuel pressure is provided by the booster pumps (if installed) when the booster pump is ON or by manually operating the hand wobble pump (if installed).

STARTING SYSTEM.

A direct cranking or, on some aircraft, a combination inertia-direct-cranking starter with a solenoid meshing device, is mounted on each engine. The starters are operated by switches located in the cockpit.

Starter Switches (Direct Cranking).

Two 2-position starter switches, one for each engine, are mounted on the electrical control panel. The RIGHT switch engages the 28-volt d-c starter for the right engine; the LEFT switch engages the starter for the left engine.

Some aircraft are equipped with one 3-position spring-loaded switch. The down position engages the starter for the RIGHT engine; the up position engages the starter for the left engine. The switch is spring loaded to the off (center) position.

Starter Switches (Inertia-Direct Cranking).

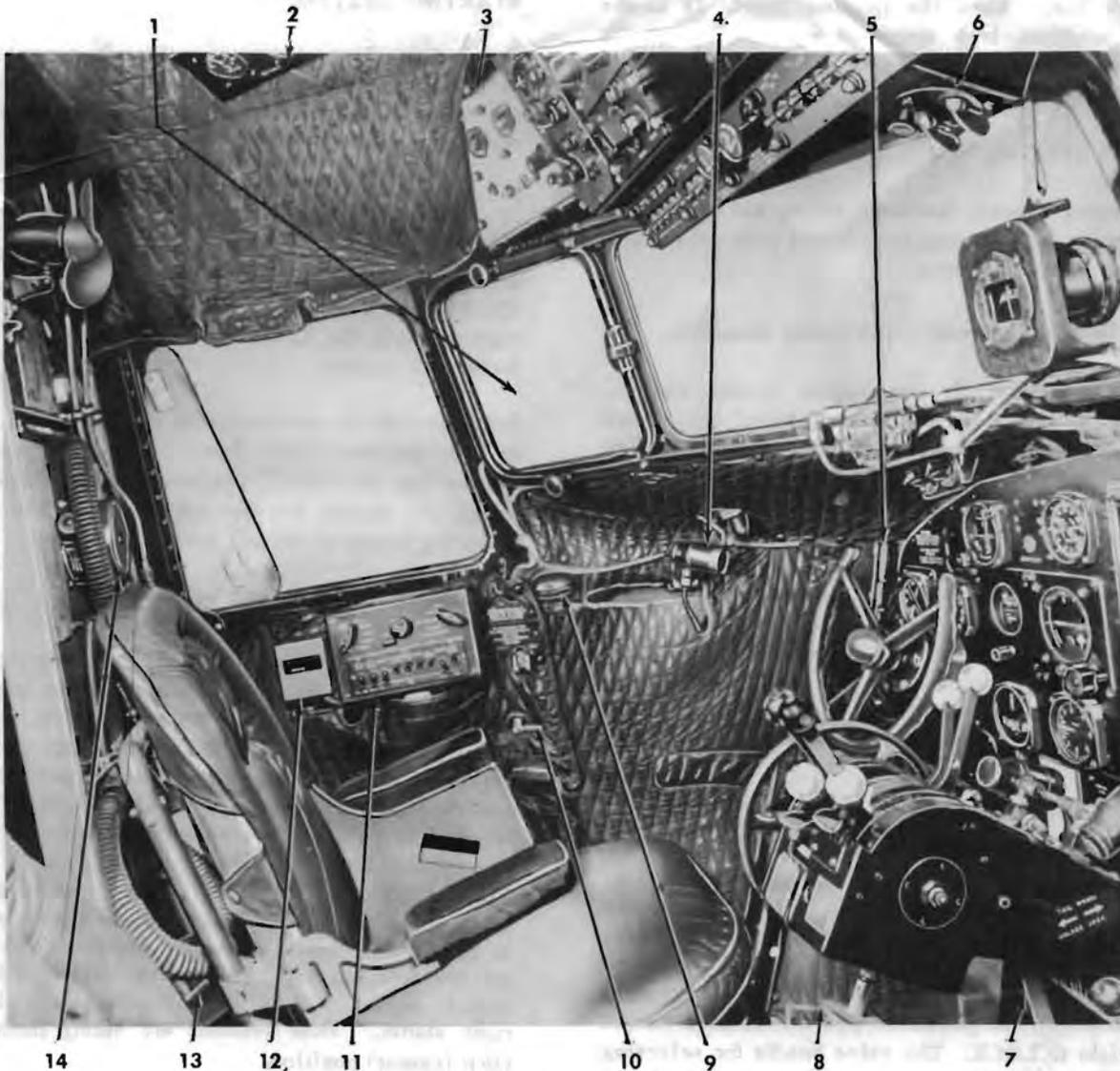
Two 3-position starter switches, one for ENERGIZE and one for MESH, are mounted on the electrical control panel (16, figure 1-13, and 17, 18, figure 1-14). The STARTER ENERGIZE switch is used to energize the 28-volt starter motor and build up sufficient inertia before the STARTER MESH switch is used to energize the solenoid meshing device to engage the starter. Placing the STARTER ENERGIZE switch in the RIGHT (down) position, energizes the starter for the right engine, and placing it in the LEFT (upper) position, energizes the starter for the left engine. Placing the STARTER MESH switch in the RIGHT (down) position meshes the right starter. Both switches are spring loaded to the OFF (center) position.

ENGINE INSTRUMENTS.

All engine instruments are dual indicating. A direct-reading manifold pressure gage on the main instrument panel indicates the pressure in inches Hg in each engine intake manifold. A 28-volt d-c carburetor air temperature indicator and a self-generated cylinder head temperature indicator (which indicates temperature for the right engine from No. 1 cylinder and for the left engine from No. 13 cylinder), all calibrated in degrees centigrade, are mounted on the main instrument panel (13, 15, figure 1-11, and 23, 27, figure 1-12). A self-generated tachometer is installed on the main instrument panel.

COCKPIT ARRANGEMENT—TYPICAL

LEFT SIDE



- 1. CLEAR VISION WINDOWS
- 2. OXYGEN PRESSURE GAGE AND FLOW INDICATOR
- 3. LEFT ELECTRICAL PANEL
- 4. FLUORESCENT INSTRUMENT PANEL LIGHT
- 5. WING FLAP POSITION INDICATOR
- 6. IGNITION SWITCHES
- 7. TAIL WHEEL LOCK LEVER

- 8. THROTTLE FRICTION LOCK
- 9. SHIELDED MAP READING LIGHT
- 10. WINDSHIELD ALCOHOL DE-ICING VALVE CONTROL HANDLE
- 11. INTERPHONE CONTROL PANEL
- 12. RADIO FILTER
- 13. PROPELLER DE-ICER RHEOSTAT SHUTOFF VALVE AND TANK
- 14. OXYGEN FLOW REGULATOR

Figure 1-6

COCKPIT ARRANGEMENT - TYPICAL

RIGHT SIDE



1. WINDSHIELD WIPER CONTROL VALVE
2. PILOT'S RADIO CONTROL PANEL
3. RIGHT ELECTRICAL PANEL
4. SPARE LIGHTS
5. OXYGEN PRESSURE GAGE AND FLOW INDICATOR
6. CARBURETOR DE-ICING CONTROL VALVE HANDLE
7. CO-PILOT'S OVERHEAD FLUORESCENT LIGHT
8. CLEAR VISION WINDOW

9. OXYGEN FLOW REGULATOR
10. RADIO FILTER
11. INTERPHONE CONTROL PANEL
12. WINDSHIELD DE-ICING CONTROL VALVE HANDLE
13. SHIELDED MAP READING LIGHT
14. COWL FLAP HANDLES
15. FLUORESCENT INSTRUMENT LIGHT
16. HYDRAULIC SYSTEM PRESSURE GAGE
17. LANDING GEAR PRESSURE GAGE

Figure 1-7

COCKPIT ARRANGEMENT—TYPICAL

LEFT SIDE R4D SERIES AIRCRAFT

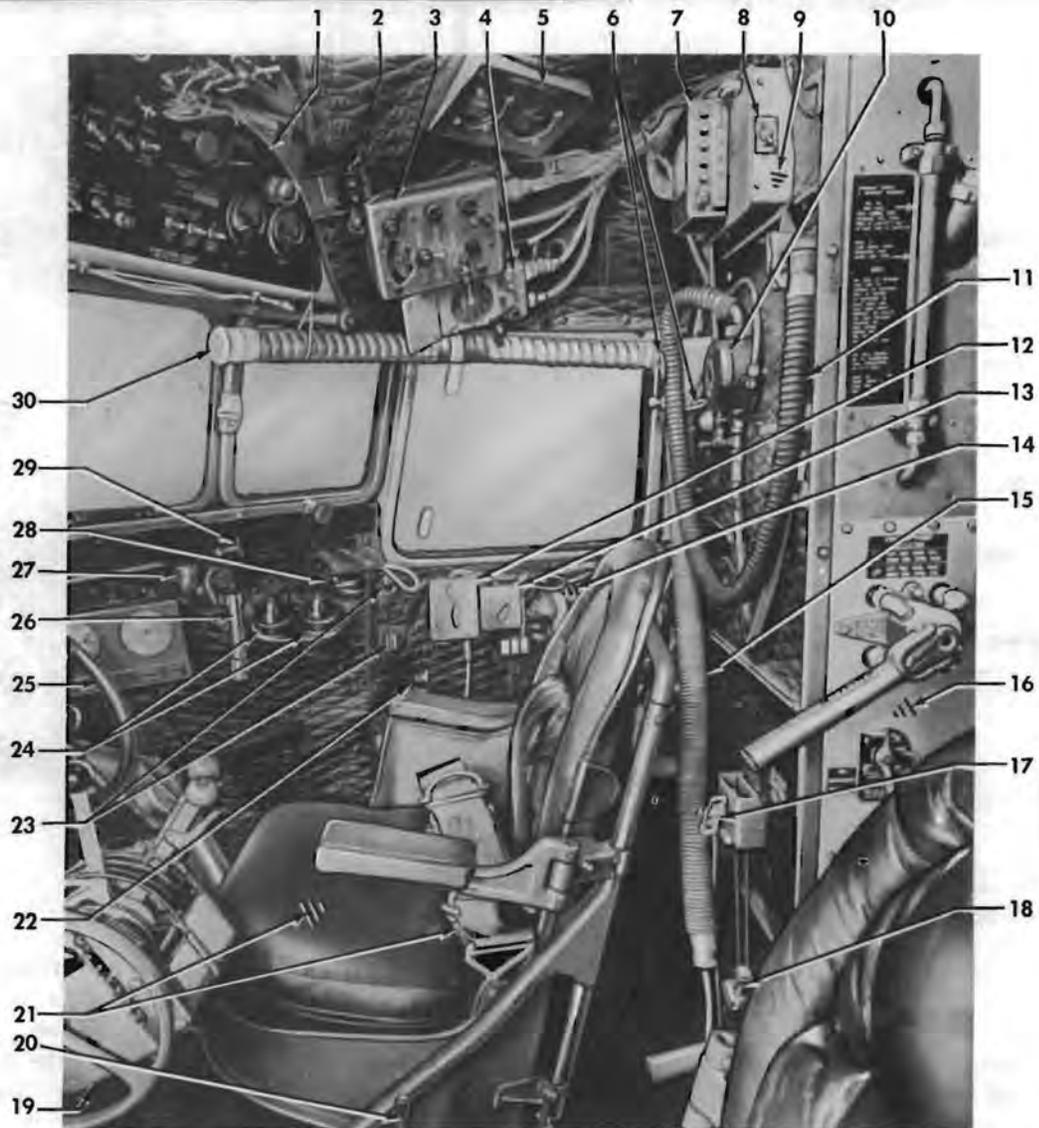


- | | | |
|---|--|--|
| 1. ELECTRICAL CONTROL PANEL | 10. CONTROL PEDESTAL | 19. FLEXIBLE HAND WARMER AND DEFROSTER HOSE |
| 2. WINDSHIELD DEFROSTER HOSE | 11. SEAT AND SAFETY BELT | 20. FUEL SYSTEM FLOW DIAGRAM |
| 3. SHIELDED LAMP | 12. FORWARD AND AFT SEAT ADJUSTING CONTROL | 21. OXYGEN REGULATOR |
| 4. SUPERCHARGER HANDLE (SOME AIRCRAFT) | 13. PROPELLER DE-ICING FLUID SUPPLY TANK | 22. WINDSHIELD DEFROSTER AND HAND WARMER CONTROL VALVE HANDLES |
| 5. WINDSHIELD WIPER OPERATING MECHANISM | 14. PROPELLER DE-ICING RHEOSTAT | 23. OXYGEN REGULATOR TO MASK HOSE |
| 6. FLUORESCENT LAMP | 15. WINDSHIELD DE-ICING CONTROL VALVE HANDLE | 24. COMMAND RECEIVER PANEL CONTROL HEAD |
| 7. CARBURETOR AIR CONTROL SELECTOR | 16. INTERPHONE JUNCTION BOX | 25. COMMAND TRANSMITTER CONTROL PANEL |
| 8. CONTROL WHEEL | 17. RADIO FILTER BOX | 26. HAND FIRE EXTINGUISHER |
| 9. PILOT'S CHECK LIST | 18. SUIT HEAT RHEOSTAT | |

Figure 1-8

COCKPIT ARRANGEMENT—TYPICAL

RIGHT SIDE R4D SERIES AIRCRAFT



- | | |
|---|---|
| 1. ELECTRICAL CONTROL PANEL | 16. HYDRAULIC CONTROL PANEL |
| 2. RADIO COMPASS SWITCH | 17. WING AND EMPENNAGE DE-ICING SYSTEM CONTROL HANDLE |
| 3. RADIO COMPASS REMOTE CONTROL UNIT | 18. COCKPIT MIXING CHAMBER CONTROL KNOB |
| 4. AZIMUTH CONTROL | 19. CONTROL PEDESTAL |
| 5. OXYGEN PRESSURE GAGE AND FLOW INDICATOR | 20. FORWARD AND AFT SEAT ADJUSTING CONTROL |
| 6. WINDSHIELD DEFROSTER AND HAND WARMER CONTROL VALVE HANDLES | 21. SEAT AND SAFETY BELT |
| 7. VHF COMMAND RADIO CONTROL PANEL | 22. WINDSHIELD DE-ICING CONTROL VALVE |
| 8. LIAISON RADIO POWER SWITCH | 23. MICROPHONE HOOK AND HOLDER |
| 9. CO-PILOT'S JUNCTION BOX | 24. COWL FLAP HANDLES |
| 10. OXYGEN REGULATOR | 25. CONTROL WHEEL |
| 11. OXYGEN REGULATOR TO MASK HOSE | 26. FLUORESCENT LAMP |
| 12. INTERPHONE JUNCTION BOX | 27. SHIELDED LAMP |
| 13. RADIO FILTER BOX | 28. SHIELDED MAP READING LAMP |
| 14. SUIT HEATER RHEOSTAT | 29. WINDSHIELD DE-ICING HAND PUMP HANDLE |
| 15. FLEXIBLE HAND WARMER HOSE | 30. WINDSHIELD DEFROSTER HOSE |

Figure 1-9

CONTROL PEDESTAL — TYPICAL

1. PROPELLER CONTROL LEVERS
2. THROTTLE LEVERS
3. MIXTURE CONTROL LEVERS
4. CARBURETOR AIR CONTROL LEVERS
5. RIGHT ENGINE FUEL TANK SELECTOR
6. THROTTLE LEVER FRICTION LOCK
7. PARKING BRAKE CONTROL KNOB
8. AILERON TRIM TAB CRANK AND INDICATOR
9. CROSS-FEED CONTROL VALVE HANDLE (SOME A MODELS)
10. AUTOPILOT CONTROL VALVE HANDLE
11. RUDDER TRIM CRANK AND INDICATOR
12. TAIL WHEEL LOCK LEVER
13. LEFT ENGINE FUEL TANK SELECTOR
14. ELEVATOR TRIM TAB WHEEL AND INDICATOR

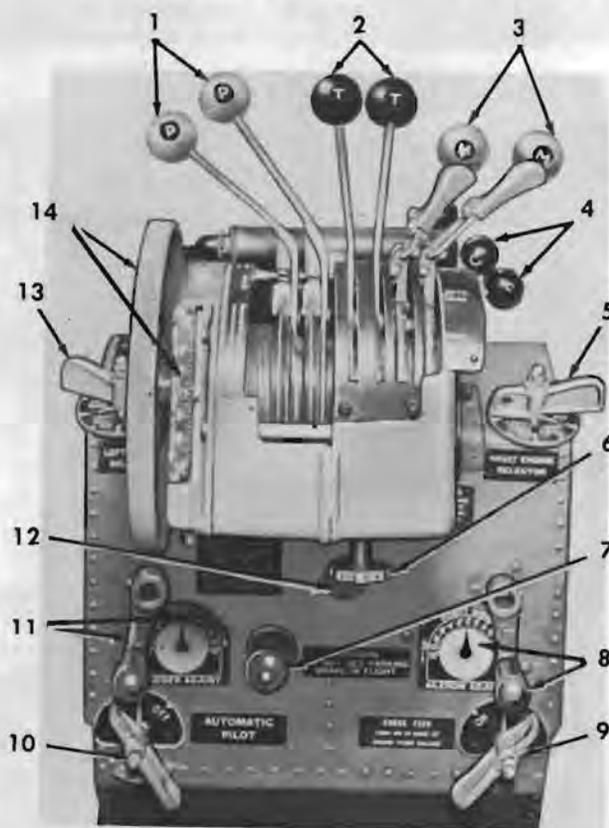


Figure 1-10

Fuel Pressure Gage.

A dual, direct-reading, hydrostatically operated, fuel pressure gage is mounted on the main instrument panel (26, figure 1-11, and 30, figure 1-12), and is calibrated in pounds per square inch. Two lines connected to the fuel pressure gage in the cockpit connect to each carburetor.

Oil Pressure Gage.

A dual, direct-reading, hydrostatically operated oil pressure gage is mounted on the main instrument panel (27, figure 1-11, and 31, figure 1-12) and is calibrated in pounds per square inch.

Oil Temperature Indicator.

A dual, 28-volt d-c oil temperature indicator, graduated in degrees centigrade, is mounted on the main instrument panel (25, figure 1-11, and 16, figure 1-12). A temperature bulb on the rear of the engine accessory case or in the oil supply pipe aft of the oil dilution fuel pipe connection furnishes remote indication to the temperature indicator of the oil entering the engine.

PROPELLERS.

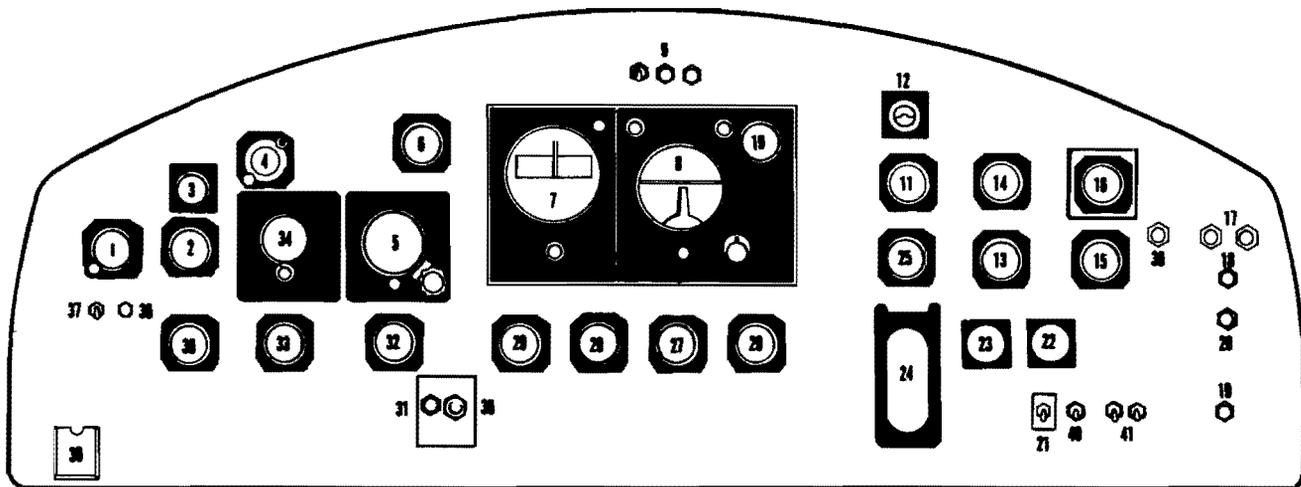
A Hamilton Standard 3-bladed, full-feathering, hydromatic propeller is provided for each engine. The propeller governor on each engine automatically maintains constant engine speed by changing the propeller blade angle through the constant speed range to compensate for changes in altitude and throttle setting. The blade angle is changed hydraulically by the flow of engine oil under pressure. The engine oil for propeller feathering is supplied from a reserve in the bottom of the oil tank, and pressure is provided by a 28-volt d-c propeller feathering pump.

PROPELLER CONTROL LEVERS.

Two propeller control levers, located on the control pedestal (1, figure 1-10), through mechanical linkage provide for adjustment of the propeller governor on the nose section of each engine. The control levers have INCREASE (high rpm) and DECREASE (low rpm) placarded positions. Intermediate positions of the levers are used to regulate rpm as desired. The governors maintain constant propeller speed, as selected by the control levers.

MAIN INSTRUMENT PANEL—TYPICAL

C-47 AND C-117 SERIES AIRCRAFT



- | | | |
|---|---|---|
| 1. FLUX GATE COMPASS REPEATER INDICATOR | 14. ALTIMETER, CO-PILOT'S | 28. MANIFOLD PRESSURE GAGE (DUAL) |
| 2. AIRSPEED INDICATOR, PILOT'S | 15. CARBURETOR AIR TEMPERATURE INDICATOR (DUAL) | 29. TACHOMETER (DUAL) |
| 3. CLOCK | 16. RADIO MAGNETIC INDICATOR (RMI) | 30. CARBON MONOXIDE WARNING LIGHT (C-117) |
| 4. COURSE INDICATOR AND MARKER BEACON LIGHT | 17. CRITICAL TEMPERATURE WARNING LIGHTS | 31. CARBON MONOXIDE RESET BUTTON (C-117) |
| 5. ATTITUDE INDICATOR | 18. LANDING GEAR INDICATOR LIGHT (RED) | 32. VERTICAL VELOCITY INDICATOR |
| 6. RADIO MAGNETIC INDICATOR (RMI) | 19. DOOR OPEN WARNING LIGHT | 33. TURN-AND-SLIP INDICATOR |
| 7. AUTOPILOT DIRECTIONAL INDICATOR | 20. LANDING GEAR INDICATOR LIGHT (GREEN) | 34. DIRECTIONAL INDICATOR |
| 8. AUTOPILOT ATTITUDE INDICATOR | 21. STATIC PRESSURE SELECTOR VALVE | 35. ALTIMETER, PILOT'S |
| 9. ENGINE FIRE DETECTION WARNING LIGHTS AND TEST SWITCH | 22. AUTOPILOT OIL PRESSURE GAGE | 36. FLUX GATE COMPASS WARNING LIGHT |
| 10. AUTOPILOT VACUUM GAGE | 23. DE-ICING SYSTEM PRESSURE GAGE | 37. FLUX GATE COMPASS CAGING SWITCH |
| 11. AIRSPEED INDICATOR, CO-PILOT'S | 24. FUEL QUANTITY INDICATOR | 38. HEAT SYSTEM WARNING LIGHT |
| 12. FREE AIR TEMPERATURE INDICATOR | 25. OIL TEMPERATURE INDICATOR (DUAL) | 39. ALTIMETER CORRECTION CARD |
| 13. CYLINDER HEAD TEMPERATURE INDICATOR (DUAL) | 26. FUEL PRESSURE GAGE (DUAL) | 40. FUEL CROSSFEED SWITCH |
| | 27. OIL PRESSURE GAGE (DUAL) | 41. FUEL DUMP SWITCHES |

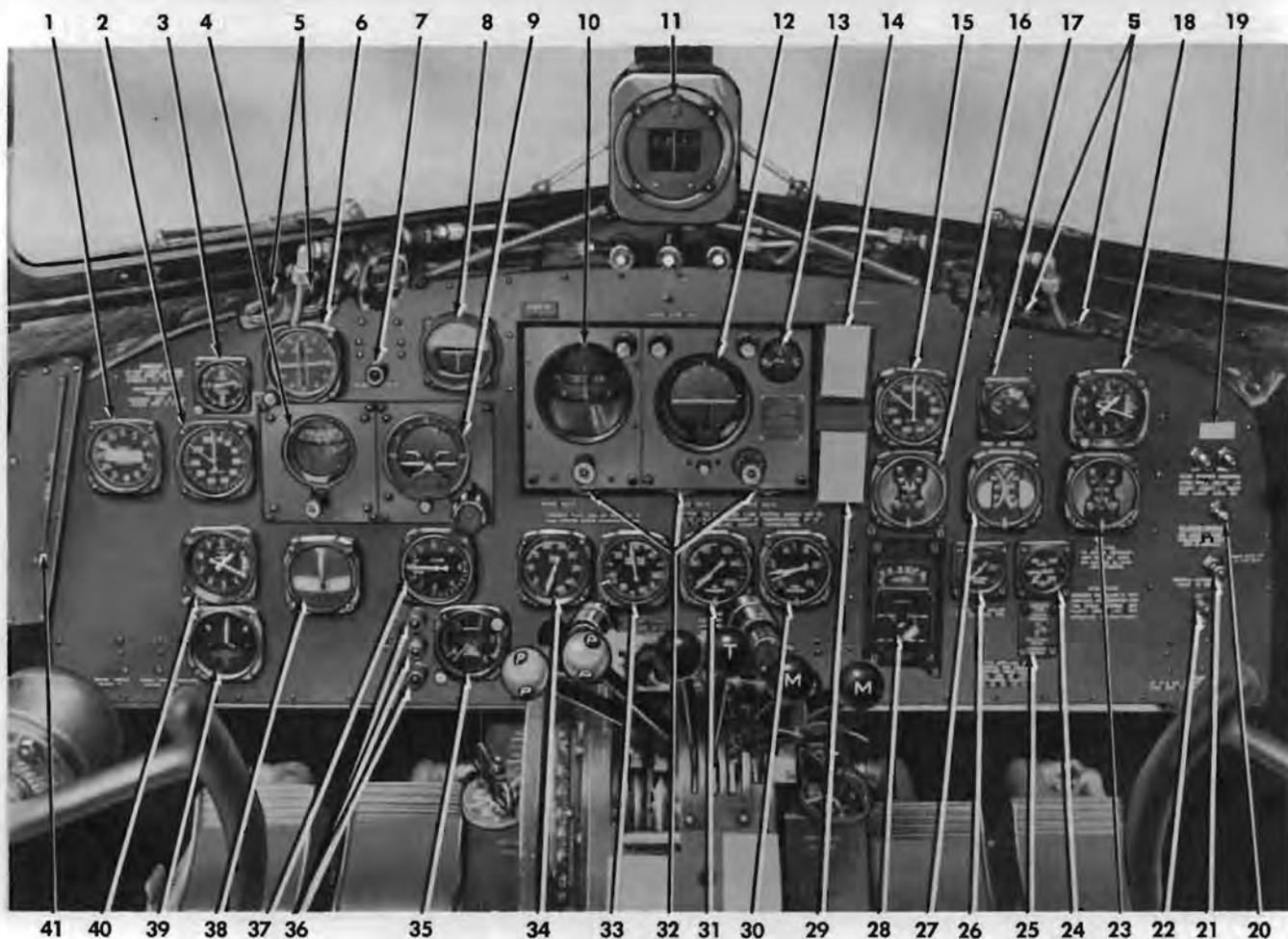
Figure 1-11**PROPELLER FEATHERING SWITCHES.**

Two pushbutton propeller feathering switches, one for each propeller system, are mounted on the electrical control panel (17, 18, figure 1-13, and 3, 9, figure 1-14). Each switch is used, in conjunction with a propeller feathering relay and a pressure limit switch, to control a feathering pump motor. When either propeller feathering switch is pushed IN to feather a propeller, a 28-volt d-c holding coil

holds the switch in. A pressure limit switch in the propeller governor releases the holding coil when the propeller is feathered, at which time the switch pops out to the normal position. The feathering operation may be interrupted by manually pulling out the feathering switch. When the propeller feathering switch is pushed IN to unfeather a propeller, it must be held in manually until the propeller has moved out of the feathered position.

MAIN INSTRUMENT PANEL—TYPICAL

R4D SERIES AIRCRAFT



- | | | |
|--------------------------------------|---|---|
| 1. RADIO MAGNETIC INDICATOR (RMI) | 18. ALTIMETER (CO-PILOT'S) | 28. FUEL QUANTITY INDICATOR |
| 2. AIRSPEED INDICATOR (PILOT'S) | 19. CRITICAL TEMPERATURE WARNING LIGHTS | 29. REMOTE COMPASS CORRECTION CARD |
| 3. CLOCK | 20. LANDING GEAR INDICATOR LIGHT (RED) | 30. FUEL PRESSURE GAGE (DUAL) |
| 4. DIRECTIONAL INDICATOR | 21. LANDING GEAR INDICATOR LIGHT (GREEN) | 31. OIL PRESSURE GAGE (DUAL) |
| 5. FLUORESCENT LIGHT SWITCHES | 22. DOOR-OPEN WARNING LIGHT | 32. AUTOPILOT SPEED CONTROL VALVE KNOBS |
| 6. REMOTE COMPASS INDICATOR | 23. CARBURETOR AIR TEMPERATURE INDICATOR (DUAL) | 33. MANIFOLD PRESSURE GAGE (DUAL) |
| 7. MARKER BEACON INDICATOR LIGHT | 24. AUTOPILOT OIL PRESSURE GAGE | 34. TACHOMETER (DUAL) |
| 8. GLIDE SLOPE AND COURSE INDICATOR | 25. STATIC PRESSURE SELECTOR VALVE SWITCH | 35. RADIO ALTIMETER |
| 9. ALTITUDE INDICATOR | 26. DE-ICING SYSTEM PRESSURE GAGE | 36. ALTITUDE LIMIT INDICATOR LIGHTS |
| 10. AUTOPILOT DIRECTIONAL INDICATOR | 27. CYLINDER HEAD TEMPERATURE INDICATOR (DUAL) | 37. VERTICAL VELOCITY INDICATOR |
| 11. MAGNETIC (STANDBY) COMPASS | | 38. TURN-AND-SLIP INDICATOR |
| 12. AUTOPILOT ATTITUDE INDICATOR | | 39. ALTITUDE LIMIT INDICATOR |
| 13. AUTOPILOT VACUUM GAGE | | 40. ALTIMETER (PILOT'S) |
| 14. COMPASS CORRECTION CARD | | 41. WING FLAP POSITION INDICATOR |
| 15. AIRSPEED INDICATOR (CO-PILOT'S) | | |
| 16. OIL TEMPERATURE INDICATOR (DUAL) | | |
| 17. FREE AIR TEMPERATURE INDICATOR | | |

Figure 1-12

ELECTRICAL CONTROL PANELS – TYPICAL

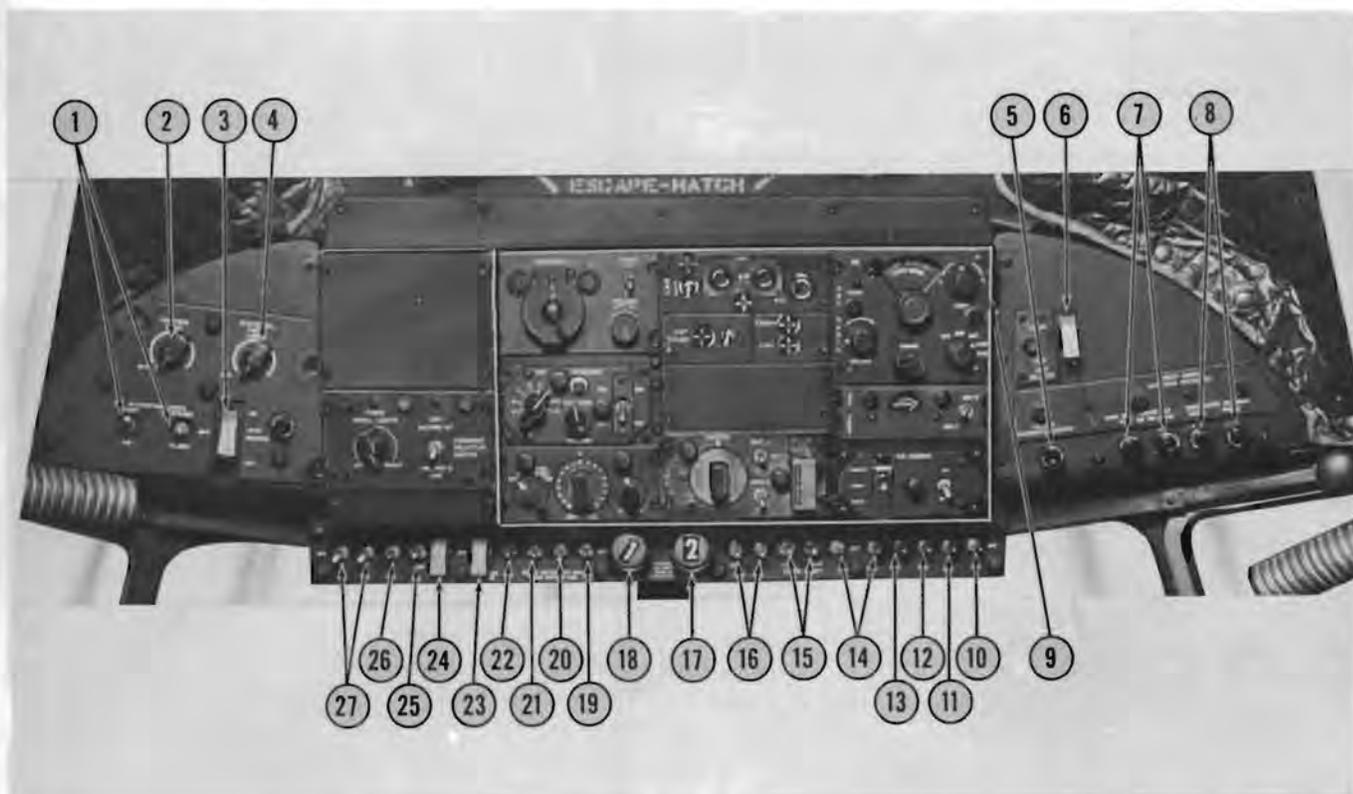


Figure 1-13

- | | |
|--|---|
| 1. NAVIGATION LIGHTS SWITCH | 15. OIL DILUTION AND ENGINE PRIMER SWITCHES |
| 2. COMPASS LIGHT RHEOSTAT | 16. STARTER SWITCHES |
| 3. JATO MASTER SWITCH | 17. RIGHT ENGINE PROP FEATHERING SWITCH |
| 4. ELECTRICAL PANEL LIGHTS RHEOSTAT | 18. LEFT ENGINE PROP FEATHERING SWITCH |
| 5. HEATER OVERHEAT WARNING LIGHT | 19. BATTERY MASTER SWITCH |
| 6. JATO RELEASE SWITCH | 20. EMERGENCY POWER SWITCH |
| 7. MAIN INVERTER FAIL WARNING LIGHT | 21. COCKPIT LIGHTS SWITCH |
| 8. GENERATOR FAILURE WARNING LIGHTS | 22. ANTI-COLLISION LIGHT SWITCH |
| 9. RADIO CONTROL PANEL | 23. PARAPACK SALVO-SWITCH |
| 10. AFT PITOT HEATER SWITCH | 24. BAILOUT WARNING SWITCH |
| 11. FORWARD PITOT HEATER SWITCH | 25. JUMP WARNING SWITCH |
| 12. PROP DEICER SWITCH | 26. PASSING LIGHTS SWITCH |
| 13. CARB. AND WINDSHIELD DEICER SWITCH | 27. LANDING LIGHTS SWITCHES |
| 14. BOOSTER PUMP SWITCHES | |

JATO SYSTEM.

Some aircraft are equipped with bomb type shackles for attaching four canted JATO units beneath the fuselage. A four bottle cradle is located in the cargo compartment to secure the units until they are needed. Igniters are stored in an ignitor box which is stowed on the floor at the aft end of the cargo compartment. The JATO system is operated from the pilots' compartment. The JATO system as installed on this aircraft permits the use of four different types of JATO bottles; the 14AS-1000, 14DS-1000 Mark IV Model 2, 14DS-1000 M-8, and 16NS-1000 M-15. These bottles are designed to give 1000 pounds of thrust for an average of 14 to 16 seconds. Temperature limits for firing are $-55^{\circ}\text{F} + 130^{\circ}\text{F}$. Expended units may be jettisoned either electrically or mechanically. The aircraft electrical firing circuit should be thoroughly inspected before departure on a mission requiring JATO. It should be determined that there is sufficient current and voltage to ignite the units and that there is no electricity in the circuit when the firing switches are off. JATO attachment fittings should also be tested before the mission to determine the proper operation of the locking mechanism. Air crew members will install and arm the JATO units when the aircraft is in take-off position. For JATO handling procedures, see Section VII.

JATO MASTER SWITCH.

The JATO MASTER switch is a guarded ON-OFF switch located on a panel to the left and above the pilot (3, figure 1-13). The switch must be placed to the ON position before the JATO can be fired.

JATO FIRING SWITCH.

The JATO FIRING SWITCH is a button type switch mounted on the wheel of the pilot's control column. The JATO is fired by depressing the button. The switch will not operate unless the JATO MASTER switch is ON.

JATO RELEASE SWITCH.

The JATO RELEASE switch is a safety - wired guarded 2-position switch (6, figure 1-13), with OUTBD and INDB decals. Expended JATO units can be jettisoned by moving the JATO release switch to the INBD position then to the OUTBD position releasing two bottles each time.

JATO MANUAL RELEASE.

In the event of a failure in the electrical system for jettisoning JATO bottles a manual system is installed in the aircraft. In the main cargo compart-

ment in the wall are two handles decalced CAUTION MANUAL JATO RELEASE OUTBD INBD. JATO bottles may be jettisoned by pulling the handles.

OIL SYSTEM.

Each engine oil system is supplied from a 29 US gallon oil tank. The tanks should be filled to only 25 US gallons to allow for expansion. (See figure 1-30 for tank location and oil grade.) Oil pressure is maintained by two engine-driven oil pumps, one on each engine. The oil from the engine returns to the tank through a free-flow-type oil cooler. The quantity of oil flowing through the cooler is automatically regulated by thermostatic control. An oil dilution system is provided for dilution of the engine oil when a cold weather start is anticipated.

OIL DILUTION SWITCH (Some Aircraft).

A 3-position, 28-volt d-c oil dilution switch is mounted on the electrical control panel (15, figure 1-13 and 20, figure 1-14) and has LEFT, RIGHT, and OFF positions. When the switch is held in the LEFT position, a 28-volt d-c circuit energizes the oil dilution solenoid and fuel is introduced into the oil of the left engine to aid in cold-weather starting. When the switch is held in the RIGHT position, engine oil is diluted for the right engine in the same manner. The switch is spring loaded to the OFF position.

OIL DILUTION AND PRIMER SWITCHES (Some Aircraft).

Refer to the paragraph on Oil Dilution and Primer Switches under Priming System, this Section.

FIREWALL SHUTOFF VALVES.

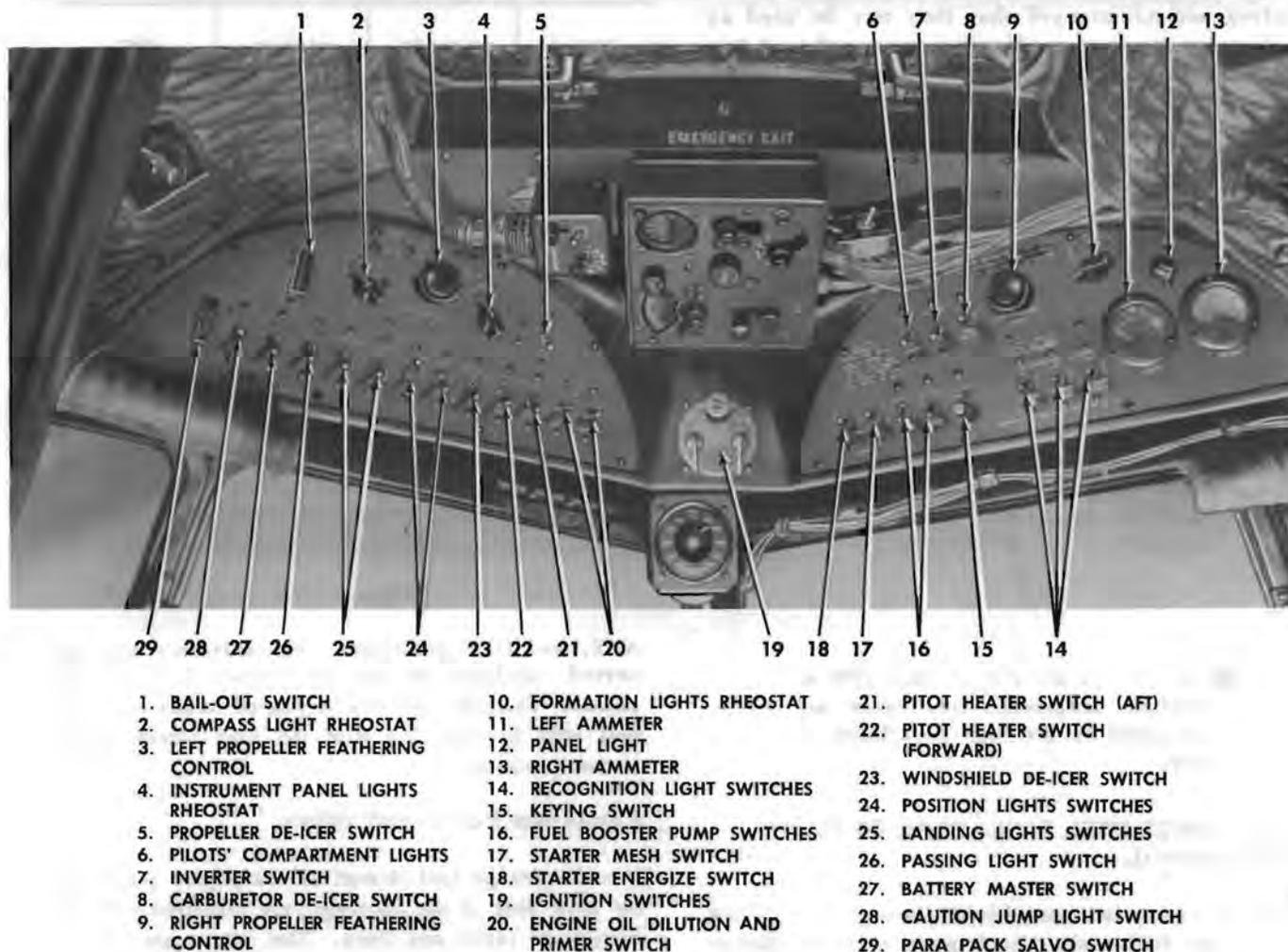
See the paragraph on Firewall Shutoff Valve Handles, this section.

FUEL SYSTEM.

Fuel is supplied from two main tanks and two auxiliary tanks installed in the center wing section (figure 1-16). The fuel quantity is measured by a 28-volt liquidometer system and indicated by the fuel quantity indicator in the cockpit. During normal operation, the left engine is supplied by fuel from the left tanks, and the right engine by the right tanks; however, by using the fuel tank selectors in the cockpit, fuel may be supplied from any tank to either engine. Lines lead from the selector valves to the two wobble pumps which are hand-operated by a single control. These pumps are used to raise the fuel pressure when starting the engines, or before the engine-driven pumps are in operation. A cross-

ELECTRICAL CONTROL PANEL—TYPICAL

R4D SERIES AIRCRAFT



- | | | |
|---------------------------------------|---|-----------------------------------|
| 1. BAIL-OUT SWITCH | 10. FORMATION LIGHTS RHEOSTAT | 21. PITOT HEATER SWITCH (AFT) |
| 2. COMPASS LIGHT RHEOSTAT | 11. LEFT AMMETER | 22. PITOT HEATER SWITCH (FORWARD) |
| 3. LEFT PROPELLER FEATHERING CONTROL | 12. PANEL LIGHT | 23. WINDSHIELD DE-ICER SWITCH |
| 4. INSTRUMENT PANEL LIGHTS RHEOSTAT | 13. RIGHT AMMETER | 24. POSITION LIGHTS SWITCHES |
| 5. PROPELLER DE-ICER SWITCH | 14. RECOGNITION LIGHT SWITCHES | 25. LANDING LIGHTS SWITCHES |
| 6. PILOTS' COMPARTMENT LIGHTS | 15. KEYING SWITCH | 26. PASSING LIGHT SWITCH |
| 7. INVERTER SWITCH | 16. FUEL BOOSTER PUMP SWITCHES | 27. BATTERY MASTER SWITCH |
| 8. CARBURETOR DE-ICER SWITCH | 17. STARTER MESH SWITCH | 28. CAUTION JUMP LIGHT SWITCH |
| 9. RIGHT PROPELLER FEATHERING CONTROL | 18. STARTER ENERGIZE SWITCH | 29. PARA PACK SALVO SWITCH |
| | 19. IGNITION SWITCHES | |
| | 20. ENGINE OIL DILUTION AND PRIMER SWITCH | |

Figure 1-14

feed line is connected on the pressure side of each engine-driven pump, and the two cross-feed valves in this line are operated by a single control in the cockpit. The cross-feed system enables both engines to receive fuel from one engine-driven pump in case either pump fails. On late aircraft, the wobble pumps are replaced by two electric booster pumps with a control switch located on the electrical control panel. On aircraft equipped with booster pumps, there is no cross-feed system. The booster pumps will furnish ample pressure and fuel supply for operation in case either engine-driven pump fails. A vapor overflow line connects from the top chamber of the carburetor to the main and auxiliary tanks. During operation, the maximum return flow is approximately 10 gallons per hour. The majority of the return flow will be directed to the main tanks. A fuel line from each carburetor operates the fuel pressure gage in the cockpit. For fuel grades, see

figure 1-30; for fuel grade operating limits, refer to Section V, Operating Limitations. See figure 1-15 for Fuel Quantity Data.

LONG-RANGE FUEL SYSTEM (Some Aircraft).

On some aircraft, provisions have been made for two, long-range fuel tanks. The tanks have a 500 gal. capacity and are installed on cradles at the forward end of the main cargo compartment, one on each side. The tanks are cylindrical metal, non-selfsealing.

WARNING

Due to the slope of the main cargo compartment floor when the aircraft is on the ground, the long-range fuel tank capacity is limited to 385 gallons each (380 gallons of usable fuel).

Each tank is provided with a booster pump, vent, filler, drain, and fuel line connections. Two manually operated globe valves (figure 1-17) are located at the forward end of the main cargo floor. These valves are so arranged that they may be used as selector valves or as shutoff valves, and fuel from either tank may be diverted to either engine, or both, or turned off completely.

WARNING

● The main fuel tank selector valves must be in the OFF position, when the long-range fuel system is being used, to prevent gravity fuel flow or fuel under booster pump pressure from overflowing the main fuel tanks. When the long-range fuel tanks are empty, the valves must be in the OFF position or air will be drawn from the long range tanks, causing air locks in the fuel system.

● Do not operate the aircraft APP at anytime long-range fuel tanks are installed to preclude possibility of fire.

LONG RANGE FUEL TANKS BOOSTER PUMPS (Some Aircraft).

A booster pump is mounted in the forward end of each long-range fuel tank. Each pump receives 28-volt d-c power from the main electrical junction box, and is operated by an ON, OFF switch on the fuel pump control panel, mounted on the aft side of the main cargo compartment forward bulkhead.

LONG-RANGE FUEL TANK DUMP VALVE (Some Aircraft).

The manually operated long-range fuel tank dump valve is installed in the fuel dump line on the right side of the catwalk between the long-range fuel tanks. The dump valve is normally safety-wired CLOSED. When the valve is moved to the OPEN position, fuel will be dumped overboard, either under booster pump pressure or gravity flow.

Fuel Tank Selectors.

Two fuel tank selectors, one for each engine, are mounted on the left and right sides of the control pedestal (5, 13, figure 1-10). Each selector has LEFT AUX, LEFT MAIN, RIGHT MAIN, RIGHT

FUEL QUANTITY DATA CHART

GALLONS

TANK	NUMBER OF TANKS	USABLE FUEL (EACH)	FUEL SERVICE (EACH)
MAIN	2	202.0	204.0
AUXILIARY	2	199.0	202.0

TOTAL USABLE FUEL.....802 GALLONS
 LONG-RANGE FUEL TANKS 385 GALLONS EACH

INSTALLATION OF TWO TANKS POSSIBLE

TOTAL USABLE FUEL IN EACH
 LONG RANGE FUEL TANK 380 GALLONS

Note: Level flight assumed to be 3 degrees nose up.

Figure 1-15

AUX, and OFF positions. The selectors are connected mechanically to the valves by rods and cables. When the selector is placed in any position, fuel will be supplied from the tank corresponding to that position.

Long-Range Fuel Shutoff Valves.

Two long-range fuel shutoff valves (figure 1-17), one for each side of the fuselage, are installed with the long-range tanks and lines. The valves are located in front of and between the front two long-range tanks in the main cabin compartment. The valves may be opened manually by rotating the handles in a counterclockwise direction.

WARNING

Do not operate internally installed auxiliary power plant at any time long-range auxiliary fuel tanks are installed.

Fuel Booster Pump Switches.

The 28-volt d-c electrically driven booster pumps are energized by the two booster pump ON-OFF switches mounted on the electrical control panel (14, figure 1-13, and 16, figure 1-14). Positioning either switch to ON completes the 28-volt d-c circuit to its respective booster pump motor.

Fuel Quantity Indicator.

A 28-volt d-c liquidometer fuel quantity indicator is installed on the main instrument panel (24, figure 1-11), and 28, figure 1-12) to indicate the fuel quantity in the two main and two auxiliary tanks. A selector handle on the indicator has LEFT AUX, LEFT MAIN, RIGHT MAIN, and RIGHT AUX position. As the selector is moved from one position to another, the calibrated dial for the new position flips up into the window of the indicator and the quantity of fuel in the corresponding tank may be read.



The selector must be turned clockwise to prevent jamming.

FIREWALL SHUTOFF VALVES.

See the paragraph on Firewall Shutoff Valve Handles, this section.

FUEL SYSTEM

(Some SC-47 Aircraft).

Fuel is supplied from two main tanks, two auxiliary tanks, and four wing tanks. The main and auxiliary tanks are installed in the center wing section, and the elliptical drum type metal wing tanks are installed in each outer wing panel on each side of the center spar between the rear and front spar; these two tanks are connected with an equalizing line on the bottom inboard end which allows the tanks to function as a single storage unit. The wing tanks have an electrically operated dump valve which is located in each dump line. The valve is controlled by a switch in the cockpit. The fuel quantity is measured by a 28-volt d-c liquidometer system and indicated by the fuel quantity indicator in the cockpit. During normal operation, the left engine is supplied by fuel from the left tanks and the right engine by the right tanks; however by using the cross feed valve controls in the cockpit, fuel may be supplied from one wing to the opposite engine. Fuel lines lead from the selector valves to the two booster pumps, one from each engine, which furnish pressure and fuel supply for operation in case either engine driven pump fails (figure 1-16). A vapor vent return line connects from the top chamber of each carburetor to the main and auxiliary tanks. During operation, the maximum return flow is approximately 10 gallons per hour. The majority of return flow will be directed to the main tanks. A fuel line from each carburetor operates the fuel pressure gage in the cockpit. For fuel grades see figure 1-30; for

fuel grade operating limits, refer to section V, Operating Limits. For Fuel Quantity Data, see chart.

FUEL QUANTITY DATA CHART-GALLONS.

FULLY SERVICED AND USABLE			
TANK	NUMBER OF TANKS	USABLE FUEL (each)	FULLY SERVICED
Main	2	202	204
Auxiliary	2	199	200
Wing(outer)	4	200	200
TOTAL USABLE FUEL			1802

FUEL TANK SELECTORS (Some SC-47 Aircraft).

Two fuel tank selectors, one for each engine, are mounted on the left and right sides of the control pedestal, (5, 13, figure 1-10). The valves operate independent of each other since with the installation of the outer wing tanks, the fuel system feeds the right engine from the right tanks and the left engine from the left tanks. The right selector has R. H. AUX 200 GALS, R. H. MAIN 202 GALS, R. H. WING 400 GALS and OFF positions. The positions on the left selector are L. H. AUX 200 GALS, L. H. MAIN 202 GALS, L. H. WING 400 GALS and OFF. The selectors are connected mechanically to the valves by rods and cables. When the selector is placed in any position, fuel will be supplied from the tank corresponding to that position.

FUEL CROSS-FEED SWITCH (Some SC-47 Aircraft).

The electrically operated cross-feed valve is energized by a three position switch installed on the lower right side of the instrument panel (40, figure 1-11). The cross-feed switching system incorporates a red warning light, located on the right side of the cross-feed switch, which illuminates during the time that the valve is closing or opening. In the OPEN position the valve is energized to open. In the OFF position the circuit is neutral and the CLOSED position shuts the valve off. To operate the cross-feed system, place the fuel selector to the tank to be used. Place cross-feed switch ON and turn opposite selector valve (engine receiving cross-feed fuel) to OFF.

NOTE

The engine being fed fuel during this operation will show an approximate two pound fuel pressure fluctu-

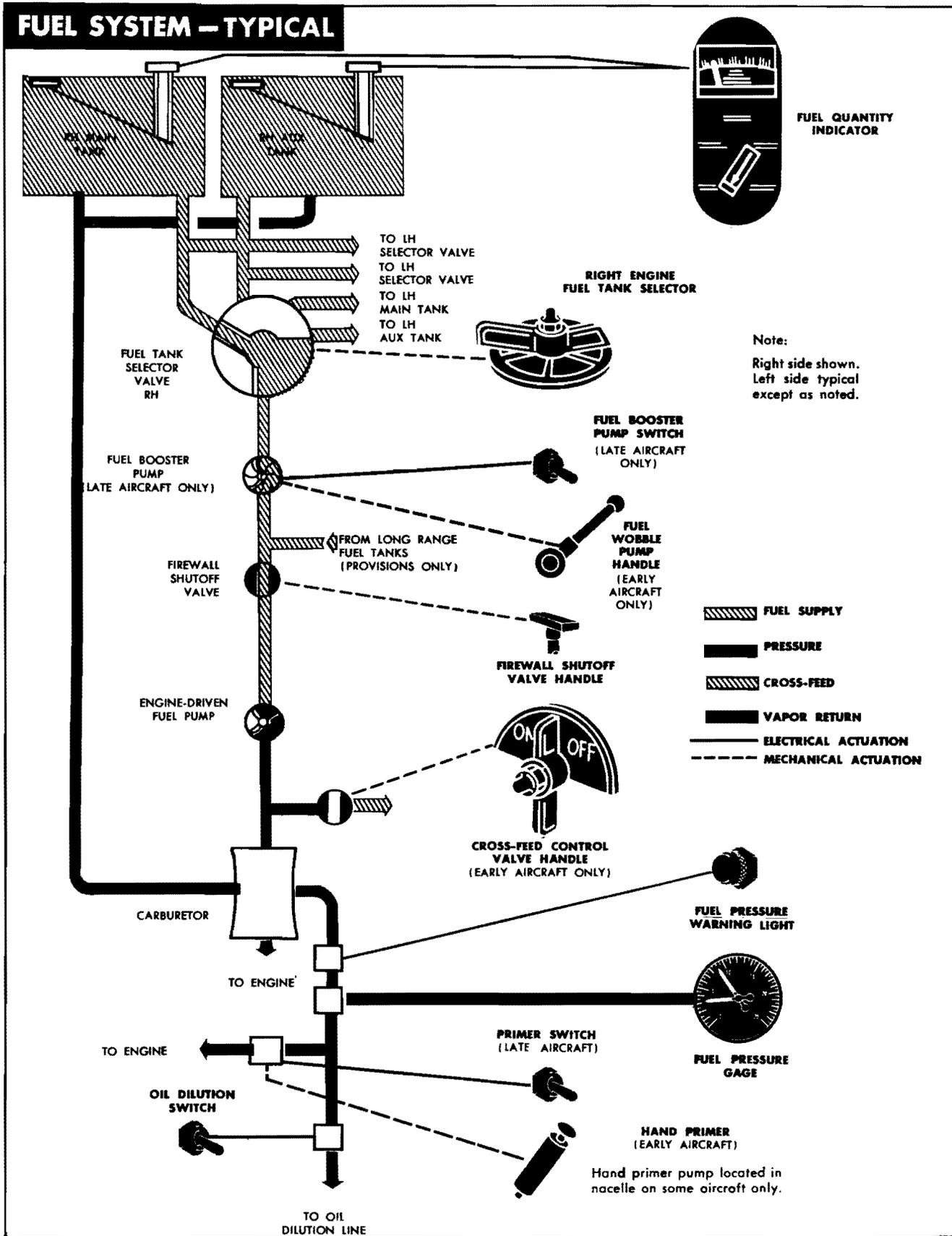


Figure 1-16 (Sheet 1 of 2)

FUEL SYSTEM (SOME SC-47 AIRCRAFT)

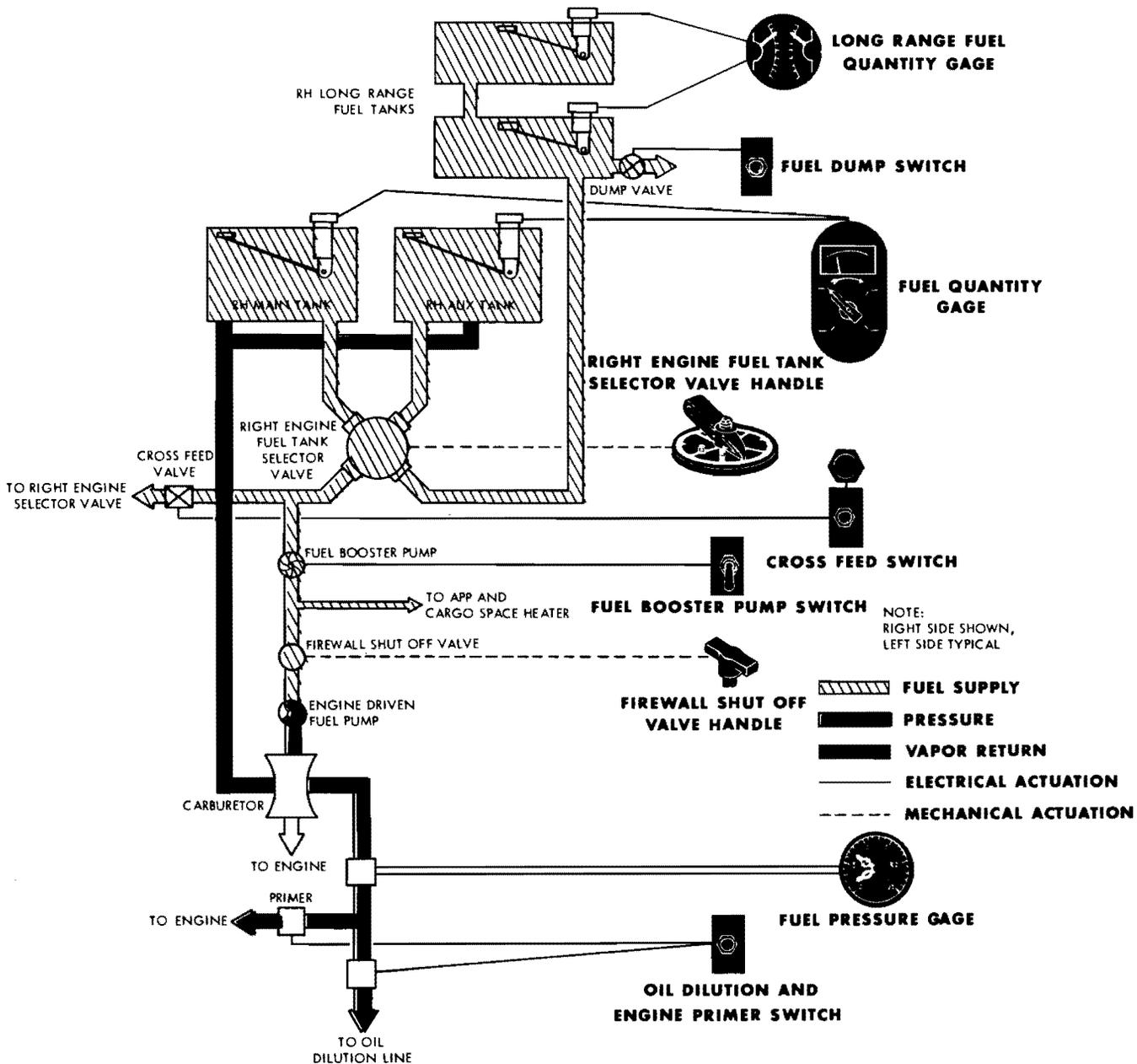
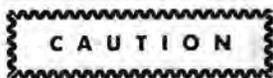


Figure 1-16 (Sheet 2 of 2)

ation because of the added fittings in the line. The pressure fluctuation will not be sufficient to hinder engine operation.

FUEL DUMP SWITCHES (Some SC-47 Aircraft).

Two 28-volt d-c three position guarded switches (41, figure 1-11) operate the dump valves in the outer wing tanks. The switches are placarded OFF, CLOSE, and DUMP. To dump fuel place the fuel selector valves to tanks other than outer wing tanks. Place both switches to the DUMP position.



Never dump fuel with flaps down.

FUEL QUANTITY INDICATORS. (Some SC-47 Aircraft).

A 28-volt d-c liquidometer fuel quantity indicator is installed in the main instrument panel (24, figure 1-11), to indicate the fuel quantity in the two main and two auxiliary tanks. A selector handle on the indicator has LEFT AUX, LEFT MAIN, RIGHT MAIN, and RIGHT AUX positions. As the selector is moved from one position to another, the calibrated dial for the new position flips up into the window of the indicator and the quantity of fuel in the corresponding tank may be read. A fuel indicator is located on the instrument panel to indicate fuel in either outer wing tank.

NOTE

The outer wing fuel meter will not give an accurate reading when the airplane is on the ground.

ELECTRICAL POWER SUPPLY SYSTEM.

D. C. POWER SUPPLY.

The DC electrical power supply system is a 24 to 28 volt, single conductor, ground return type, DC power is supplied by two engine driven generators, two 12 volt 88 ampere hour storage batteries wired in series and on some aircraft, an auxiliary power plant. On the ground, power may be supplied from an external power unit when plugged into the external power receptacle. Each generator circuit includes a voltage regulator and a reverse current relay. For DC power distribution see figure 1-18. The CB fire extinguishing system, alarm and warning system

LONG-RANGE FUEL SHUTOFF VALVES

LOCATION: FORWARD MAIN CABIN—FLOOR LEVEL



Figure 1-17

and the main junction box light circuit are connected directly to the aircraft batteries. On some aircraft, the alarm and warning system is connected to the main junction box bus. Refer to the ALARM SYSTEM and FIRE EXTINGUISHER SYSTEM, this section. Power is supplied to the DC electrically operated equipment through circuit protectors connected to the bus in the main electrical junction box (figure 1-21, and figure 1-22). In case both generators fail, the DC equipment can be supplied by the aircraft batteries when the battery switch is ON. In order to conserve the batteries, only the equipment essential for safe operation of the aircraft should be operated.

On some aircraft two higher capacity generators, a bus priority system and third inverter have been installed. On these aircraft, in the event one generator fails, power from the surviving generator is automatically directed to the No. 1 radio bus.

Battery Master Switch.

The 28-volt d-c ON-OFF battery master switch is located on the electrical control panel (19, figure 1-13, and 27, figure 1-14). Operation of the switch will open or close the battery circuit. The battery switch should be in the OFF position when an external power source is plugged in. To assure fully charged batteries, the battery master switch should be turned ON before take-off.

Generator (Main Line) Switches.

Two ON-OFF switches are incorporated into the main line circuit to select either or both of the generators to supply current to the electrical system. The ON position of the switches closes the generator circuits and the battery circuit through the circuit breaker bus in the main electrical junction box. The OFF position opens the circuits. These switches are located in the main electrical junction box on the aft wall of the forward baggage loading door companionway (19, figure 1-1).

External Power Receptacle.

A ground power receptacle is located on the underside of the fuselage aft of the batteries (18, figure 1-1), and connects the external d-c power to the aircraft electrical system when the ground power supply is plugged in.

Utility Power Outlet.

Utility power outlets are installed at various locations throughout the aircraft. On some aircraft, one utility power outlet is installed on the left side of the main cargo compartment, immediately forward of the main cargo door. On C-117 series aircraft, two power outlets are installed at the buffet.

Generator Warning Lights.

Two 28-volt d-c generator warning lights, one for each generator, are mounted on the electrical control panel to provide indication of generator failure (8, figure 1-13). On some aircraft, generator warning lights are also located on the power systems junction box control panel, mounted on the aft wall of the forward baggage loading door companionway (figure 1-21). If the output voltage of a generator becomes less than that of the batteries, the respective reverse-current relay will prevent current flowing from the bus to the generator and will illuminate the generator warning light for the faulty generator.

GROUND TEST POWER SWITCH (Some Aircraft).

The ground test power switch (19, figure 1-21) is provided to over ride the bus priority relay for those aircraft equipped with the 200 ampere generator priority bus system. On aircraft equipped with this system, the bus priority relay will automatically disconnect the main junction box number two bus and the radio junction box number two bus when either or both generators are not supplying power to the electrical system. Until all critical equipment is relocated from the number two to the number one bus system, the ground test power switch should be in the ON position at all times. The ground test

power switch is located on the power systems junction box control panel, mounted on the aft wall of the forward baggage loading door companionway.

Ammeters.

Two ammeters, one for each generator, are provided to measure the amperage output of the generators (figure 1-18). The ammeters are located on the right side of the electrical control panel (11, 13, figure 1-14). On some aircraft, the ammeters are located on the power systems junction box controls panel, mounted on the aft wall of the forward cargo loading door companionway.

A-C POWER SUPPLY.

Two inverters are operated by the DC system to supply 115 volt, 400 cycle, AC power for operation of various items of electrical and electronic equipment (figure 1-18). The AC power is supplied to the equipment through circuit protectors located on the radio circuit breaker panel (figure 1-20), and is controlled by switches located on the electrical control panel. (See 7, figure 1-14.)

On some aircraft, to provide additional AC power, one spare and two main inverters have been installed in conjunction with a bus priority system (Figure 1-18). No. 1 and No. 2 inverters supply power to the No. 1 and No. 2 AC busses respectively. The spare inverter may supply power to either bus in the event one inverter fails. The inverters are controlled by switches located on the power systems junction box control panel (figure 1-21).

Inverter Switch.

An ON-OFF inverter switch, located on the electrical control panel (7, figure 1-14) completes the 28-volt d-c circuit to the inverter when in the ON position. On aircraft equipped with a generator-inverter and bus priority system, the inverter ON-OFF switches for the No. 1 and No. 2 inverters and the spare inverter are located on the power systems junction box control panel, mounted on the aft wall of the forward baggage loading door companionway (figure 1-21).

HYDRAULIC POWER SUPPLY SYSTEM.

A pressure accumulator hydraulic power supply system (figure 1-23) operates the landing gear, wing flaps, brakes, cowl flaps, nonram carburetor air filter mechanism, and the windshield wipers, skis, and blower clutches.

Hydraulic fluid is supplied by gravity from the hydraulic fluid reservoir to the engine-driven hydraulic pumps (one on each engine), which supply fluid pressure for the hydraulic system and the autopilot

MAIN POWER DISTRIBUTION SCHEMATIC - TYPICAL

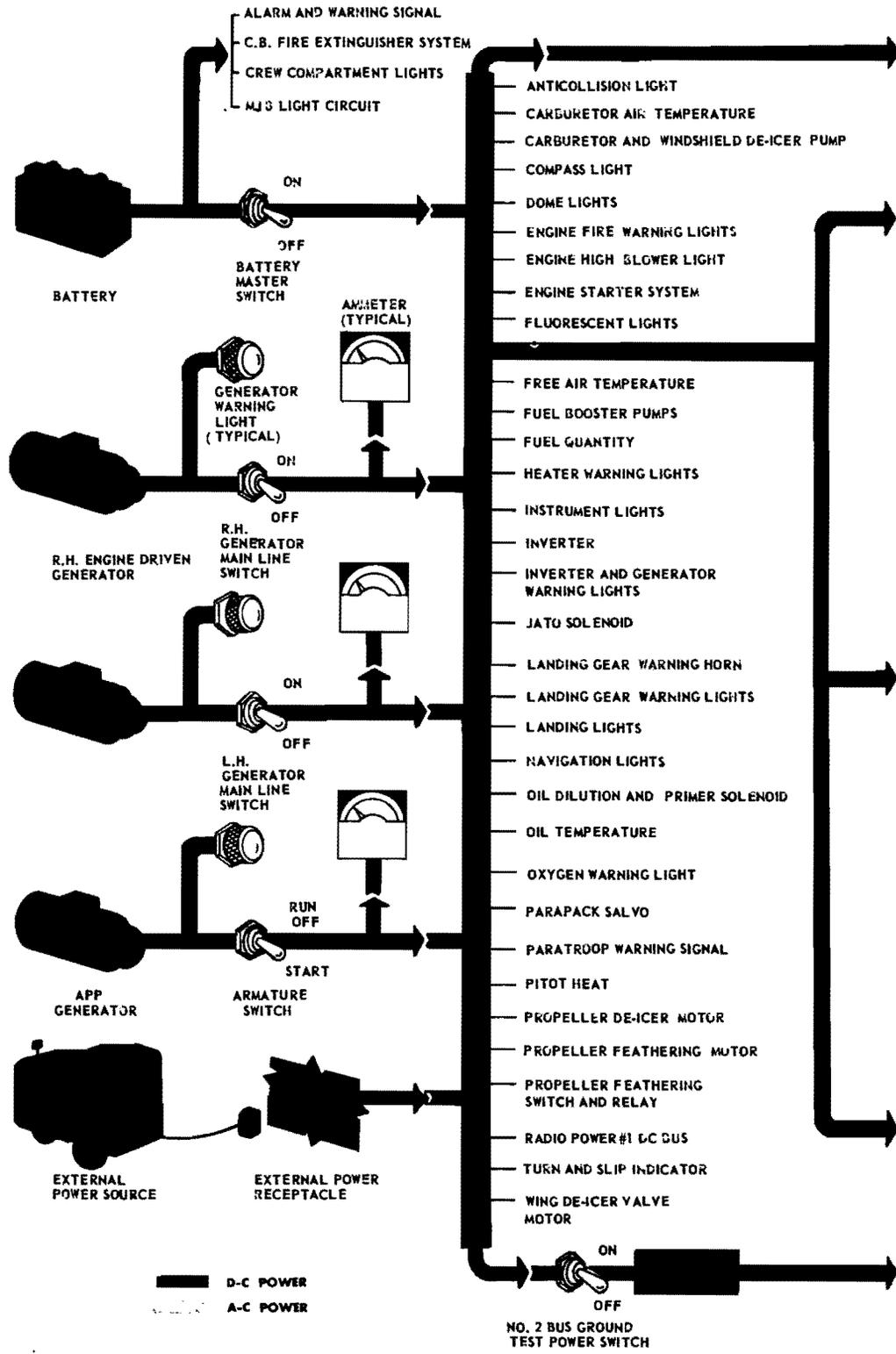


Figure 1-18 (Sheet 1 of 2)

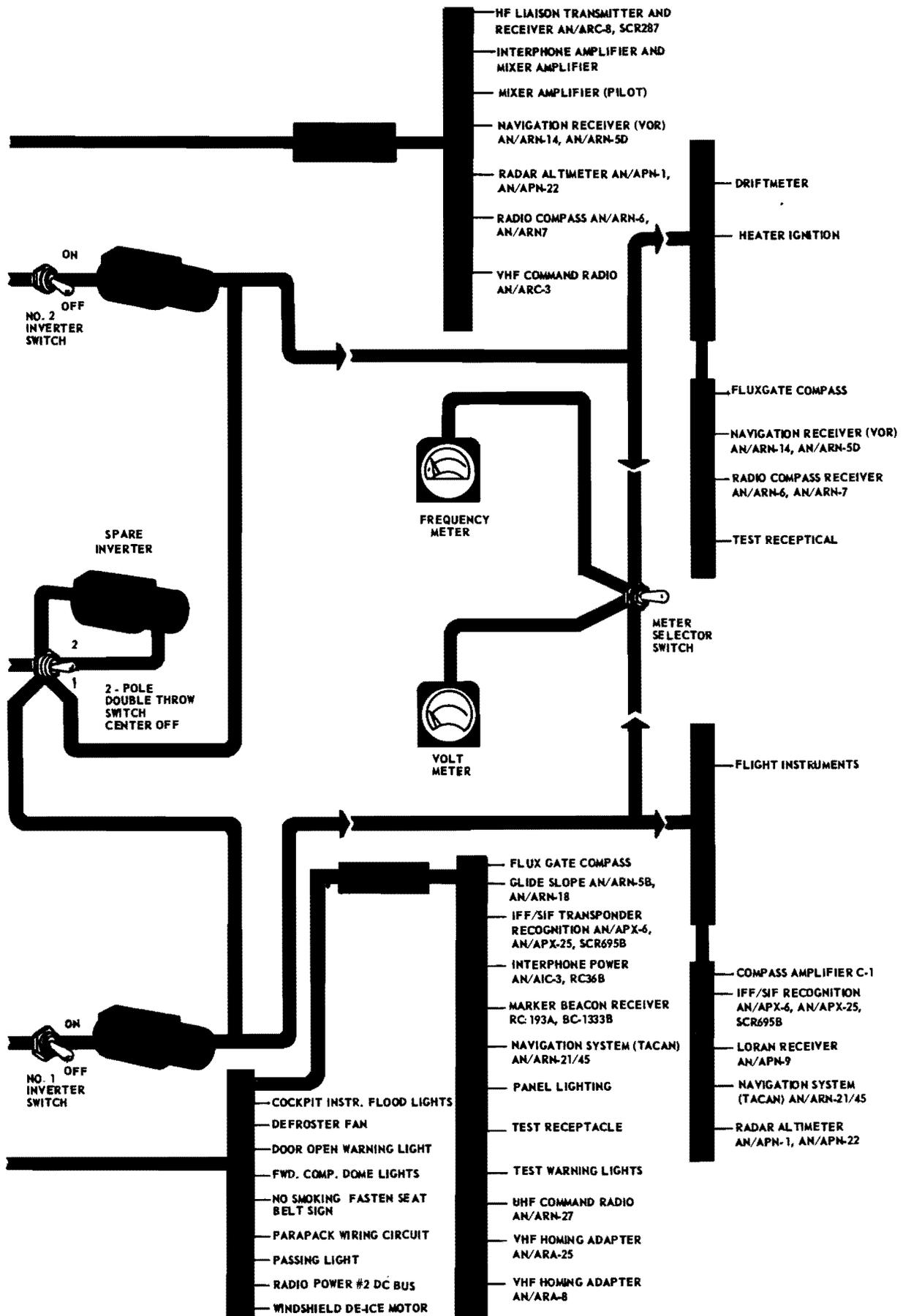


Figure 1-18 (Sheet 2 of 2)

MAIN POWER DISTRIBUTION SCHEMATIC - SOME AIRCRAFT

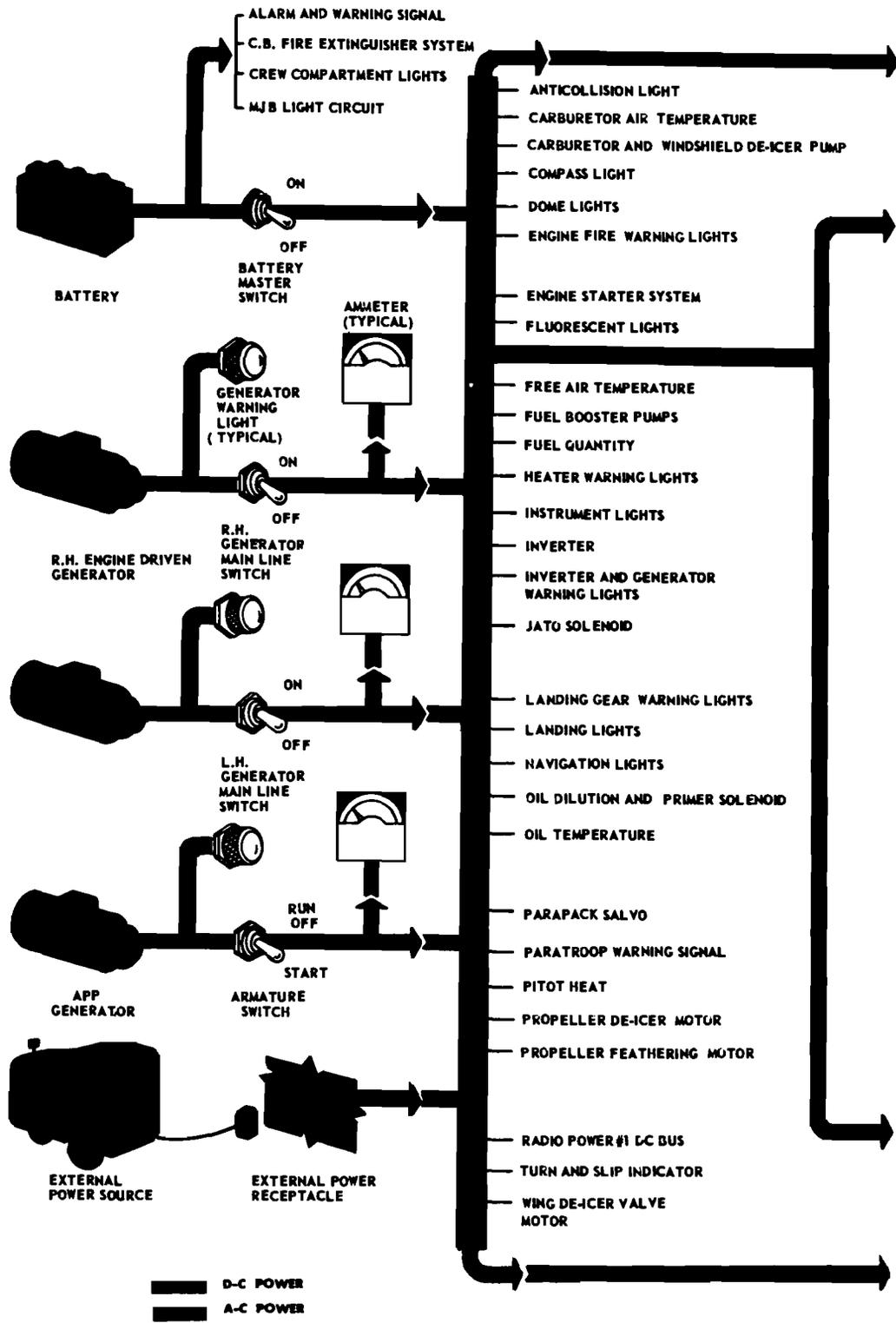


Figure 1-19 (Sheet 1 of 2)

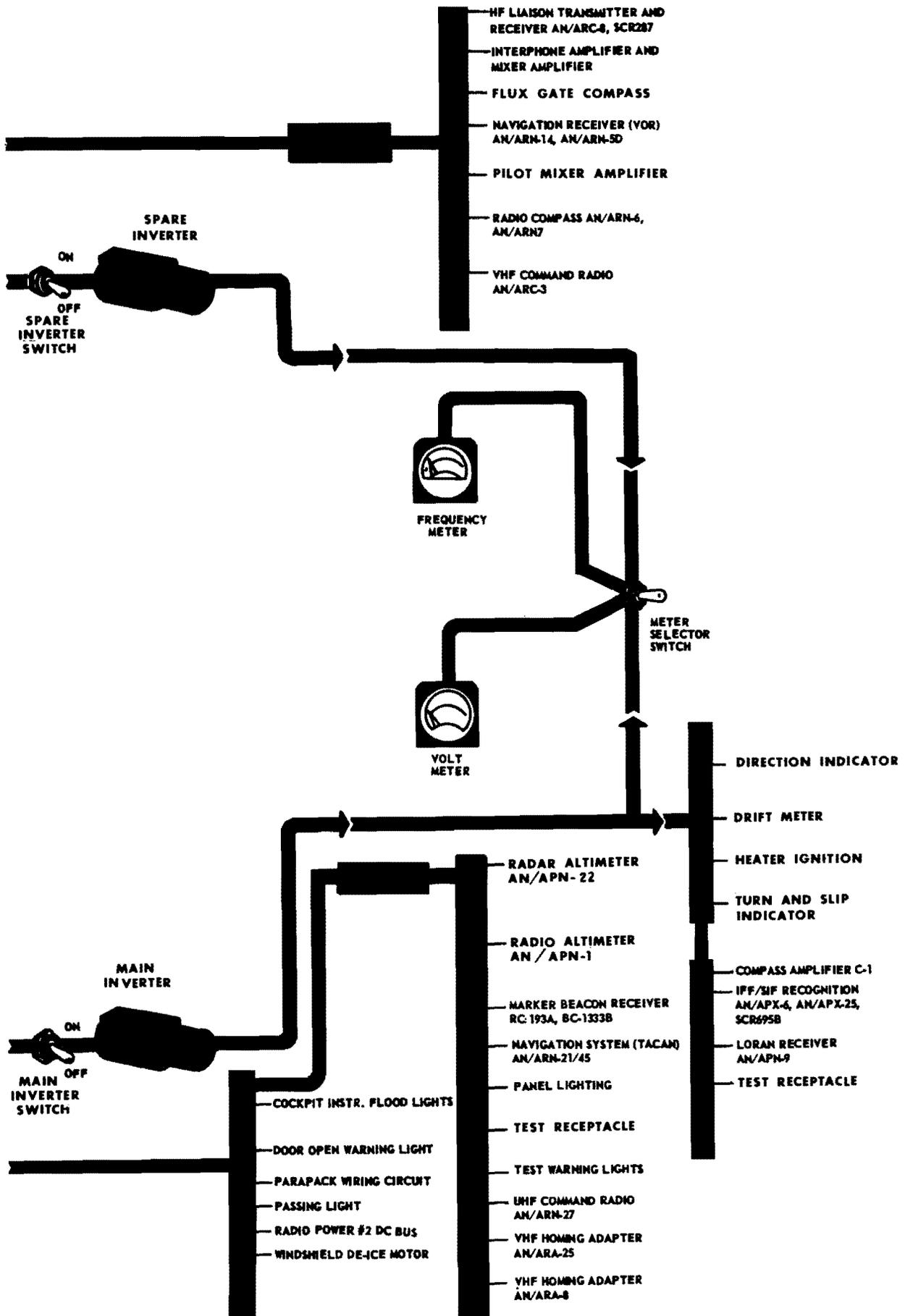


Figure 1-19 (Sheet 2 of 2)

RADIO CIRCUIT BREAKER PANEL

LOCATED: RADIO RACK AT RADIO OPERATOR'S STATION

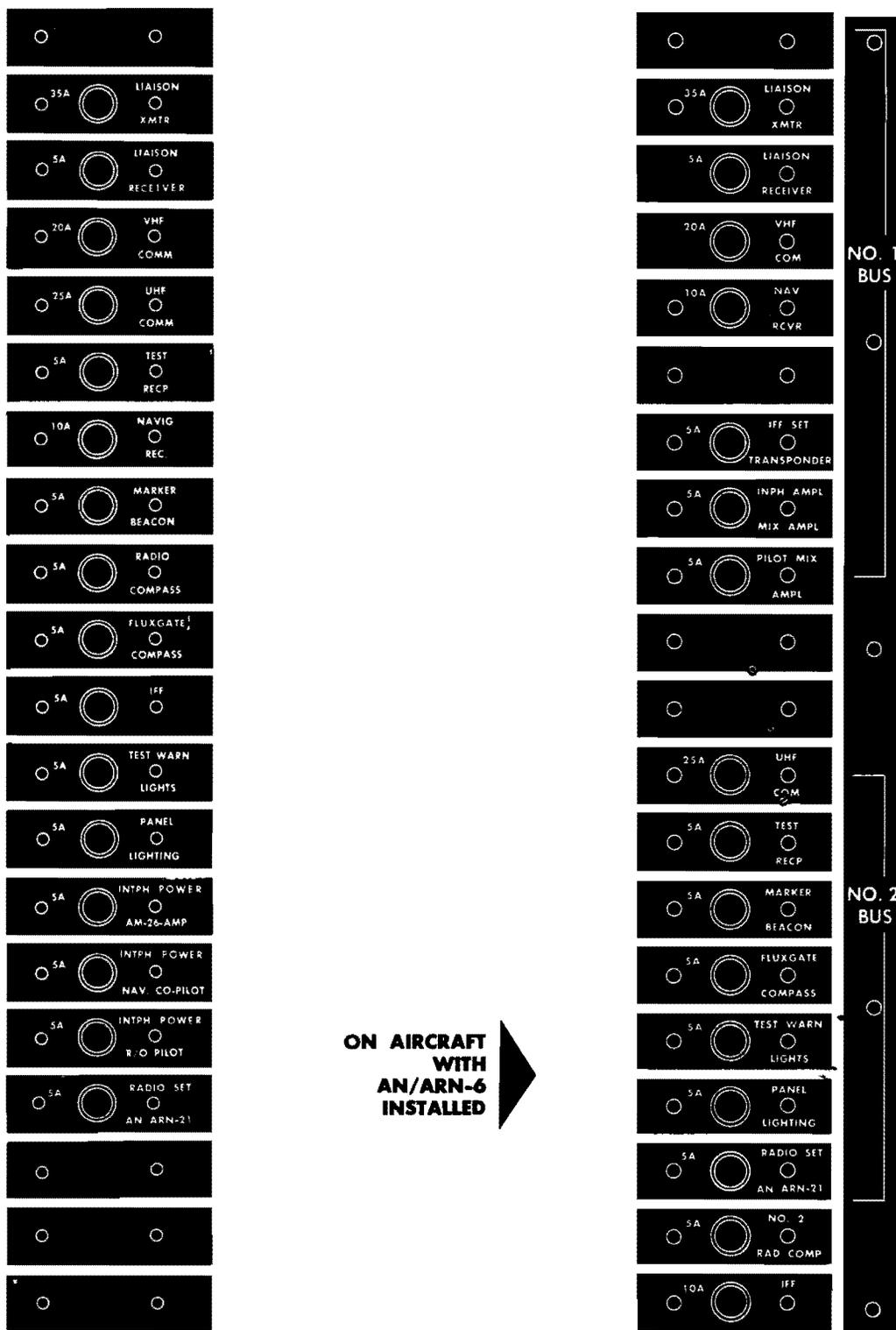


Figure 1-20

system. However, the fluid flow from the engine-driven pumps may be selected by means of the hydraulic pump selector valve, located on the hydraulic control panel in the flight compartment. The hydraulic pressure accumulator is attached to a bracket adjacent to the hydraulic fluid reservoir and aft of the bulkhead behind the co-pilot's seat. The lower chamber of the pressure accumulator is charged with air through the air valve fitting to an initial pressure of 250 psi. A system pressure relief valve, installed in the hydraulic system fluid pressure line, functions to protect the hydraulic system from excessive fluid pressure when the system pressure increases to 1000 (\pm 50) psi. A hydraulic hand pump is incorporated in the system for use when the engine-driven pumps fail to supply sufficient pressure or for ground operation of the hydraulic system when the engines are not running. A pressure regulator is installed in the main system pressure line to regulate system pressure between 600 and 875 psi. When system pressure is below 600 psi, the accumulator is charged until system pressure reaches this value. If system pressure exceeds 875 psi, fluid is ported to return until the pressure drops below 875 psi. The fluid capacity of the hydraulic reservoir is 10 quarts. Seven quarts are available to the engine-driven hydraulic pumps, while the remaining 3 quarts in the reservoir sump are available only to the hydraulic hand pump for emergency operation. For fluid specification and reservoir location, see figure 1-30.

HYDRAULIC PUMP SELECTOR VALVE LEVER.

The hydraulic pump selector valve lever located on the hydraulic control panel (4, figure 1-24), controls the flow of fluid for operation of the hydraulic system. Selection of the hydraulic engine pump is governed by the position of the selector valve lever. For normal operation, the lever is placed in the LEFT ENG. HYDR. SYS. - RIGHT ENG. GYRO PILOT (aft) position and the left engine pump supplies pressure for the hydraulic system and the right engine pump supplies pressure for the autopilot system. When the control lever is in the LEFT ENG. GYRO PILOT - RIGHT ENG. HYDR. SYS. (forward) position, the systems for which the pumps supply pressure are reversed. The control lever operates in a notched quadrant and it is necessary to lift the lever slightly before moving it from one position to another. There is no difference in the functioning of the hydraulic system when the fluid delivery of the engine-driven pumps is changed.

HYDRAULIC PUMP SELECTOR VALVE LEVER (MODIFIED AIRCRAFT).

On aircraft modified in accordance with T. O. 1C-47-507, or T. O. 1C-1-514, the hydraulic pump selector valve lever provides selection for two modes of operation (4, figure 1-24), TAKE-OFF POSITION and GYRO PILOT POSITION. In the TAKE-OFF POSITION, both the left and right engine pumps supply pressure for the hydraulic system. In the GYRO PILOT POSITION, the left engine pump supplies pressure for the autopilot system and the right engine pump supplies pressure for the hydraulic system.

HYDRAULIC HAND PUMP.

The hydraulic hand pump, located at the bottom of the hydraulic control panel, has a handle that extends between the pilot's and co-pilot's seats (9, figure 1-24). This hand pump is used when the engine-driven hydraulic pumps fail to supply sufficient pressure, when the hydraulic fluid supply (except the hand pump reserve) has been lost, or for ground operation of the hydraulic system when the engines are not running. The hand pump may be used to supply pressure to any unit operated by the hydraulic system, except the autopilot.

STAR VALVE.

The hand pump to pressure accumulator shutoff valve handle, (star valve), located on the hydraulic control panel (6, figure 1-24) has two placarded positions, ON and OFF. When the star valve is turned to the ON (open) position, the hydraulic hand pump can be used to increase hydraulic pressure in the pressure accumulator for operation of the hydraulic units when the aircraft is on the ground and the engines are not running. When the star valve is turned to the OFF (closed) position, the hydraulic units (except the autopilot) may be actuated directly by operation of the hydraulic hand pump. The star valve should be safetywired to the OFF (closed) position.

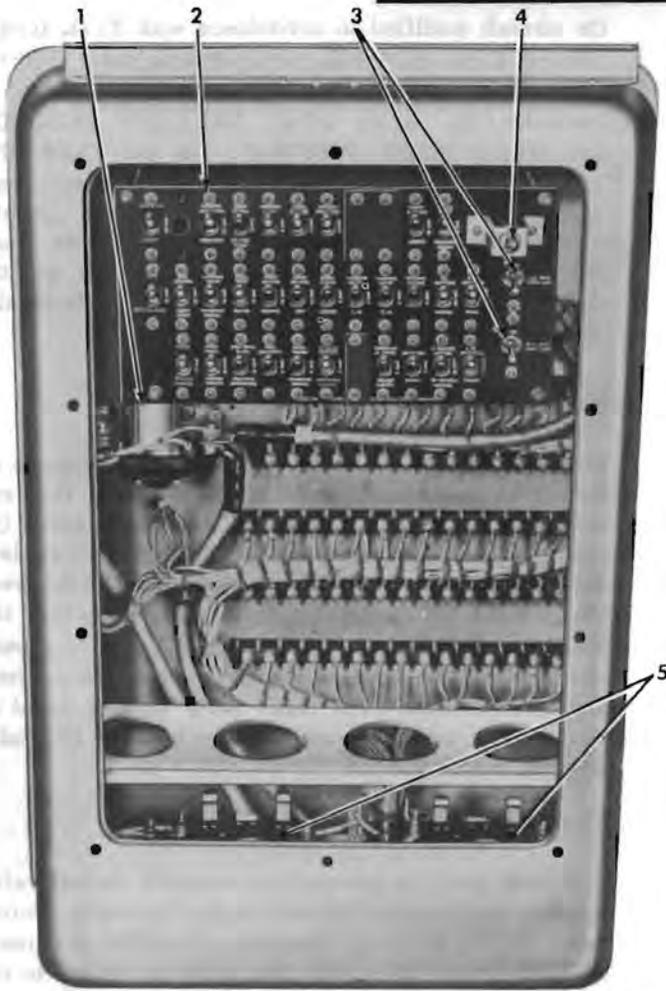
Hydraulic Fluid Quantity Sight Gage.

A hydraulic fluid quantity sight gage is located at the top of the hydraulic control panel (2, figure 1-24) to indicate fluid quantity. A placard for servicing instructions is mounted adjacent to the sight gage.

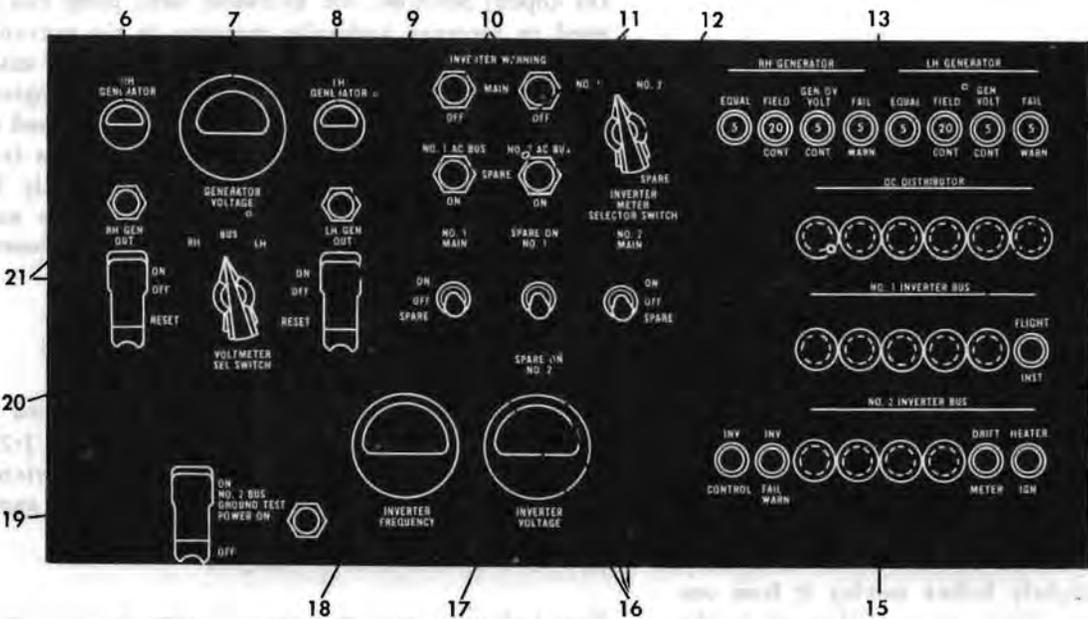
Hydraulic System Pressure Gages.

Two hydraulic system pressure gages mounted in a bracket assembly below the right windshield at the co-pilot's station (16, 17, figure 1-7), are direct-

MAIN ELECTRICAL JUNCTION BOX C-47 AND R4D SERIES AIRCRAFT



1. BATTERY CONNECTOR RELAY
2. CIRCUIT BREAKER PANEL
3. GENERATOR MAIN LINE SWITCHES
4. JUNCTION BOX LAMP SWITCH
5. VOLTAGE REGULATOR MOUNTS
6. RH GENERATOR LOADMETER
7. VOLTMETER
8. LH GENERATOR LOADMETER
9. LH GENERATOR SWITCH AND LIGHT
10. MAIN INVERTER WARNING LIGHTS
11. SPARE INVERTER WARNING LIGHTS
12. INVERTER METER SELECTOR SWITCH
13. GENERATOR CIRCUIT BREAKERS
14. NO. 1 INVERTER BUS CIRCUIT BREAKERS
15. NO. 2 INVERTER BUS CIRCUIT BREAKERS
16. INVERTER SWITCHES
17. INVERTER VOLTAGE METER
18. INVERTER FREQUENCY METER
19. GROUND TEST POWER SWITCH
20. VOLTMETER SELECTOR SWITCH
21. RH GENERATOR SWITCH AND LIGHT



JUNCTION BOX CONTROL PANEL

(ON AIRCRAFT WITH GENERATOR-INVERTER AND BUS PRIORITY SYSTEMS INSTALLED)

Figure 1-21

reading, pressure operated gages calibrated from 0 to 2000 psi. One gage indicates the fluid pressure in the hydraulic system and the other indicates the fluid pressure in the landing gear DOWN line when the landing gear control lever is in the DOWN or NEUTRAL position.

FIREWALL SHUTOFF VALVES.

See paragraph on the Firewall Shutoff Valve Handles, this section.

FLIGHT CONTROL SYSTEM.

The flight control system consists of independent elevator, aileron, and rudder systems. All flight controls are directly controlled and are operated by dual wheel and rudder pedals. The elevator, aileron, and rudder systems incorporate trim tabs.

RUDDER PEDALS.

The rudder is mechanically controlled by a duplicate set of hinged rudder pedals incorporating toe brakes. The pedals can be adjusted forward or aft for proper length by means of the adjusting lever mounted on each rudder pedal.

Rudder Trim Crank.

Rudder trim is mechanically controlled by a rotatable crank mounted on the aft face of the control pedestal (11, figure 1-10). Movement of the trim tab is shown on the indicator immediately below the crank.

CONTROL COLUMNS.

Dual control columns, mounted forward of the pilot's and co-pilot's seats, provide mechanical control of the ailerons and elevators. The columns incorporate a wheel for aileron control, while elevator control is gained by forward and aft movement of the column.

Aileron Trim Crank.

Right aileron trim is mechanically controlled by a rotatable crank mounted on the aft face of the control pedestal (8, figure 1-10). Movement of the trim tab is shown on the indicator immediately below the crank.

Elevator Trim Wheel.

Elevator trim is mechanically controlled by a handwheel located on the pilot's side of the control pedestal (14, figure 1-10). Movement of the trim tabs is shown on an indicator adjacent to the handwheel.

MAIN ELECTRICAL JUNCTION BOX C-117 SERIES AIRCRAFT



1. BATTERY CONNECTOR RELAY
2. CIRCUIT BREAKER PANEL
3. GENERATOR MAIN LINE SWITCHES
4. JUNCTION BOX LAMP SWITCH
5. VOLTAGE REGULATORS

Figure 1-22

CONTROL-SURFACE LOCKS.

The rudder, both ailerons, and both elevators are locked while on the ground by use of 5 control-surface locks. The locks are felt-padded and equipped with small bungees which hold them firmly in place when slipped into position between the control surface and fixed surface. When not in use, the locks are stowed in the lavatory compartment (10, figure 1-1). On C-117 series aircraft, the locks are stowed in the aft baggage compartment.

HYDRAULIC SYSTEM

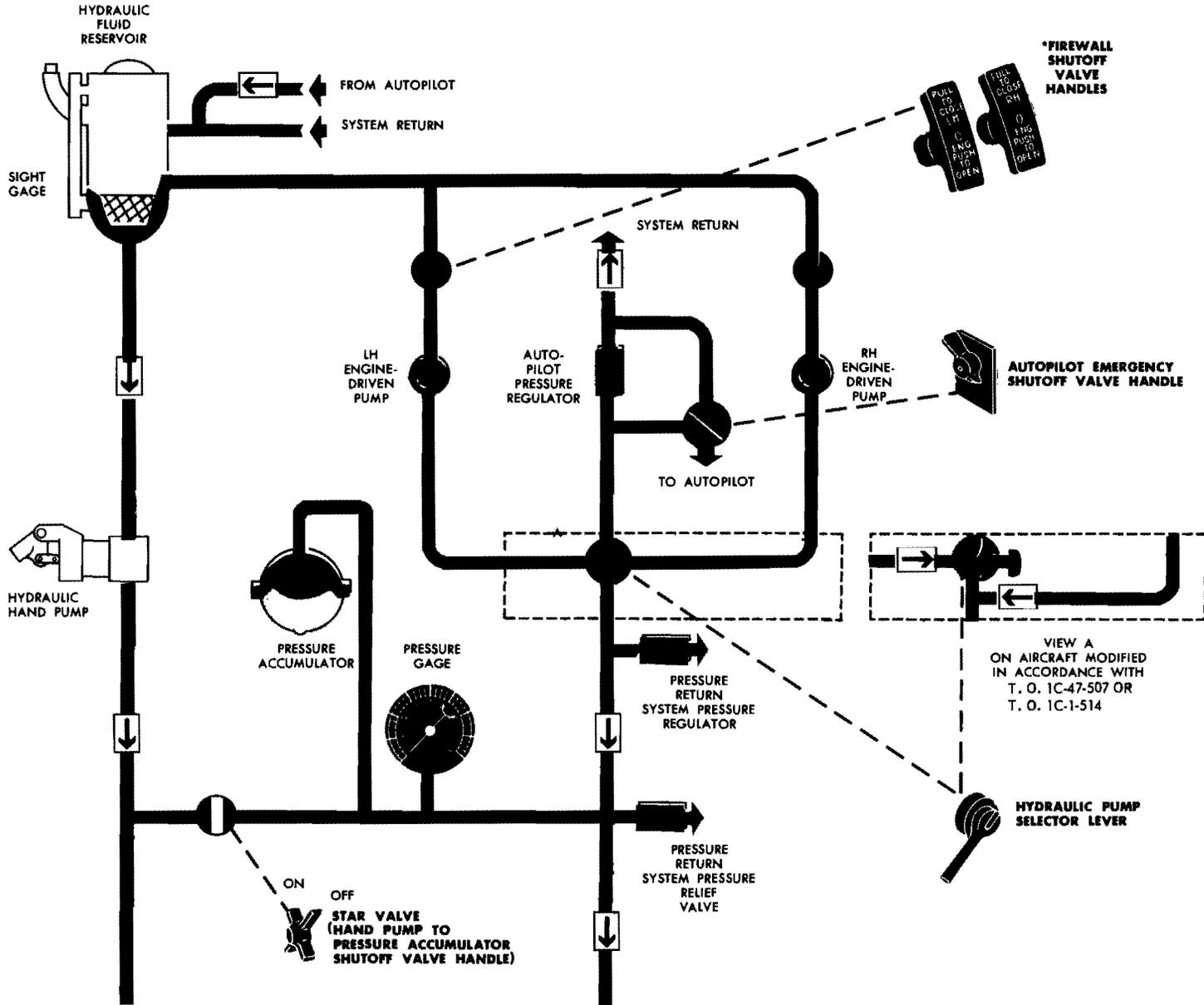
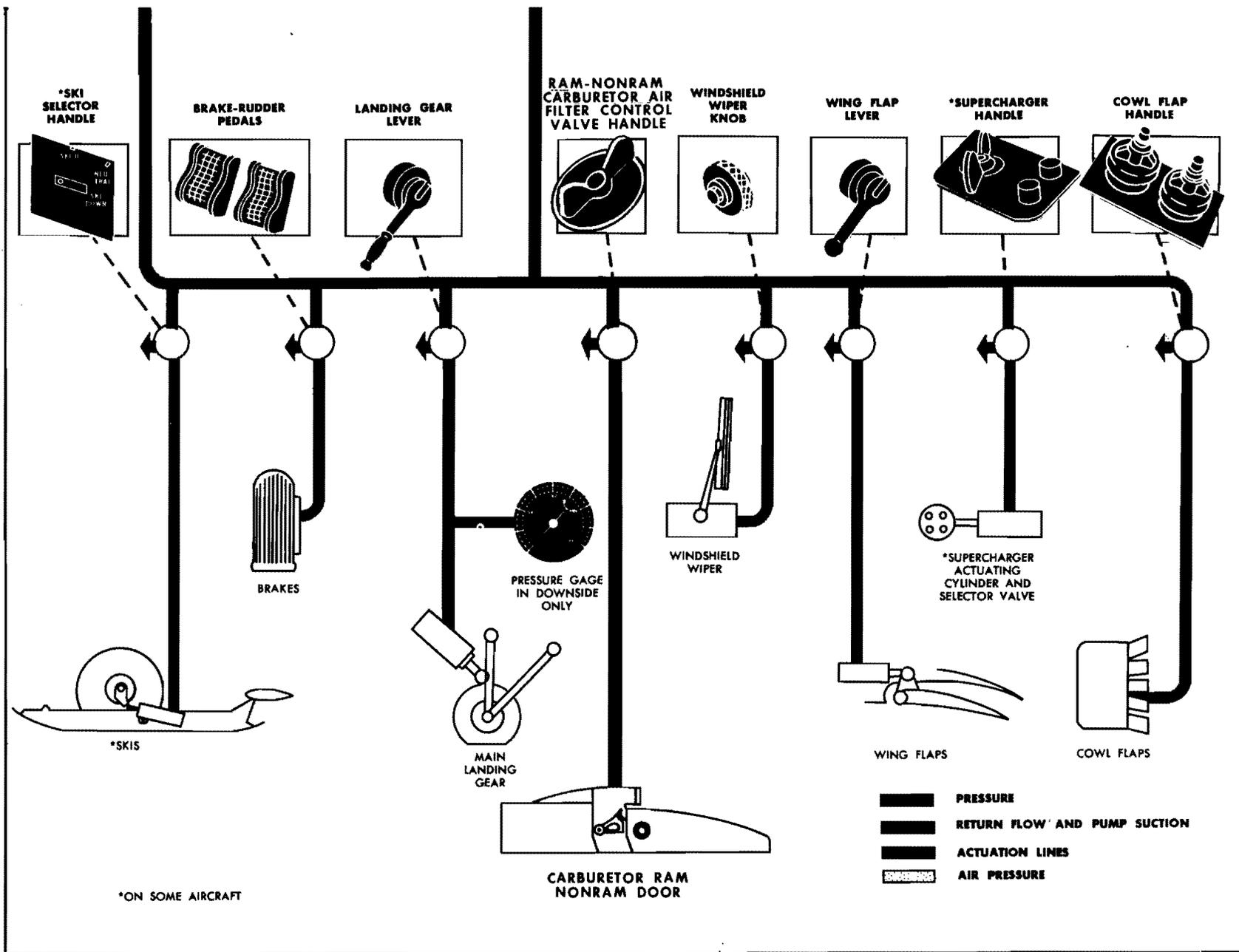


Figure 1-23 (Sheet 1 of 2)

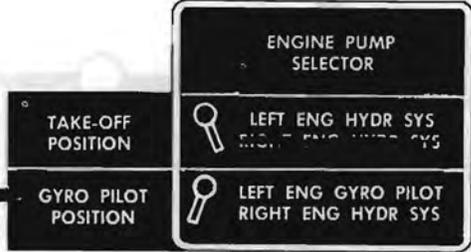
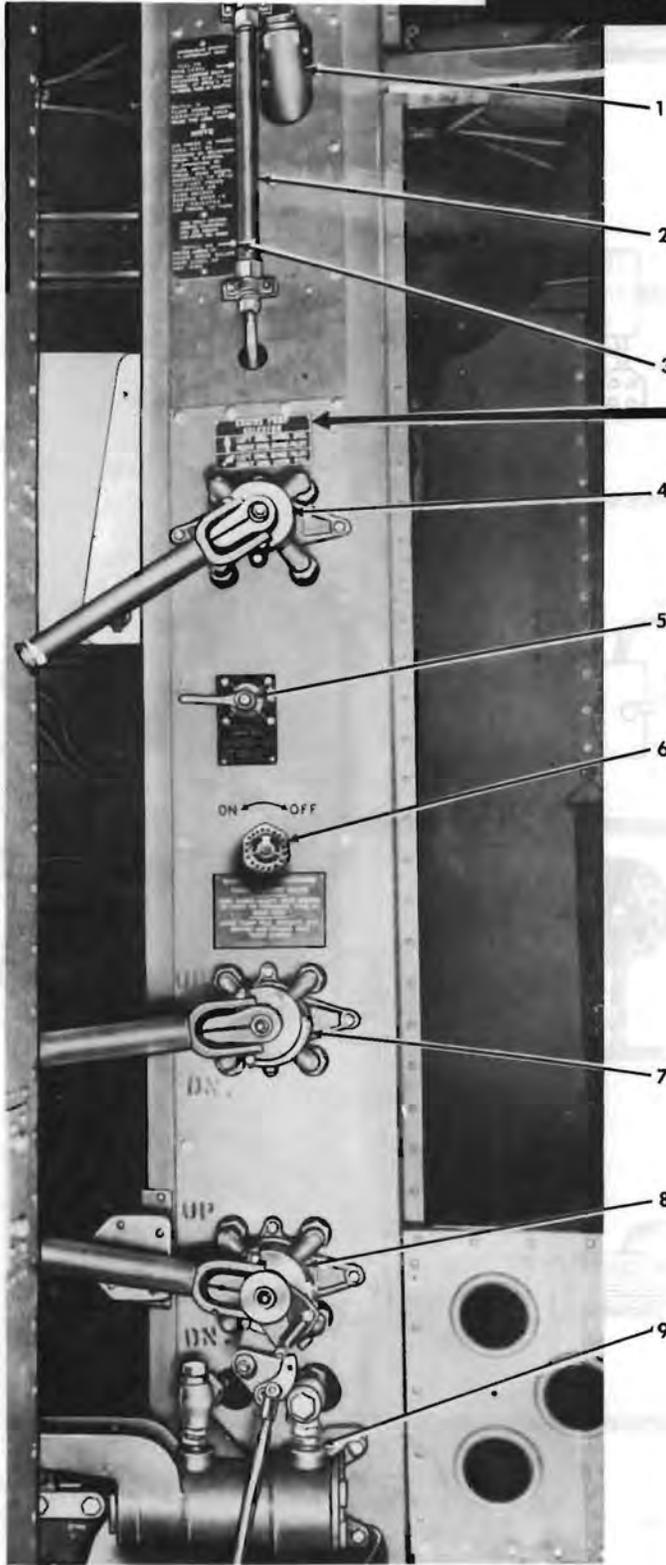
Figure 1-23 (Sheet 2 of 2)



T. O. 1C-47-1

Section I

HYDRAULIC CONTROL PANEL



ON AIRCRAFT MODIFIED TO T.O. 1C-47-507
OR T.O. 1C-1-514

1. HYDRAULIC FLUID RESERVOIR FILLER NECK
2. HYDRAULIC FLUID QUANTITY SIGHT GAGE
3. HYDRAULIC FLUID RESERVOIR FILLING INSTRUCTIONS
4. HYDRAULIC PUMP SELECTOR VALVE
5. AUTOPILOT EMERGENCY SHUTOFF VALVE
6. STAR VALVE
7. WING FLAP CONTROL VALVE
8. LANDING GEAR CONTROL VALVE
9. HYDRAULIC HAND PUMP

Figure 1-24



Figure 1-25

WING FLAPS.

The metal wing flaps are composed of four sections which extend from the inboard end of the left wing aileron under the fuselage to the inboard end of the right wing aileron and are of the split trailing-edge type. The flaps are hinged to the under side of the center wing section, and are hydraulically lowered or raised as a unit. The flaps have a travel of 0 to 45 degrees. Wing flap movement is hydraulically controlled by a lever located in the cockpit. Movement of the flaps is indicated by the wing flap position indicator located in the cockpit.

WING FLAP CONTROL LEVER.

The wing flap control lever, located on the hydraulic control panel (7, figure 1-24), has UP, DOWN, and NEUTRAL positions. Movement of the control lever to the DOWN position directs hydraulic fluid pressure to the wing flap actuating cylinder downline to lower the flaps. When the control lever is placed in the UP position, the flow of fluid is reversed to raise the flaps. When the flaps are positioned UP or DOWN as required, the control lever should be returned to the NEUTRAL (halfway) position to trap the fluid in the actuating cylinders and hold the desired flap setting.

Wing Flap Position Indicator.

A mechanically actuated wing flap position indicator is mounted either vertically, at the left of the pilot's main instrument panel, or horizontally, on the bottom of the pilot's main instrument panel (5, figure 1-6 and 41, figure 1-12). Any movement of the wing flap actuating cylinder is shown by an equivalent move-

ment of the pointer on the indicator by means of a flexible steel wire, sheathed in a tube and connected to the actuating cylinder at one end and to the indicator needle at the other end. The placarded positions indicated are UP $-\frac{1}{4}$ $-\frac{1}{2}$ $-\frac{3}{4}$ -DOWN.

LANDING GEAR SYSTEM.

The landing gear consists of main landing gear and a tail gear. The hydraulically operated main gear is extended or retracted by two hydraulic actuating cylinders (figure 1-23), one located in each nacelle, and controlled by a lever located on the hydraulic control panel in the cockpit. A mechanical safety latch is provided to prevent inadvertent raising of the main landing gear. In the event of a landing gear hydraulic line failure, the gear will free fall when the landing gear control lever is moved to the DOWN position. The tail wheel is not retractable, but is full swiveling and can be locked in the trail position.

LANDING GEAR LEVER.

The landing gear lever, located on the hydraulic control panel (8, figure 1-24), has DOWN, NEUTRAL, and UP positions. Movement of the lever to the DOWN position directs hydraulic fluid pressure to the landing gear downline to extend the main gear. When the lever is placed in the UP position, the flow of fluid is reversed to the upline to retract the main gear. When the lever is in the NEUTRAL position, fluid flow is blocked to both the upline and the downline. When the main gear is extended or retracted as required, the lever should be returned to the NEUTRAL (halfway) position to hold the desired setting.

NOTE

The landing gear latch must be released (LATCH RAISED position) before the main gear can be retracted because a catch and dog prevent the landing gear lever from being moved into the UP position.

LANDING GEAR LATCH LEVER.

The landing gear safety latches for both main gear are controlled simultaneously by cables connected to the landing gear latch lever, located on the floor to the right of the pilot's seat (figure 1-25). The safety latch automatically latches to lock the landing gear when the landing gear is fully extended, by engaging a slot in the lower end of the actuating cylinder piston rod. For operation of the landing gear safety latch lever, see figure 1-26.

LANDING GEAR LATCH LEVER OPERATION

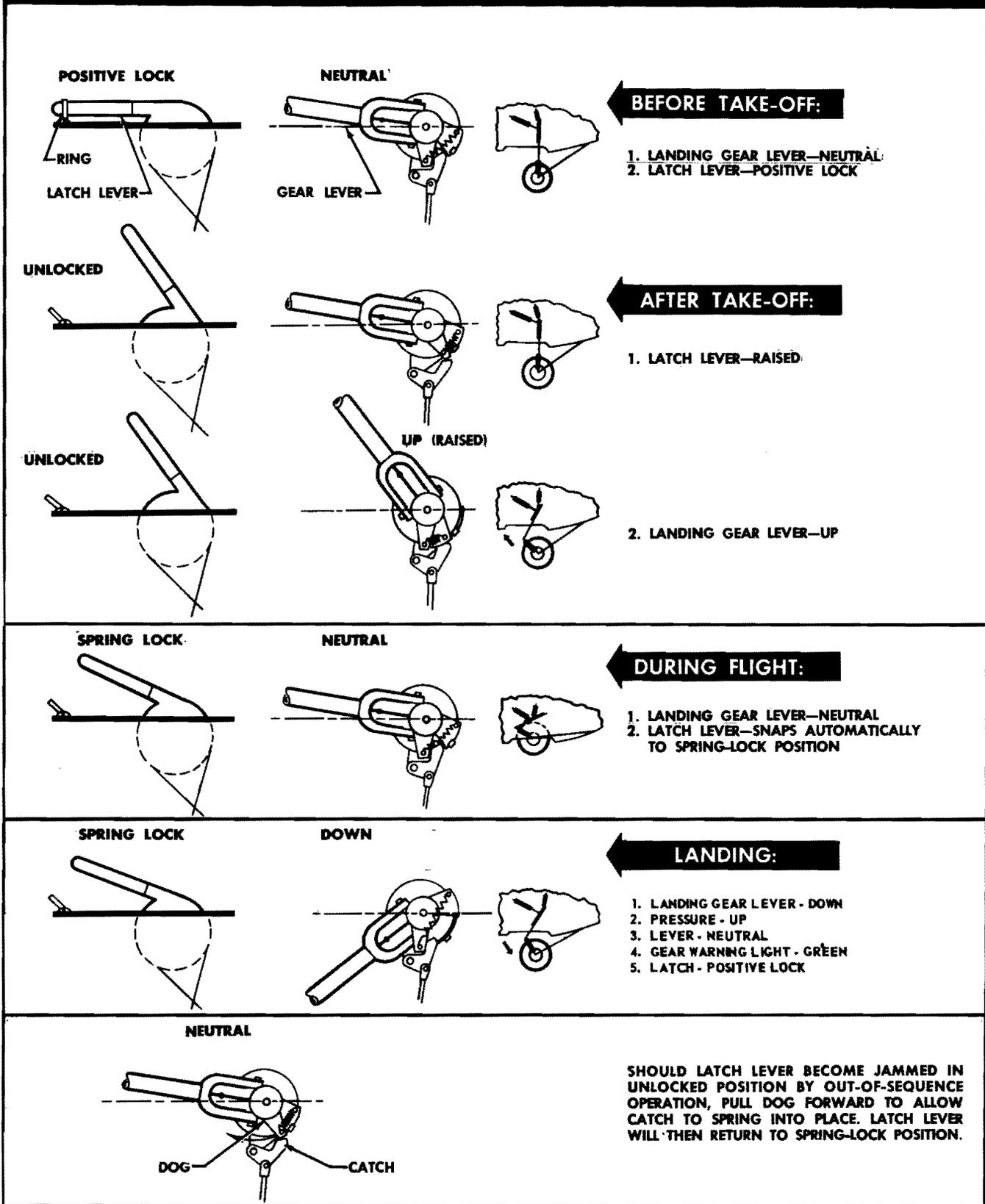


Figure 1-26

LANDING GEAR LATCH LEVER AND GEAR SAFETY PIN

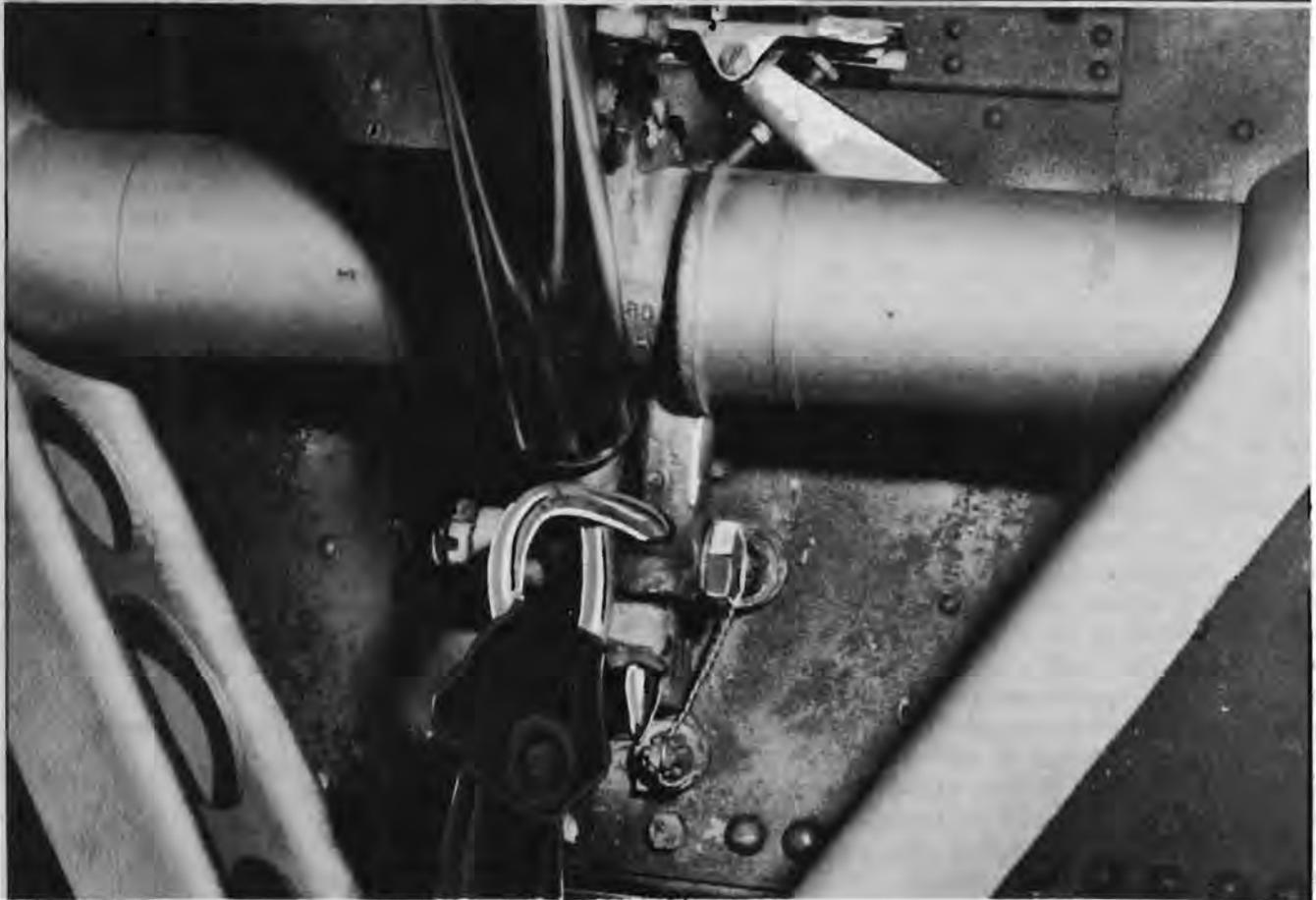


Figure 1-27

Landing Gear Safety Pins.

Landing gear safety pins are provided to prevent inadvertent retraction of the landing gear when the aircraft is on the ground (figure 1-27). When not installed, the safety pins are stowed in the canvas pocket on the aft bulkhead of the main cabin compartment (8, figure 1-1).

Landing Gear Indicator Lights.

The 28-volt d-c landing gear red and green indicator lights are located on the right side of the main instrument panel (18 and 20, figure 1-11, and 20 and 21, figure 1-12). 28-volt d-c microswitches are mounted next to the landing gear lever and on each main gear. These switches are actuated by movement of the landing gear lever and the main gear to indicate the position of the main gear and lever by means of the red and green indicator lights. The green light will be illuminated

when both main gears are down and locked and the lever is in the NEUTRAL position. If the landing gear is retracted, or in any intermediate position or down and unlatched, or the landing gear is down and latched with the lever not in NEUTRAL position, the red indicator light will be illuminated. The red indicator light will go out when the landing gear is down and locked and the lever is in the NEUTRAL position. On some aircraft, the red indicator light will go out when the gear is fully retracted.

Landing Gear Warning Horn.

The 28-volt d-c landing gear warning horn, located in the fuselage to the left of the pilot's seat, will sound when one or both throttles are less than approximately $\frac{1}{4}$ open and the landing gear is not down and locked with the lever in the NEUTRAL position, or when the landing gear lever is not in the NEUTRAL position. No switch is provided for silencing the horn.

Tail Wheel Lock Lever.

The mechanically operated tail wheel lock lever is located on the control pedestal below the throttle levers (12, figure 1-10), and has LOCK and UNLOCK positions. The LOCK position locks the tail wheel in the trailing position for take-offs and landings; the UNLOCK position allows free swiveling of the wheel for taxiing.

NOTE

The tail wheel must be in the centered position before the tail wheel lock pin will engage the tail wheel in the LOCK position.

SKIS.

The ski installation provides a ski for each main gear and one for the tail gear. The main skis are designed for a gross weight of 15,000 pounds each. The tail ski is designed for a gross weight of 4000 pounds. The main skis add approximately 1026 lb. to the gross weight and the tail ski adds approximately 61 pounds to the aircraft gross weight. The main skis are allowed a maximum pitching range from normal, of approximately 20° negative to 15° positive, enabling the skis to follow uneven terrain while taking-off, taxiing, or landing. The pitching range is controlled by limiting cables to prevent the skis from overtraveling their maximum safe operating limits. When the main landing gear is up and the skis are retracted on the wheels, the skis rest against the bottom of each nacelle. Two rubber bumper pads are installed on each ski to prevent vibration or damage when the skis and landing gear are both retracted. During flight when the main gear is extended, the main skis are held in proper position by means of aerodynamic riggers. These riggers consist of airfoils attached to the aft section of the skis. The main skis may be extended or retracted permitting the airplane to take-off and land on a clear runway, as well as on one covered with ice or snow. When the skis are retracted, the tires extend approximately 8 inches below the bottom surface of the skis. The tail ski is not retractable. Limiting cables installed fore and aft prevent pitching beyond safe angles of incidence and lateral rotation. A mechanical rigger holds it in the proper flight position.

SKI SELECTOR HANDLE.

A 3-position ski selector handle is installed on the floor below the control pedestal to provide for retraction and extension of the main wheel skis. When the selector is turned to the SKI UP position, the

control valve is positioned to direct hydraulic fluid pressure to the up side of the actuating cylinder for retracting the skis. Turning the selector handle to SKI DOWN, directs hydraulic fluid pressure to the down side of the actuating cylinder to extend the skis. When the selector is turned to the NEUTRAL position, pressure and return fluid is locked in the lines, preventing movement of the skis from the set position.

BRAKE SYSTEM.

The main landing gear wheel hydraulic brakes may be applied independently or simultaneously by means of two brake control valves, which are contained in a single housing and linked to the rudder brake pedals. Application of toe pressure on the rudder brake pedals allows hydraulic fluid under pressure to flow through the brake control valves and brake operating lines to the brake actuating cylinders. The brake actuating pistons force the brake shoes against the brake drums to produce the braking action. The pressure applied to the brakes is proportional to the toe pressure applied to the rudder pedals. When the rudder brake pedal is released, springs return the brake shoes to the off position, and the excess hydraulic fluid flows through the brake operating line to the brake control valve and into the return line to the hydraulic reservoir. A parking brake mechanism is provided to hold the brakes on when the aircraft is parked.

HYDRAULIC BRAKE CONTROLS.

The hydraulically operated brakes are controlled by toe pressure on the rudder brake pedals. Full braking action is possible even when the landing gear is retracted.

Parking Brake Control Knob.

The main wheel brakes may be locked on for parking by means of the mechanical parking brake control knob mounted on the lower portion of the control pedestal (7, figure 1-10). To set the parking brake, the pilot's rudder brake pedals should be fully depressed and the parking brake control knob pulled out. The rudder brake pedals should be released before the parking brake control knob is released. To release the parking brake, toe pressure should be applied on the rudder brake pedals. The brakes on both wheels should be locked and released simultaneously.

NOTE

The parking brakes are locked and released by use of the pilot's rudder brake pedals only.

INSTRUMENTS.

The dual manifold pressure gage is a direct-reading instrument. The free air temperature indicator is electrically operated. The vacuum-operated instruments include the attitude indicator, the directional indicator, and the turn-and-slip indicator. For proper operation of the vacuum instruments, engine rpm should be at least 1000.

VACUUM SYSTEM.

The vacuum system consists of two engine-driven vacuum pumps, two vacuum relief valves, two check valves, a vacuum manifold, two air filters, a vacuum restrictor for the turn-and-slip indicator, and the connecting lines. A direct-pressure-operated vacuum gage mounted on the main instrument panel (10, figures 1-11 and 13, figure 1-12) indicates the vacuum pressure in inches Hg. (See the paragraph on the Autopilot, Section IV.)

PITOT-STATIC SYSTEM.

The pitot-static system instruments and equipment consist of two airspeed indicators, two altimeters, and a vertical velocity indicator, all installed on the main instrument panel (figures 1-11 and 1-12); and two pitot-static tubes mounted on masts on the underside of the fuselage nose section (21, figure 1-1), a static selector, and the connecting lines. The static selector control switch mounted on the main instrument panel (21, figure 1-11, and 25, figure 1-12), provides for selection of an alternate static source (16, figure 1-1) in the event of malfunctioning of the normal static source. On some aircraft, the alternate static source is located in the left aft fuel tank bay. The selector switch is safetywired to the normal static source. The pitot-static tubes are protected from ice by integral heating elements.

ELECTRICALLY OPERATED INSTRUMENTS. (Some Aircraft).

The attitude indicator and the directional indicator are driven by AC power. The turn and slip indicator is driven by DC power and has a separate switch directly to the battery. Reference, Ground Test Power switch, this section.

FREE AIR TEMPERATURE INDICATOR.

One 28-volt d-c free air temperature indicator is mounted on the main instrument panel (12, figure 1-11, and 17, figure 1-12). The indicator is connected to the thermometer resistance bulb on the underside of the nose section so that changes in the temperature of the outside air will be registered on the indicator face by means of changes in the electrical current

between the bulb and the indicator. The indicator is calibrated in degrees centigrade.

EMERGENCY EQUIPMENT.

FIRE EXTINGUISHING SYSTEM.

The aircraft is equipped with a single-shot bromochloromethane (CB) engine fire extinguishing system. The system incorporates two CB spherical containers, one located in each engine nacelle (24, figure 1-1), the necessary piping for routing the agent to the spray ring mounted on each engine, and the controls for operation of the system. Each CB container is pressurized with nitrogen to 410 psi standard day and incorporates a pressure gage for checking pressure within the container. A fire detection circuit is also provided for each engine.

NOTE

The CB fire extinguishing system is connected directly to the batteries and will operate regardless of battery switch position.

Two portable hand fire extinguishers, one mounted on the bulkhead above the pilot's seat, and one mounted on the rear section of the main cabin door or, on C-117 series aircraft, immediately forward of the passenger entrance door, are provided for combating fires in the fuselage.

WARNING

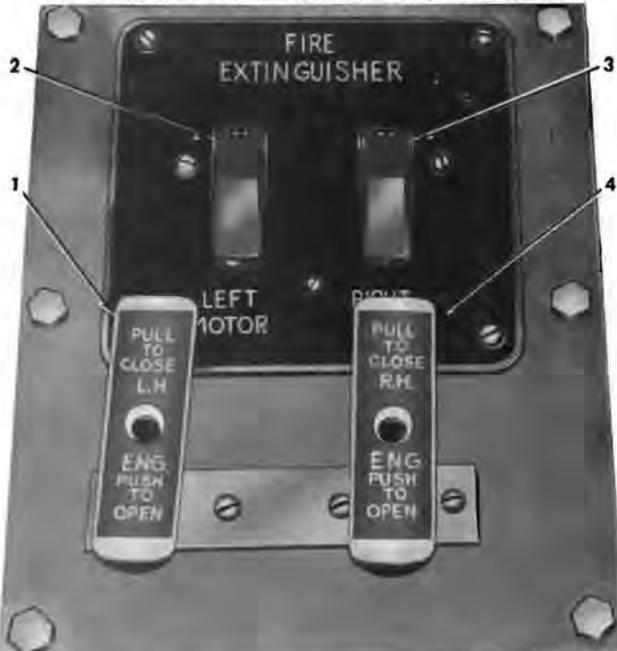
Prolonged exposure (5 minutes or more) to high concentrations of bromochloromethane (CB) or its decomposition products should be avoided. CB is an anesthetic agent of moderate intensity. It is safer to use than previous fire extinguishing agents (carbon tetrachloride or methylbromide). However, especially in confined spaces, adequate respiratory and eye protection from excessive exposure (pronounced irritation of eyes and nose), including the use of oxygen when available, should be sought as soon as the primary fire emergency will permit.

Engine Fire Extinguisher Switches.

Two guarded ON-OFF fire extinguisher switches (2 and 3, figure 1-28), one for the left engine and one for the right engine, are located under the hinged

ENGINE FIRE EXTINGUISHER CONTROLS

LOCATED: COCKPIT FLOOR BETWEEN PILOTS' SEATS



1. LEFT ENGINE FIREWALL SHUTOFF VALVE HANDLE
2. LEFT ENGINE FIRE EXTINGUISHER DISCHARGE SWITCH
3. RIGHT ENGINE FIRE EXTINGUISHER DISCHARGE SWITCH
4. RIGHT ENGINE FIREWALL SHUTOFF VALVE HANDLE

Figure 1-28

door on the flight compartment floor between the pilot's and co-pilot's seats. When either switch is placed in the ON position, a 28-volt d-c circuit is energized to discharge the CB agent to the respective spray ring around the engine.

CB Container Pressure Gages.

A pressure gage mounted on each CB container indicates the charge in psi within the container. When the container is fully charged the indicator should read 410 psi standard day.

Firewall Shutoff Valve Handles.

The firewall shutoff valve handles for shutting off the flow of fuel, engine oil, and hydraulic fluid are located under the engine fire extinguisher access door between the pilot's and co-pilot's seats (1 and 4, figure 1-28). The shutoff valves are connected by cables to the handles. In case of fire in either engine, the corresponding handle is pulled, shutting off the flow of fuel, engine oil, and hydraulic fluid to that engine.

NOTE

When a firewall shutoff valve handle is actuated, oil for propeller feathering and hydraulic pressure for cowl flap operation is still available.

ENGINE FIRE DETECTION WARNING SYSTEM. (IF INSTALLED).

Two 28-volt d-c fire detection press-to-test warning lights, one for each nacelle, are located on the main instrument panel (9, figure 1-11). The system has a thermocouple circuit for detecting fire. When either engine fire detector circuit detects fire, the respective fire warning light for that circuit illuminates.

PILOT'S SEAT



1. MOVABLE ARM REST
2. VERTICAL ADJUSTMENT LEVER
3. FORWARD AND AFT ADJUSTMENT CONTROL

Figure 1-29

A circuit breaker for the fire detection system is provided on the upper right side of the main junction box.

Fire Detector Test Switch.

A 28-volt d-c fire detector pushbutton test switch, located adjacent to the warning lights, provides a method of checking the fire detection warning circuits. When the test switch is held in for 10 seconds or less, both warning lights should illuminate. If the warning lights do not illuminate when the test switch is held in, the circuit is defective.

ALARM AND WARNING SYSTEM.

An emergency warning bell is mounted on the left side of the main cargo compartment forward bulkhead. The bell is operated by a 28-volt d-c switch mounted on the electrical control panel (24, figure 1-13 and 1, figure 1-14); on some aircraft it is wired directly to the aircraft batteries, and on other aircraft to the main junction box bus. See Section III for Emergency Alarm Bell Procedures.

FIRE EXTINGUISHER SYSTEM (R4D-7).

The aircraft is equipped with a one-shot, mechanically controlled CO₂ fire extinguisher system for the protection of each engine accessory section. Strategically located fire detectors actuate fire warning lights on the main instrument panel. A yellow celluloid indicator is mounted on the right side of the fuselage nose section skin, to indicate manual discharge of CO₂.

FIRE EXTINGUISHER SELECTOR VALVE CONTROL (R4D-7).

A three position fire extinguisher selector valve control is located under an access door in the floor between the pilot's and co-pilot's seat for selecting engine for CO₂ discharge.

DISCHARGE CONTROL HANDLE (R4D-7).

One CO₂ discharge control handle is located under an access door in the floor between the pilot's and co-pilot's seats.

LIFE RAFTS (C-47 AND R4D SERIES AIRCRAFT).

Provision is made from stowage of suitable life rafts on the right side of the main cabin compartment (5, figure 3-3).

EXTENSION LADDER.

A 3-section extension ladder is stowed on the aft side of the forward baggage compartment bulkhead.

When fully extended, it provides a means for emergency exit or entrance through the small baggage door.

EMERGENCY TRANSMITTER.

The aircraft is equipped with an emergency radio transmitter which is strapped on the bulkhead next to the cargo door.

EMERGENCY EXITS (C-47 AND R4D SERIES AIRCRAFT).

The five emergency exits consist of the hatch above the pilot and co-pilot, the forward panel of the main cargo door; the fifth window aft on both sides of the main cargo compartment, and the small baggage door in the forward baggage compartment (figure 3-5).

EMERGENCY EXITS (C-117 SERIES AIRCRAFT).

The six emergency exits include the hatch above the pilot and co-pilot, the small baggage door in the forward baggage compartment, the fifth and sixth windows aft on the right side of the main cabin, the fifth window aft on the left side of the main cabin, and the main cabin entrance door (figure 3-5).

MISCELLANEOUS EMERGENCY EQUIPMENT.

The following miscellaneous emergency equipment is shown on figure 3-3.

Hand fire extinguishers.

First aid kits.

Fire axe.

Pyrotechnic pistol (C-47 and R4D series aircraft).

Parachute stowage (C-47 and R4D series aircraft).

Parachute flare release tubes (SC-47 and C-117 series aircraft).

ENTRANCE DOORS.

Entrance to the aircraft is normally made through the forward cargo (passenger) loading door, located on the aft left side of the fuselage. External and internal latch handles, located on the aft end of the forward door, are provided for latching or unlatching the door. A clip is provided to secure the door against the fuselage when fully opened. If entry through the cargo doors is not feasible, an extension ladder is provided for entrance through the small forward baggage loading door, located on the left side of the fuselage immediately aft of the pilot's station. A door open warning light is installed on the extreme right hand side of the instrument panel (figure 1-11 and 1-12) to indicate when either or both of the doors is not correctly locked.

PILOTS' SEATS.

The pilot's and co-pilot's seats (figure 1-32) provide forward, aft, and vertical adjustments. The inboard armrest of each seat can be pivoted to provide easy access to the seat.

PILOTS' SEAT FORWARD AND AFT ADJUSTMENT CONTROLS.

A short cable at the lower right of the pilot's seat and the lower left of the co-pilot's seat (3, figure 1-29) operates the horizontal release catch to adjust the seat forward or aft on two horizontal tracks. Adjustment is accomplished by shifting body weight as required.

PILOTS' SEAT VERTICAL ADJUSTMENT LEVERS.

A lever at the left of the pilot's seat and the right of the co-pilot's seat (2, figure 1-29) operates the vertical release catch to adjust the seat vertically on vertical tracks. The seat is raised by bungees when the vertical adjustment catch is released.

Adjustment is accomplished by increasing or decreasing body weight as required.

AUXILIARY EQUIPMENT.

The following auxiliary equipment is described in Section IV:

- Heating and ventilating system.
- Anti-icing and deicing systems.
- Oxygen systems.
- Communication equipment.
- Autopilot.
- Navigation equipment.
- Lighting system.
- Cargo tie-down provisions.
- Casualty carrying provisions.
- Cargo loading equipment.
- Troop carrying equipment.
- Passenger carrying equipment.
- Auxiliary power plant (APP).
- Miscellaneous equipment.
- Loudspeaker system (SC-47).