T.O. 1C-45H-1

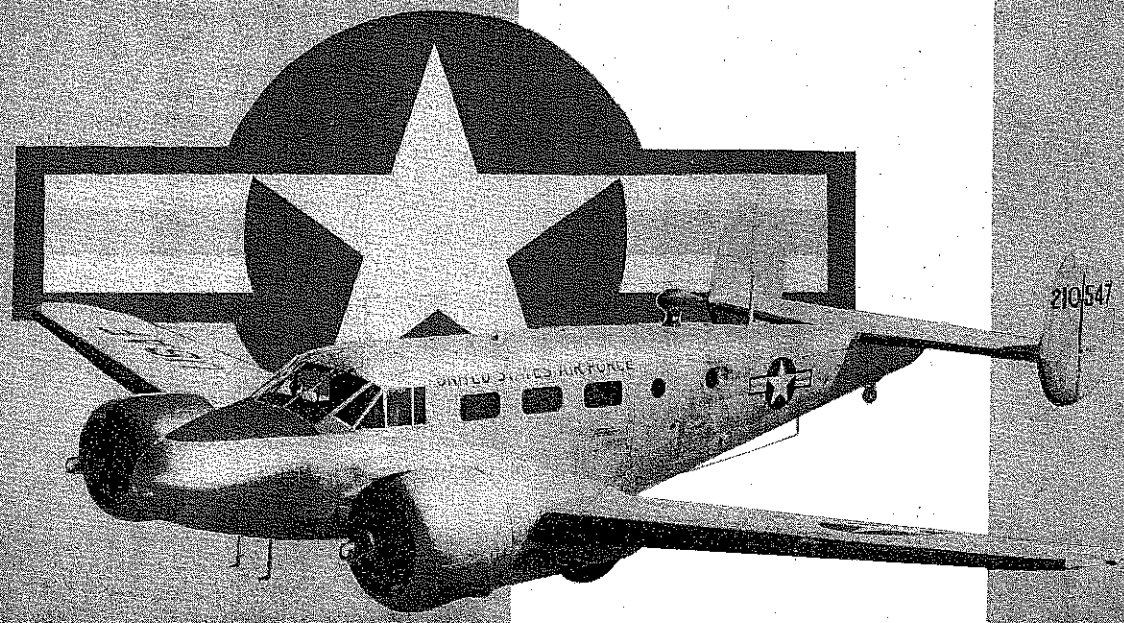
(FORMERLY AN 01-90 CDC-1)

FLIGHT HANDBOOK

USAF SERIES

C45H

AIRCRAFT



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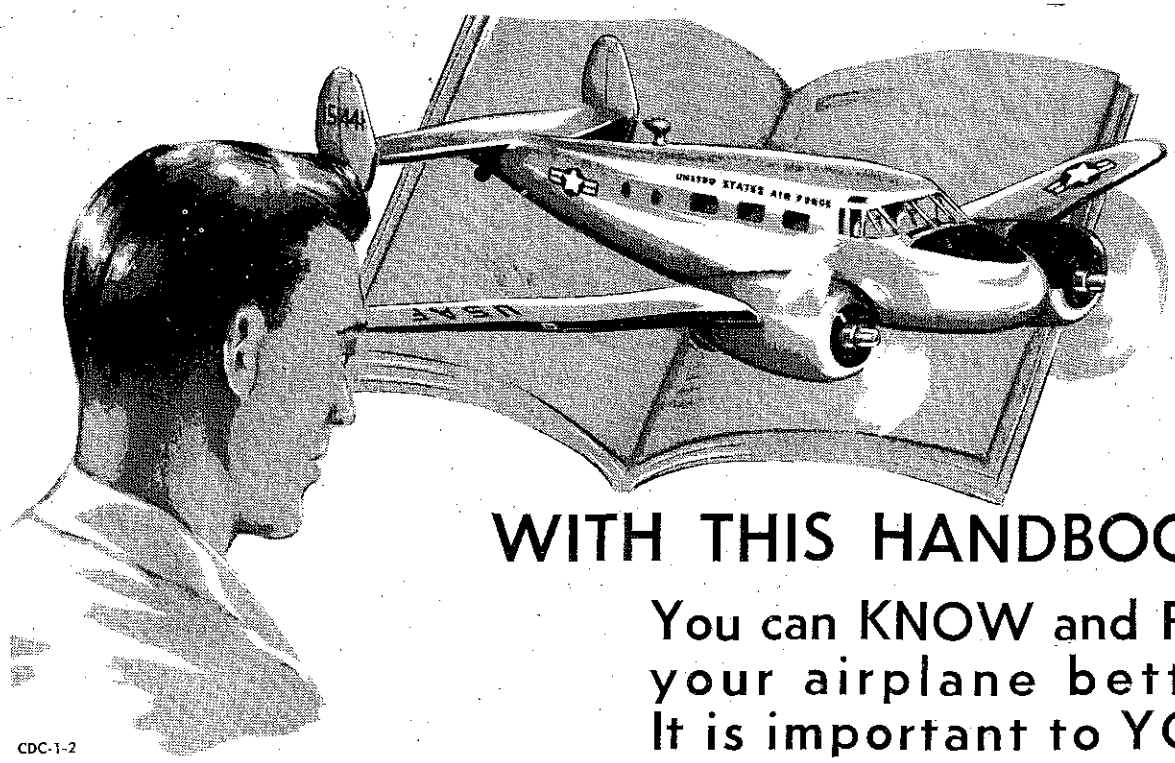


CDC-1-2

WITH THIS HANDBOOK···

You can KNOW and FLY your airplane better. It is important to YOU

This handbook contains all the information necessary for safe and efficient operation of the C-45H. These instructions do not teach basic flight principles, but are designed to provide you with a general knowledge of the airplane, its flight characteristics, and specific normal and emergency operating procedures. Your flying experience is recognized, and elementary instructions have been avoided.

The instructions in this handbook are designed to provide for the needs of a crew inexperienced in the operation of this aircraft. This book provides the best possible operating instructions under most circumstances, but it is a poor substitute for sound judgment. Multiple emergencies, adverse weather, terrain, etc., may require modification of the procedures contained herein.

Once you have learned to use one Flight Handbook, you will know how to use them all — closely guarded standardization assures that the scope and arrangement of all Flight Handbooks are identical.

These Flight Handbooks are constantly maintained current through an extremely active revision program. Frequent conferences with operating personnel and constant review of UR's, accident reports, flight test reports, etc., assure inclusion of the latest data in these handbooks. In this regard, it is essential that you do your part! If you find anything you don't like about the book, let us know right away. We cannot correct an error whose existence is unknown to us. Each flight crew member, EXCEPT THOSE ATTACHED TO AN ADMINISTRATIVE BASE, is entitled to have a personal copy of the Flight Handbook. *Air Force Regulation* 5-13 specifically makes that provision. Flexible, loose leaf tabs and binders have been provided to hold your personal copy of the Flight Handbook. These good-looking, simulated-leather binders will make it much easier for you to revise your handbook as well as to keep it in good shape. These tabs and binders are secured through your local contracting officer.

If you want to be sure of getting your handbooks on time, order then before you need them. Early ordering will assure that enough copies are printed to cover your requirements.

TECHNICAL ORDER 0-5-2 explains how to order Flight Handbooks so that you automatically will get all revisions, reissues, and Safety of Flight Supplements. Basically, all you have to do is order the required quantities in the PUBLICATION REQUIREMENTS TABLE (T. O. 0-3-1). Talk to your base supply officer — it is his job to fulfill your Technical Order requests. Make sure to establish some system that will rapidly get the books to the flight crews once they are received on the base.

For your information, the warnings, cautions, and notes found throughout the handbook bear the following connotation:

WARNING — Injury to personnel

CAUTION — Damage to equipment

NOTE — Information requiring

Comments and questions regarding any phase of the Flight Handbook program are invited and should be

addressed to the Directorate of Systems Management, Headquarters Air Research and Development Command, Attention RDZSTH, Detachment #1, Wright-Patterson Air Force Base, Ohio.

Section I. DESCRIPTION. Here is described the aircraft and the location and function of those controls and systems which are essential to flight. Also discussed in this section are the locations and descriptions of all items of emergency equipment which are not part of an auxiliary system.

Section II. NORMAL PROCEDURES. This section contains operating instructions arranged in proper sequence to be followed from the time the flight crew approaches the airplane until it is left parked on the ramp after the completion of a normal flight.

Section III. EMERGENCY PROCEDURES. This section contains concise instructions to be followed in meeting any emergency (except those involving operational equipment) that can reasonably be expected.

Section IV. DESCRIPTION AND OPERATION OF AUXILIARY EQUIPMENT. This section contains a description, plus all normal and emergency operating instructions for equipment and systems not actually essential to the flight of the airplane.

Section V. OPERATING LIMITATIONS. This section includes operating limitations of the aircraft that must be observed during all operating conditions.

Section VI. FLIGHT CHARACTERISTICS. This section describes the general flight characteristics of the airplane.

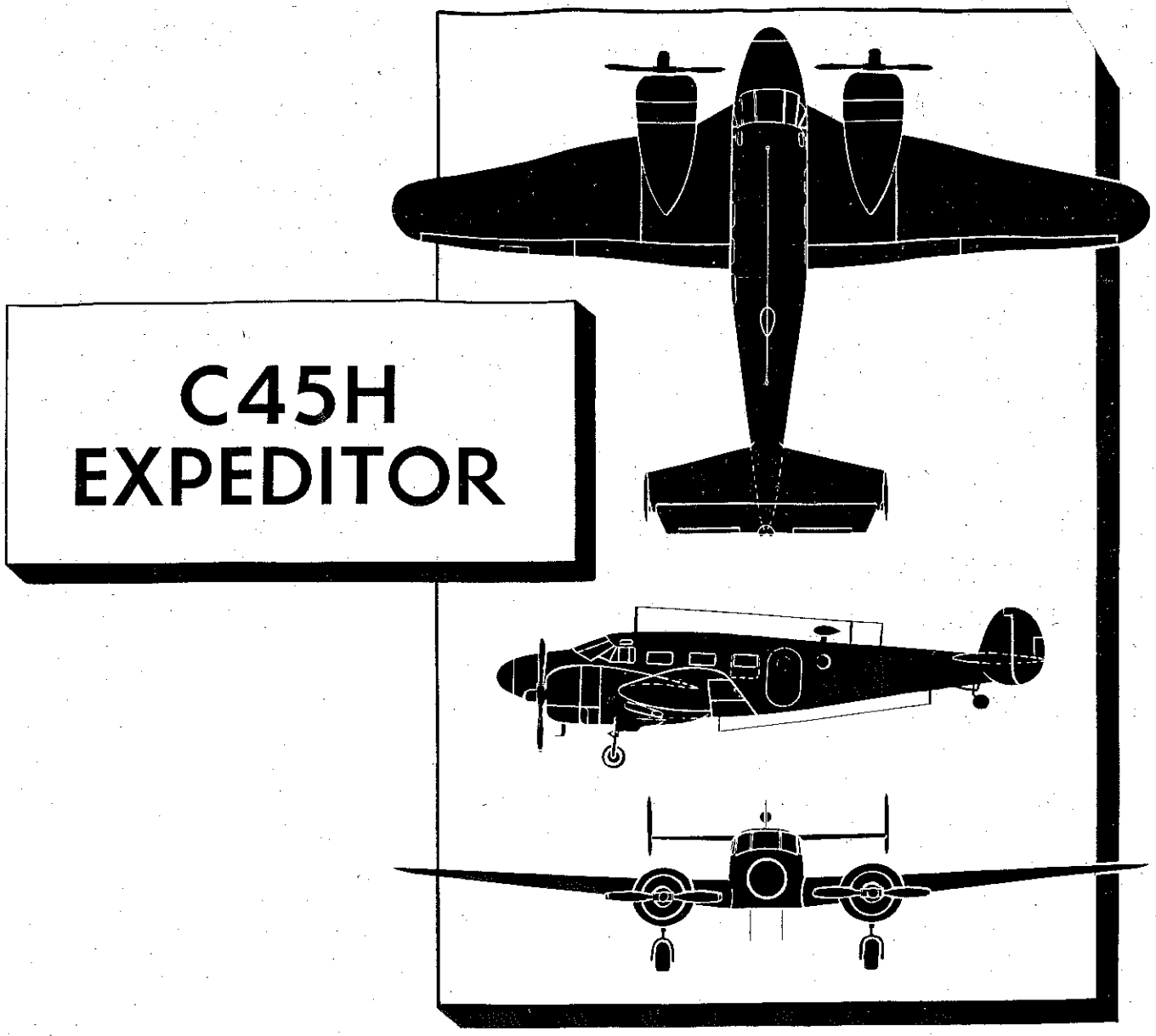
Section VII. SYSTEMS OPERATION. This section discusses the operation and characteristics of specific aircraft systems under various conditions of aircraft operation.

Section VIII. CREW DUTIES. Since the Model C-45H airplane may be flown by one pilot, this section is not applicable.

Section IX. ALL-WEATHER OPERATION. This section covers the proper procedures and techniques to be employed during night flight, instrument flight, turbulent air flight and extreme cold and hot weather operation.

APPENDIX I. PERFORMANCE DATA. This appendix contains all operating data graphs necessary for pre-flight and in-flight mission planning and includes explanatory text and sample problems for the data presented.

C45H EXPEDITOR



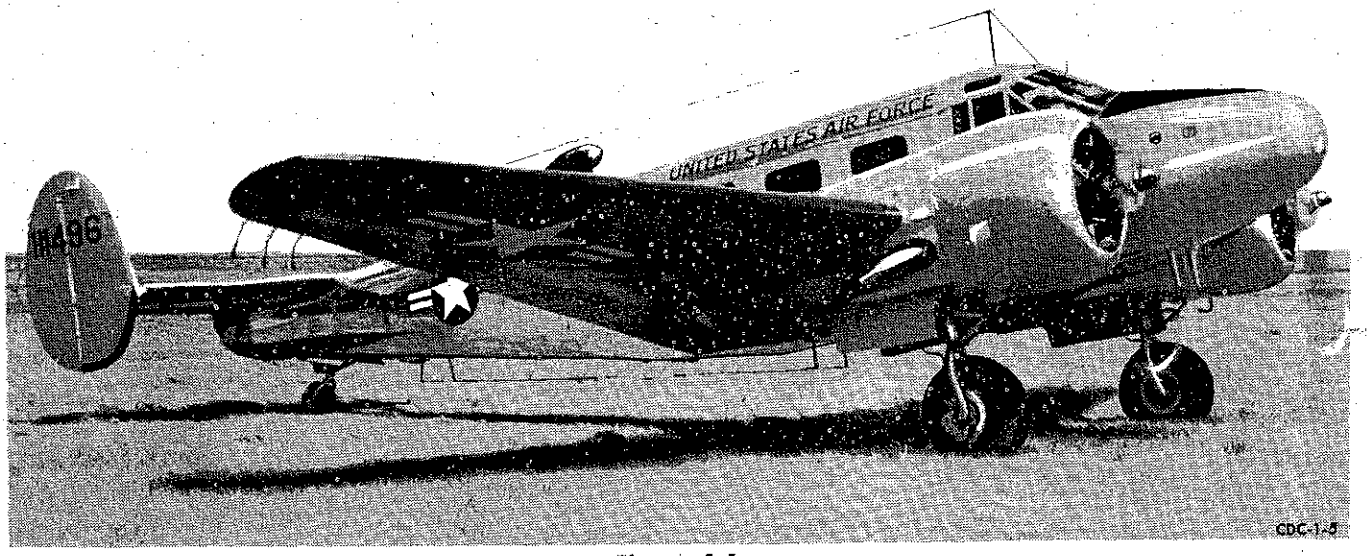
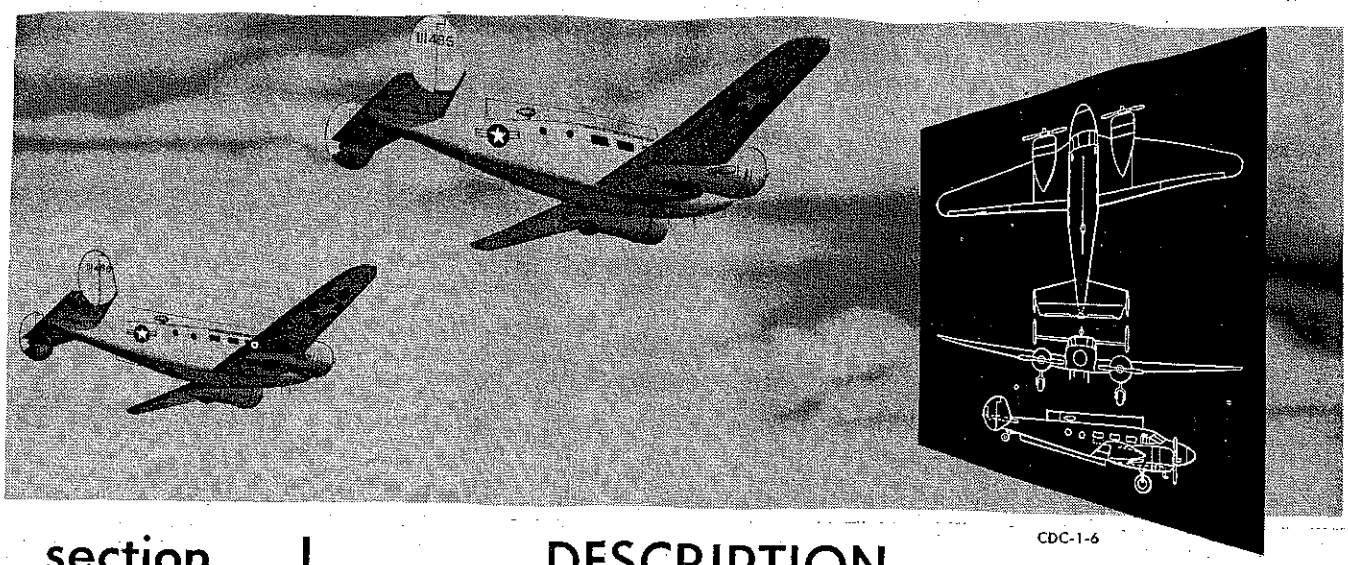


Figure 1-1



CDC-1-6

section I DESCRIPTION

THE AIRCRAFT.

The C-45H is a twin engine, low wing, land monoplane manufactured by the Beech Aircraft Corporation. This aircraft, as modified, differs only slightly from the C-45G; however, it is greatly improved, structurally and aerodynamically, where compared with the earlier C-45B and C-45F models.

Basic design and configuration remains unchanged except as noted in the Main Differences Tables, figure 1-2.

The primary mission of the aircraft is personnel transportation and four seats for passengers are provided in the cabin.

Although dual controls and dual flight instrumentation are provided, the aircraft can be safely and efficiently operated by one pilot from the left pilot seat.

Dual flight instrumentation, plus interior and exterior lighting are provided for safe and efficient operation at night or under instrument conditions.

DIMENSIONS.

The following are approximate dimensions of the aircraft:

Wing Span	47 ft. 8 in.
Length	34 ft. 2 in.
Height	9 ft. 2 in.
Tread (Main Wheels)	12 ft. 10 in.

GROSS WEIGHT.

The approximate gross take-off weight of the aircraft is 9300 pounds. Reference should be made to Section V for a complete discussion of conditions created by various loadings.

ENGINES.

The aircraft is powered by two R-985-AN-14B, 9-cylinder, single row, radial, air cooled engines. The engines have direct propeller drive and incorporate a noncontrollable, single speed, single stage blower which operates whenever the engine is running. Engine controls are mounted on the control pedestal (figure 1-5) and are easily accessible to either pilot.

THROTTLES.

The throttles (figure 1-5), mounted on the pedestal, are mechanically linked to the carburetors. The throttle friction lock (figure 1-5), between the throttles, prevents creeping from any desired position by increasing friction on the levers. Upward movement of the lock handle increases, while downward movement decreases, the friction. Switches which close the circuit to the landing gear warning horn and the landing gear malfunction light, are actuated by the throttles when they are retarded to a position which corresponds to approximately 12 inches of manifold pressure.

MIXTURE LEVERS.

The mixture levers (figure 1-5), located on the pedestal, are mechanically linked to the mixture control valves in the carburetor. They are used for manually changing the fuel-air mixture to the engine to obtain efficient engine operation and maximum fuel economy. The fully advanced position is FULL RICH, while the fully retarded position is the IDLE-CUT-OFF position. The FULL RICH position provides the high fuel air ratios needed for high power operation such as take-off and landing (in the case of a go-around). The IDLE-CUT-OFF position shuts off all fuel flow to the engine except through the priming system.

The mixture lever friction lock (figure 1-5) on the right side of the pedestal is the same in operation as the throttle lock; it also applies friction to the oil shutter levers.

MANIFOLD HEAT LEVERS.

The manifold heat levers (figure 1-5), located on the

MAIN DIFFERENCES TABLE

ITEM	C-45B, F	C-45G	C-45H	TC-45G
Nacelle	Short Upper Section	Upper Section Extender	Upper Section Extender	Upper Section Extender
Center Section Leading Edge		Leading Edge Extended Between Fuselage and Nacelles	Leading Edge Extended Between Fuselage and Nacelles	Leading Edge Extended Between Fuselage and Nacelles
Cabin Interior	5 Passenger Seats	4 Passenger Seats	4 Passenger Seats	3 Navigation Positions
Oxygen Equipment	2 Type G-1 Cylinders on Some Aircraft	3 Type G-1 Cylinders	None	3 Type G-1 Cylinders
Propeller	Hamilton Standard Constant Speed (Aeroproducts Full Feathering on Some Aircraft)	Aeroproducts Full Feathering	Hamilton Standard Hydramatic Full Feathering	Aeroproducts Full Feathering
Emergency Fuel Pump	Hand Operated Wobble Pump	Electric Fuel Booster Pumps (Front Wing Tanks Only)	Electric Fuel Booster Pumps (Front Wing Tanks Only)	Electric Fuel Booster Pumps (Front Wing Tanks Only)
Landing Gear	Welded Steel Shock Strut Fork Retractable Tail Wheel	Formed Steel Tube Shock Strut Fork Retractable Tail Wheel	Formed Steel Tube Shock Strut Fork Retractable Tail Wheel	Formed Steel Tube Shock Strut Fork Retractable Tail Wheel
Brakes	Bendix Internal	Goodyear External Single Disc Key or Gear Type	Goodyear External Single Disc Key or Gear Type	Goodyear External Single Disc Gear Type
Auto Pilot	A3 Sperry or A-3A Jack & Heintz on Most Aircraft	A-3A Jack & Heintz	None	A-3A Jack & Heintz
Upper Exterior Fuselage	No Astrodome	No Astrodome	No Astrodome	Astrodome
Engine Fire Extinguisher	CO_2	CO_2	CB	CO_2
Ignition Switches	Off in Vertical Position	Off in Horizontal Position	Off in Horizontal Position	Off in Horizontal Position

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Figure 1-2

pedestal, employ mechanical linkage to the manifold heat valves at the base of the carburetor throats. The full up position of the levers is the COLD position and full down is the HOT position, with intermediate positions delivering mixed hot and cold air. Air for carburetor anti-icing is ducted from inlets between the engine cylinders to muffs around the exhaust collector ring. It is heated and then ducted to the carburetor intake, where it is either dumped overboard or directed into the carburetor, depending on the position of the manifold heat valves. Heat will be used only when the mixture temperature is in the icing range, temperatures below the icing range should not necessarily be avoided.

The manifold heat lever friction lock (figure 1-5), on the left side of the pedestal, is the same in operation as the throttle friction lock. It is also used to apply friction to the propeller levers.

COWL FLAP HANDLES.

The cowl flap handles (figure 1-6), on the left side of the pedestal, are mechanically linked to the cowl flaps on the lower portion of the engine cowling. The handles have a lock incorporated in their housings, which lock the handles, and also the cowl flaps in the desired position. Turning the handles one quarter turn clockwise will disengage the lock, allowing the handles to be repositioned. The full out position of the handles is the FULL OPEN, or maximum engine cooling, position of the cowl flaps; and full in on the handle is the FULL CLOSED position. There is also a slightly open, or "TRAIL" position, which allows sufficient air flow for adequate cooling at reduced airspeeds.

IGNITION SWITCHES.

The ignition switches (figure 1-7) on the left subpanel are the conventional individual engine ignition switches which incorporate a master on-off switch.

STARTING SYSTEM.

The starting system employs a direct drive electric starter, an ignition booster coil and an electric primer for each engine. One set of controls operates both systems and is routed through the engine selector switch to the units of the engine being started.

ENGINE SELECTOR SWITCH.

The engine selector switch (figure 1-7) on the left

subpanel, used to select the engine for starting, has LEFT ENGINE-OFF-RIGHT ENGINE positions. When moved to either engine position, it completes the electrical circuits between the starter, primer and ignition booster switches and their respective units on the engine selected. When the engine selector switch is in the OFF position, the control switches are inoperative.

STARTER SWITCH.

The starter switch (figure 1-7) under the safety cover on the left subpanel is a push-button switch which energizes the starter as selected by the engine selector switch.

PRIMER SWITCH.

The primer switch (figure 1-7) located under the safety cover on the left subpanel, is a push-button switch electrically connected to the priming solenoid through the engine selector switch. When the primer switch is depressed, it opens the priming valve, allowing raw fuel under boost pump pressure to enter the top five cylinders of the engine selected. The primer switch is also electrically connected to the fuel booster pumps through the engine selector switch and will activate both booster pumps regardless of the position of the fuel booster pump switch. However, fuel will be delivered only to the engine selected since only that primer solenoid valve will be open.

IGNITION BOOSTER SWITCH.

The ignition booster switch (figure 1-7), under the safety cover on the left subpanel, is a push-button switch which, through the engine selector switch, activates the ignition booster coil of the engine selected. Since output of the magnetos is very low at the slow speeds encountered in starting, the induction vibrator has been incorporated in the ignition system to boost the voltage for easier starting.

ENGINE INSTRUMENTS.

ENGINE GAGE UNITS.

An engine gage unit for each engine is mounted on the instrument panel. These instruments utilize direct pressure lines to indicate fuel and oil pressure in pounds per square inch; and a temperature bulb, dependent on the aircraft electrical system, to indicate oil temperature in degrees centigrade.

MANIFOLD PRESSURE GAGE.

This instrument, mounted on the instrument panel, is a dual gage furnishing, in inches Hg, an indication of the pressure within the intake manifold of each engine. A direct pressure line connects the gage to each engine.

TACHOMETER.

The tachometer, also on the instrument panel, is a dual instrument using self generated current, completely independent of the aircraft electrical system, to indicate the speed of each engine.

CARBURETOR MIXTURE TEMPERATURE GAGE.

Aircraft electrical power is utilized to transmit an indication of the temperature of the fuel-air mixture in each engine's induction system to a dual gage on the instrument panel. The indication is in degrees centigrade.

CYLINDER HEAD TEMPERATURE GAGE.

The temperature of cylinder heads on each engine is indicated on a dual gage on the instrument panel. The units operate on current generated by thermocouples and so are independent of the aircraft electrical system.

PROPELLERS.

This aircraft is equipped with Hydromatic, two blade, constant speed, full feathering propellers. These propellers utilize engine oil under engine pump pressure, and engine oil under governor boost pump pressure, to hydraulically change propeller pitch so that a given engine speed, as determined by governor setting, remains constant.

PROPELLER FEATHERING.

Engine oil is also used for the feathering and unfeathering functions of the propeller. In these instances, however, both the pressure and quantity of oil delivered to the propeller is increased by an electrically operated feathering pump. This pump makes possible a much more rapid feathering operation.

PROPELLER LEVERS.

The propeller levers, located on the left side of the pedestal (figure 1-5), control the governor setting and thus engine speed. They are so adjusted that the full forward, or TAKE-OFF RPM, position positions the governor so that the proper rpm for maximum power is the result. Moving the propeller levers aft results in progressively reduced engine speed. These levers are mechanically linked to their respective propeller governors.

PROPELLER FEATHERING BUTTONS.

Two propeller feathering buttons, one for each propeller, are located on a small panel in the cutout for the automatic pilot (figure 1-10). These buttons operate the feathering pump motor and are so designed that to feather the propeller it is necessary only to "push" the button. The button remains in until feathering is complete and then automatically "pops out". To unfeather, the same button is again depressed, but in this case it is necessary to hold the button in until the engine is turning approximately 1000 rpm.

OIL SYSTEM.

The oil system in this airplane is a simple system used for engine lubrication and propeller operation. Oil is supplied to the oil pressure pump from the oil supply tank and returns to the tank through the oil cooler radiator. The oil supply tank filler openings are located on the inboard upper portion of the nacelles. Each tank has a capacity of 8 gallons, of which 6½ gallons are usable, and an expansion space of 3 gallons. Within the tank, approximately 6 quarts of oil are

GENERAL ARRANGEMENT DIAGRAM

A. Nose Baggage Compartment
B. Pilot's Compartment
C. Cabin
D. Radio and Toilet
E. Tail Section
1. Emergency Escape Hatch
2. Rear Cabin Red Dome Light Switch
3. Static Source
4. Rear Radio Junction Box
5. Chemical Toilet
6. Tool Kit and Misc. Equipment
7. Parachute Stowage
8. Generator Control Box
9. External Power
10. Pilot's Inertia Reel
11. Battery (typical both sides)
12. Relief Tube
13. Pitot Mast

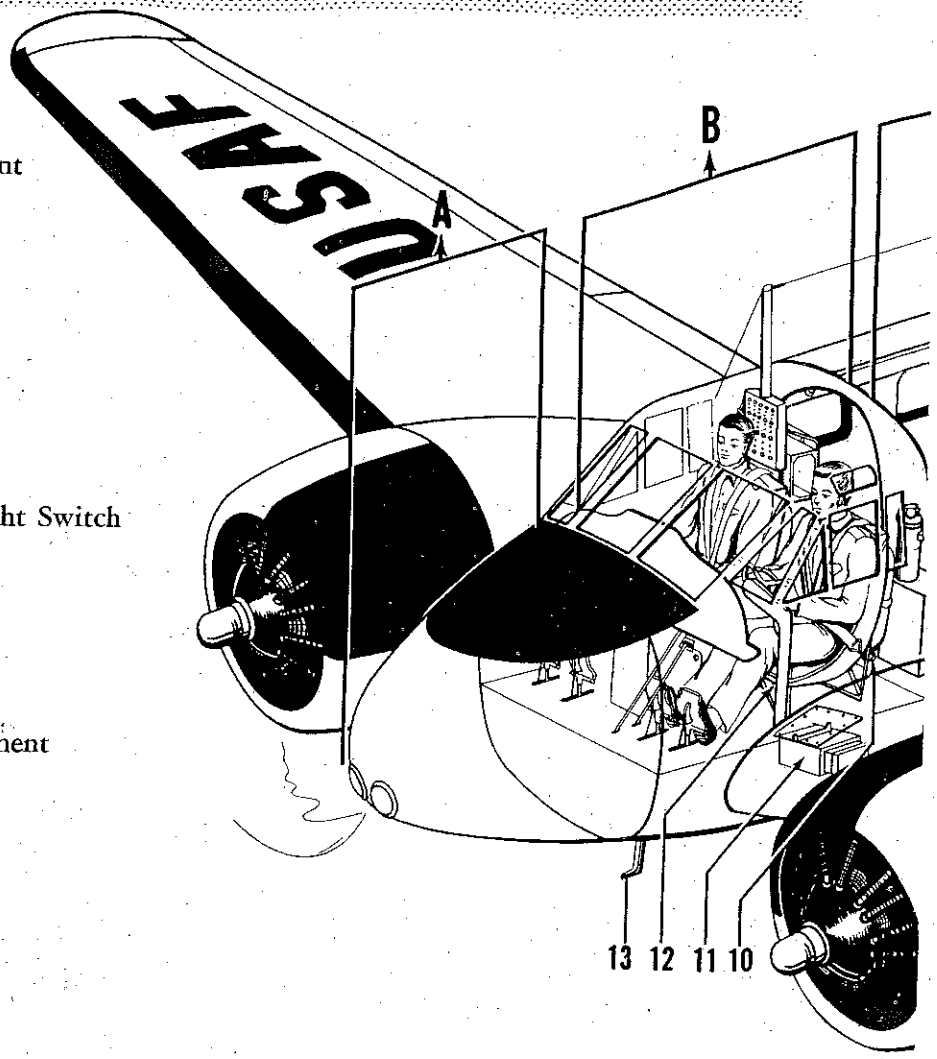

Figure 1-3. (Sheet 1 of 2)

held in reserve so the propeller can be feathered even though the engine oil is depleted. Oil grade and specification will be found in the Servicing Diagram, Section I.

OIL COOLERS.

The oil coolers, located in the firewall in each nacelle, are radiators for cooling the returning engine oil. The volume of air allowed to pass through the coolers is controlled by the oil cooler shutters located in the air duct on the air inlet side of the radiators.

OIL SHUTTER LEVERS.

The oil shutter levers (figure 1-5), located on the

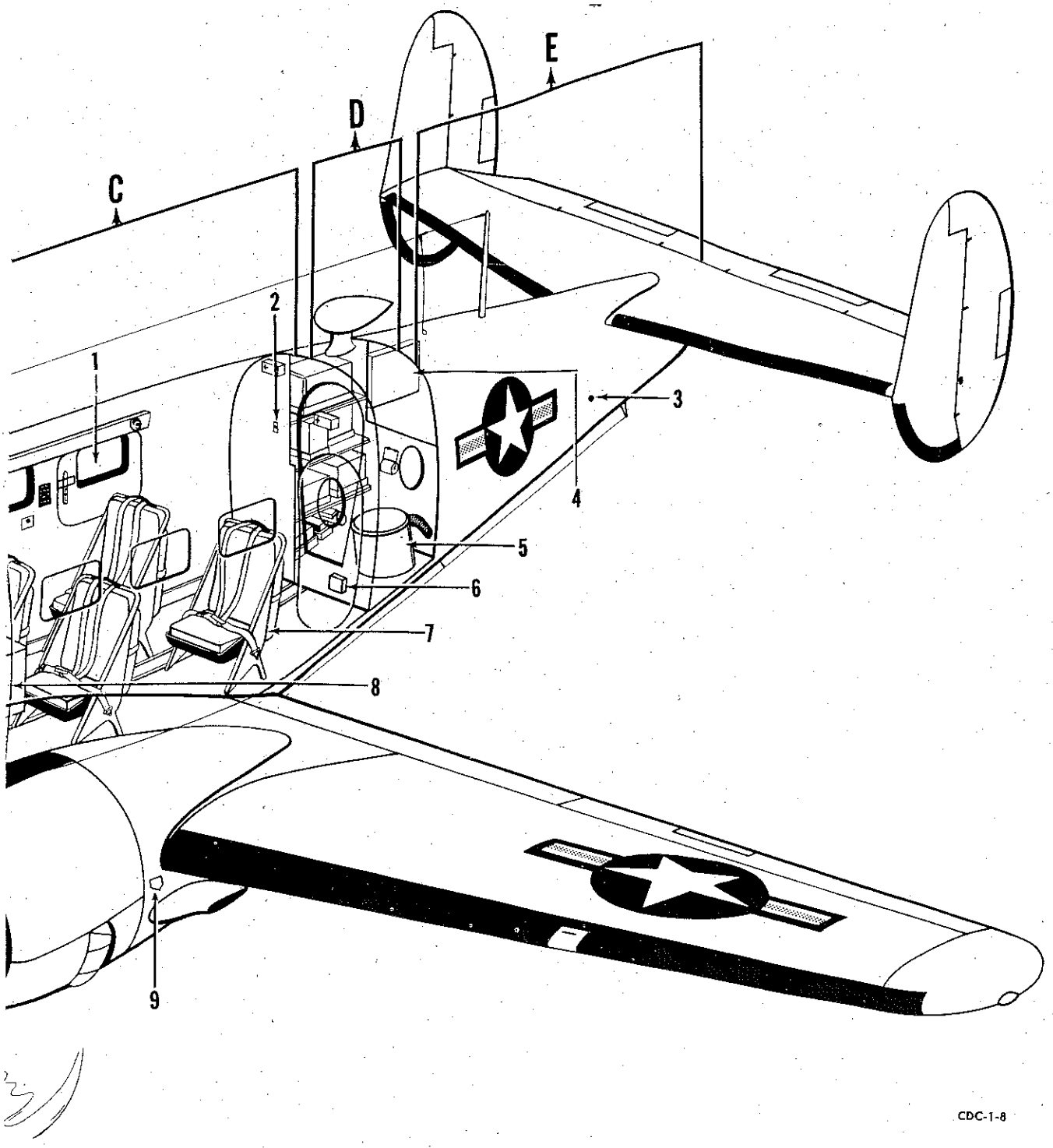

Figure 1-3. (Sheet 2 of 2)

pedestal, are mechanically linked to the shutters, which regulate the volume of air allowed to pass through the coolers. The full up position of the levers is the COLD (shutters opened) position; full down is the HOT (shutters closed) position. The shutters may be set in any desired position through their full travel, as conditions require.

The oil shutter levers, and thus the shutters, may be locked in any desired position by the friction lock (figure 1-5) on the right side of the pedestal. The friction lock is the same in operation as the throttle friction lock and also serves the mixture control levers.

PILOTS' COMPARTMENT

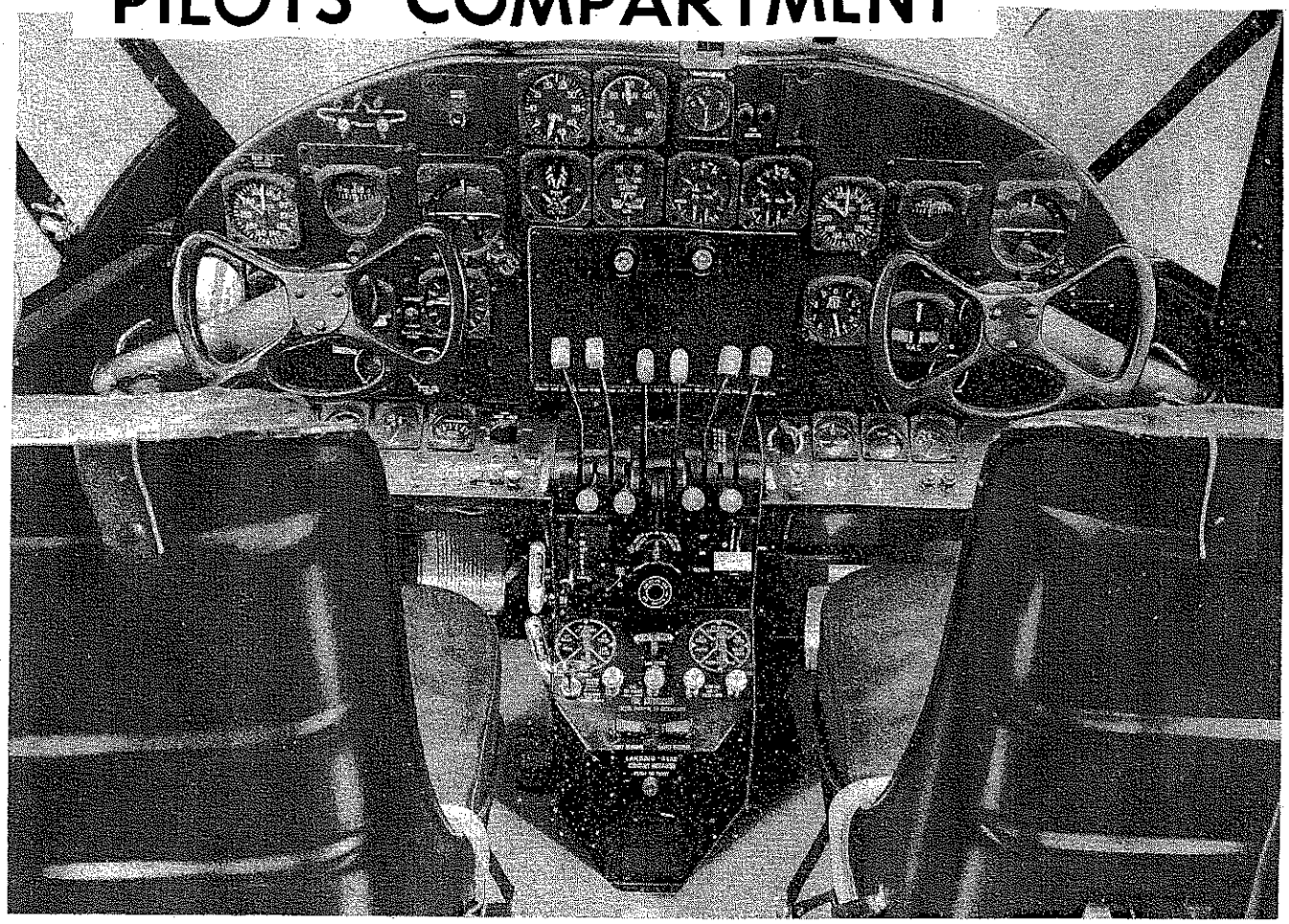

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Figure 1-4

OIL BY-PASS BUTTONS.

The oil by-pass buttons (figure 1-5) on the pedestal are mechanically linked to the oil by-pass valves in the engine compartments. The controls are the push-pull type, incorporating an automatic position lock which should be released by depressing the center plunger when the control is repositioned. Pulling the button all the way out places the valve in the HOT oil (by-pass valve open) position, pushing it all the way in places the valve in the COLD oil (by-pass valve closed) position. The control has only two operating positions, full out or full in. Pulling the control out allows the oil to by-pass the coolers and flow from the engine directly to the oil supply tank for quicker warm-ups in cold weather and to maintain oil temperature during cold weather operation.

The by-pass valves are relief type valves and in the event of a clogged cooler or one in which the oil has congealed, they will automatically by-pass the oil around the cooler to the supply tank, preventing damage to the cooler or loss of oil from ruptured lines.

OIL DILUTION SWITCHES.

The oil dilution switches (figure 1-7) on the left subpanel are momentary toggle switches, which are normally in the OFF position. When the switch is moved to the ON position, it opens the oil dilution solenoid valve allowing fuel, under pressure, from the carburetor to be injected into the "Y" drain of the oil system to facilitate cold weather starting.

FUEL SYSTEM.

The fuel system basically is an individual system for each engine, interconnected by a suction cross-feed

1. Propeller Levers.
2. Throttles.
3. Warning Horn Silencer.
4. Mixture Levers.
5. Mixture and Oil Shutter Levers Lock.
6. Oil Shutter Levers.
7. Aileron Trim Tab Wheel.
8. Flap Lever.
9. Right Engine Fuel Selector Handle.
10. Cabin Heat Buttons.
11. Left and Right Engine Fire Extinguisher Switches.
12. Landing Gear Motor Circuit Breaker.
13. Oil By-Pass Buttons.
14. Parking Brake Handle.
15. Right Engine Cowl Flap Handle.
16. Left Engine Fuel Selector Handle.
17. Tail Wheel Lock Handle.
18. Landing Gear Lever.
19. Landing Gear Malfunction Light Test Switch.
20. Left Engine Cowl Flap Handle.
21. Aileron Trim Tab Position Indicator.
22. Throttle Lock.
23. Manifold Heat Levers.
24. Propeller and Manifold Heat Levers Lock.

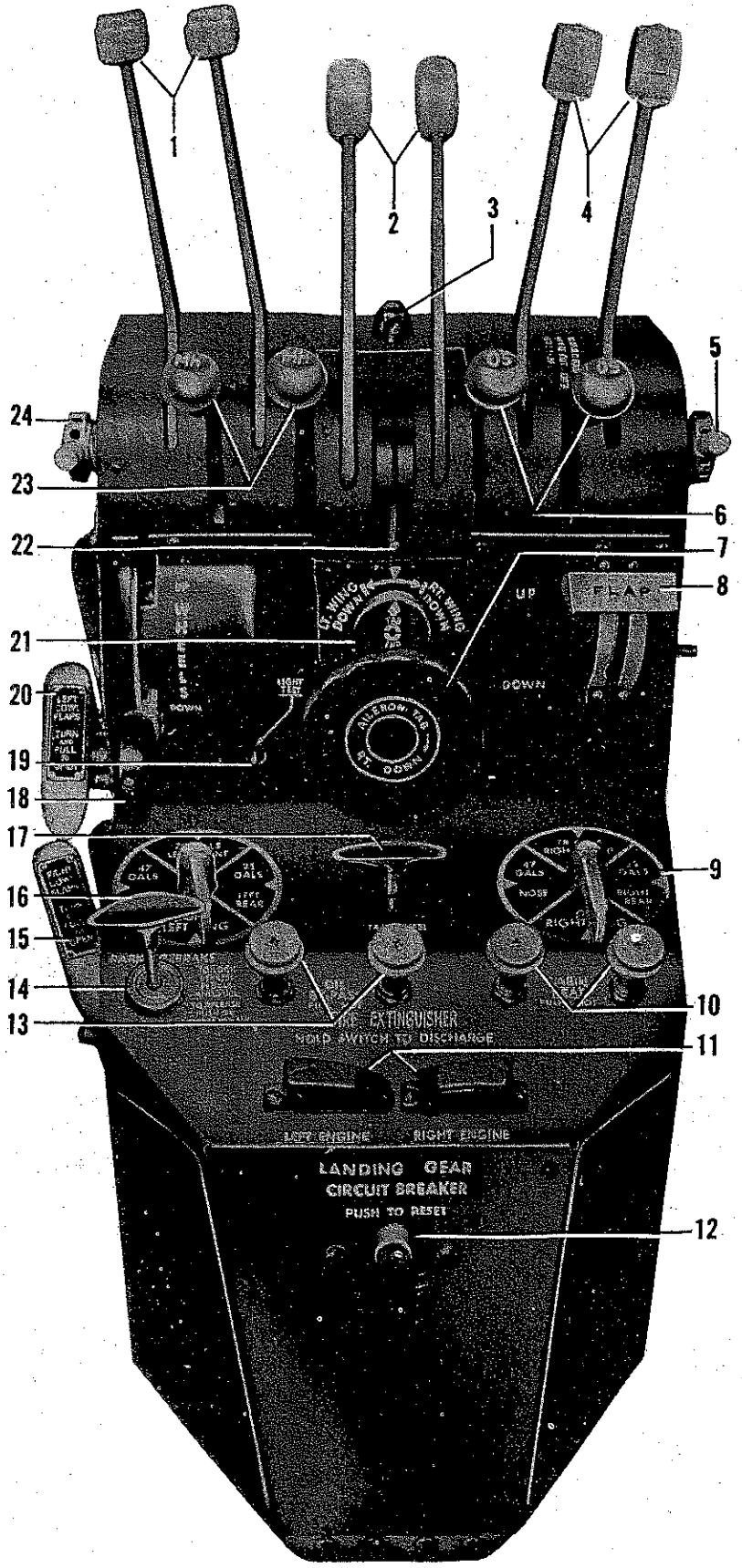

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Figure 1-5. Control Pedestal

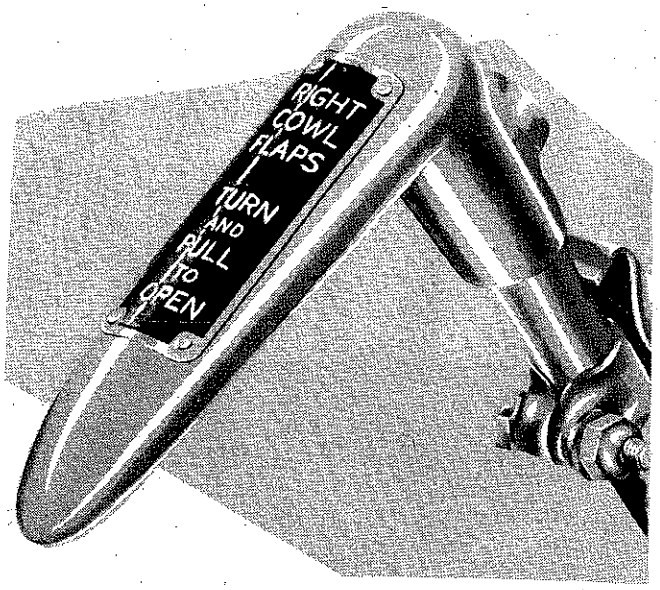


Figure 1-6. Cowl Flap Handle

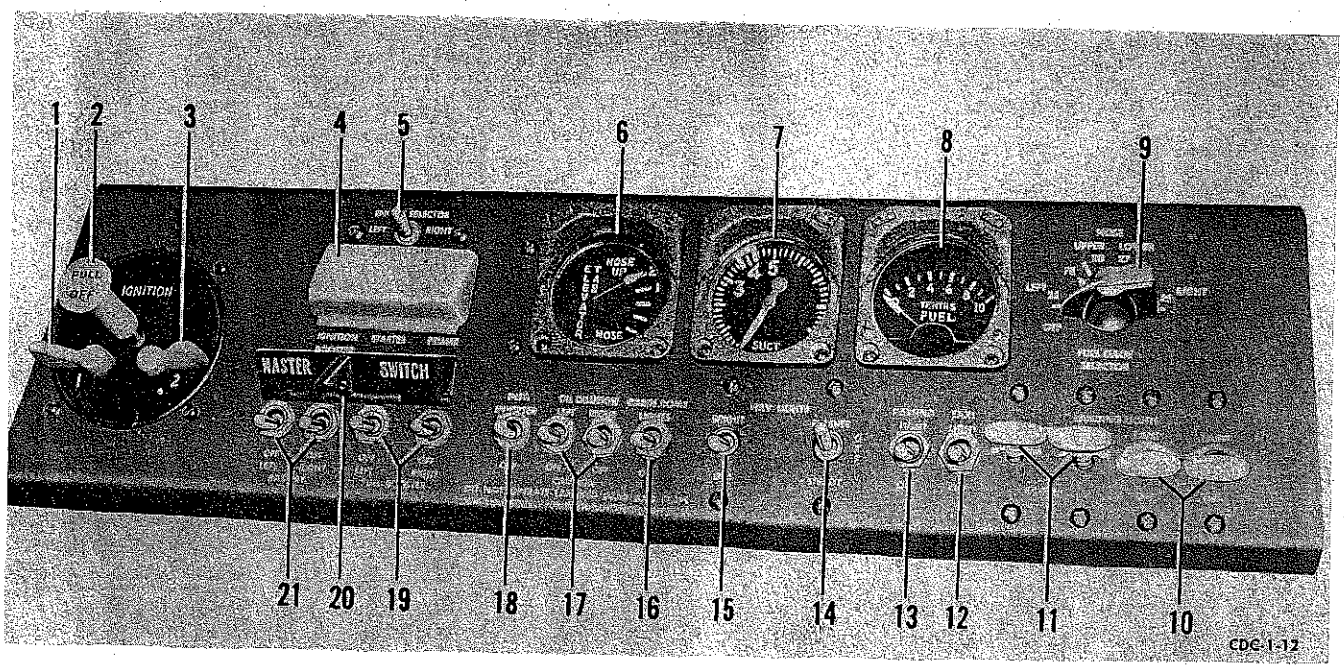
valve. In each system there is a front fuel tank, which has a submerged electric fuel booster pump; and a rear fuel tank, both located in the wing root. In the nose is a tank comprised of two fuel cells (upper and lower) which is a part of both systems. The nose cells are separated for ease of installation, but are interconnected and drain through a common sump. Fuel quantities for each tank and cell are read on a single instrument.

NOTE

The engines will not operate on gravity pressure alone if both engine and boost pumps fail, since the tanks are so near the same level as the carburetors.

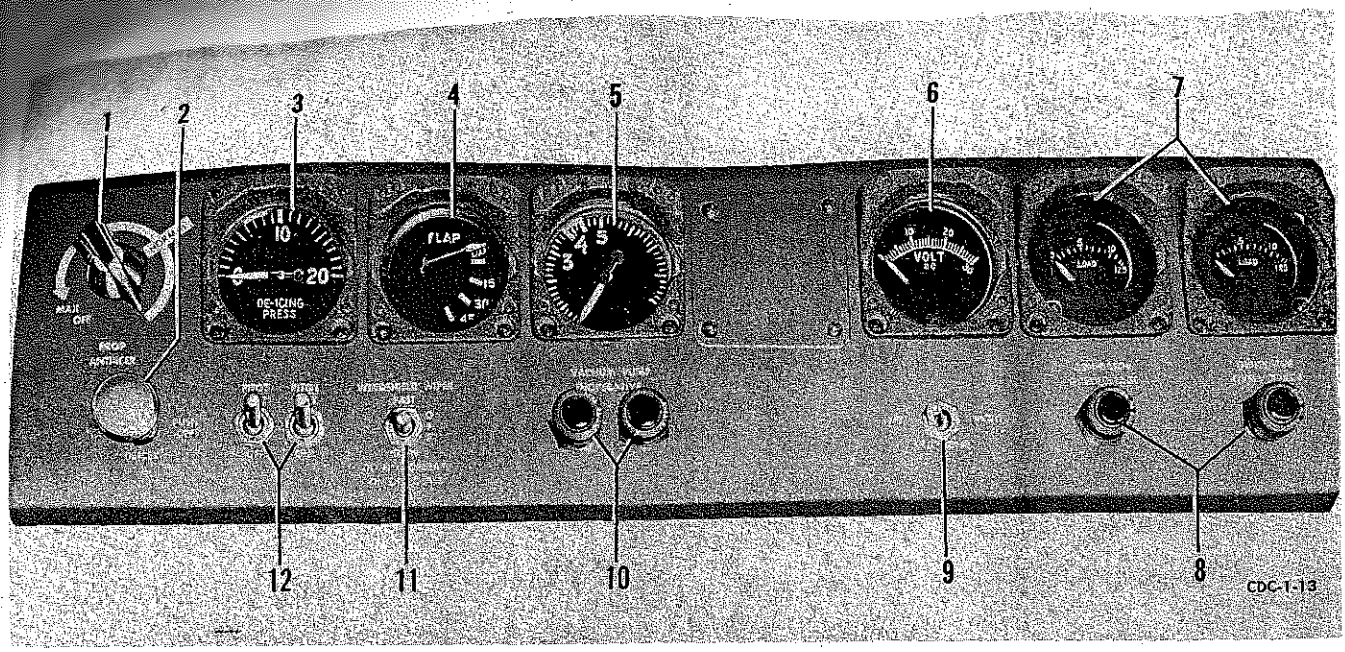
ENGINE FUEL SELECTOR HANDLES.

The fuel selector handles (figure 1-12) on the pedestal are used, one for each engine, to select the tank from which you wish to operate the engine. The left handle is placarded LEFT ENGINE OFF - NOSE - LEFT FRONT - LEFT REAR. The right handle is similarly placarded for the right tanks and engine. Each selector will allow fuel to flow from only one tank at a time.



1. Left Engine Ignition Switch.
2. Master Engine Ignition Switch.
3. Right Engine Ignition Switch.
4. Ignition Booster, Starter and Primer Switches Cover.
5. Engine Selector (Starting System).
6. Elevator Tab Position Indicator.
7. Pilot's Suction (Vacuum) Gage.
8. Fuel Gage.
9. Fuel Gage Tank Selector Switch.
10. Landing Light Lamp Switches.
11. Landing Light EXTEND-RETRACT Switches.
12. Taxi Light Switch.
13. Passing Light Switch.
14. Navigation Lights Switch.
15. Navigation Lights Dimmer Switch.
16. Cabin Dome Lights Switch (White Lights).
17. Engine Oil Dilution Switches.
18. Instrument Inverter Switch.
19. Fuel Booster Pump Switches.
20. Master Switch Bar.
21. Battery Switches.

Figure 1-7. Left Subpanel



1. Prop Anti-Icer Pump Knob.
2. Wing and Tail Deicer Button.
3. Wing and Tail Deicer Pressure Gage.
4. Flap Position Indicator.
5. Copilot's Suction (Vacuum) Gage.
6. Voltmeter.
7. Generator Load Meters.
8. Generator Inoperative Lights.
9. Voltmeter Switch.
10. Vacuum Pump Warning Lights.
11. Windshield Wiper Switch.
12. Pitot Heater Switches.

Figure 1-8. Right Subpanel

SUCTION CROSS-FEED HANDLE.

The suction cross-feed handle (figure 1-13), located under the copilot's seat, is for use in those emergencies where it is necessary to operate both engines from the same tank or where it is necessary to operate one engine from the tanks in the other engine's fuel system. This cross-feed connects the two fuel supply systems up stream of the engine driven pumps.

FUEL BOOSTER PUMPS SWITCHES.

Two electric fuel booster pumps are provided in the aircraft, one in each front (main) wing fuel tank. Individual booster pump switches (figure 1-7) on the left subpanel activate the electric fuel booster pumps. The pumps are provided to supply fuel under pressure to the carburetors for priming and starting, to supplement the engine driven pumps in an emergency and as a safety feature for take-offs and landings. The engine driven pump has a by-pass valve incorporated in it through which the fuel from the booster pump passes.

NOTE

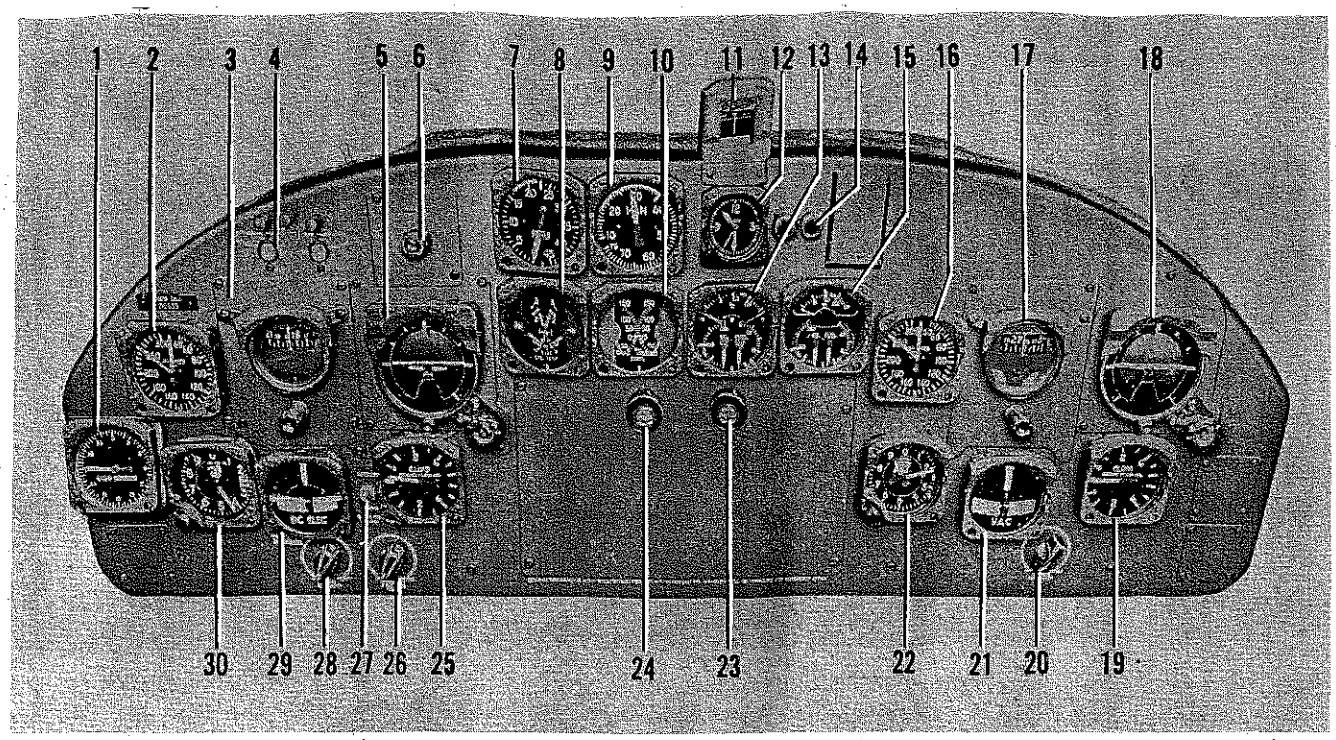
The primer switch will momentarily activate the fuel booster pumps, so that pressure is available for priming even though the booster pump switch may not have been turned ON.

FUEL SYSTEM INDICATORS.

The fuel gage and the fuel gage tank selector switch (figure 1-7) on the left subpanel are used to determine the quantity of fuel in each individual tank. The gage is calibrated in tenths of tank capacity, not in gallons.

The selector switch has seven positions, one for each tank and an OFF position. The selector switch completes the electrical connection between the gage and the liquidometers in the individual fuel tanks, eliminating the necessity for multiple gages. Each engine system has a pressure warning light (figure 1-9), mounted on the instrument panel, which will light whenever the pressure drops to 3 psi or less.

Two fuel pressure gages, one for each engine, are provided in the engine gages units on the instrument panel.



CDC-1-14 A

1. Radio Compass Indicator.
2. Pilot's Airspeed Indicator.
3. Pilot's Directional Gyro.
4. Landing Gear Position Indicator.
5. Pilot's Gyro Horizon.
6. Marker Beacon Light.
7. Dual Tachometer.
8. Dual Cylinder Head Temperature Gage.
9. Dual Manifold Pressure Gage.
10. Dual Carburetor Mixture Temperature Gage.
11. Standby Magnetic Compass.
12. Clock.
13. Left Engine Gage Unit.
14. Fuel Pressure Warning Lights.
15. Right Engine Gage Unit.
16. Copilot's Airspeed Indicator.
17. Copilot's Directional Gyro.
18. Copilot's Gyro Horizon.
19. Copilot's Rate-of-Climb Indicator.
20. Copilot's Flight Instruments Lights Rheostat Switch.
21. Copilot's Turn-and-Bank Indicator.
22. Copilot's Altimeter.
23. Right Propeller Feathering Button.
24. Left Propeller Feathering Button.
25. Pilot's Rate-of-Climb Indicator.
26. Engine Instruments and Subpanel Lights Rheostat.
27. Pilot's Turn-and-Bank Power Selector Switch.
28. Pilot's Flight Instruments Lights Rheostat Switch.
29. Pilot's Turn-and-Bank Indicator (dc electric).
30. Pilot's Altimeter.

Figure 1-9. Instrument Panel

ELECTRICAL POWER SUPPLY SYSTEM.

The electrical power supply system as provided in this aircraft is a 24 volt, direct current, single wire system, utilizing the airframe as a common ground return. Power is supplied to the system by two 28 volt, engine driven generators, one on each engine; and supplemented by two 24 volt batteries, one on each side of the fuselage, mounted in the leading edge of the center section wing between the fuselage and the engine nacelle. An external power supply receptacle is provided on the outboard side of the left engine nacelle for starting and for ground operation of electrical equipment. Refer to electrical system diagram (figure 1-15) for ac and dc operated equipment.

WARNING

DELETED

MASTER SWITCH BAR.

The master switch bar (figure 1-7), on the left subpanel, is provided so that both booster pump switches and both battery switches may be turned OFF simultaneously in event of an emergency. The bar is spring-loaded to hold it away from the switches so that it will not interfere with their normal operation.

BATTERY SWITCHES.

The battery switches (figure 1-7) on the left subpanel connect both batteries to the electrical system.

GENERATOR SWITCHES.

The generator switches (figure 1-16), one on top of each generator control box at either side of the entrance to the pilots' compartment, are toggle switches having three positions: ON - OFF - RESET. ON and OFF are fixed positions, while RESET is a momentary position. Each switch is covered by a plastic guard to prevent its being inadvertently moved to the OFF position. With the guard closed, the switch can be only in the ON position. The RESET position is provided so that in the event the overvoltage relay should trip off, disconnecting the generator, the circuit may be reclosed. For all normal operations, these switches are in the ON position, being turned OFF only in emergencies.

OVERVOLTAGE RELAY.

An overvoltage relay is provided in each generator control box to protect the system from excessive voltages. The relay is adjusted to trip off whenever the generator output voltage rises to between 31 and 33 volts, with additional safety provisions for disconnecting at a maximum high voltage of 35. When the overvoltage relay trips off, the pilot is warned of the condition by the automatic lighting of the generator inoperative light for that particular generator.

GENERATOR INOPERATIVE LIGHTS.

The generator inoperative lights (figure 1-8) on the right subpanel are so connected to the overvoltage relay that they are turned on whenever the overvoltage relay trips off. Resetting the overvoltage relay automatically turns these lights off.

VOLTMETER SWITCH.

The voltmeter switch (9, figure 1-8) is located on the right subpanel and is used for the selection of the desired generator voltage to be indicated on the voltmeter. The switch is a two-position toggle type, moving from right to left to select the desired generator voltage reading. When the switch is moved to the right the voltage of the right generator is read on the voltmeter. When moved to the left the left generator's voltage may be read on the same voltmeter. The switch may be left in either position upon completion of the check.

LOADMETERS.

Two electric loadmeters (figure 1-8) are mounted on the right subpanel. These meters show what percentage of the total potential of the generators is being used. Thus, 100 percent indication shows that full generator capacity is utilized. The loadmeters are protected by circuit breakers (figure 1-16) located on the inboard side of each generator control box.

PILOTS' TURN-AND-BANK POWER SELECTOR SWITCH.

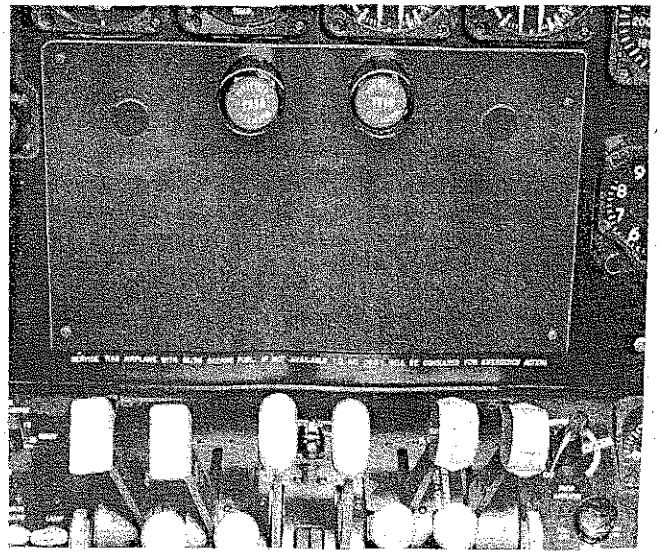
The pilots' turn-and-bank power selector (figure 1-9), on the instrument panel adjacent to the indicator, permits the use of this instrument even though the battery switches may be turned off. The switch has two positions, NORMAL and ALTERNATE, and is a fixed position toggle switch with no off position. When the switch is in the NORMAL position, it connects the indicator to the secondary bus for its power source; when in the ALTERNATE position, it connects the indicator directly to the right battery. The switch should be placed in the ALTERNATE position only in such emergencies as require battery switches to be turned off when the instrument is required. At all other times it will remain in the NORMAL position. The switch should never be left in the ALTERNATE position when the airplane is parked since it will continue to operate on the direct line from the battery.

CIRCUIT BREAKERS.

All circuit breakers with the exception of the landing gear motor, loadmeter and propeller feathering circuit breakers are located in the circuit breaker boxes (figure 1-17) on the bulkhead behind the copilot's head. The landing gear motor circuit breaker is located on the control pedestal (figure 1-5), the loadmeter circuit breakers (figure 1-16) on the generator control boxes and the propeller feathering circuit breakers are located on the windshield cowl. The landing gear motor circuit breaker is of the push-to-reset type, the propeller feathering circuit breakers are switch type, all others are of the trip-free, push-to-reset type that can be pulled out (tripped) manually. The landing gear circuit breaker cannot be pulled out (tripped) manually.

INSTRUMENT INVERTER.

An inverter is installed to convert dc current to the 400 cycle ac current required by the gyrosyn compass system.



CDC-1-79

Figure 1-10. Propeller Feathering Buttons

FUEL SYSTEM DIAGRAM

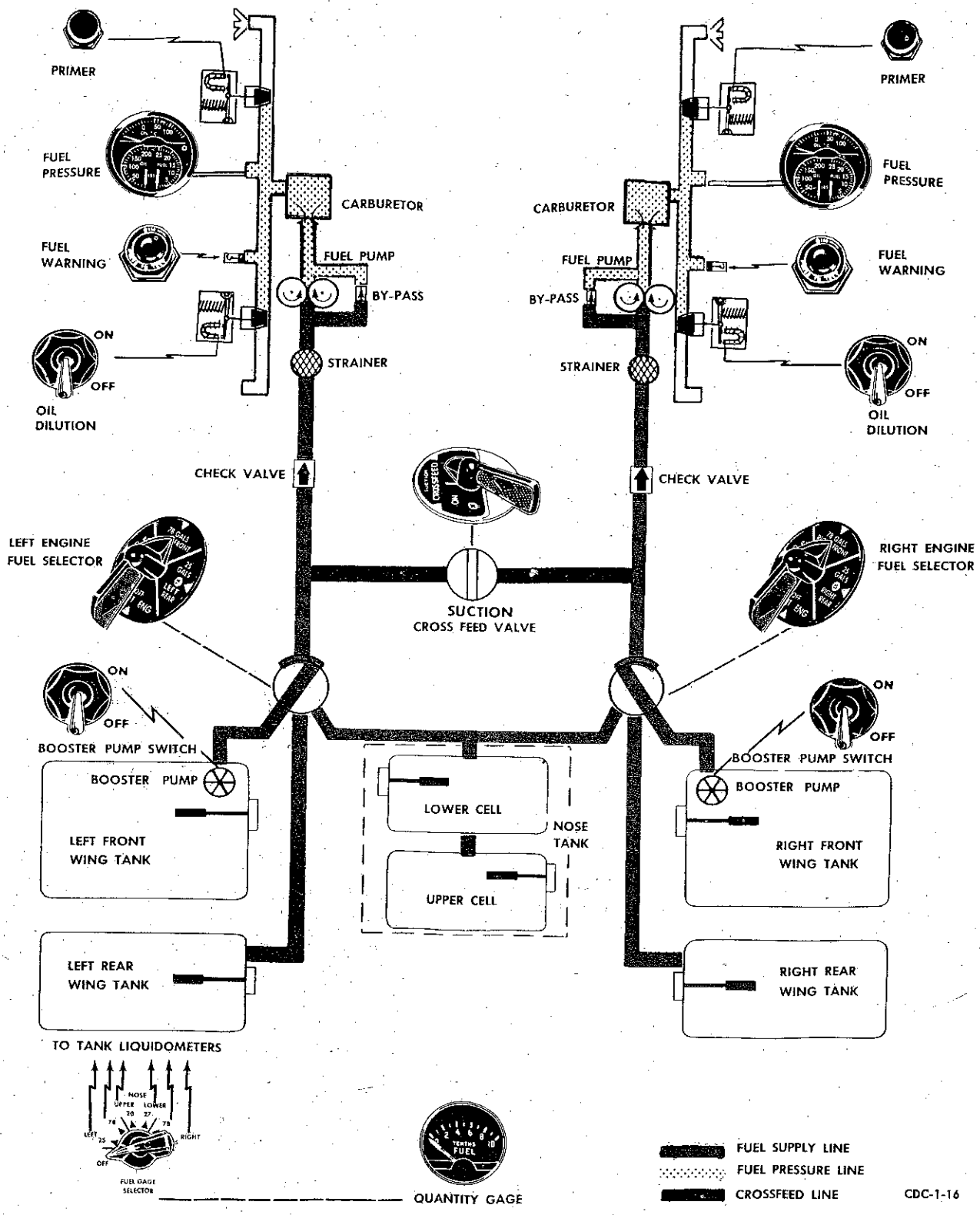
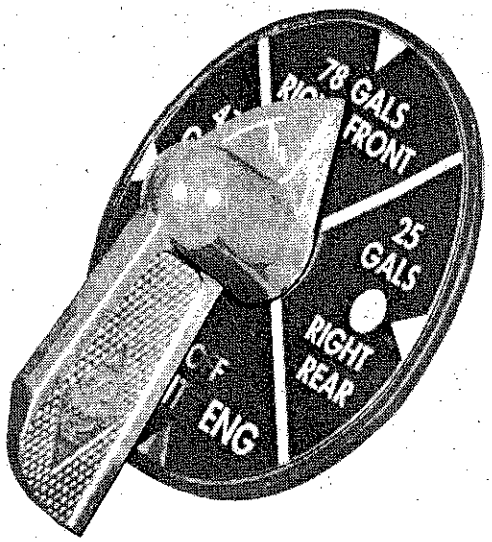


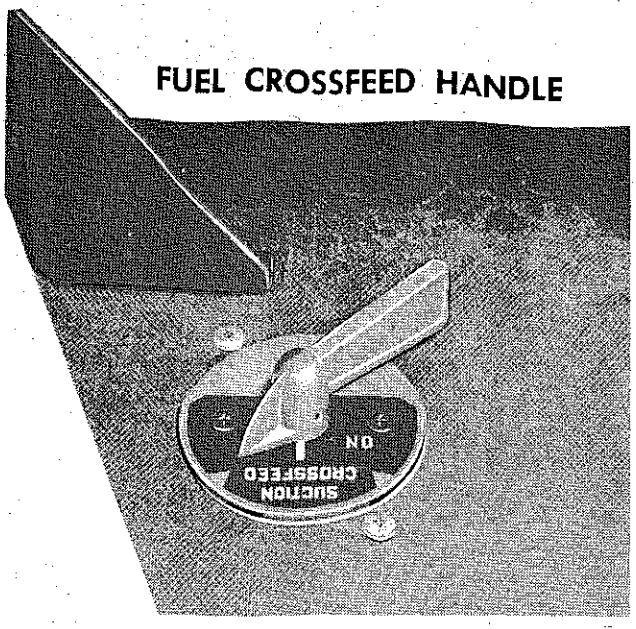
Figure 1-11



ENGINE FUEL SELECTOR HANDLE

CDC-1-17

Figure 1-12



CDC-1-18

Figure 1-13

INSTRUMENT INVERTER SWITCH.

The instrument inverter switch (figure 1-7) on the left subpanel is a toggle switch having ON and OFF positions. This switch opens and closes the dc circuit to the inverter.

FUEL QUANTITY DATA

(U. S. GALLONS)

TOTAL USABLE FUEL 252.0 GALLONS

TANKS	NO.	USABLE FUEL (EACH)	FULLY SERVICED	EXPANSION SPACE (EACH)	TOTAL VOLUME (EACH)
Front Wing	2	77.7	78.0	2.3	80.3
Rear Wing	2	24.8	25.0	0.8	25.8
Nose	1				
Upper Nose Cell	1	20.0	20.0	0.0	20.0
Lower Nose Cell	1	27.0	27.0	0.0	27.0

NOTE The outlets are designed for level flight. The above figures will vary slightly with changes in attitude.

CDC-1-19

Figure 1-14

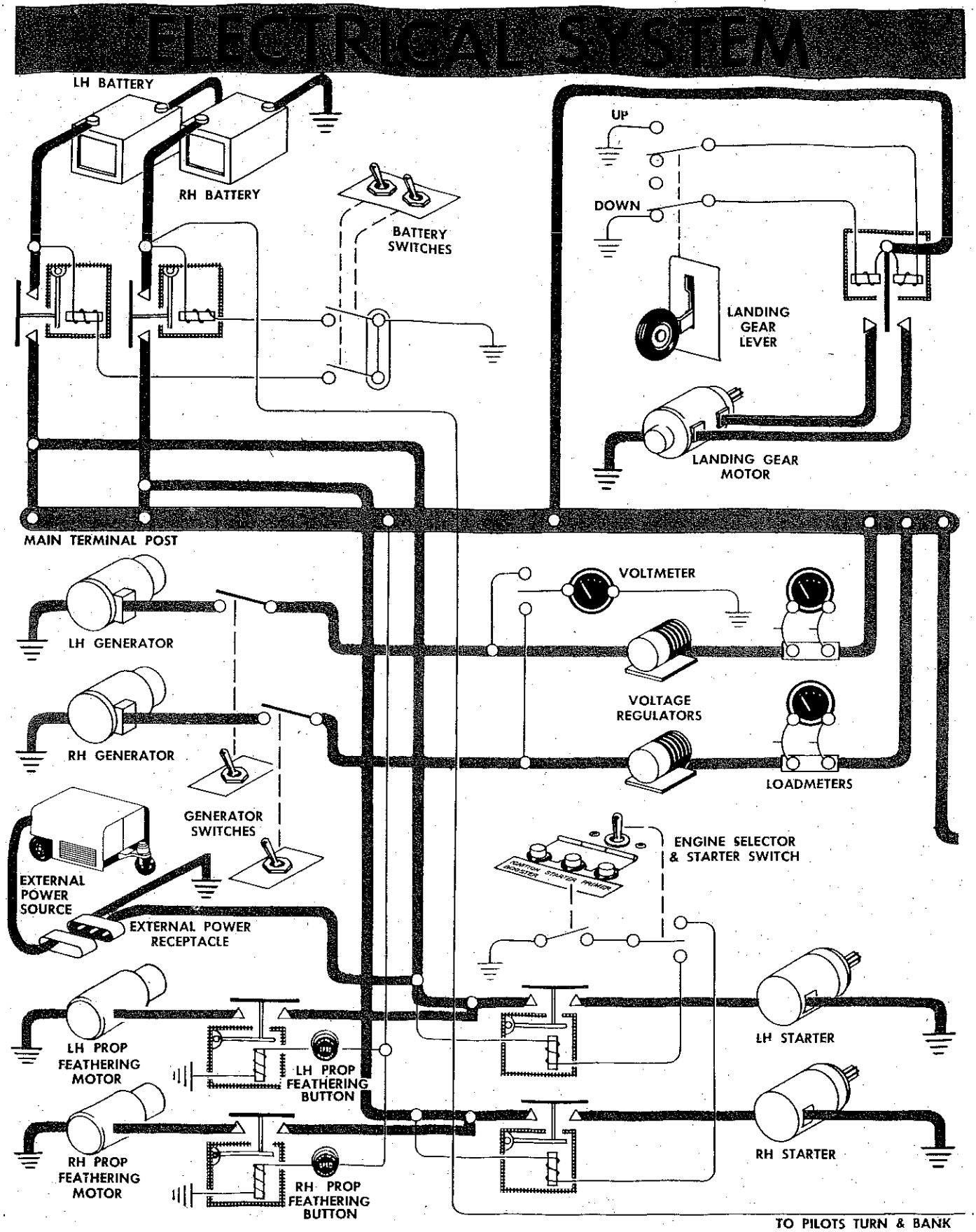


Figure 1-15. (Sheet 1 of 2)

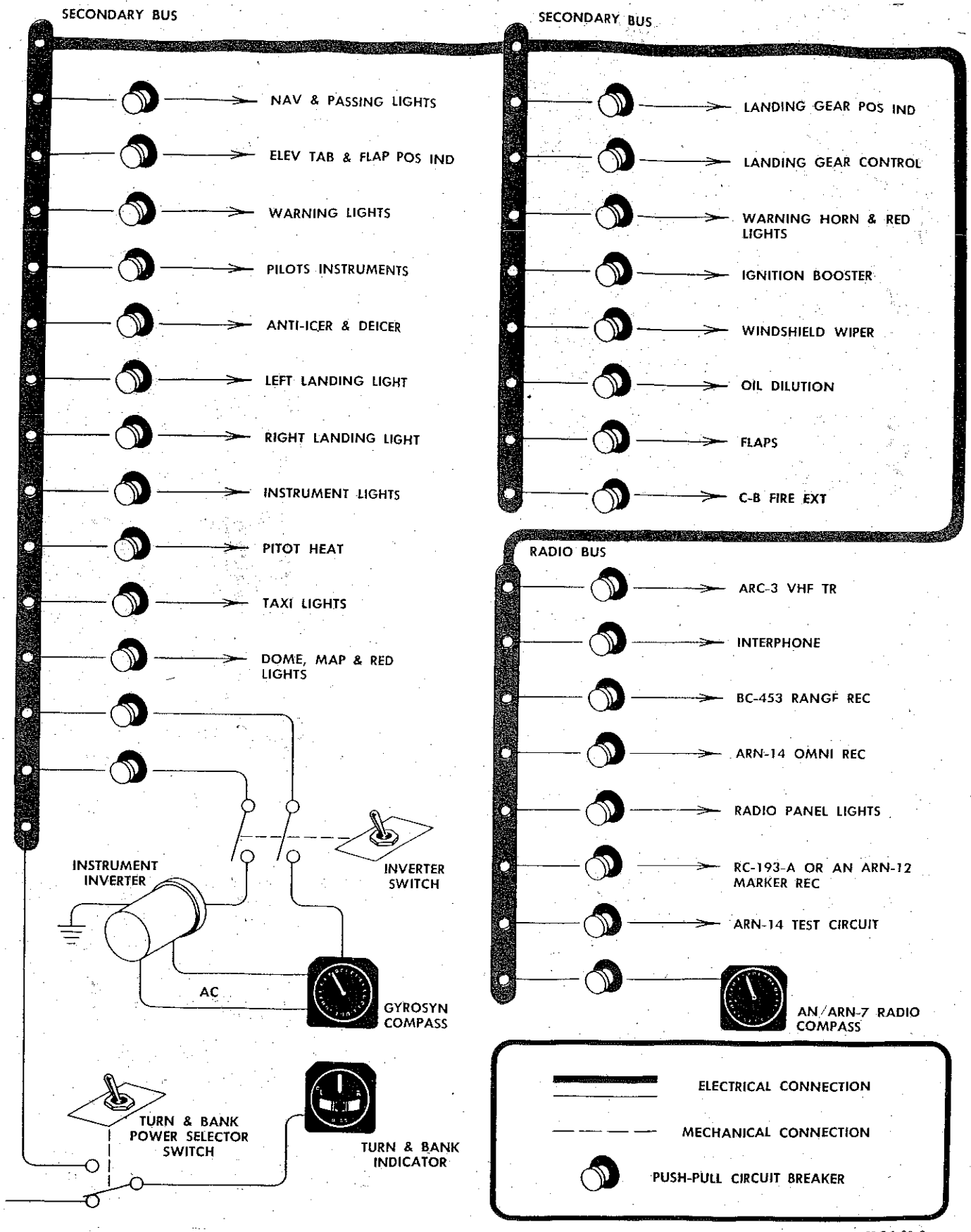
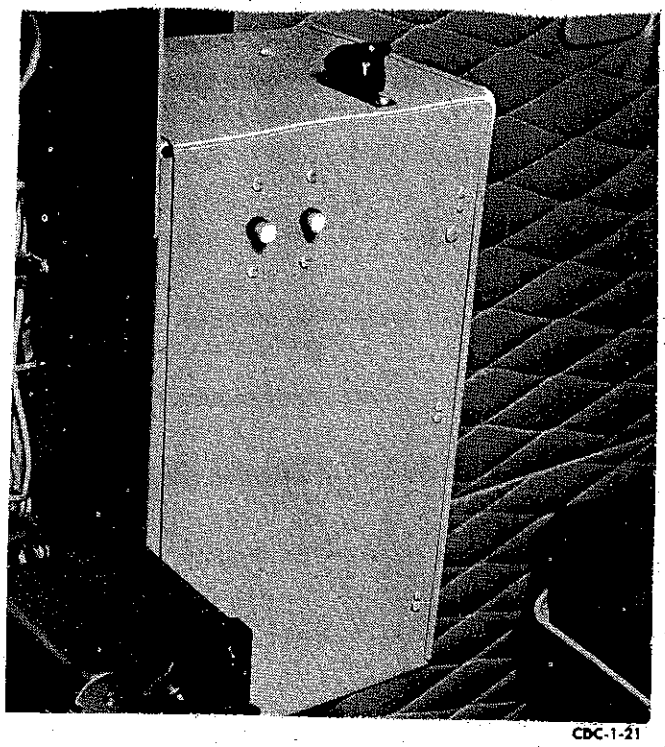


Figure 1-15. (Sheet 2 of 2)



CDC-1-21

Figure 1-16. Generator Control Box

VACUUM SYSTEM.

Pumps, one on each engine, supply vacuum for those flight instruments which require vacuum for operation. The exhaust from these pumps is utilized to supply pressure for the wing and tail deicing system. Both pumps are integrated into a single system which uses check valves in such a manner that failure of a single pump results only in decreased capacity, rather than failure of the entire system.

VACUUM CONTROL

The pilot has no operating controls for the system. The vacuum pumps operate whenever the engine on which it is installed is operating. Relief valves are preset to maintain proper operating pressures.

VACUUM INDICATORS.

A warning light (figure 1-8), for each pump, is mounted on the right subpanel. These lights are operated by pressure switches and when lighted indicate failure of the corresponding pump.

Suction (vacuum) gages (figures 1-7 and 1-8) are mounted on the right and left subpanels for indication of the exact value of the vacuum being delivered.

FLIGHT CONTROL SYSTEM.

The flight control system in this aircraft is a conventional wheel, column and rudder pedal combination, mechanically linked to the control surfaces. The rudder pedals are not adjustable; however, a comfortable pedal position may be obtained by adjusting the seat fore and aft. The upper portion of the rudder pedals are the toe brake pedals.

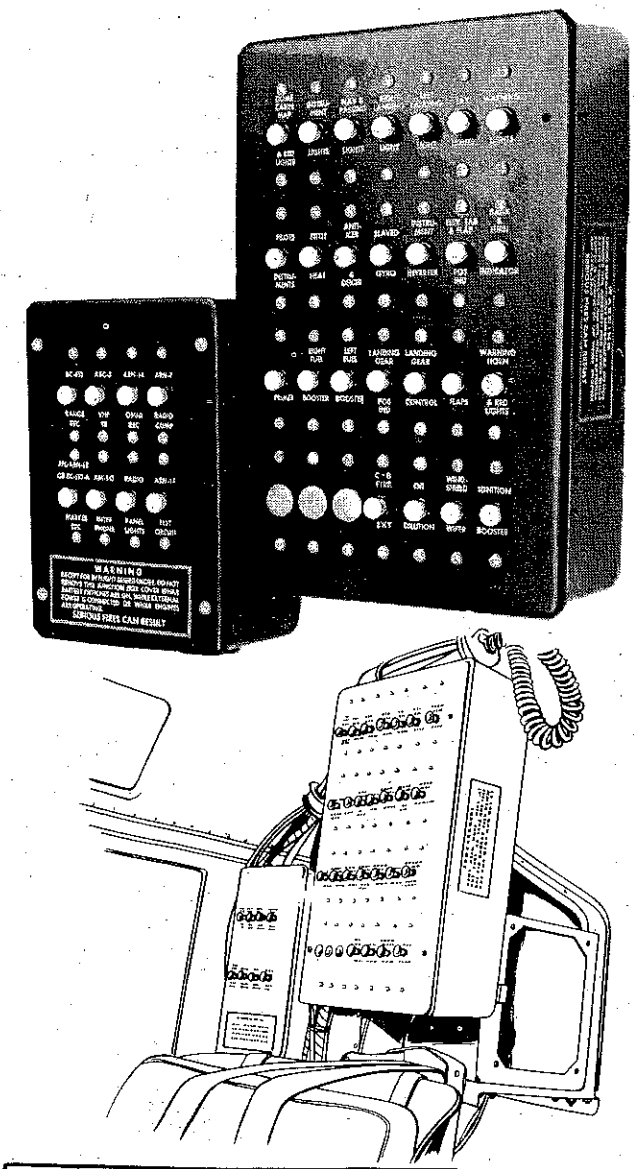
All primary flight controls and trim tab controls are closed systems of cables or chains and cables.

FLIGHT TAB CONTROLS.

The three mechanically operated tab controls (figure 1-18) will trim the aircraft in the same direction as control movement.

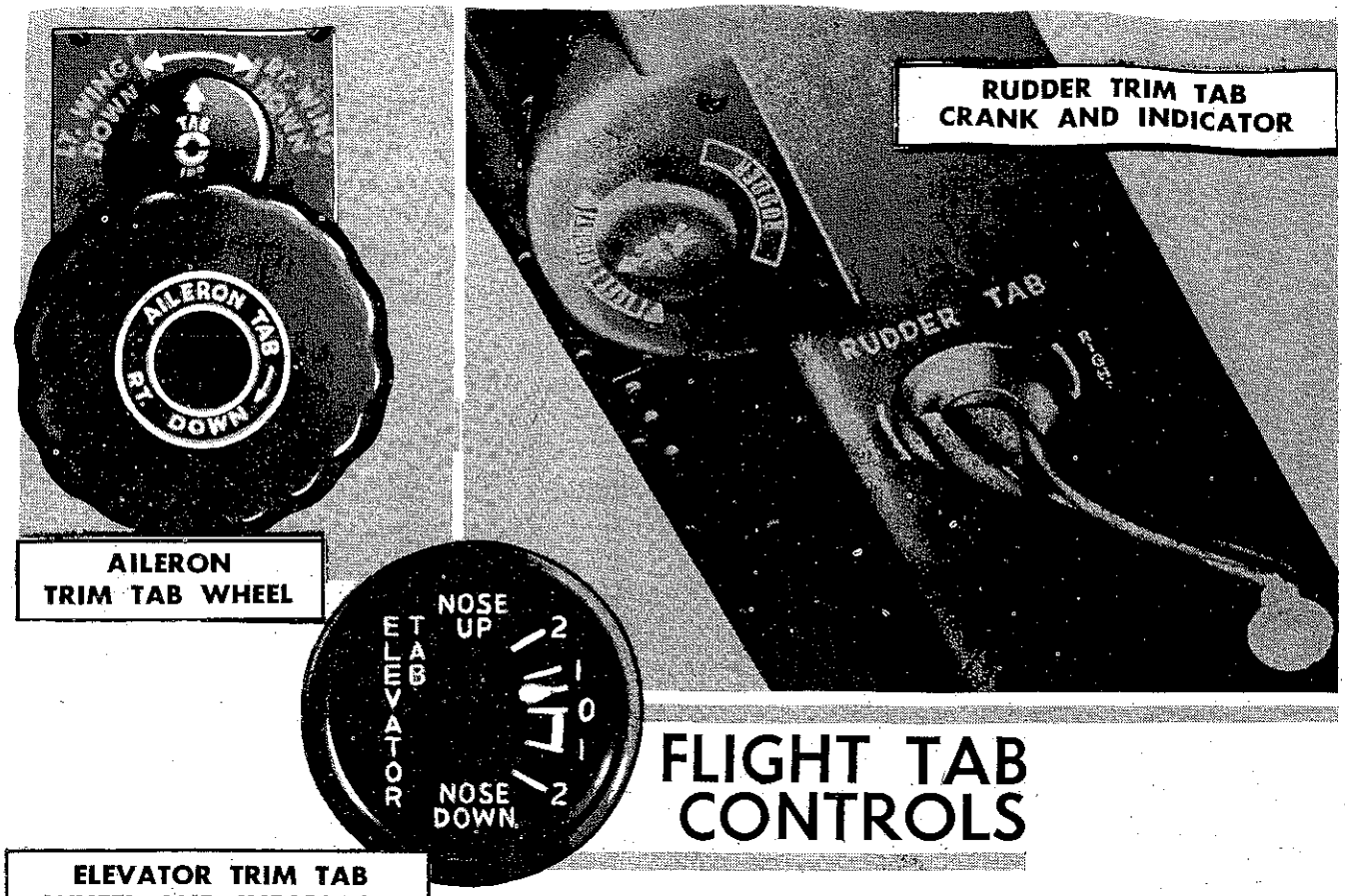
FLIGHT CONTROLS LOCK.

The lock assembly for the flight controls (figure 1-20) is a loose item which, when not in use, is stowed on the pilots' compartment floor. It consists of steel tubing with pins for locking the rudder pedals, a clamp for the control column (elevators) and a thumb screw which locks the control wheel sprocket for the ailerons.



CDC-1-22

Figure 1-17



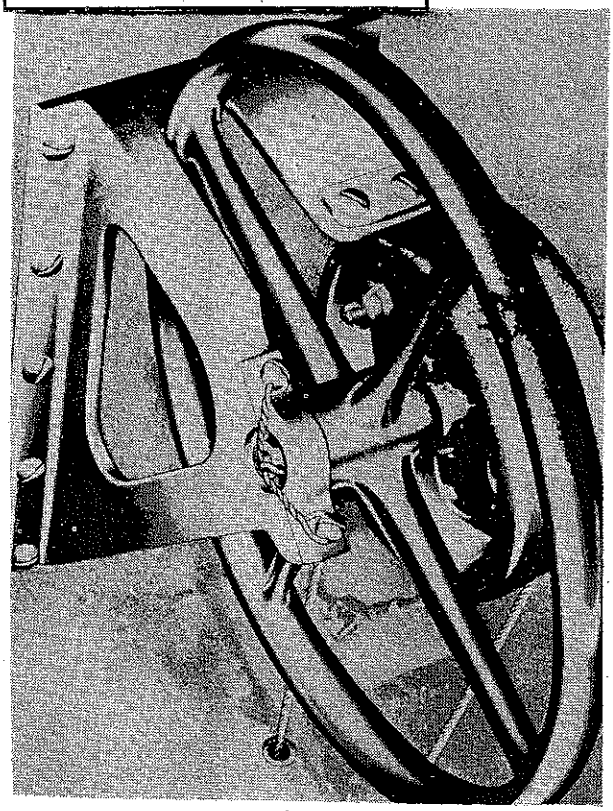


Figure 1-18

CDC-1-23

When put in the locking position, the required operations are:

Unfasten strap at aft end of the stowed lock.

Raise forward end of lock assembly.

Pinch pins on rudder pedal lock assembly together.

Place lock between rudder pedals and allow pins to enter end of rudder cross bars.

Raise aft end of assembly.

Position column latch, on the aft end of the assembly, around vertical portion of column (do not tighten clamp).

Insert wheel lock assembly into inboard end of the control column.

Tighten column latch.

The column latch should not be tightened until thumb screw on the wheel lock assembly is installed, as it may be necessary to move the clamp either up or down to align thumb screw. The thumb screw goes all the way through the column, passing between the teeth of the control wheel sprocket; it is usually necessary to wiggle the wheel a little to properly align the sprocket and thumb screw.

FLIGHT TAB POSITION INDICATORS.

AILERON AND RUDDER. The relative position of the aileron and rudder trim tabs is indicated by the small discs (figure 1-18), adjacent to the respective

tab controls. These indicators are not calibrated in degrees, but simply indicate the relative effect the tab will produce.

ELEVATOR. The elevator tab position indicator (figure 1-7) on the left subpanel is an electric, dial indicator, graduated from "2" (nose up) to "0" (neutral) to "2" (nose down). The graduations have no significance other than reference to relative position of the tab. The "2" nose up and nose down are simply the extreme positions of the tab. The normal flight position is between "0" and "1" nose down. The indicator is controlled by a rheostat located in the horizontal stabilizer; the rheostat is mechanically linked to the left trim tab actuator rod.

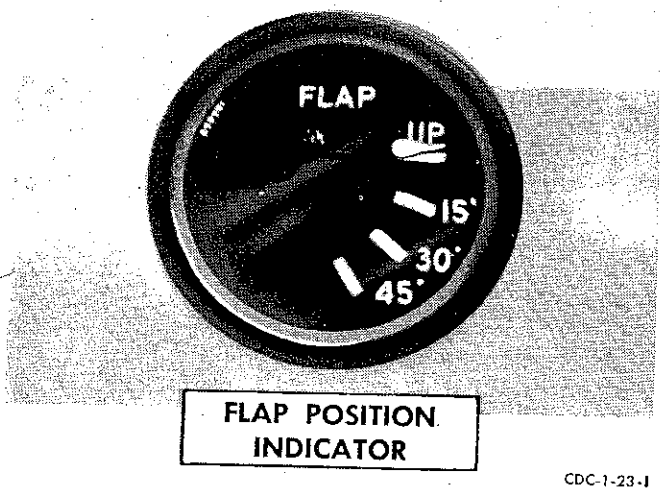


Figure 1-19

WING FLAPS.

The aircraft is equipped with trailing edge flaps for use primarily as a landing aid; however, they may also be used for short field and emergency take-offs. The flaps are actuated normally by an electric motor, but they may be operated manually by the emergency hand crank. They are held in any preset position by the mechanical advantage of the system.

WING FLAP LEVER.

The position of the wing flaps is selected by the flap lever (figure 1-5), on the pedestal, which closes the dc circuit to the flap motor. The lever has two positions: UP — DOWN. The lever is placed in the UP position to raise the flaps, and in the DOWN position to lower the flaps. Before the switch lever can be moved, it is first necessary to move it to the right since it is spring loaded to hold in the detents of a lock plate.

There is incorporated in the system a dynamic brake relay which will stop the movement of the flap motor instantaneously when the flap limit switches are tripped.

EMERGENCY HAND CRANK.

The landing gear and flaps may be raised or lowered by means of the emergency hand crank (figure 1-21) located to the right of the pilot's seat. The crank is pushed in (toward the pilot) for flap operation and pulled out (away from the pilot) for landing gear operation.

FLAP POSITION INDICATOR.

The flap position indicator (figures 1-8 and 1-19), on the right subpanel, is an electrical indicator controlled by a rheostat located in the wing. The indicator shows the flap position in 15 degree increments ranging from 0 (full up) to 45 degrees, which is the full travel of the flaps.

LANDING GEAR SYSTEM.

The landing gear actuating mechanism is electrical, the main wheels retracting into the engine nacelles. The tail wheel, which is full swiveling but lockable, has been permanently fixed in the down position and does not retract. The landing gear doors remain open when the gear is in any position other than retracted. When the gear is retracted, there is approximately

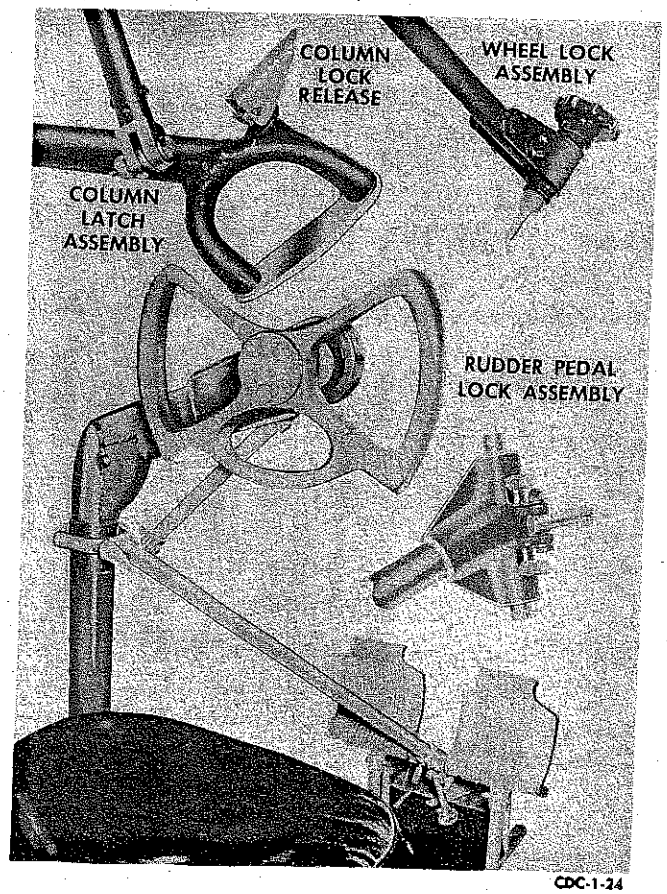
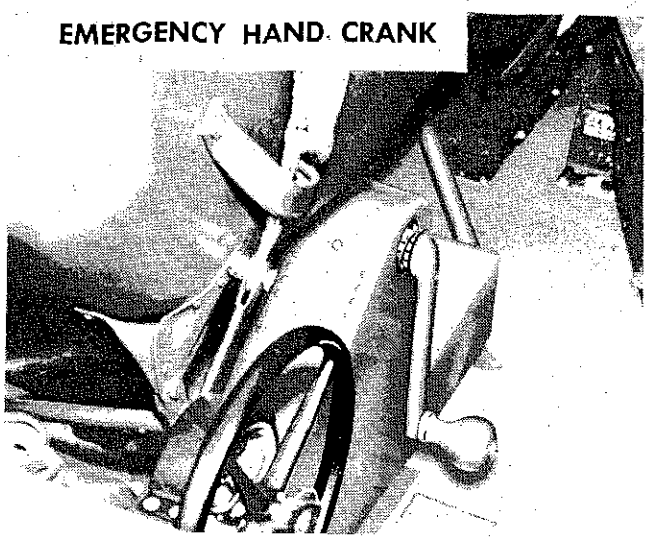


Figure 1-20. Flight Control Lock

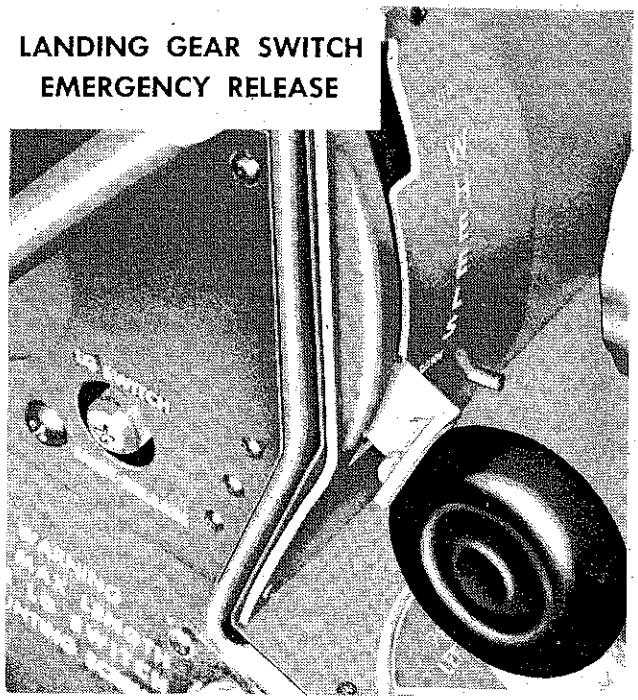


CDC-1-25

Figure 1-21

one-third of the main landing gear wheels exposed with the doors cut out for the exposed portion.

No manual up or down lock is provided since the motor and worm drive gear will lock the gear in place. The gear may be raised or lowered manually in emergency by means of the emergency hand crank.



CDC-1-26

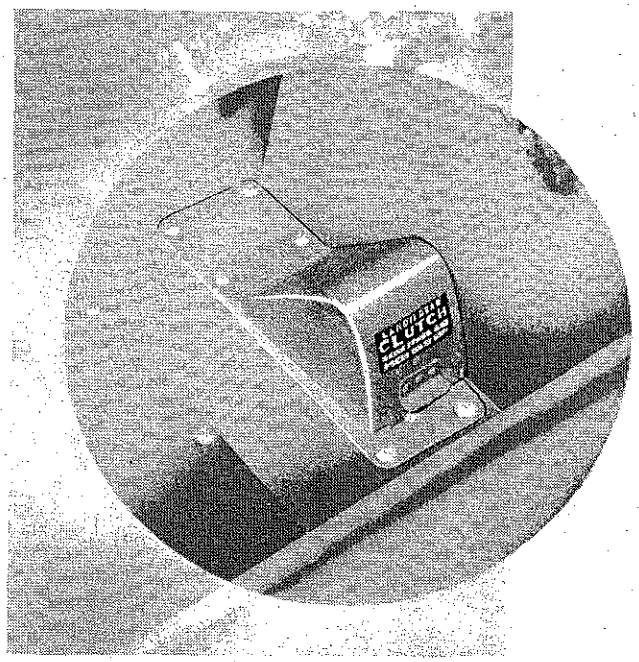
Figure 1-22

LANDING GEAR LEVER.

The position of the landing gear is selected by the two-position landing gear lever (figure 1-5) on the control pedestal. When the lever is moved to UP, the motor is energized and the landing gear retracts. It extends when the lever is moved to DOWN.

LANDING GEAR LEVER EMERGENCY RELEASE.

Within the pedestal is a latching solenoid which prevents the landing gear lever from being moved to the UP position while the aircraft is on the ground. This solenoid is controlled by safety switches, one on each main landing gear strut, which open the circuit to the solenoid when the strut is compressed ½ inch or more and close the circuit when the strut is fully extended. When the circuit is closed, it activates the solenoid, pulling the latching bar away from the switch lever so that it can be moved to the UP position. Should the solenoid fail to function properly, the latching bar may be moved manually to release the landing gear lever by pushing the button on the left side of the pedestal, marked LG SWITCH EMER RELEASE (figure 1-22).



LANDING GEAR EMERGENCY CLUTCH

Figure 1-23

CDC-1-27

LANDING GEAR MALFUNCTION LIGHT.

The landing gear lever has a small red plastic wheel-shaped knob in which there is a light. This light illuminates the knob any time the position of the landing gear does not correspond to the position of the lever. Also, the knob will be illuminated when the throttles are retarded to a point which corresponds to approximately 12 in. Hg. provided the landing gear is not fully extended. This light can be tested by pushing the button below the landing gear lever. See figure 1-5.

LANDING GEAR WARNING HORN.

When the throttles are retarded to a position on the quadrant equivalent to approximately 12 inches Hg, they close the ground circuit to the landing gear warning horn, located on the floor board under the copilot's seat. The positive circuit of the horn is broken by the landing gear lower (down) limit switch so the horn will not operate when the gear is in the full down position.

WARNING HORN SILENCER. A spring loaded, self centering landing gear warning horn silencer knob (figure 1-5) is located ahead of and between the throttles. Rotating the knob toward the throttle which is actuating the horn will silence the horn until the throttle is advanced and then retarded.

LANDING GEAR POSITION INDICATORS.

The position of the landing gear is illustrated by the electrically operated position indicators (figure 1-9) on the upper left portion of the instrument panel. The indicators are in the outline of an airplane, with a small window at each landing gear position. When the gear is fully extended, a picture of a wheel and strut appears in each window; when the gear is retracted, the word UP appears in each of the windows. A set of diagonal lines appears in each window when the gear is in any position other than full up or full down, or when the electrical power is off.

CDC-1-28

Figure 1-24. Free Air Temperature Gage

LANDING GEAR EMERGENCY CLUTCH.

A clutch pedal (figure 1-23), on the floor to the left of the pedestal, is provided to disengage the electric drive so the landing gear may be operated with the emergency hand crank. By pushing forward on the pedal, the electric drive mechanism is disengaged; however, the clutch must be released and the electric drive re-engaged to lock the gear after it has been repositioned.

EMERGENCY HAND CRANK.

The landing gear and flaps may be operated manually by using the emergency hand crank (figure 1-21) located to the right of the pilot's seat. Pulling the crank out (away from the pilot) engages it to the landing gear mechanism, pushing it in engages it to the flap mechanism. In either case, extension is accomplished by turning the crank forward at the top of the stroke; retraction by turning aft.

The position of the landing gear lever has no effect on the emergency operation of the landing gear if the gear fails to operate normally. This is because the entire control system is electrical, while the emergency operation is entirely mechanical. However, as a safety precaution, since failure of the normal control system might well be the severance of an electrical circuit which could reconnect, the landing gear lever should be positioned at DOWN and the landing gear control circuit breaker pulled off before use of the emergency mechanism.

TAIL WHEEL LOCK SYSTEM.

The tail wheel locking system is a mechanical linkage from the tail wheel lock handle, on the pedestal, to a locking pin at the tail wheel. When engaged, the lock will hold the tail wheel in a straight fore and aft position which will aid in preventing the aircraft from turning in either direction.

TAIL WHEEL LOCK SYSTEM CONTROL.

The tail wheel lock handle (figure 1-5) is a "T" handle located on the control pedestal. It is a push-pull control equipped with a position lock, which is locked by turning the handle clockwise and unlocked by turning counterclockwise.

Pulling the handle out unlocks the tail wheel, pushing the handle in causes the tail wheel to be locked. However, the lock will not engage until the tail wheel is in its centered position. The tail wheel is locked for take-off and landing and unlocked for ground operation to facilitate maneuvering.

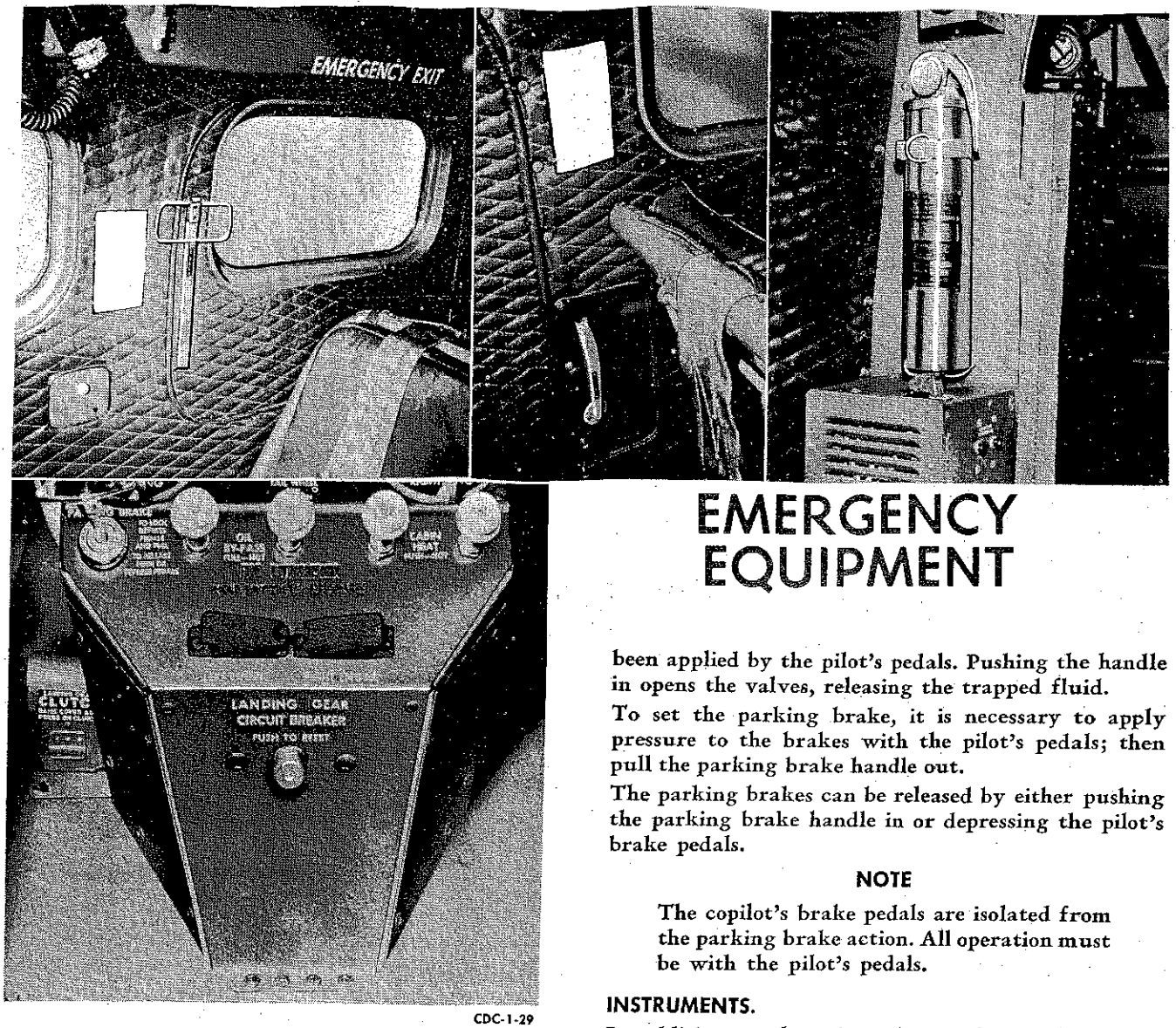
While spring tension will hold the entire mechanism in the locked position, it is necessary to lock the control out when it is desired the wheel swivel freely.

CAUTION

When locked, the tail wheel lock mechanism may be damaged by any extreme forces which tend to turn the aircraft.

BRAKE SYSTEM.

The hydraulic pressure required for braking action is created entirely by toe pressure. The aircraft, being provided with two individual brake systems, has one system actuated by toe pressure on the pilot's rudder



CDC-1-29

Figure 1-25

EMERGENCY EQUIPMENT

pedals and the other by the copilot's. These separate systems join at shuttle valves on each main wheel brake housing. By means of these shuttle valves, either system is closed off when the other is being used. The system having the greater pressure applied is the one which will be effective in braking the airplane, the other will be completely ineffective. The additional safety provided by separate systems eliminates the necessity for a separate emergency brake system.

PARKING BRAKE HANDLE.

The parking brake handle (figure 1-5), on the pedestal, is mechanically linked to parking brake valves which are incorporated only in the pilot's brake system.

When the handle is pulled out, the valves are closed thus maintaining, on the brake, whatever pressure has been applied by the pilot's pedals. Pushing the handle in opens the valves, releasing the trapped fluid.

To set the parking brake, it is necessary to apply pressure to the brakes with the pilot's pedals; then pull the parking brake handle out.

The parking brakes can be released by either pushing the parking brake handle in or depressing the pilot's brake pedals.

NOTE

The copilot's brake pedals are isolated from the parking brake action. All operation must be with the pilot's pedals.

INSTRUMENTS.

In addition to those instruments discussed as indicators for specific systems, the aircraft instrumentation includes the following, all of which are located on the instrument panel (figure 1-9):

Gyro flight instruments for both pilot and copilot which, with the exception of the pilot's turn-and-bank indicator, are vacuum operated. The pilot's turn-and-bank requires dc power and a switch, adjacent to the instrument, provides for the sources of power. This switch is completely discussed under the electrical system in this section.

Two altimeters and two rate-of-climb indicators, all of which rely on static pressure for their operation.

Two airspeed indicators which require both pitot and static pressure.

One 8 day clock.

A gyrosyn compass system, requiring both dc and ac current for operation.

A direct reading outside air temperature gage (figure 1-24), mounted at the top of the windshield.

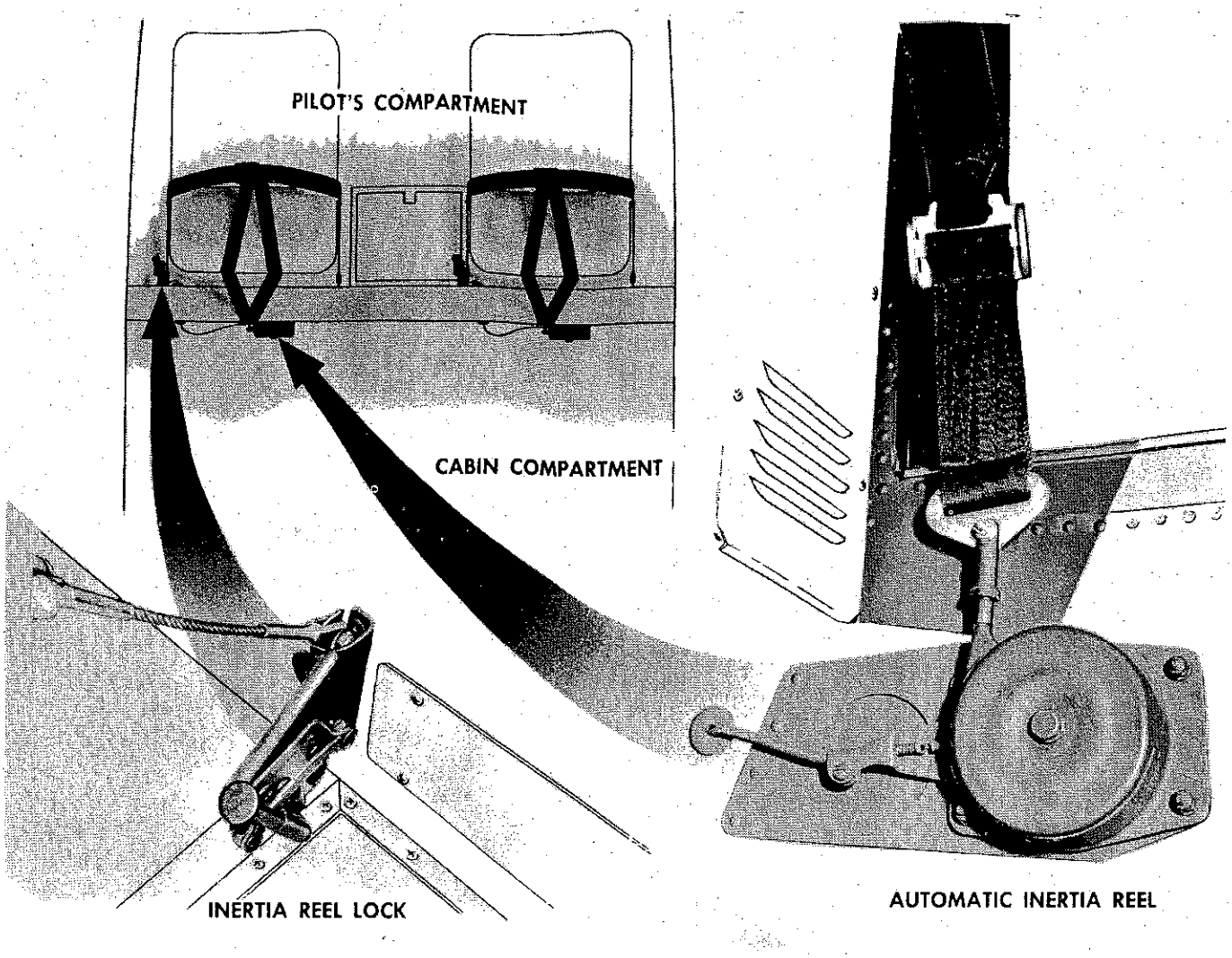


Figure 1-26. Automatic Inertia Reel

PITOT AND STATIC PRESSURE SOURCE.

The aircraft is equipped with two pitot masts, located on the underside of the aircraft, which deliver impact pressure only. The static source is two static buttons, one on each side of the rear portion of the fuselage, ahead of and below the leading edge of the horizontal stabilizer. There is no alternate static source.

EMERGENCY EQUIPMENT.

HAND FIRE EXTINGUISHER.

A type A-20 hand fire extinguisher is installed on the aft side of the front cabin bulkhead, to the left of the pilots' compartment door. The extinguisher contains bromochloromethane which is charged with dry air to a pressure of 150 to 175 psi. A pressure gage is installed on the top of the extinguisher, providing a visual check of the condition of the extinguisher.

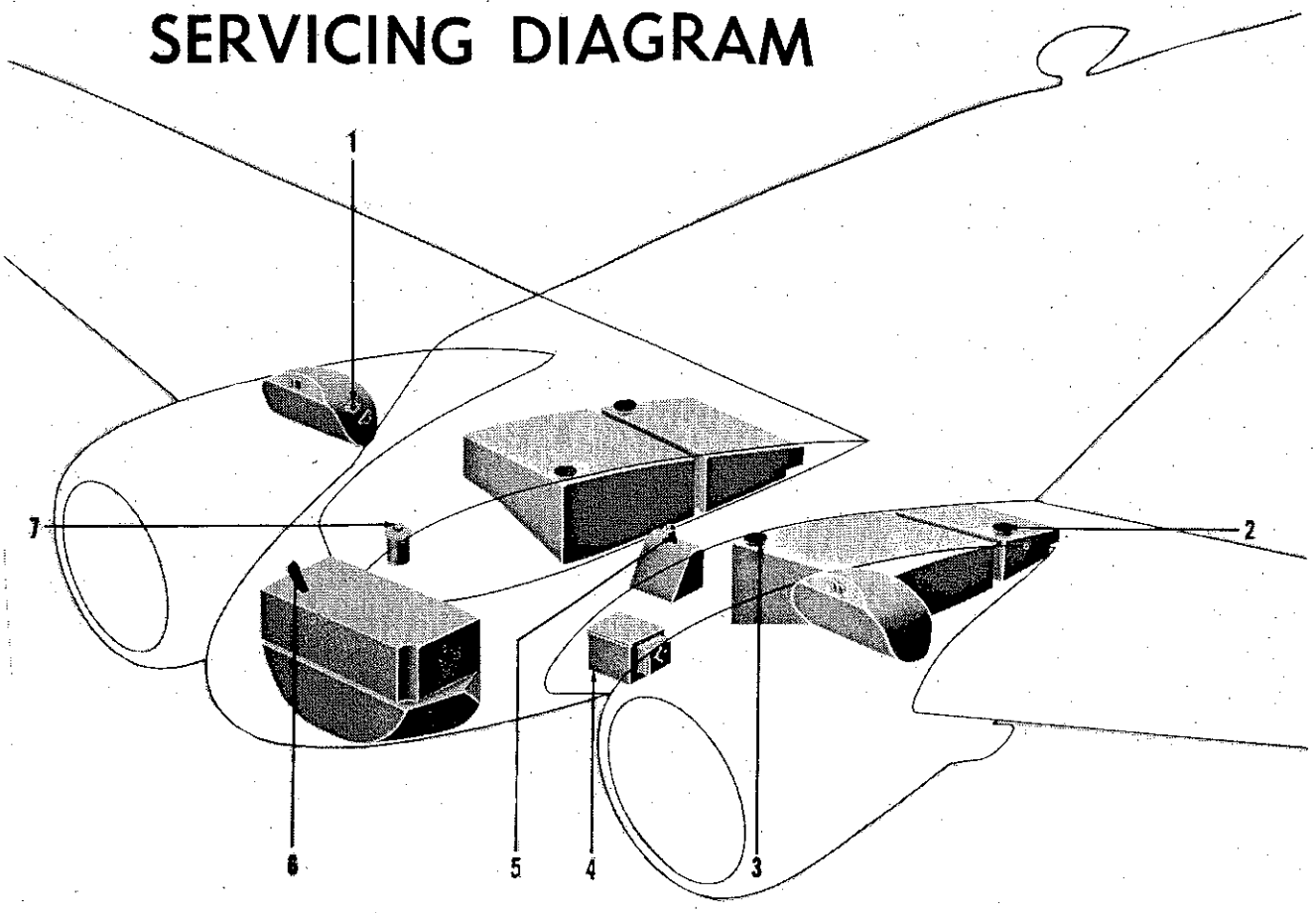
ENGINE FIRE EXTINGUISHER.

The engine fire extinguishing system is a single shot CB system with the sphere (bottle) located under the pilot compartment. The sphere is accessible for replacement or inspection through a large door on the underside of the airplane.

ENGINE FIRE EXTINGUISHER CONTROLS. On the lower portion of the pedestal, under safetied plastic guards, are two momentary toggle switches; the left switch for the left engine, the right switch for the right. By holding either switch in the ON position, a solenoid valve directs flow to the engine selected and then discharges the CB. This is the only operation necessary to discharge the system with this particular installation.

ENGINE FIRE EXTINGUISHER INDICATORS. The engine fire extinguisher system is not provided with an indicator which is visible in flight. A pressure gage is mounted on the sphere to indicate, on inspection, the system has not been discharged.

SERVICING DIAGRAM



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*1. Oil Supply Tank Filler (RH).
*2. Left Rear Fuel Tank Filler.
*3. Left Front Fuel Tank Filler.
*4. Battery (LH).
5. Anti-Icer Fluid Tank Filler.
6. Nose Tank Filler.
7. Brake Fluid Reservoir Filler.

*Asterisk indicates typical of both sides.
Fuel: Specification MIL-F-5572
Grade 91/96
Oil: Specification MIL-L-6082A
Grade 1100
Hydraulic Fluid: Specification MIL-O-5606
Anti-Icer Fluid: Specification MIL-F-5566

Figure 1-27

WARNING

CB is toxic, particularly when used to fight a fire in a closed area where various kinds of materials are burning. It is important to use as little CB as possible and to avoid inhaling CB fumes as much as possible. Dizziness and nausea are symtoms of CB poisoning sufficient to require medical treatment.

EMERGENCY CABIN DOOR RELEASE HANDLE.

The cabin door is provided with a mechanism for releasing the hinge pins so that the door may be jettisoned for emergency exit. The release handle (figure 1-25) is located in the cabin wall at the forward edge of the door.

EMERGENCY ESCAPE HATCH RELEASE HANDLE.

The emergency escape hatch, in the right cabin wall, is designed primarily for escape when the cabin door is jammed or blocked and should not be opened except in an emergency. The release handle (figure 1-25) is at the front edge of the hatch.

FIRST AID KITS.

Two first aid kits are provided, one on the front side of the lavatory door and one on the forward side of the rear cabin bulkhead.

SEATS.

Both pilots' seats are adjustable by a crank located just below the front edge and in the center of each seat. The construction of the seat legs is such that the seat rises as it moves forward and lowers as it moves back.

SHOULDER HARNESS LOCKING LEVER.

A two position (locked-unlocked) shoulder harness inertia reel lock control (figure 1-26) is located on the left side of both pilots' seats. A latch is provided for positively retaining the control handle in either position on its quadrant. By pressing down on the top of the control handle, the latch is released and the handle may then be freely repositioned.

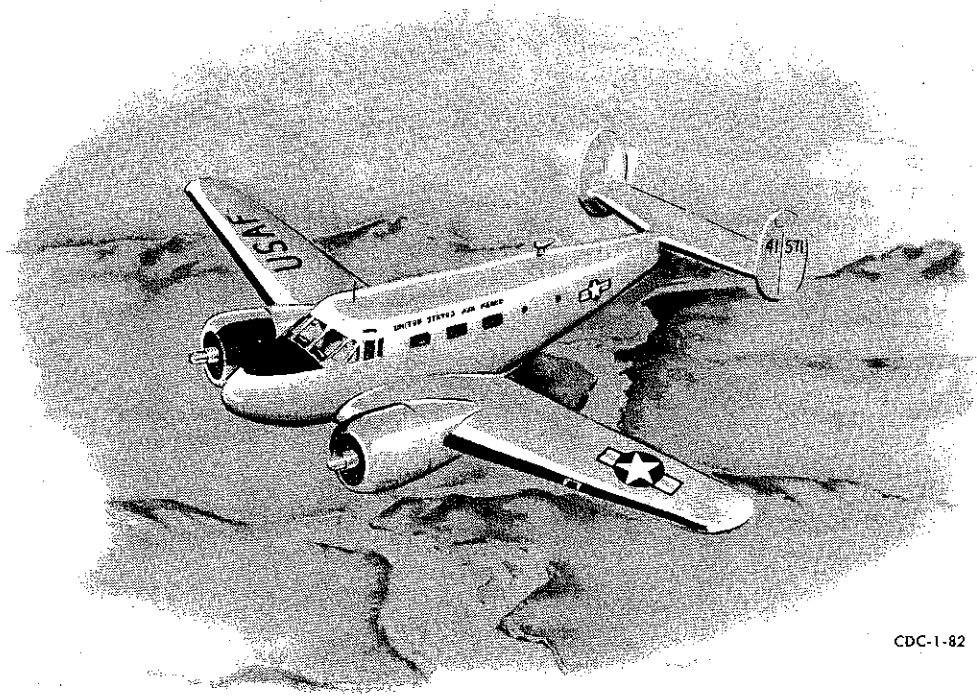
When the control is in the unlocked position (full back), the reel harness cable will extend, allowing the occupant to lean forward in the seat; however, the reel harness cable will automatically lock when an impact force of two to three g's is encountered on the aircraft. When the reel is locked in this manner, it will remain locked until the control handle is moved to the locked and then to the unlocked position.

When the control is in the locked position (full forward), the reel harness cable is manually locked so that the user is prevented from bending forward. The locked position is used when a crash landing is anticipated. This position provides an added safety precaution over and above that of the automatic safety lock.

AUXILIARY EQUIPMENT.

The following auxiliary equipment is fully described in Section IV:

Heating and Ventilating System
Windshield Defrosting System
Propeller Anti-Icing System
Wing and Tail Deicing System
Lighting Equipment
Radio Equipment
Miscellaneous Equipment.



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