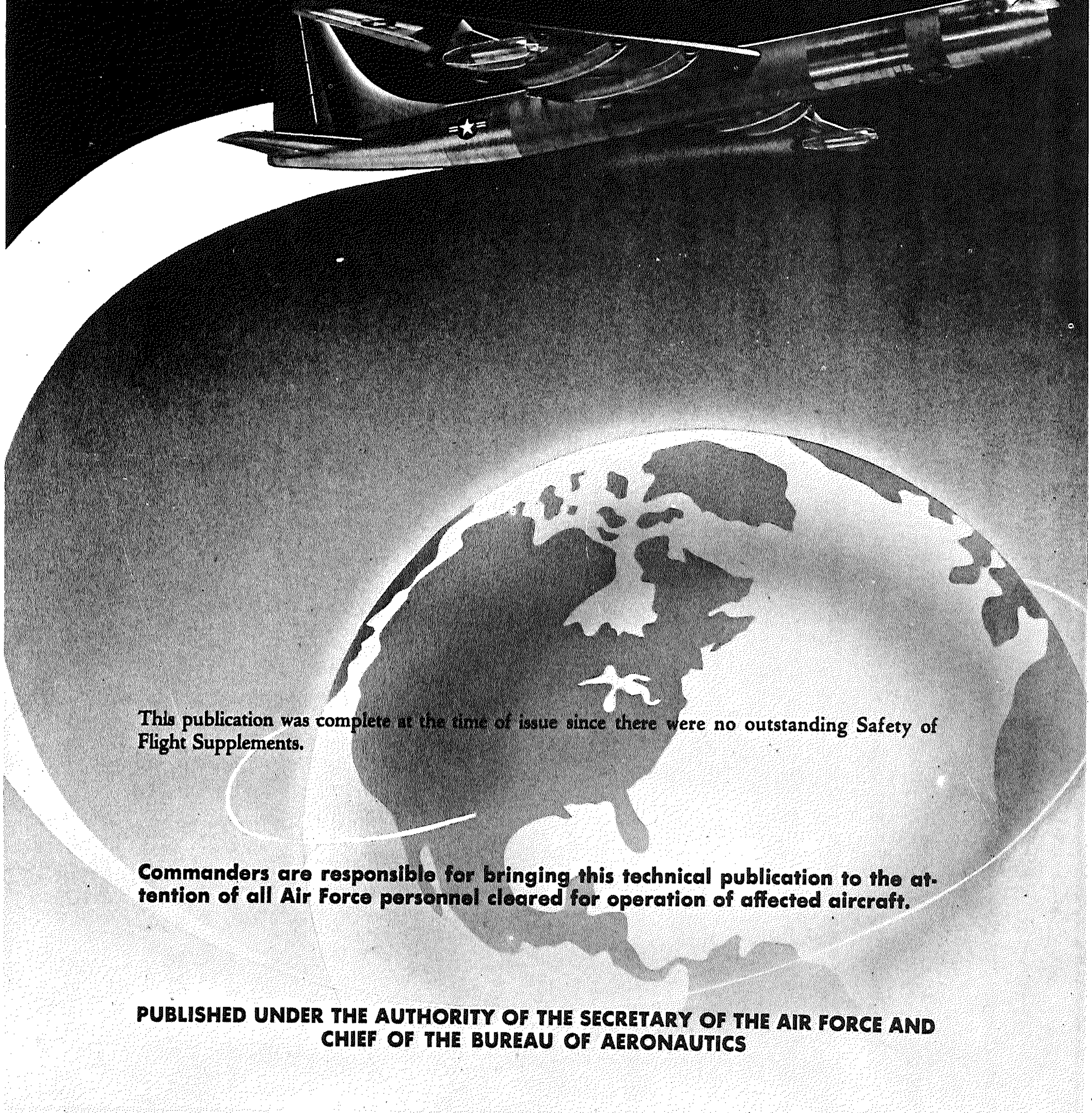
FLIGHT HANDBOOK

T. O. 1B-36(R)D(III)-1

USAF SERIES
RB-36D&E-III
AIRCRAFT
(FEATHERWEIGHT—CONFIGURATION III)



This publication was complete at the time of issue since there were no outstanding Safety of Flight Supplements.

Commanders are responsible for bringing this technical publication to the attention of all Air Force personnel cleared for operation of affected aircraft.

PUBLISHED UNDER THE AUTHORITY OF THE SECRETARY OF THE AIR FORCE AND CHIEF OF THE BUREAU OF AERONAUTICS

72-114-A

AFPS—SA—6-55-1600

6 MAY 1955

LIST OF REVISED PAGES ISSUED

INSERT LATEST REVISED PAGES. DESTROY SUPERSEDED PAGES.

ADDITIONAL COPIES OF THIS PUBLICATION MAY BE OBTAINED AS FOLLOWS:

A
USAF

USAF ACTIVITIES.—In accordance with Technical Order No. 00-5-2.
NAVY ACTIVITIES.—Submit request to nearest supply point listed below, using form NavAer-140; NASD, Philadelphia, Pa.; NAS, Alameda, Calif.; NAS, Jacksonville, Fla.; NAS, Norfolk, Va.; NAS, San Diego, Calif.; NAS, Seattle, Wash.; ASD, NSC, Guam.
For listing of available material and details of distribution see Naval Aeronautics Publications Index NavAer 00-500.

68-216-A

This handbook contains all the information necessary for safe and efficient operation of the B-36 airplanes. The instructions do not teach basic flight principles but 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 are avoided.

The only source of current, technically accurate operating instructions is your Flight Handbook. Instructions in the handbook are based on the technical knowledge of the aircraft manufacturer and the Air Force, as well as on the experience of the using commands. This handbook has no similarity to your old -1 Technical Order. Here your specific problems have been considered - - - - current and accurate information is presented to you in an attractive and usable form. Not all Flight Handbooks have been prepared in accordance with the new requirements, but you can easily tell the new from the old. New type handbooks have a full page cover illustration; old type books have only a small "spot" illustration.

Each flight crew member *except those attached to an administrative base* is entitled to a personal copy of the flight handbook while he is stationed at a given base. Do not let anyone tell you differently! *Air Force Regulation 5-13,* issued in 1953, specifically makes this provision.

You will be surprised at how well the Technical Order distribution system will work if you do your part. Order your required quantity of handbooks before they are needed instead of waiting until the need arises. If you order them early, the Air Force will print enough to cover your requirements. If you delay you will probably be kept waiting a long time when you order, because sufficient copies may not have been originally printed to cover your request. It sometimes takes a discouragingly long time to get new printing! The Technical Order system is very easy to cope with. *Technical Order OO-5-2* explains in a very few pages the easy means by which you can set the automatic machinery in motion. Actually, all you have to do is register your required quantities on the *Publications Requirements Table, T.O. O-3-1;* then all revisions, reissues, and supplements will be automatically forwarded to you in the same quantities. Talk to your base supply officer—he should know all about the system since it is his job to fulfill your technical order requests. Each base must develop a system of feeding the handbooks and related data to their flight crew members so that no one will be using an obsolete book. One more thing - - - we admit it takes a long time to revise the Flight Handbook. And, since the time lag is excessive for safety of flight information, a new program has been put into effect to get such information to you in a hurry. This is done by means of Safety of Flight Supplements which use the same number as your flight handbook except for the addition of a suffix letter. Supplements covering loss of life will get to you in 48 hours; those concerning serious damage to equipment will make it in ten days. And what do you have to do to get these supplements? Absolutely nothing! If you have ordered your Flight Handbook on the *Publications Requirements Table,* you will automatically receive all supplements pertaining to your aircraft. (Additional information regarding these supplements can be obtained from *Technical Order 00-5-1E.)*

Just as it is necessary to have a thorough knowledge of the airplane in order to operate it efficiently, so must you understand the arrangement of this handbook in order to benefit from it fully. A list of the sections and the type of information contained in each is given here to aid you in using your handbook.

Your comments and questions regarding any phase of the Flight Handbook program are invited. They should be directed to the Wright Air Development Center, Attn: WCSOH.

SECTION I, DESCRIPTION—A detailed description of the airplane and all its systems and controls which contribute to the physical act of flying the airplane. Also, this section includes all the emergency equipment that is not part of an auxiliary system. This section is reserved solely for descriptive material and, therefore, does not contain any operating procedures.

SECTION II, NORMAL PROCEDURES—A section containing the procedures to be accomplished from the time the airplane is approached by the flight crew until it is left parked on the ramp after accomplishing one complete flight under normal conditions.

SECTION III, EMERGENCY PROCEDURES—Specific instructions to be followed by the crew under all emergency conditions (except those connected with the auxiliary equipment) that could reasonably be expected to be encountered.

SECTION IV, DESCRIPTION AND OPERATION OF AUXILIARY EQUIPMENT—A section including the description, normal operation, and emergency operation of all equipment not directly contributing to flight, such as armament, radio, oxygen, etc.

SECTION V, OPERATING LIMITATIONS—A section covering all airplane and engine operating limitations that must be observed during normal operation.

SECTION VI, FLIGHT CHARACTERISTICS—A section describing the flight characteristics of the airplane.

SECTION VII, SYSTEMS OPERATION—A discussion of the operation of the various airplane systems under all conditions of airplane operation.

SECTION VIII, CREW DUTIES—An amplified check list covering a discussion of the primary and alternate functions of each crew member.

SECTION IX, ALL WEATHER OPERATION—A supplement to Section II providing additional instructions for turbulent aid and instrument flying, and for cold weather, desert, and tropical operation.

APPENDIX I, PERFORMANCE DATA—A section containing operating data essential to flight planning.

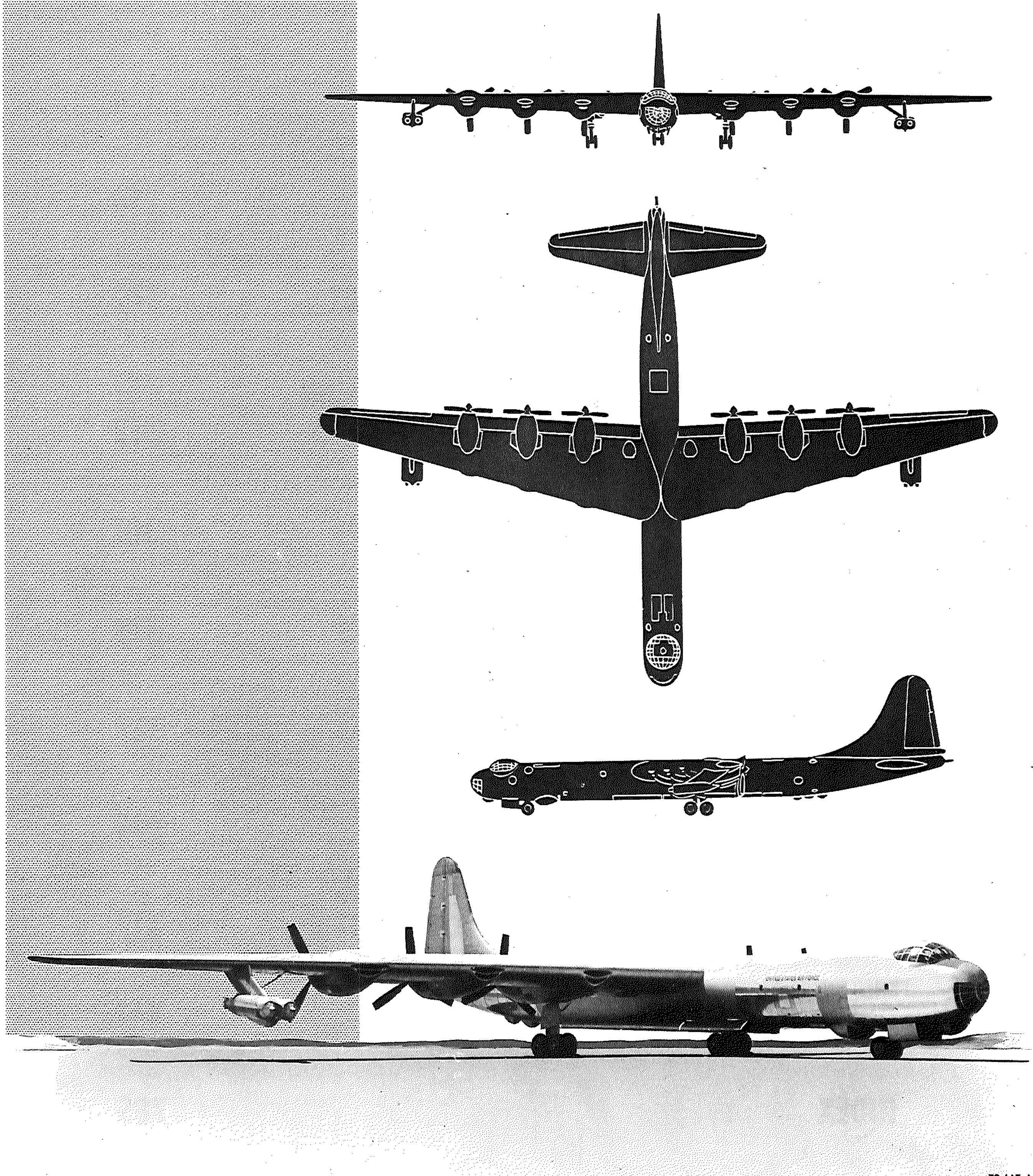
AIRPLANE GROUP NUMBER CODE.

Airplanes having a particular control or system in common have been assigned group numbers to avoid breaking the continuity of the text with listings of airplane serial numbers. The groups with the airplanes they include and the items that are peculiar to each group are listed as follows:

GROUP 1—Airplanes which have undergone latest modifications. (These modifications will be processed on all airplanes eventually.) Certain items covered by text are not necessarily included on pertinent illustrations.

Table of Contents

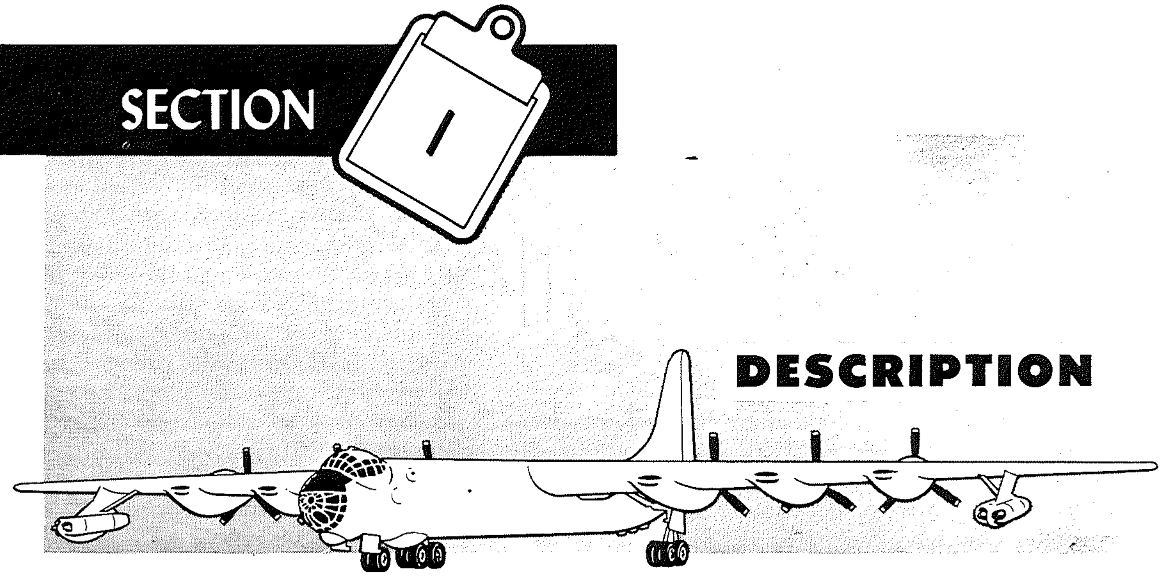
The RB-36D&E-III AIRPLANE



72-115-A

SECTION 1

DESCRIPTION



72-124-A

THE AIRPLANE.

The RB-36-III is a long-range, high-altitude, very heavy strategic reconnaissance airplane built by Convair, a Division of General Dynamics, Fort Worth, Texas. The airplane is equipped to perform all-purpose strategic reconnaissance missions which include intelligence, day and night mapping, charting, and bomb damage assessment. Six Pratt and Whitney R4360-41 reciprocating engines drive pusher-type Curtiss propellers which can be synchronized in normal or reverse pitch. Additional power is provided by four General Electric J47 jet engines. The control surfaces consist of servo-tab-operated ailerons, elevators, and rudder. The flap system consists of three pairs of flaps. Four a-c alternators, driven by four of the reciprocating engines through constant-speed drives, furnish power to operate the airplane's electrical equipment. A portion of the a-c power is rectified to provide d-c power and electrical control. The landing gear, the brakes, the bomb bay doors, and the nose wheel steering system are hydraulically operated. The crew compartments and the camera compartment are pressurized, heated, and ventilated, and are provided with an oxygen system. Compartment heating; enclosure and camera window defrosting; and wing and tail anti-icing are accomplished by heated air. Heat for the air is obtained through the use of heat exchangers installed in the reciprocating engine exhaust systems. Defensive armament consists of a nonretractable, radar-controlled tail turret containing two 20-millimeter guns. Tactical equipment includes radar equipment, aerial cameras for high altitude photography, and photo flash bombs carried in bomb bays No. 2 and 3. The No. 3 bay is equipped to carry a bomb bay fuel tank as an alternate load.

Airplane Dimensions

Approximate overall dimensions are as follows:

- **Length .... 162 feet, 2 inches**
- **Wing Span .... 230 feet**
- **Height (to top of fin) . 46 feet, 10 inches**
- **Wing Area .... 4772 square feet**

G1-298-A

DESIGN GROSS WEIGHT.

The design gross weight is 357,500 pounds.

FLIGHT CREW.

The normal flight crew consists of 19 men as follows:

FORWARD CABIN

- Aircraft Commander
- Pilot
- Copilot
- First Engineer
- Second Engineer
- Primary Navigator
- Photo-Navigator
- Radar Observer
- Weather Observer
- First Radio Operator
- Second Radio Operator
- ECM Observer (Low Frequency)

CAMERA COMPARTMENT
First Photographer

AFT CABIN
ECM Observer (Intermediate Frequency)
ECM Observer (Medium Frequency)
ECM Observer (High Frequency)
Lower Aft Scanner (Right)
Lower Aft Scanner (Left)
Tail Gunner

RECIPROCATING ENGINES.

The airplane is primarily powered by six pusher-type, Pratt and Whitney, R4360-41 Wasp Major engines. Each engine has 28 cylinders which are arranged helically in seven four-row banks around the crankshaft which rotates counterclockwise as viewed from aft of the wing. Each engine is equipped with a water injection system which permits the horsepower rating to increase from 3250 (dry)to 3500. A torquemeter system for each engine measures the torque transmitted by the crankshaft to the propeller. This measurement is used to determine the actual power output of the engine. Carburetor and engine cooling air enters each nacelle at the wing leading edge. The flow of engine cooling air is augmented by an engine-driven fan. Controls are provided for varying the temperature of carburetor air, and two turbosuperchargers maintain the required carburetor inlet pressure for each engine during high altitude operation. The cylinders of each engine are fired by a seven-magneto, high tension ignition system which is automatically pressurized for operation at high altitudes. A two-position controllable spark advance system permits efficient engine operation with certain power settings.

Main Differences TABLE

72-116-A

MODEL	DESIGN G.W. (LBS)	PRESSURIZED CREW COMPARTMENTS	CREW	ENGINEER'S STATION	RECIP. ENGINES	WING FUEL TANKS	GUN TURRETS	BOMB BAYS	BOMBING SYSTEM
B-36D	357,500	2	15	SINGLE	R4360-41	8	8	4	K( ) & UNIVERSAL
B-36D-II	357,500	2	15	SINGLE	R4360-41	8	8	4	K( ) & UNIVERSAL
B-36D-III	357,500	2	13	SINGLE	R4360-41	8	1	4	K( ) & UNIVERSAL
B-36F	357,500	2	15	SINGLE	R4360-53	8	8	4	K( ) & UNIVERSAL
B-36F-II	357,500	2	15	SINGLE	R4360-53	8	8	4	K( ) & UNIVERSAL
B-36F-III	357,500	2	13	SINGLE	R4360-53	8	1	4	K( ) & UNIVERSAL
B-36H	357,500	2	15	DUAL	R4360-53	8	8	4	K( ) & UNIVERSAL
B-36H-II	357,500	2	15	DUAL	R4360-53	8	8	4	K( ) & UNIVERSAL
B-36H-III	357,500	2	13	DUAL	R4360-53	8	1	4	K( ) & UNIVERSAL
B-36J	410,000	2	13	DUAL	R4360-53	10	1	4	K( ) & UNIVERSAL
RB-36D & E	357,500	3	22	SINGLE	R4360-41	8	8	2	CONV. & UNIVERSAL
RB-36D & E-II	357,500	3	22	SINGLE	R4360-41	8	8	3	CONV. & UNIVERSAL
RB-36D & E-III	357,500	3	19	SINGLE	R4360-41	8	1	3	CONV. & UNIVERSAL
RB-36F	357,500	3	22	SINGLE	R4360-53	8	8	2	CONV. & UNIVERSAL
RB-36F-II	357,500	3	22	SINGLE	R4360-53	8	8	3	CONV. & UNIVERSAL
RB-36F-III	357,500	3	19	SINGLE	R4360-53	8	1	3	CONV. & UNIVERSAL
RB-36H	357,500	3	22	DUAL	R4360-53	8	8	2	CONV. & UNIVERSAL
RB-36H-II	357,500	3	22	DUAL	R4360-53	8	8	3	CONV. & UNIVERSAL
RB-36H-III	357,500	3	19	DUAL	R4360-53	8	1	3	CONV. & UNIVERSAL

72-116-A

Figure 1-1.

THROTTLE CONTROLS.

A set of throttle levers (14, figure 1-14) on the pilots' pedestal is mechanically interconnected with a set of throttle levers (16, figure 1-21) at the engineers' table. A lock lever (13, figure 1-14) on the pilots' pedestal will lock the throttle levers in any desired position. This lock can be overridden by the engineer.

A warning horn provides an indication of an unsafe condition of the throttle levers with respect to the position of the flaps or landing gear. The horn will sound when all six reciprocating engine throttle levers are advanced for take-off and the flaps are not extended at least 20 (± 4) degrees. The horn will also sound when the landing gear is up and locked and any throttle lever is retarded below minimum cruise. See "Landing Gear Warning Horn" and "Flap Warning Horn" of this section.

MIXTURE CONTROLS.

Two methods are available for controlling the mixture. Normally, control is accomplished electronically through the use of a set of control levers located on the engineer's table. Each lever is geared to a potentiometer which is located beneath the lever. Movement of the lever will move the potentiometer to originate a signal which is set through an amplifier to an a-c actuator in the nacelle. The actuator positions the mixture control valve of the carburetor in response to the signal. In the event this method becomes inoperative, the mixture can be controlled by a set of override switches located on the engineers' table. These switches are connected directly to the mixture control actuators in the nacelles through an electrical circuit and provide emergency means of positioning the control valves. Both the normal and the override method of mixture control use 115-volt a-c power. No mixture controls are provided for the pilots.

Mixture Control Selector Switches.

Six two-position switches (8, figure 1-21), one for each engine, are provided to select the method of controlling the mixture. When these switches are placed in the LEVER position, the mixture control levers are effective for mixture control. When the switches are placed in the SWITCH position, the mixture control override switches become the means of controlling the mixture.

Mixture Control Levers.

Six mixture control levers (13, figure 1-21) are located on the engineer's table for normal control of the mixture. The positions on the control quadrant are IDLE CUT-OFF, NORMAL, and RICH.

WARNING

On some airplanes the IDLE CUT-OFF position on the mixture control quadrant is *away* from the operator. On other airplanes the IDLE CUT-OFF position is *toward* the operator. Therefore, the engineer must carefully check the arrangement of the mixture control quadrant of the airplane he is going to fly and become thoroughly familiar with mixture control lever positions.

The NORMAL position, which is used for all normal operation, is a rich setting and the range between NORMAL and IDLE CUT-OFF provides manual lean settings. The range between NORMAL and RICH provides a mixture too rich for normal engine operation; however, settings in this range can be used effectively under certain operating conditions. (Refer to "Cooling," Section VII.) Six normal mixture indicator lamps (6, figure 1-21) are provided and will glow when the mixture controls are set for normal mixture. The control quadrant is graduated with index marks for reference in positioning the control levers.

CAUTION

Should an output tube of the electronic mixture control system fail while the selector switch is in the LEVER position, the mixture can be expected to go to the idle cut-off or rich position, depending on which tube fails.

Mixture Control Override Switches.

Six mixture control override switches (7, figure 1-21), located on the engineer's table, are provided for controlling the mixture in the event the normal mixture controls become inoperative. Each switch has a spring-loaded IDLE CUT-OFF position, a spring-loaded AUTO-RICH position, and a neutral center position. No NORMAL position is provided, but a normal setting can be obtained by jiggling the switches between IDLE CUT-OFF and AUTO-RICH until the normal mixture indicator lamps light.

CARBURETOR AIR TEMPERATURE CONTROL.

Temperature control of carburetor air is accomplished by varying the volume of cooling air passing through the intercooler. This operation is accomplished through the use of intercooler shutters, which are controlled electrically from the engineer's station. Induction air may be heated before it enters the carburetor by diverting heated engine cooling air through the turbosuperchargers (figure 1-6) by means of the carburetor preheat switches.

Three dual indicating carburetor air temperature gages (23, figure 1-17) are located on the engineer's main instrument panel of airplanes not in group 1. Six single indicating carburetor air temperature gages (13, figure 1-16) are located on the same panel of group 1 airplanes.

Intercooler Shutter Switches.

The six three-position intercooler shutter switches (1, figure 1-22) are on the engineer's auxiliary control panel. Each switch has a spring-loaded OPEN position, a spring-loaded CLOSE position, and a neutral OFF position. When a switch is held in the OPEN or CLOSE position, a 28-volt d-c control circuit energizes relays to supply 115-volt alternating current to the intercooler shutter actuators to obtain the desired carburetor air temperature. The switches can be placed simultaneously in the OPEN position by means of a gang bar.

Note

On some airplanes the left intercooler shutter closes automatically when a shift from dual to single turbo is accomplished.

Carburetor Air Filter Switch.

Provisions have been made for the installation of carburetor air filters. When these filters are installed, they are controlled by an on-off switch (12, figure 1-17) on the engineer's main control panel. Placing the switch in the ON position, closes off ram air to the turbo-superchargers and draws air from the underside of the nacelles through the carburetor air filters. In the ON position, the switch closes a 28-volt d-c conrtol circuit which in turn supplies 115-volt a-c power to the carburetor air filter actuators.

Carburetor Preheat Switches.

Three carburetor preheat switches (32, figure 1-20) are ganged together on the engineer's control panel. A 28-volt d-c control circuit supplies 115-volt alternating current to the carburetor preheat actuators. Placing the switches in the ON position closes valves in the turbo air inlet ducts and opens valves in the carburetor preheat ducts. This permits heated engine cooling air, which is obtained from the engine bay, to circulate through the turbos.

GENERAL ARRANGEMENT *Diagram*

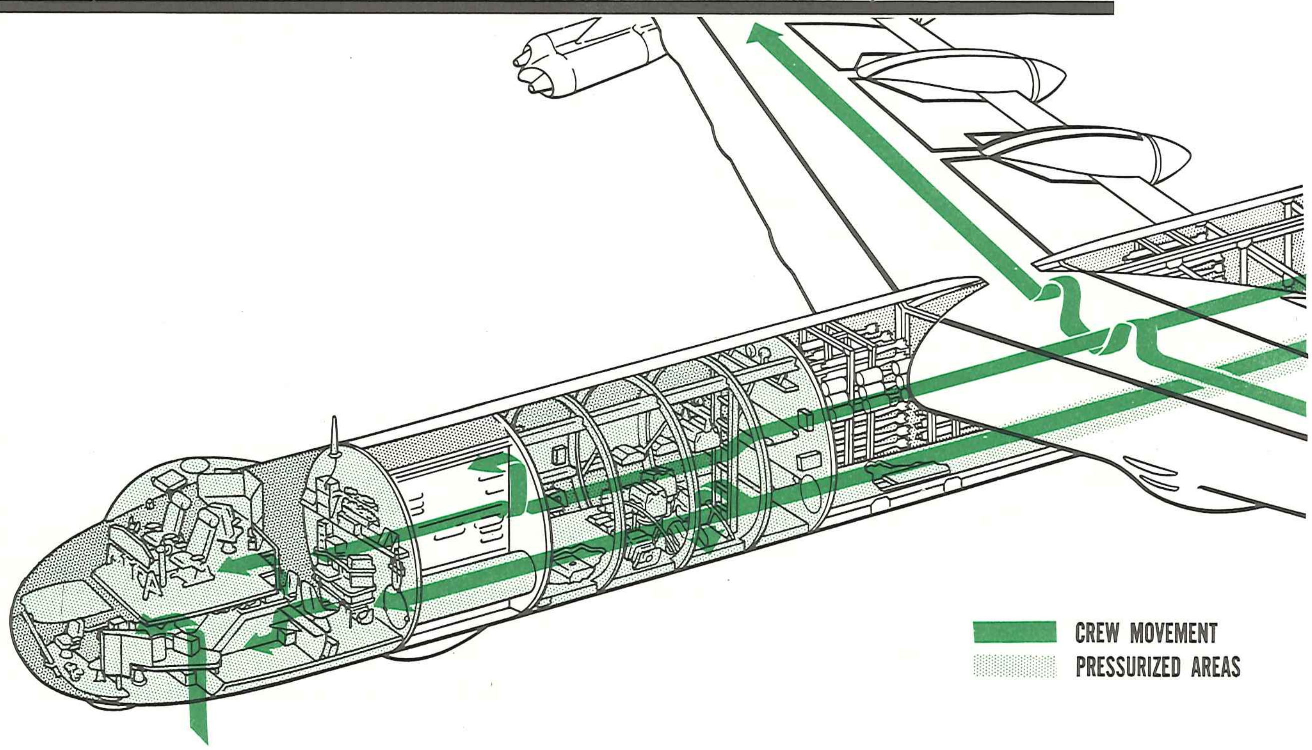


Figure 1-2. (Sheet 1 of 2)

CAUTION

When the preheat valves open, the cabin pressure wing shutoff valves automatically close to prevent the possibility of carbon monoxide contamination of the cabin air.

Note

Additional control of carburetor air temperature is available when carburetor preheat is on, by use of the intercooler shutter control switches.

TURBO SYSTEM.

Each reciprocating engine has two exhaust-driven turbosuperchargers which are used to maintain a constant carburetor inlet pressure up to 35,000 feet. The right turbo for each engine also provides pressurized air for the cabins. (See figure 4-9.)

Engine Supercharger Switches.

Six two-position switches (12, figure 1-20), located on the engineer's control panel, are provided to select dual or single turbo operation. Placing the switch in R.H. ONLY will apply 115-volt a-c power to a turbo selector valve to divert all exhaust gases through the

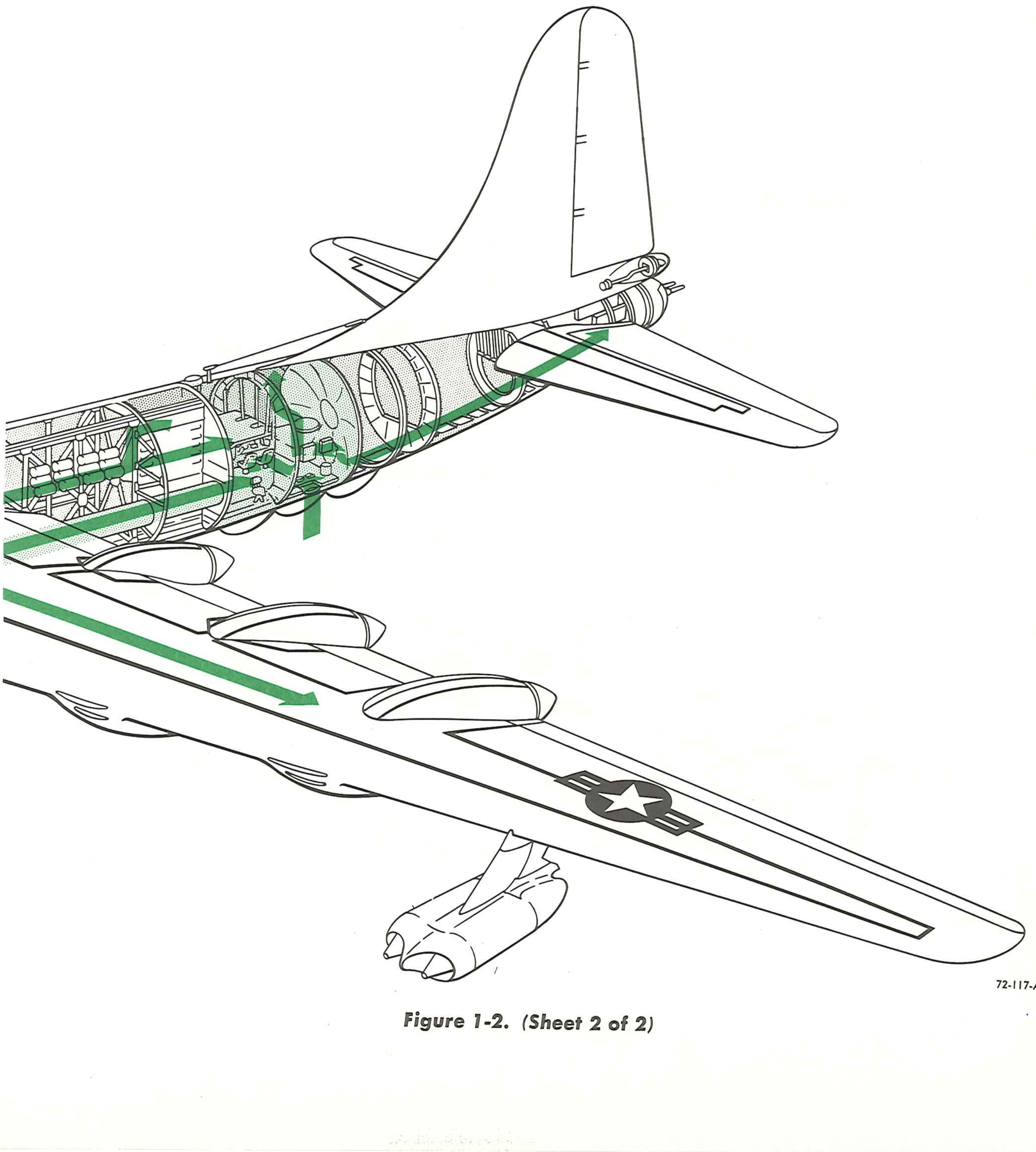
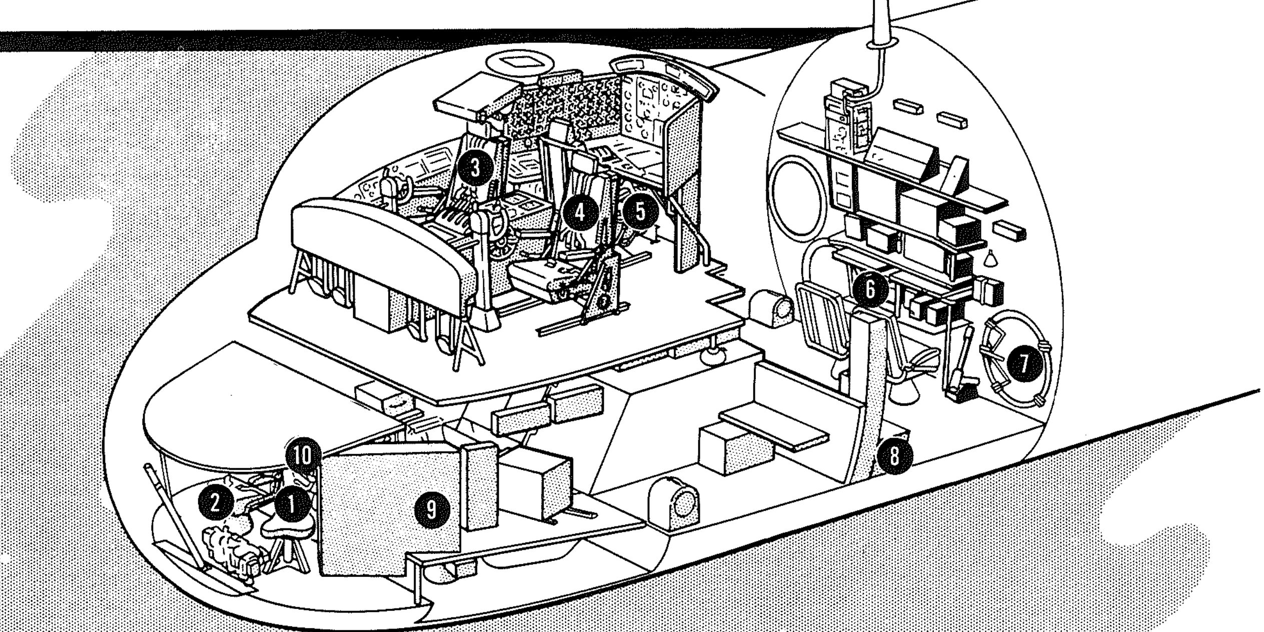


Figure 1-2. (Sheet 2 of 2)

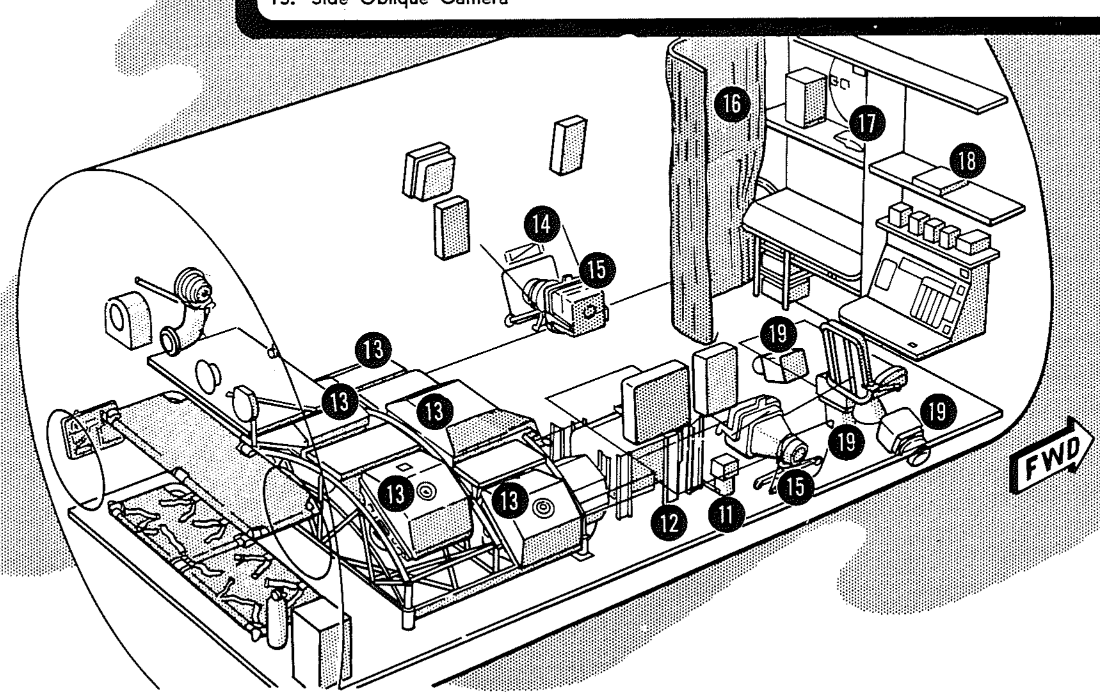
FORWARD CABIN *Arrangement*

1. Photo-Navigator's Sighting Station
2. Weather Observer's Station
3. Pilot's Station
4. Aircraft Commander's Station
5. Engineer's Station
6. Radio Operator's Station
7. Communication Tube Door
8. Sextant Stowage
9. Photo-Navigator's Station
10. Radar Observer's Station



CAMERA COMPARTMENT *Arrangement*

11. Photo Cell Trip Unit
12. Vertical Camera Mount
13. Multi Cameras
14. Side Oblique Camera Stowage Support
15. Side Oblique Camera
16. Dark Room Curtain
17. Tool Kit
18. Blowout Safety Strap Stowage
19. Trimetrogon Cameras



72-118-A

Figure 1-3.

right turbo. On some airplanes, placing the switch in R. H. ONLY, positions the turbo selector valve and also closes the intercooler shutters on the left side of the induction system to reduce drag. Dual operation is provided when the switch is in the BOTH position.

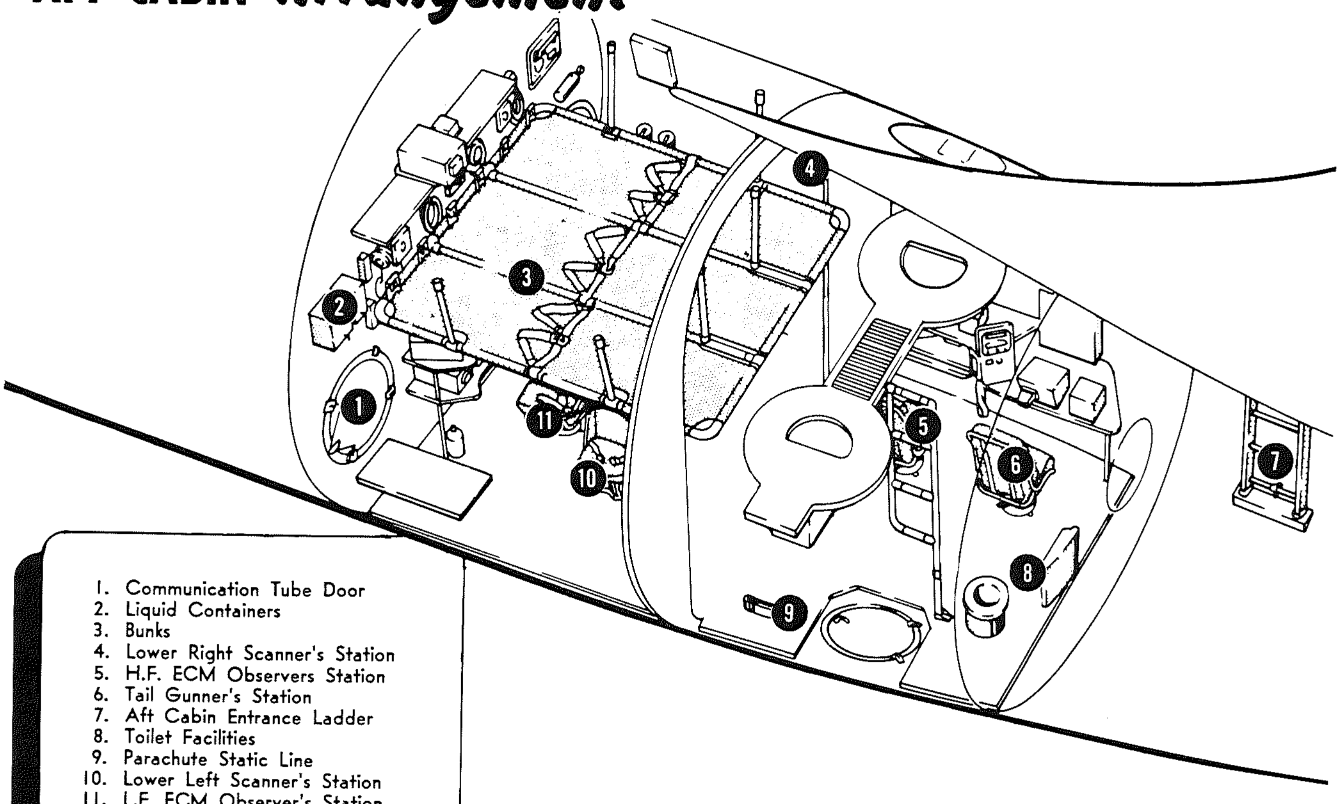
Turbo Boost Selector.

An electronic turbo regulator system is used to control the boost of the turbos and is regulated from a master control panel on the engineer's table. This panel contains a turbo boost selector lever (4, figure 1-21) and six calibration potentiometer knobs (5, figure 1-21). The knobs are used to make small individual adjustments of manifold pressures during flight to compensate for small differences in engine or turbo performances. Moving the knobs counterclockwise reduces manifold pressure. Once the system is calibrated, the engineer can control the boost of all engines simultaneously by operating the turbo boost selector lever. The lever has travel graduations from 0 to 10. Normally, position 7 is used for take-off and contains a detent to hold the lever in that position. The lever can be forced past the detent toward position 10 to obtain additional boost. A turbo boost selector lever (22, figure 1-14) is also provided for the pilots and is mechanically interconnected to the engineers' lever. This lever is located on the pilots' pedestal. The regulator system operates on 115-volt alternating current.

Turbo Control Change-Over Switches.

Six two-position switches (21, figure 1-21), marked MAN. and AUTO, are located on the engineers' table on group 1 airplanes. When the switches are in AUTO the turbo electronic regulator systems control the waste gates. Placing the switches in MAN. energizes one phase winding of the waste gate motor from a transformer which is energized by 115-volt alternating current. This sets up the motor for waste gate positioning through use of the override switches.

AFT CABIN *Arrangement*

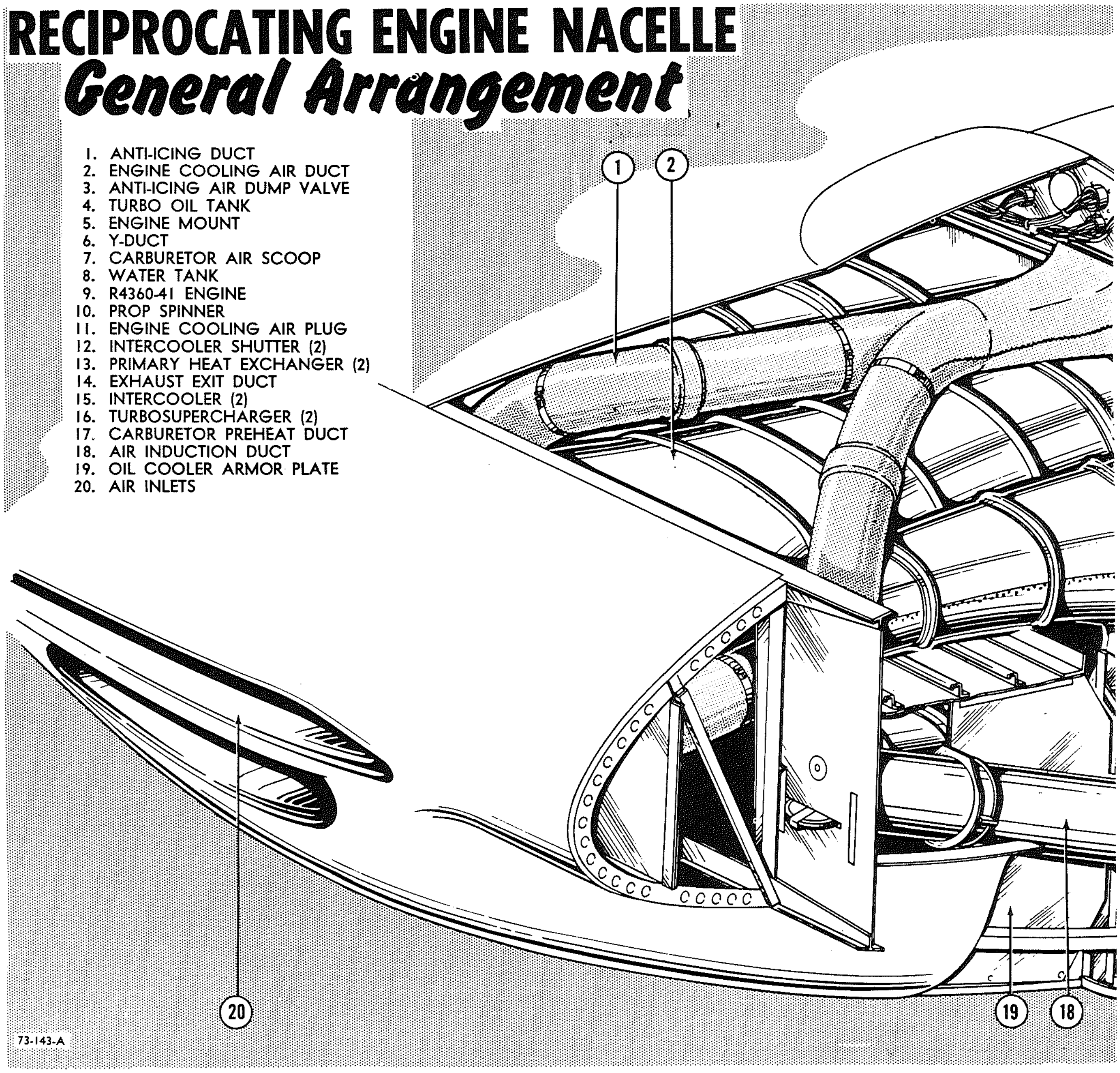


1. Communication Tube Door
2. Liquid Containers
3. Bunks
4. Lower Right Scanner's Station
5. H.F. ECM Observers Station
6. Tail Gunner's Station
7. Aft Cabin Entrance Ladder
8. Toilet Facilities
9. Parachute Static Line
10. Lower Left Scanner's Station
11. L.F. ECM Observer's Station

72-119-A

72-119-A

Figure 1-4.



73-143-A

Figure 1-5. (Sheet 1 of 2)

Turbo Control Override Switches.

Six override switches (21, figures 1-21) are located on the engineers' table of group 1 airplanes. Each switch has a spring-loaded OPEN position which opens the turbo waste gates, a spring-loaded CLOSE position which closes the turbo waste gates, and a neutral OFF position. With a turbo change-over switch in the MAN. position, the respective turbo override switch can be used to open or close the turbo waste gates. When the override switch is placed in the OPEN or CLOSED position, 230-volt alternating current is taken from a transformer to energize the unenergized waste gate motor windings for actuating the waste gate to the desired position. The transformer has an input of 115-volt alternating current. When the override switch is placed in the OPEN or CLOSE position 230-volt current is taken from a transformer to energize the unenergized waste gate motor windings for actuating the waste gate to the desired position. The transformer has an input of 115-volt alternating current. The switches can also be utilized during emergency electrical operation. (See "Obtaining Emergency Electrical Power," Section III.)

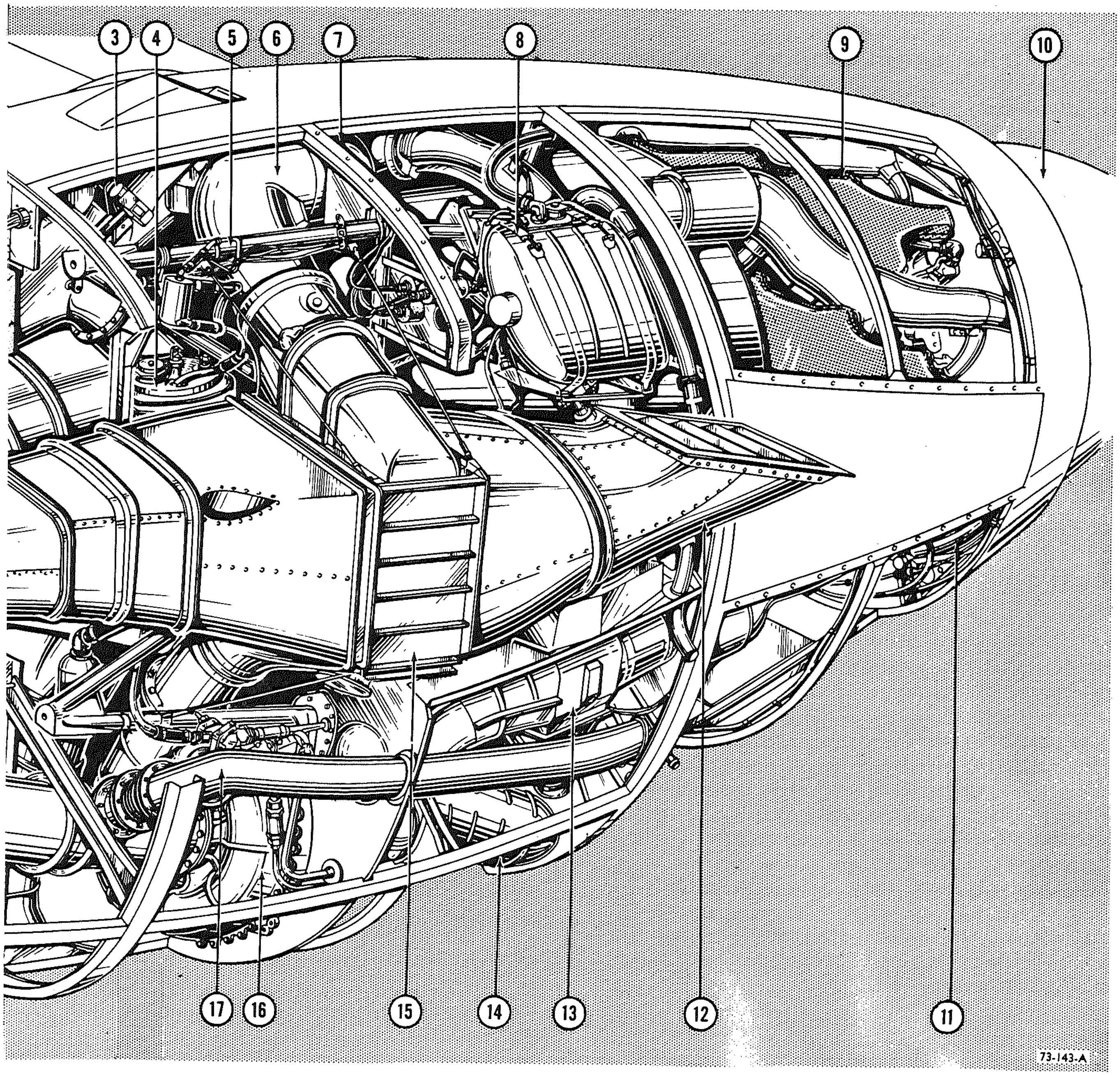


Figure 1-5. (Sheet 2 of 2)

73-143-A

Turbo Control Vernier Switch.

On group 1 airplanes, a switch-type circuit breaker (21, figure 1-21), located on the engineer's table, provides 28-volt d-c power to the turbo override relays for incremental operation of the waste gates when the turbo control override system is in use. When this switch is ON, each actuation of an override switch will operate the corresponding waste gate motor for approximately 0.05 second. With the vernier switch OFF and an override switch held in OPEN or CLOSE, the waste gate motor will operate until the override switch is released or until the waste gates reach their travel limit.

Turbo Tachometers.

Six turbo tachometers (7, figure 1-16) are provided on the engineers' main instrument panel. Each tachometer indicates the rpm of the right turbo for the respective engine.

Note

The speed of the left turbo is normally equal to right turbo speed since a governor controls both turbos.

WATER INJECTION SYSTEM.

Each reciprocating engine is equipped with a water injection system for permitting the development of additional power during take-off. The systems are of the nonhesitating type and include a nine-gallon water tank, a booster pump, and a water regulator. A 28-volt d-c circuit controls 208-volt alternating current for pump power. The regulator controls the flow of water as it is injected into the blower case to be mixed with fuel and air before entering the intake manifold. On airplanes not in group 1, with the booster pumps operating, the regulators will automatically meter the water to the engines when a manifold pressure of 53.5 inches is reached. The systems will then operate continuously for approximately 5 minutes, after which time the water supply will be depleted and the booster pumps will automatically stop. On group 1 airplanes, water is injected into the engines by the actuation of the water injection control switches. This permits the use of water at any power setting. However, at manifold pressures less than 50 inches, the use of water has little net effect upon the power output of the engines.

Water Injection Switches.

These six on-off switches (10, figure 1-20) are located on the engineer's main control panel. When the switches on airplanes not in group 1 are placed ON, the booster pumps are stated and an electrical circuit is set up to solenoid valves in the water regulators. The valves will then open, when 53.5 inches manifold pressure is attained, permitting water to enter the engines. Placing the switches OFF renders the systems inoperative. On group 1 airplanes, the switches are a direct means of injecting water into the engines. When the switches are placed ON, the pumps are started and water enters the regulator to be metered to the engine blower case. The pumps on this group of airplanes will continue to operate after the 5-minute water supply has been depleted. They are stopped only by moving the switches to OFF.

CAUTION

On group 1 airplanes if a water pressure pump is operating and no water pressure is indicated on the gage, the water supply is depleted and the control switch should be turned OFF. The pump should not be allowed to operate for more than 2 minutes without water, since water is required to cool the pump motor.

Water Pressure Gages.

There are three dual indicating water pressure gages (15, figure 1-17) on the engineer's main instrument panel of airplanes not in group 1, and six single indicating water pressure gages (17, figure 1-16) on the same panel of group 1 airplanes, which indicate psi pressure in the water injection system.

Note

With the control switches OFF, normal indication of the gages is approximately 10 psi. This reading indicates metered fuel pressure.

ENGINE COOLING SYSTEM.

Engine cooling air is introduced into the nacelle through a cooling air tunnel. Air is taken from the tunnel for cooling the turbosuperchargers, the exhaust system, the propeller mechanism, and various electrically driven actuators. The flow of the remainder of cooling air is routed over the engine and is controlled by a ring-shaped air plug. Six switches on the engineer's auxiliary control panel are provided to control the air plugs in maintaining the proper cylinder head temperature. The position of the air plugs can be determined from the scanners' stations by observing the positions of the diamond-shaped markers painted on the air plugs. (See figure 1-8.) A two-speed engine-driven fan is installed in the air tunnel of each engine to increase the rate of cooling air flow.

Air Plug Switches.

Six three-position switches (4, figure 1-22), located on the engineers' auxiliary control panel, control the engine air plugs. Each switch has a spring-loaded OPEN position, a spring-loaded CLOSE position, and a neutral center position marked OFF. The air plug is controlled by holding the switch in either the OPEN or CLOSE position to obtain the desired cylinder head temperature. The switches are provided with a gang bar for simultaneous operation in the OPEN position. A 28-volt d-c circuit controls 208-volt alternating current, which operates the air plug actuator motor.

Fan Speed Switches.

Six two-position switches (14, figure 1-20), marked LOW RPM and HIGH RPM, control the speed of the engine cooling fans. The fan speed control actuators use 115-volt alternating current. For additional information on fan speed control see "Cooling Fan Control," Section II.

IGNITION SYSTEM.

Ignition for each engine is furnished by seven double magnetos—one for each bank of cylinders. Each of the double magnetos has a right and left system which supplies the electrical impulses to the right and left spark plug of each cylinder at the proper time of the engine cycle.

Note

The right spark plug is on the intake side of the cylinder and the left spark plug is on the exhaust side of the cylinder.

The engineer can set the spark to occur at either 20 degrees or 30 degrees before the piston reaches top dead center of the compression stroke by means of a set of spark advance switches. The 20-degree setting is used for normal operation. The spark advance setting of 30 degrees is used for certain cruise control configurations during manual leaning for greater engine efficiency (see Appendix 1) and to prevent backfiring during certain operating conditions at high altitude (see "Power Collapse," Section VII). In addition to the spark advance switches, the ignition controls include a master ignition switch and six individual engine ignition switches. An emergency igniton swtch for stopping all engines simultaneously is provided for the pilots.

Master and Individual Ignition Switches.

The master ignition switch and the individual ignition switches (19, figure 1-20) are located on the engineer's main control panel. The master switch sets up 28-volt d-c ignition circuits to the individual switches when pushed in.

Note

In an emergency the engineer can stop all engines simultaneously by pulling the master switch.

The individual ignition switches have positions marked OFF, L, R, and BOTH. The unmarked detent between L and R is another BOTH position. The L and R positions are used in checking the left and right magneto systems. When the switch is in the L position, the left magneto system is grounded and the right magneto system is the one being checked. Conversely, when the switch is in the R position, the left magneto system is being checked.

Emergency Ignition Switch.

The emergency ignition switch (44, figure 1-13) is located on the pilots' instrument panel. Pulling the switch stops all engines.

CAUTION

This switch is to be used in emergency situations only. When testing the emergency ignition circuit, actuation of the switch must be instantaneous to prevent the possibility of backfiring.

Spark Advance Switches.

The six spark advance switches (9, figure 1-21) are located on the engineer's table and have positions marked ADVANCE and RETARD. When a switch is placed in the ADVANCE position, a 28-volt d-c circuit is completed to a solenoid and the spark is advanced from the normal seting of 20 degrees to a setting of 30 degrees. Placing the switch in the RETARD position returns the spark to the normal 20-degree setting.

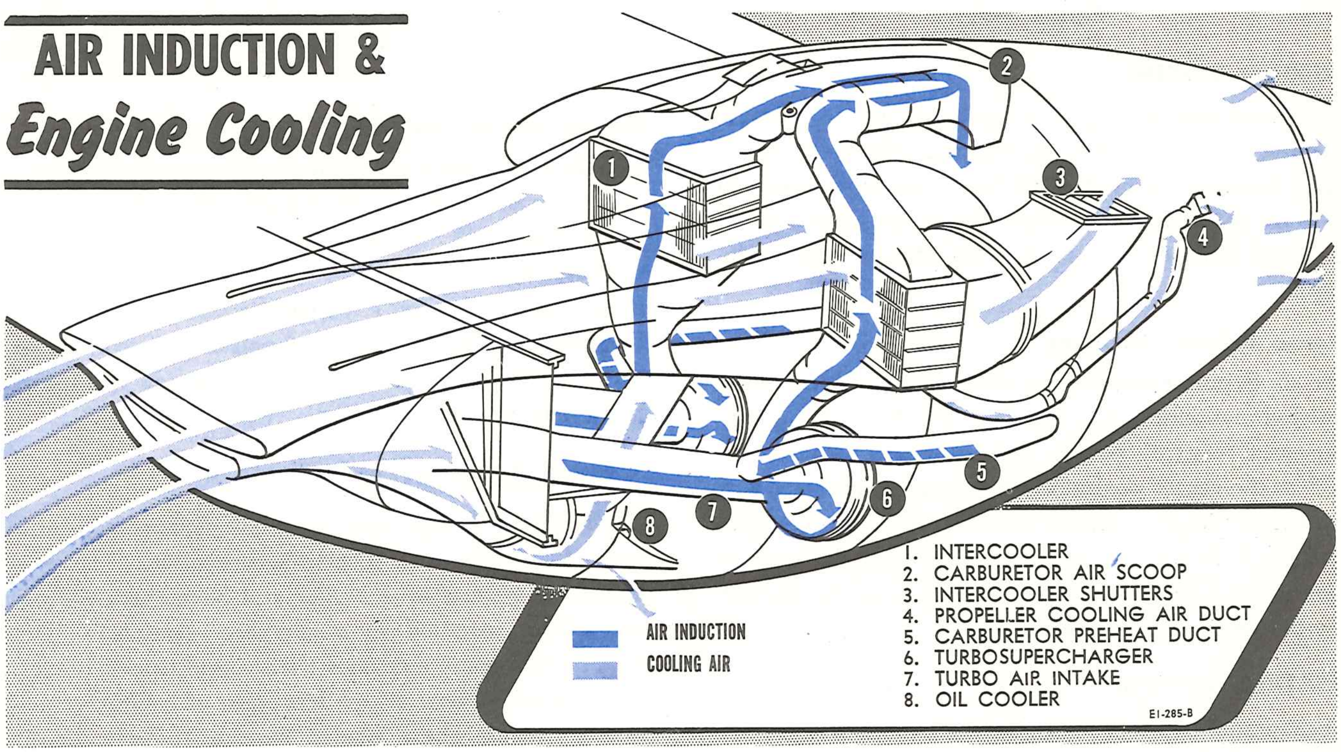


Figure 1-6.

EXHAUST & ANTI-ICING *Air Flow*

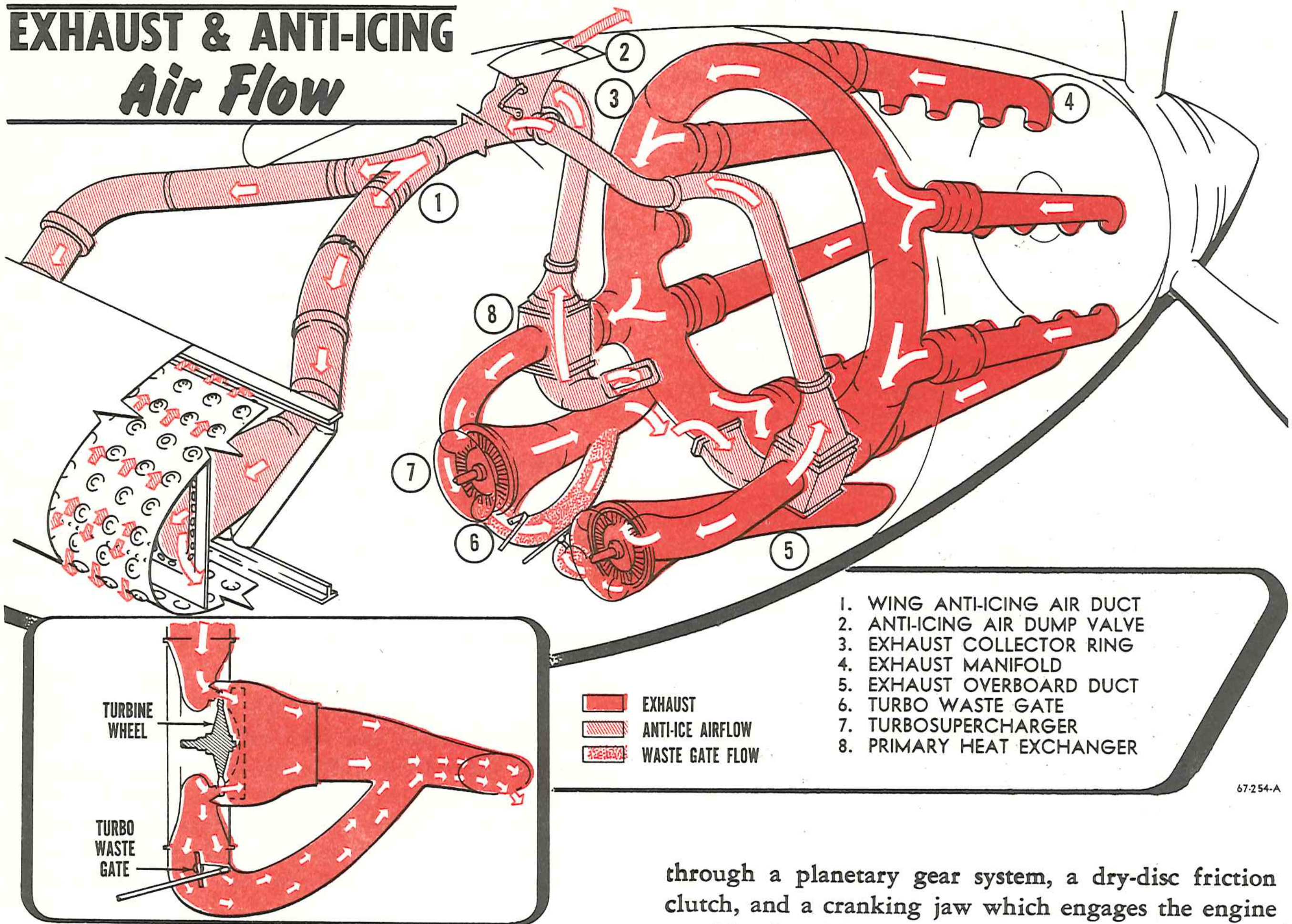


Figure 1-7.

PRIMING SYSTEM.

Each reciprocating engine is equipped with a separate priming system to assist in starting whenever necessary. Priming is controlled by a solenoid-operated valve on the carburetor which allows fuel under booster pump pressure to pass into the blower case of the engine.

Engine Primer Switches.

The six priming systems are controlled by three three-position switches (17, figure 1-20) located on the engineers' control panel. The switches are marked OFF in the center position with engine numbers above and below. When a primer switch is held in an engine position, a 28-volt d-c circuit is completed to a primer solenoid and fuel is injected directly into the blower case of the corresponding engine.

STARTING SYSTEM.

A heavy duty direct-cranking starter is mounted on the lower side of each reciprocating engine accessory case for cranking the engine. The starter cranks the engine through a planetary gear system, a dry-disc friction clutch, and a cranking jaw which engages the engine cranking jaw. The starter jaw automatically disengages when the engine starts. Engine damage due to hydraulic lock is lessened by the friction clutch which is preset to slip at approximately 400-foot pounds of torque.

Engine Starter Switches.

The six direct-cranking starters are controlled by three three-position switches (18, figure 1-20). The switches are marked OFF in the center position with engine numbers above and below. Holding a starter switch in an engine position engages the starter and cranks the corresponding engine. A 28-volt d-c control circuit controls 208-volt alternating current which is applied to the engine starter.

PROPELLER SYSTEM.

The airplane is equipped with six Curtiss constant-speed, full-feathering, reversible propellers. The propellers are 19 feet in diameter and have three hollow steel blades installed in a two-piece steel hub. The propellers of some airplanes have round-tipped blades. Other airplanes have propellers equipped with square-tipped blades. These blades have a thinner airfoil section which provides greater efficiency at higher speeds and altitudes than the blades with round tips.

The control system of both propeller models is identical and is similar to that used on previous models of synchronizer-equipped propellers except that synchronization is possible in the reverse range.

PITCH CHANGE SYSTEM.

Pitch change is accomplished mechanically by power taken directly from propeller shaft rotation. Clutch engagement for operation of the pitch changing mechanism is accomplished hydraulically. The hydraulic power is controlled by small solenoid valves. A small electric motor drives the blades in the last of the feathering and the beginning of the unfeathering cycles when the engine is operating below 450 rpm and is unable to furnish sufficient power to operate the pitch changing mechanism.

Note

Pitch change during feathering and reversing is 45 degrees per second. Pitch change during normal operation is 2-1/2 degrees per second.

NORMAL PROPELLER CONTROLS AND INDICATORS.

Control of the propeller speed is conventional, but synchronization is accomplished by making the speed of all engines compare with the speed of an electrically driven master motor. A propeller alternator on each engine supplies an electrical indication of engine speed to a contactor assembly on the master motor. If the engine speed does not coincide with that of the master motor, corrective impulses are transmitted to the pitch changing mechanism until the engine is operating at master motor rpm. All engines operate at master motor rpm when their respective selector switches are placed in the AUTOMATIC OPERATION position and their throttles are advanced sufficiently for the engine to attain master motor rpm. Because of a protective relay in the master motor, if a master motor failure occurs the propeller will remain at the pitch in effect when the failure occurred. Pitch changes will then be accomplished by moving the selector switches to the INC RPM or the DEC RPM positions.

RECIPROCATING ENGINE *Air Plug Indications*

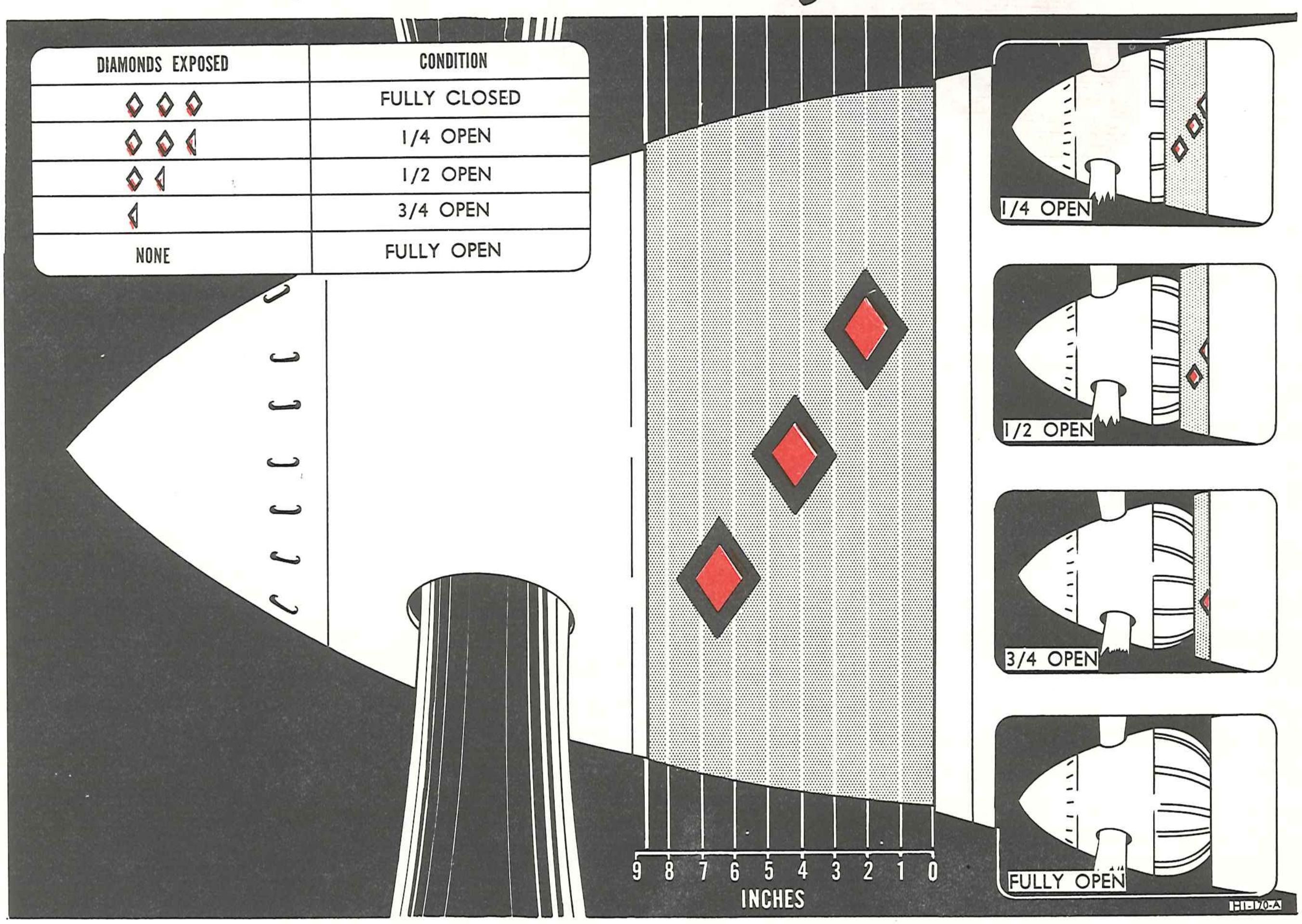


Figure 1-8.

Engineer's PROPELLER CONTROL PANEL

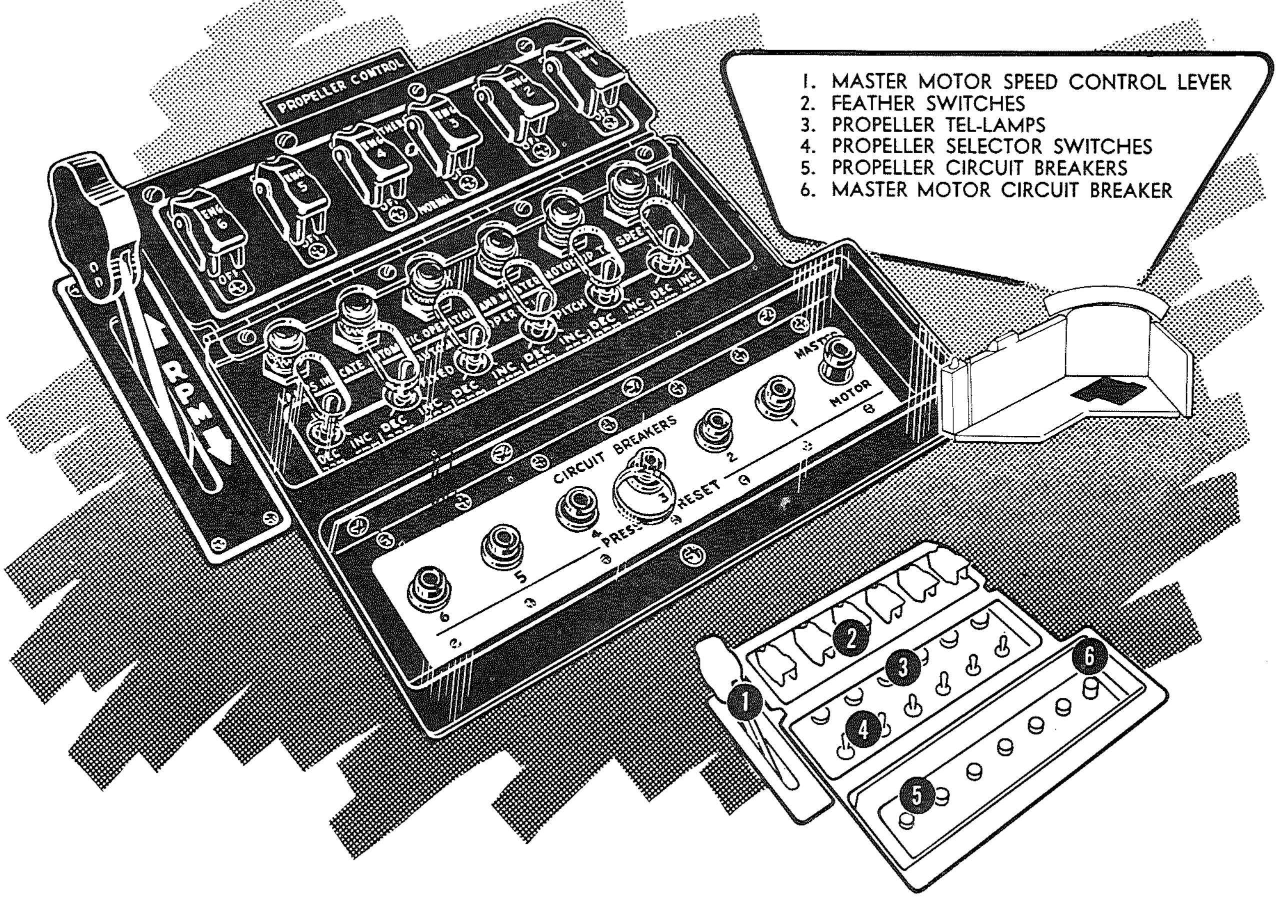


Figure 1-9.

Propeller Selector Switches.

Six conventional propeller selector switches (4, figure 1-9) having four positions—AUTOMATIC OPERATION, DEC RPM, INC RPM, and FIXED PITCH—are provided on the engineer's table and operate on 28-volt d-c power.

Master Motor Control Lever.

Two control levers (1, figure 1-9 and 19, figure 1-14) are provided to control the speed of the master motor. The lever located on the engineers' table is mechanically interconnected to the one on the pilots' pedestal. As well as controlling master motor rpm, these levers control the supply of 28-volt d-c power to operate the master motor through a microswitch that is set to cut out at 1250 rpm.

Master Tachometers.

The master tachometers (8, figure 1-13 and 5, figure 1-16) indicate master motor rpm. It should be noted that master motor rpm will not always coincide with engine rpm, since the master motor may be operating at any selected rpm during ground operations, even when the engines are not running.

Propeller Tel-Lamps.

Six push-to-test tel-lamps (3, figure 1-9) are provided to indicate proper operation of the synchronization system. When the propeller selector switches are placed in the AUTOMATIC OPERATION position and the master motor is on-speed, the tel-lamps will light. If the master motor fails, all lamps will go out. Each lamp will go out when its corresponding selector switch is moved out of the AUTOMATIC OPERATION position.

PROPELLER REVERSE PITCH CONTROLS AND INDICATORS.

Reverse Selector Switches.

Three propeller reverse selector switches (11, figure 1-14) marked READY and SAFE are located on the pilots' pedestal. These switches are used to select symmetrical pairs of propellers to be reversed by setting up a 28-volt d-c circuit to the reverse pitch switch. The propellers are returned from reverse by placing the switches in the SAFE position.

CAUTION

Although it is possible to reverse the propellers in the air, this action is strictly prohibited.

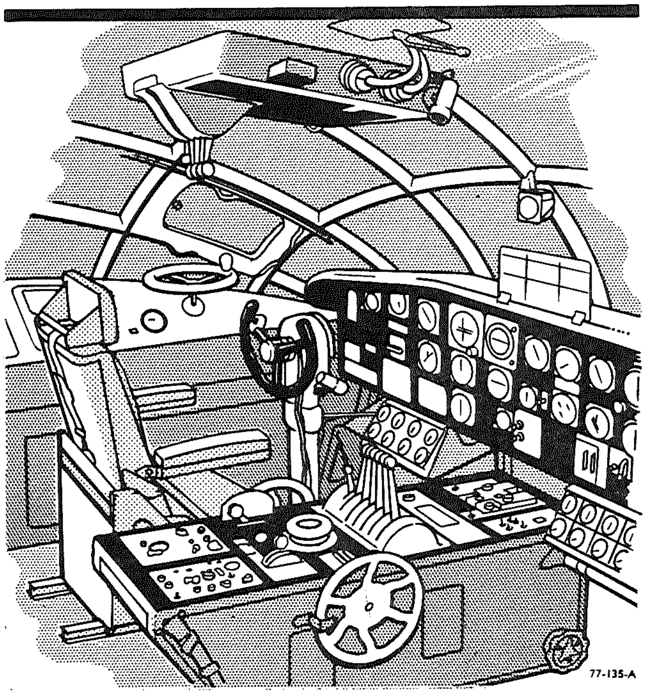
Reverse Pitch Switch.

A push-button type reverse pitch switch (20, figure 1-14), located on the pilots' pedestal, completes a 28-volt d-c circuit which reverses the symmetrical pairs of propellers selected by the reverse selector switches.

Note

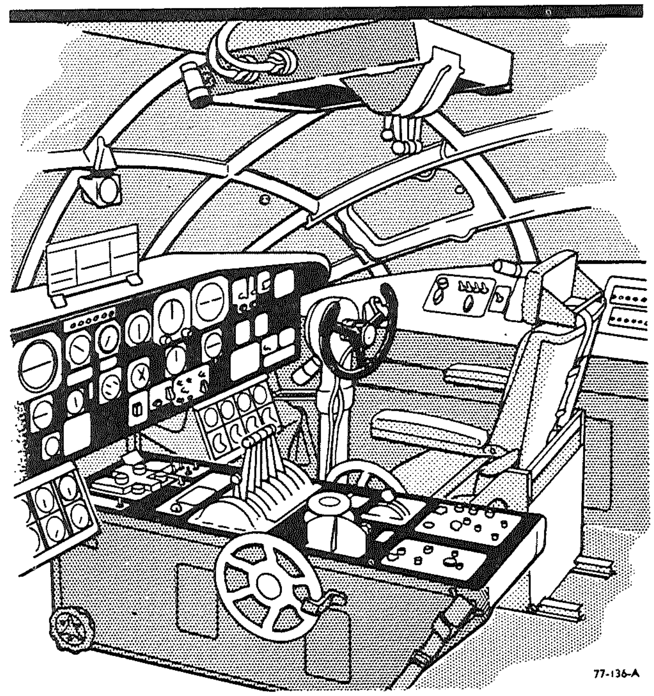
When one pair of propellers is in reverse pitch, the remaining pairs can be reversed by placing their reverse selector switches in the READY position.

AIRCRAFT COMMANDER'S *Station*



77-135-A

PILOT'S *Station*



77-136-A

WARNING

If an engine is shut down (propoller feathered), the propeller of the symmetrically opposite engine cannot be reversed unless the feather switch of the inoperative engine is returned to NORMAL. However, this would create an unsafe condition during reversing after landing in that an unbalanced power condition would be present.

Propeller Reverse Warning Lamps.

Six red warning lamps (7, figure 1-13) are located on the pilots' instrument panel. When any propeller is in reverse pitch, the corresponding red lamp will be lighted. The lamp will go out when the propeller is returned to normal pitch.

Propeller Normal Pitch Indicator Lamps.

Six green lamps (3, figure 1-16) are located on the engineer's main instrument panel. These lamps indicate when the propellers are in normal pitch. When any propeller is in reverse pitch, the respective lamp will not burn.

RECIPROCATING ENGINE OIL SYSTEM *Schematic*

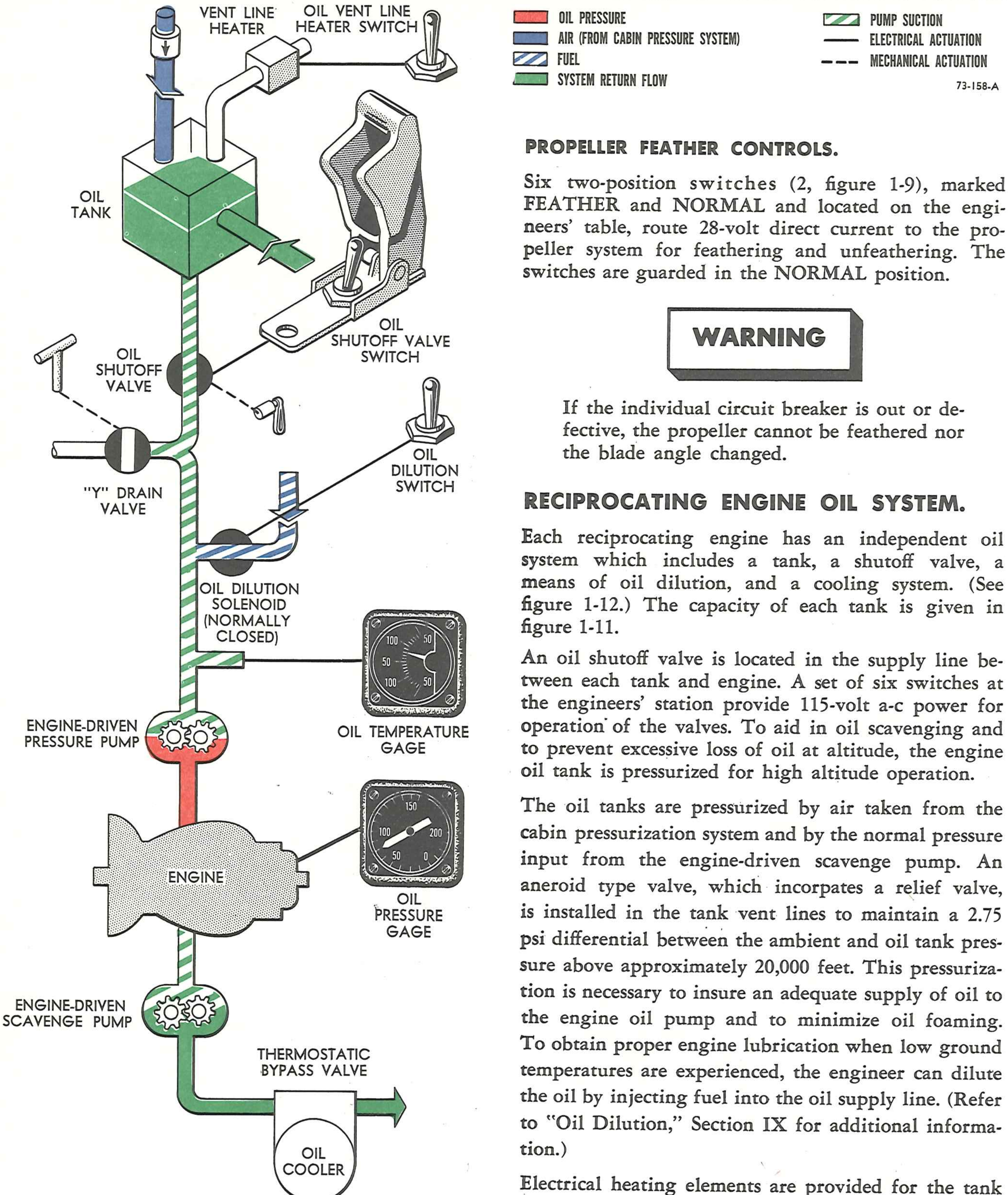


Figure 1-10.

PROPELLER FEATHER CONTROLS.

Six two-position switches (2, figure 1-9), marked FEATHER and NORMAL and located on the engineers' table, route 28-volt direct current to the propeller system for feathering and unfeathering. The switches are guarded in the NORMAL position.

WARNING

If the individual circuit breaker is out or defective, the propeller cannot be feathered nor the blade angle changed.

RECIPROCATING ENGINE OIL SYSTEM.

Each reciprocating engine has an independent oil system which includes a tank, a shutoff valve, a means of oil dilution, and a cooling system. (See figure 1-12.) The capacity of each tank is given in figure 1-11.

An oil shutoff valve is located in the supply line between each tank and engine. A set of six switches at the engineers' station provide 115-volt a-c power for operation of the valves. To aid in oil scavenging and to prevent excessive loss of oil at altitude, the engine oil tank is pressurized for high altitude operation.

The oil tanks are pressurized by air taken from the cabin pressurization system and by the normal pressure input from the engine-driven scavenge pump. An aneroid type valve, which incorpates a relief valve, is installed in the tank vent lines to maintain a 2.75 psi differential between the ambient and oil tank pressure above approximately 20,000 feet. This pressurization is necessary to insure an adequate supply of oil to the engine oil pump and to minimize oil foaming. To obtain proper engine lubrication when low ground temperatures are experienced, the engineer can dilute the oil by injecting fuel into the oil supply line. (Refer to "Oil Dilution," Section IX for additional information.)

Electrical heating elements are provided for the tank vent lines and hoppers. For detailed information see "Oil Tank Vent Heaters" and "Oil Tank Hopper Heaters" in Section IV. Refer to figure 1-47 for servicing information.

Oil Tank Capacities
APPROXIMATE GALLONS

TANK	NO.	TOTAL VOLUME (NOTE 1)	EXPANSION SPACE (NOTE 2)	MAXIMUM CAPACITY (NOTE 3)	NORMAL LOADING (NOTE 4)
INBOARD	2	241	41	200	150
CENTER	2	248	48	200	150
OUTBOARD	2	262	62	200	150

NOTES:

1. Total volume is the total amount of internal space of each tank in gallons and is NOT to be interpreted as any oil loading capacity.
2. Expansion space cannot be used for additional oil because of the location of the filler neck.
3. 200 gallons is the maximum amount of oil that can be put into the tank.
4. The maximum normal loading is 150 gallons for each tank because of the following reasons:
   A. Oil in excess of 150 gallons will vent overboard.
   B. At high altitude, oil vented overboard will congeal, break loose, and damage the airplane.
   C. 150 gallons of oil per tank is all that is needed for normal engine operation.

67-184-A

Figure 1-11.

OIL SYSTEM CONTROLS.

Oil Shutoff Valve Switches.

The engineer has six two-position switches (11, figure 1-20) on his main control panel for operating the oil shutoff valves. The switches have positions marked OPEN and CLOSE and are guarded in the OPEN position. With the exception of the valve for engine No. 6, the shutoff valves are accessible from the wing crawlways and can be operated manually.

Oil Dilution Switches.

There are six oil dilution switches (33, figure 1-20) on the engineer's main control panel. Each switch has two spring-loaded ON positions and a neutral OFF. One ON position is provided for using the switches individually. The other ON position permits gang bar operation for simultaneous dilution of the oil for all engines. When a switch is placed ON, a 28-volt d-c circuit is completed to an oil dilution solenoid, allowing fuel to be discharged into the engine oil inlet line.

OIL SYSTEM INDICATORS.

Oil Temperature Gages.

Oil temperature gages (16, figure 1-16) are located on the engineer's main instrument panel and indicate, in centigrade, reciprocating engine oil temperatures. The indicating system is energized by 28-volt d-c power.

Oil Pressure Gages.

Oil pressure gages (18, figure 1-16), located on the engineer's main instrument panel, indicate the nose oil pressure of the reciprocating engines. Each oil pressure indicating system is energized by 26-volt a-c power from the related engine power panel.

Oil Quantity Gages.

There are six single-indicating oil quantity gages (5, figure 1-17 and 22, figure 1-16) located on the engineers' main instrument panel. The gages indicate oil quantity in US gallons. The oil quantity indicating system is energized by 28-volt d-c power from the engineers' circuit breaker panel.

OIL COOLING.

Oil cooling is completely automatic for airplanes not in group 1. Thermostatically controlled valves regulate the flow of oil and cooling air through the oil cooler to keep the temperature within the desired operating range. On group 1 airplanes an oil cooler door override system is installed to provide a means of overriding the automatic control when oil temperature drops below or exceeds the normal operating temperature. Two methods of routing the cooling air through the cooler are provided to insure proper operating temperatures in both ground and flight operations. On the ground, air is drawn through the oil cooler by the engine-driven fan. During flight ram air independent of the fan passes through the oil cooler. Two doors in the air inlet ducts control the routing of the oil cooling air. The door actuators operate on 115-volt alternating current and are energized through a switch actuated by the movement of the left main gear oleo strut during take-off and landing. (See figure 1-12.) When a fuel valve is closed, 28-volt direct current closes a relay which routes 115-volt a-c power to the flight cooling door actuator of the related engine, moving the door to the closed position.

Oil Cooler Door Mode Selector Switches (Group 1 Airplanes).

Six switch-type circuit breakers (1, figure 1-16) marked AUTO and MANUAL are located on the engineer's main instrument panel. When the switches are in AUTO, the automatic control circuit operates the oil cooler doors. When the switches are in MANUAL position, the automatic circuit is cut out and 28-volt direct current is fed to a manual control circuit. This sets up the manual control circuit for operation by means of the manual override switches.

Oil Cooler Door Override Switches (Group 1 Airplanes).

Six three-position switches (1, figure 1-16) located at the engineer's station are provided for direct control

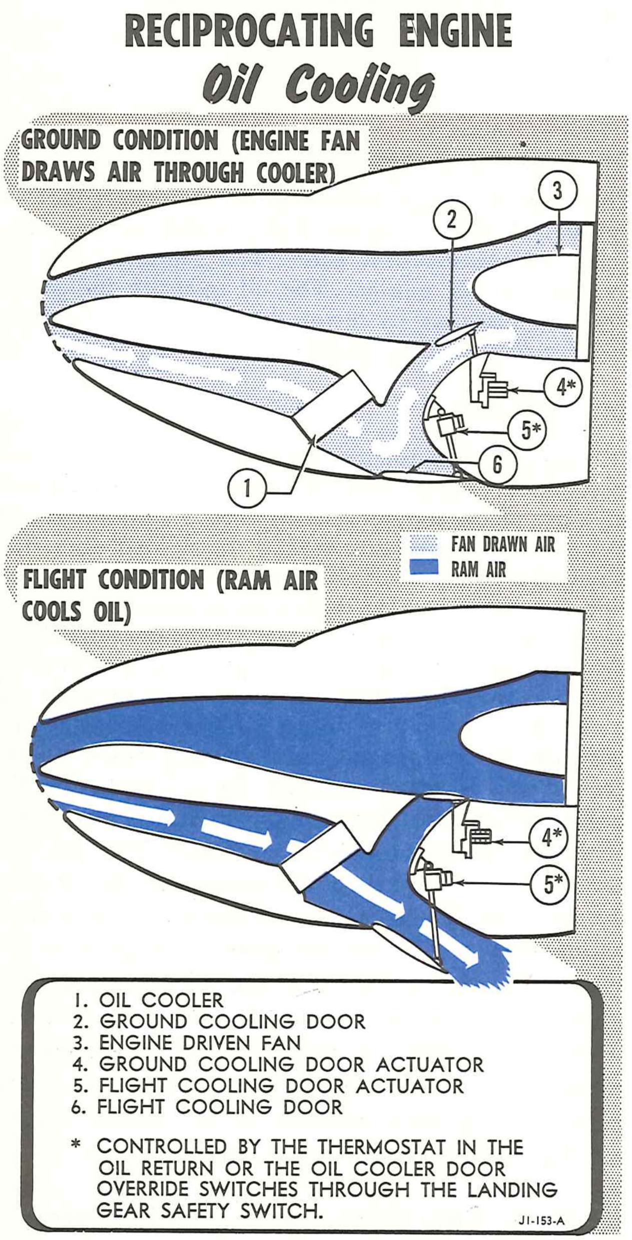


Figure 1-12.

of the oil cooler doors. Each switch has spring-loaded OPEN and CLOSE positions and a neutral OFF position. When an oil cooler door mode selector switch is in MANUAL, the related oil cooler door is operated by holding the corresponding override switch in OPEN or CLOSE. Intermediate positions of the door can be obtained by jiggling the switch. The override circuit provides 115-volt a-c power to the flight cooling door actuator during flight or the ground cooling door actuator during ground operations.

JET ENGINES.

In addition to the six reciprocating engines, the airplane is equipped with four General Electric J47-19 jet engines to provide extra power for take-off, climb, target area operation, and other instances where extra power is required.

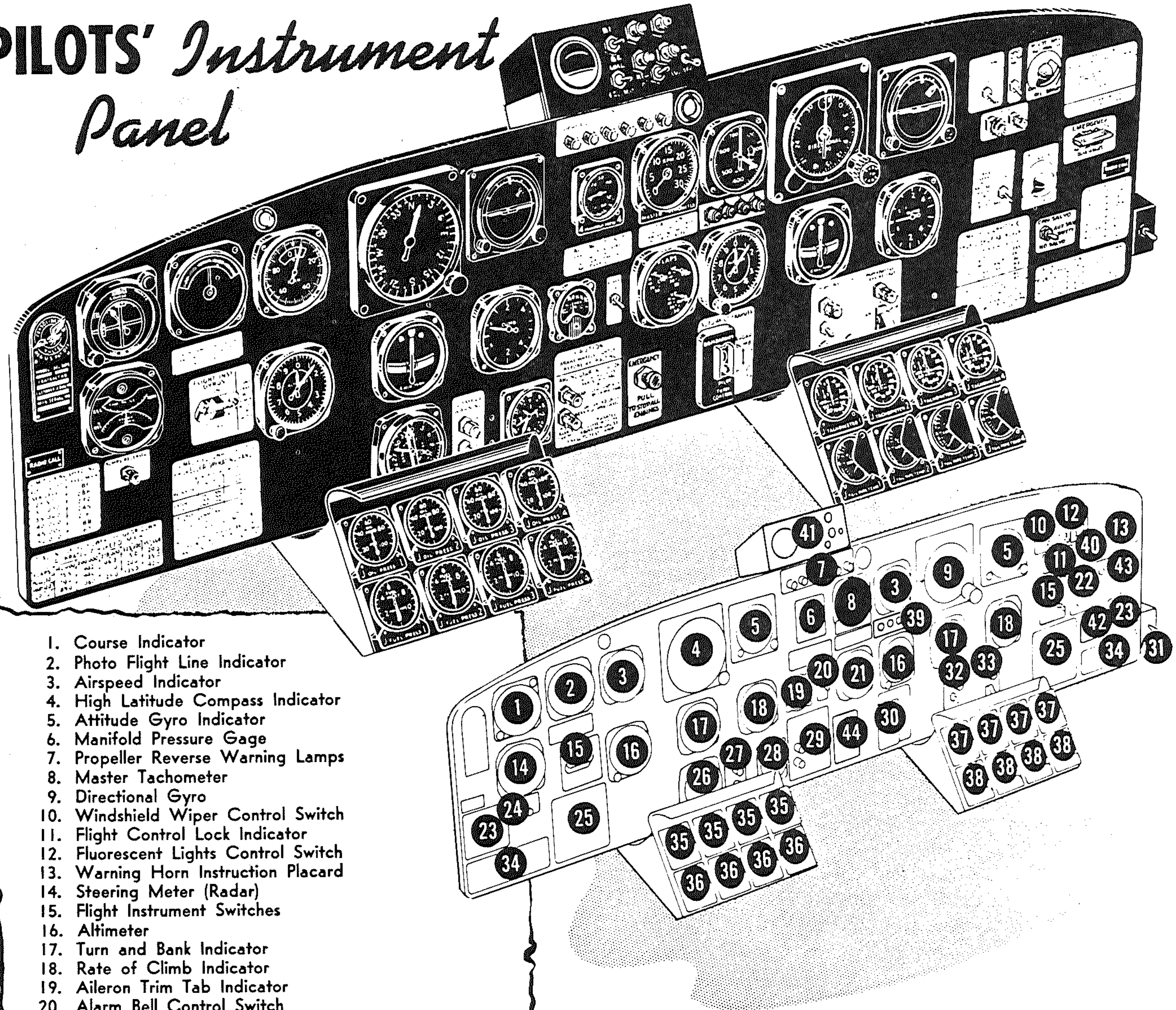
A pod nacelle containing two jet engines is suspended from each wing outer panel. Each engine is rated to deliver 5200 pounds of thrust at sea level static conditions when operating at 100 per cent rpm with tail pipe temperature at 690°C.

The main components of the jet engine include an accessory section, a 12-stage axial flow compressor, eight can-type combustion chambers, and a single stage turbine. A tail cone and tail pipe serve to conduct the hot exhaust gases away from the engines. Fuel used is the same grade as that used by the reciprocating engines and is taken from the same system. Oil for each jet is supplied from an individual oil tank. The oil is of a different specification than that used by the reciprocating engines. See figure 1-47 for servicing information on the oil system. A heating element is incorporated in each oil tank to heat the oil while the engines are not operating during flight. (For additional information, see "Jet Engine Oil Heaters," Section IV.)

All jet engine controls are grouped on an overhead panel which is located directly above the pilots' pedestal. All jet engine instruments, except the jet engine fuel flow indicators, are grouped below the pilots' instrument panel on each side of the pedestal. The fuel flow indicators are located on the engineer's main instrument panel. Each jet is controlled by a throttle lever which acts through a fuel regulator mounted on the engine accessory section. The regulator controls a fuel control valve to meter the amount of fuel to the engine called for by the throttle lever after automatically compensating for engine rpm and air density.

The airplane can fly with or without the jets in operation, according to the conditions of flight. Jet air plugs are used to shut off the engine air flow when

PILOTS' Instrument Panel



1. Course Indicator
2. Photo Flight Line Indicator
3. Airspeed Indicator
4. High Latitude Compass Indicator
5. Attitude Gyro Indicator
6. Manifold Pressure Gage
7. Propeller Reverse Warning Lamps
8. Master Tachometer
9. Directional Gyro
10. Windshield Wiper Control Switch
11. Flight Control Lock Indicator
12. Fluorescent Lights Control Switch
13. Warning Horn Instruction Placard
14. Steering Meter (Radar)
15. Flight Instrument Switches
16. Altimeter
17. Turn and Bank Indicator
18. Rate of Climb Indicator
19. Aileron Trim Tab Indicator
20. Alarm Bell Control Switch
21. Flap Position Indicator
22. Autopilot Lights Control Knob
23. Diving Speeds Limitation Placard
24. Bombs Released Indicator Lamp
25. Propeller Operating Ranges Placard
26. Radio Magnetic Indicator
27. Camera Initiation and Alert Exposure Warning Lamps
28. Clock
29. Landing Gear Indicator Lamps
30. Autopilot Transfer Switch
31. Taxi Lights Switch
32. Bomb Door Control Switch and Indicator Lamps
33. Bomb Bay Fuel Tank Release Selector Switch and Indicator Lamp
34. Stalling Speed Placard
35. Jet Oil Pressure Gage
36. Jet Fuel Pressure Gage
37. Jet Engine Tachometer
38. Jet Tail Pipe Temperature Indicator
39. Jet Engine Fire Warning Lamps (Some Airplanes)
40. Pilots Instrument Panel Lights Switch
41. I.F.M. Unit
42. Bomb Salvo Safety Switch
43. Emergency Circuit Selector Switch
44. Emergency Ignition Switch

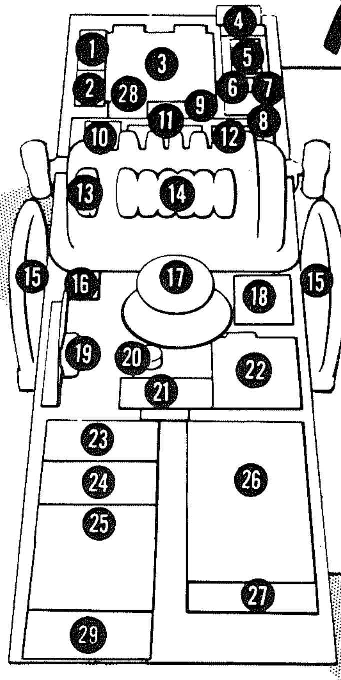
72-120-A

Figure 1-13.

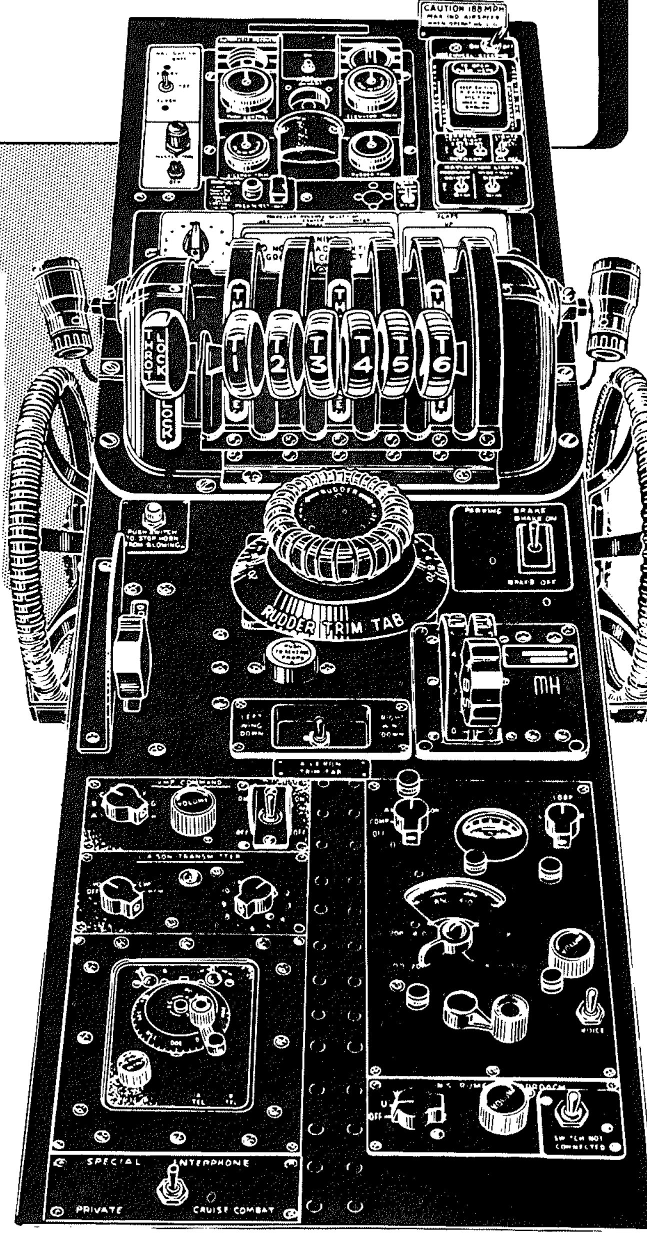
the engines are inoperative. When the air plug doors are fully closed, enough air will flow through to windmill the engines at approximately 5 per cent rpm. This low windmilling speed allows heated oil to circulate through the engines so that the oil will not congeal at low temperatures. If additional heat is needed for the oil, heated anti-icing air can be taken from the wing anti-icing system and circulated around the oil lines and the oil cooler or the oil tank heaters may be turned on. A special ignition circuit which bypasses the starters is provided to start the jet engines in flight.

An inlet air screen between the air plug doors and the inlet guide vanes of each engine prevents engine damage from foreign objects which might otherwise enter the compressor.

Pilots' PEDESTAL



1. Navigation Light Selector Switch
2. Master Code Controls
3. Autopilot Control Panel
4. Nose Wheel Steering Switch
5. Landing Gear And Brake Pump Switch
6. Landing Light Extend And Retract Switches
7. Landing Light Filament Switch
8. Navigation Light Switches
9. Formation Light Switch
10. Code Flashing Selector Switch
11. Propeller Reverse Selector Switches
12. Flap Control Switches
13. Throttle Lock Lever
14. Throttle Levers
15. Elevator Trim Tab Control Wheels
16. Warning Horn Shutoff Switch
17. Rudder Trim Tab Control Knob
18. Parking Brake Switch
19. Master Motor Speed Control Lever
20. Propeller Reverse Pitch Switch
21. Aileron Trim Tab Control Switch
22. Turbo Boost Selector Lever
23. Command Radio Control Panel
24. Liaison Radio Control Panel
25. Radio Range Receiver Control Panel
26. Radio Compass Control Panel
27. Instrument Approach Control Panel
28. Bomb Salvo Switch
29. Special Interphone Switch (Some Airplanes)



73-145-A

73-145-A

Figure 1-14.

FUEL REGULATOR CONTROLS.

Throttle Control Levers.

Four throttle levers (1, figure 1-15) and a friction lock lever (2, figure 1-15) are located on the pilots' overhead jet control panel. The lock lever will lock the throttles in any desired position. The throttle lever positions are CLOSE, IDLE, and OPEN. Throttle control employs an electronic system similar to the reciprocating engine mixture control. Movement of a lever originates a 115-volt a-c signal which ultimately positions the fuel regulator and the stopcock of the corresponding engine. The stopcock acts as a fuel shutoff valve when the throttle is closed and functions as a fuel metering valve for engine starting before the fuel regulator becomes effective. The initial movement of a lever also completes the related ignition circuit for ground starting.

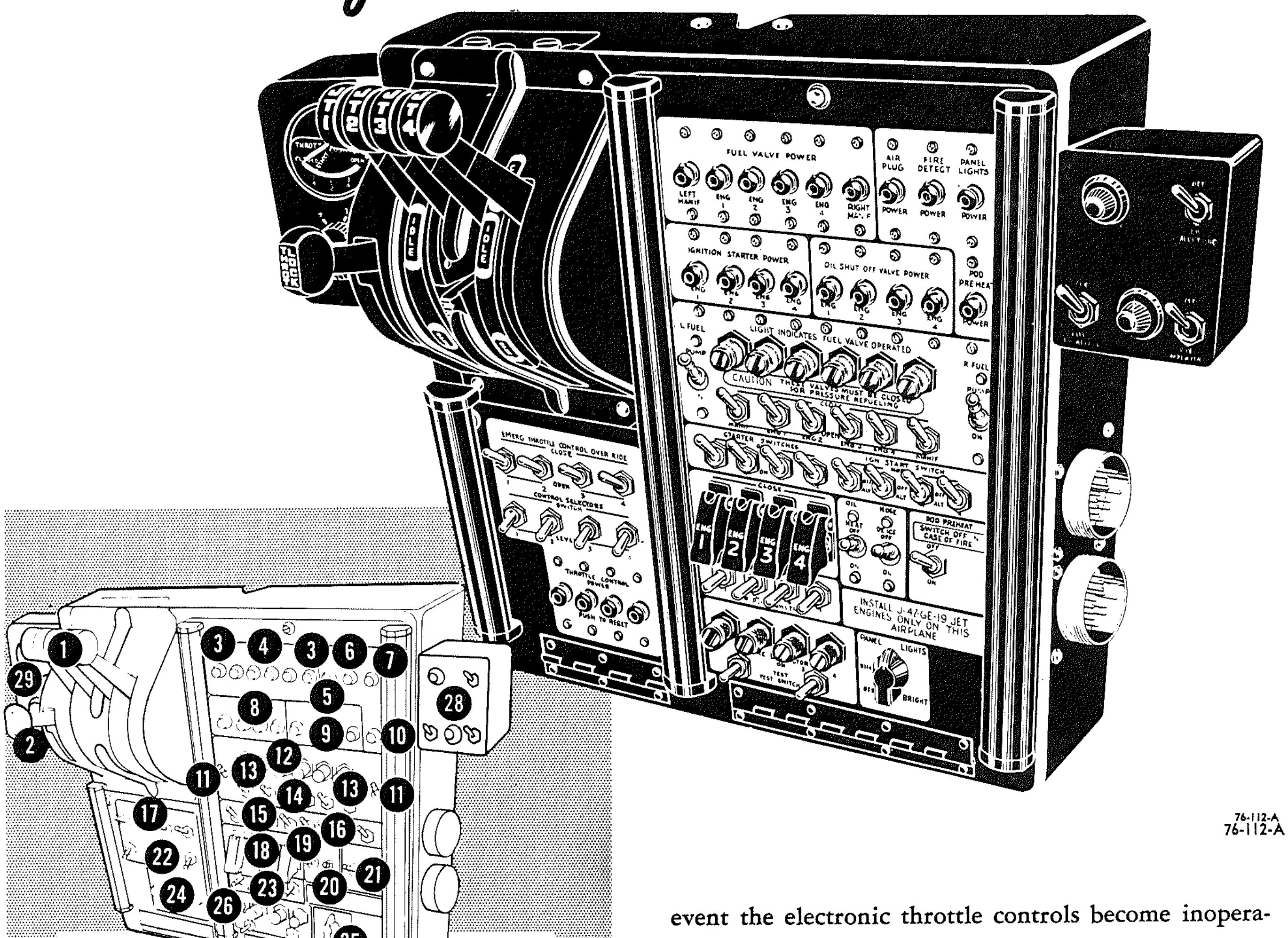
Throttle Control Selector Switches.

Four two-position switches (22, figure 1-15), located on the overhead control panel, are used to select the type of throttle control desired. When the switches are in the LEVER position, the throttle levers provide throttle control. When the switches are placed in the SWITCH position, throttle control with a set of override switches is effective.

Emergency Throttle Control Override Switches.

Four three-position switches (17, figure 1-15), located on the overhead control panel, are provided in the

PILOTS' *Jet Control Panel*



1. Throttle
2. Throttle Lock Lever
3. Manifold Fuel Valve Circuit Breakers
4. Engine Fuel Valve Circuit Breakers
5. Air Plug Circuit Breaker
6. Fire Detection Circuit Breaker
7. Control Panel Lights Circuit Breaker
8. Ignition Circuit Breakers
9. Oil Shutoff Valve Circuit Breakers
10. Pod Preheat Circuit Breaker
11. Booster Pump Switches
12. Fuel Valve Indicator Lamps
13. Manifold Valve Switches
14. Engine Valve Switches
15. Engine Starter Switches
16. Ignition Start Switches
17. Throttle Control Override Switches
18. Oil Shutoff Valve Switches
19. Oil Heater Switch
20. Nose De-Ice Control Switch
21. Pod Preheat Control Switch
22. Throttle Control Selector Switches
23. Air Plug Switches
24. Throttle Control Circuit Breakers
25. Panel Lights Control Switch
26. Fire Warning Lamps
27. Fire Detection Switches
28. Automatic Approach and Altitude Control Panel
29. Throttle Position Indicator and Selector Switch

Figure 1-15.

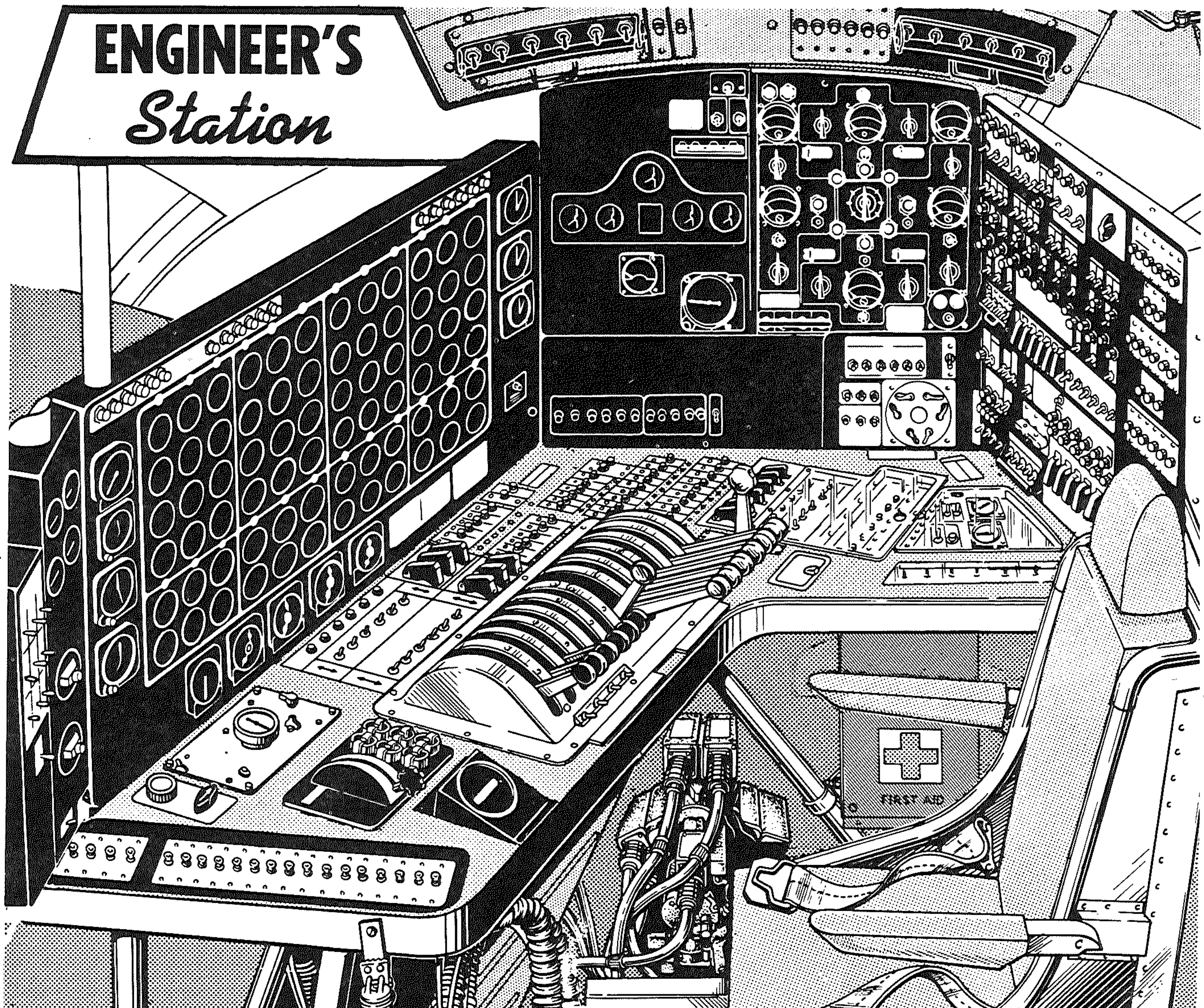
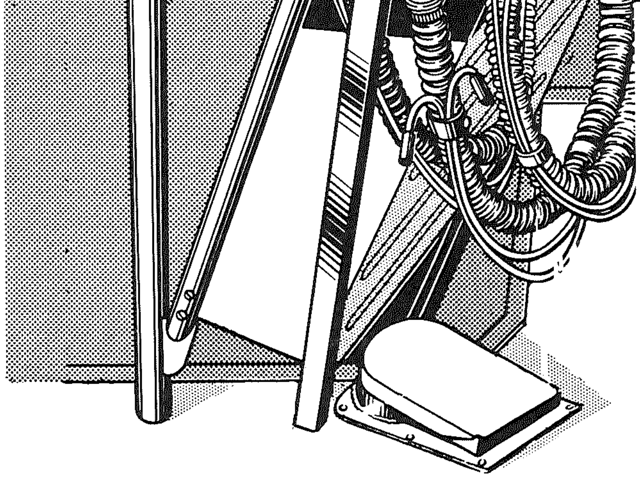
event the electronic throttle controls become inoperative. The switches are connected directly to actuators on the engines by electrical circuits and have spring-loaded OPEN and CLOSE positions and a neutral OFF position. Intermediate settings of the fuel regulator can be obtained by jiggling the override switches.

CAUTION

Throttle control is very sensitive when using the emergency throttle override switches.

THROTTLE POSITION INDICATION (SOME AIRPLANES).

An indicator and a selector switch are provided to enable the pilots to determine the position of the jet engine electronic throttle controls. The indicator is a volt-meter which is scaled to indicate the degree of throttle opening. The indicator is connected through the selector switch to the electronic throttle controls for each jet engine. When the switch is positioned to

72-136-A

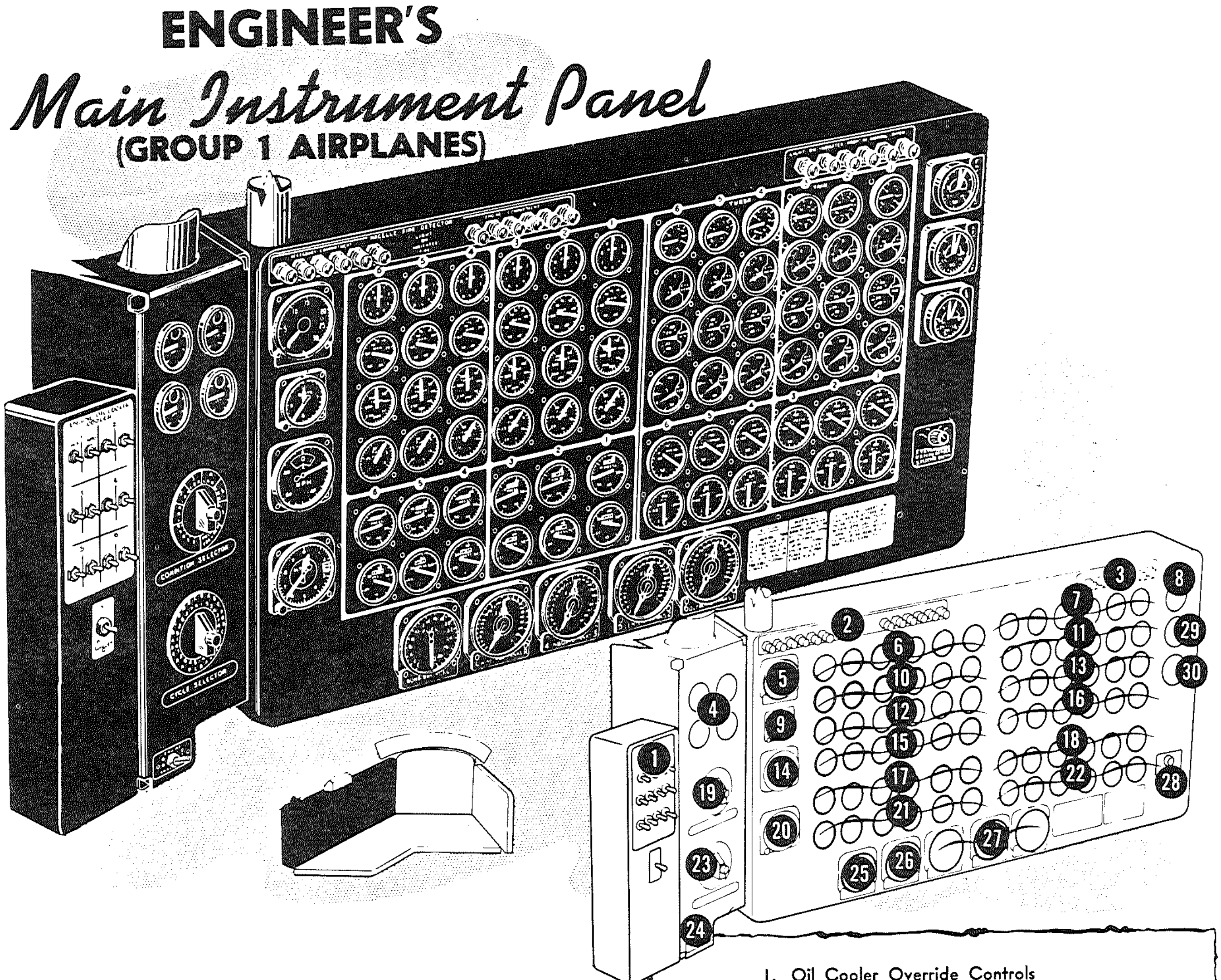
obtain an indication, the voltmeter records a voltage from the electronic controls. This voltage is read on the indicator as a throttle position. The indicator should be used to obtain indications before and during engine starts and when using the emergency throttle override controls.

Engine Selector Switch.

This switch (29, figure 1-15), located adjacent to the jet throttle position indicator, is used to select the engine for which a throttle position indication is desired. The switch has intermediate positions marked 1, 2, 3, and 4 with OFF positions at either end.

Jet Throttle Position Indicator.

This voltmeter (29, figure 1-15), located on the jet control panel, is graduated to indicate jet throttle con-



1. Oil Cooler Override Controls
2. Fire Warning Lamps
3. Propeller Normal Pitch Indicator Lamps
4. Jet Engine Fuel Flow Indicators
5. Master Tachometer
6. Engine Tachometers
7. Turbo Tachometers
8. Forward Cabin Altimeter
9. Clock
10. Manifold Pressure Gages
11. Cylinder Head Temperature Indicators
12. Torque Pressure Gages
13. Carburetor Air Temperature Indicators
14. Airspeed Indicator
15. Fuel Flow Indicators
16. Oil Temperature Indicators
17. Water Pressure Gages
18. Oil Pressure Gages
19. Condition Selector Switch
20. Outside Altimeter
21. Fuel Pressure Gages
22. Oil Quantity Gages
23. Cycle Selector Switch
24. Engine Analyzer Power Switch
25. Fuel Quantity Gage (Bomb Bay Tank)
26. Fuel Quantity Gage (Auxiliary Wing Tanks)
27. Fuel Quantity Gages (Wing Tanks)
28. Cylinder Head Temperature Selector Switch
29. Aft Cabin Altimeter
30. Camera Compartment Altimeter

72-122-A

72-122-A

Figure 1-16.

trol positions. The extreme ends of the scale are marked CLOSED and OPEN and the intermediate positions are marked 1/4, 1/2, and 3/4. In addition, a position marked START is provided at one graduation less than the 1/4 position.

AIR INTAKE CONTROL.

The air intake of each jet engine is controlled by an air plug which is made up of eight leaf-type doors and are operated by an actuator mounted in the nose cone. During jet engine operation the plugs must always be open. When the jets are shut down, the plugs should be closed to prevent excessive windmilling, minimize drag, and keep foreign objects from entering the air intake.

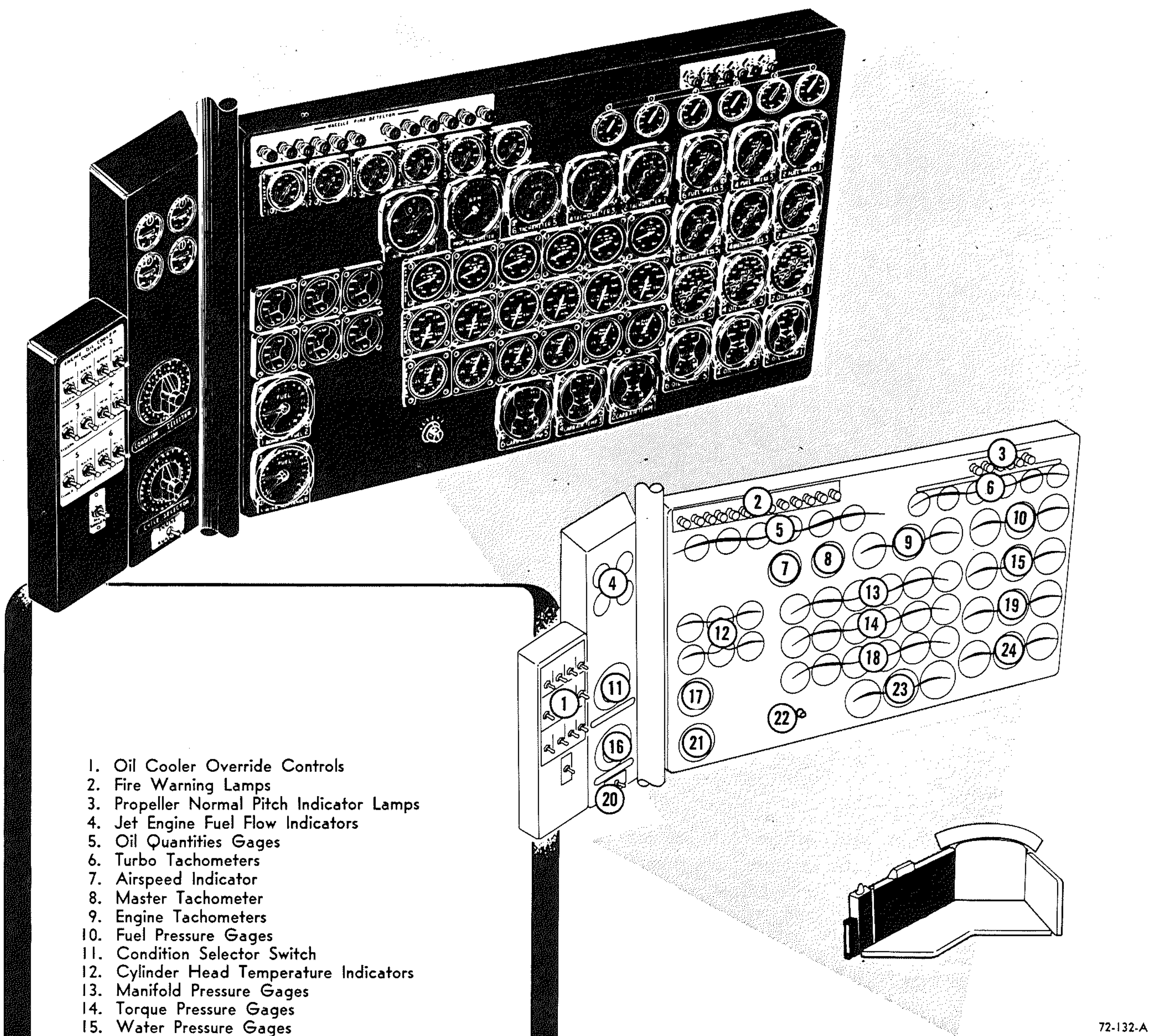
Note

> When the plugs are fully closed, the engine will windmill at approximately 5 per cent rpm to maintain oil circulation.

Air Plug Switches.

Four three-position switches (23, figure 1-15), located on the pilots' overhead jet control panel, provide con-

Engineer's MAIN INSTRUMENT PANEL (AIRPLANES NOT IN GROUP ONE)



1. Oil Cooler Override Controls
2. Fire Warning Lamps
3. Propeller Normal Pitch Indicator Lamps
4. Jet Engine Fuel Flow Indicators
5. Oil Quantities Gages
6. Turbo Tachometers
7. Airspeed Indicator
8. Master Tachometer
9. Engine Tachometers
10. Fuel Pressure Gages
11. Condition Selector Switch
12. Cylinder Head Temperature Indicators
13. Manifold Pressure Gages
14. Torque Pressure Gages
15. Water Pressure Gages
16. Cycle Selector Switch
17. Fuel Quantity Gage (Bomb Bay Tank)
18. Fuel Flow Gages
19. Oil Pressure Gages
20. Engine Analyzer Power Switch
21. Fuel Quantity Gage (Auxiliary Wing Tanks)
22. Cylinder Head Temperature Selector Switch
23. Carburetor Air Temperature Indicators
24. Oil Temperature Indicators

72-132-A

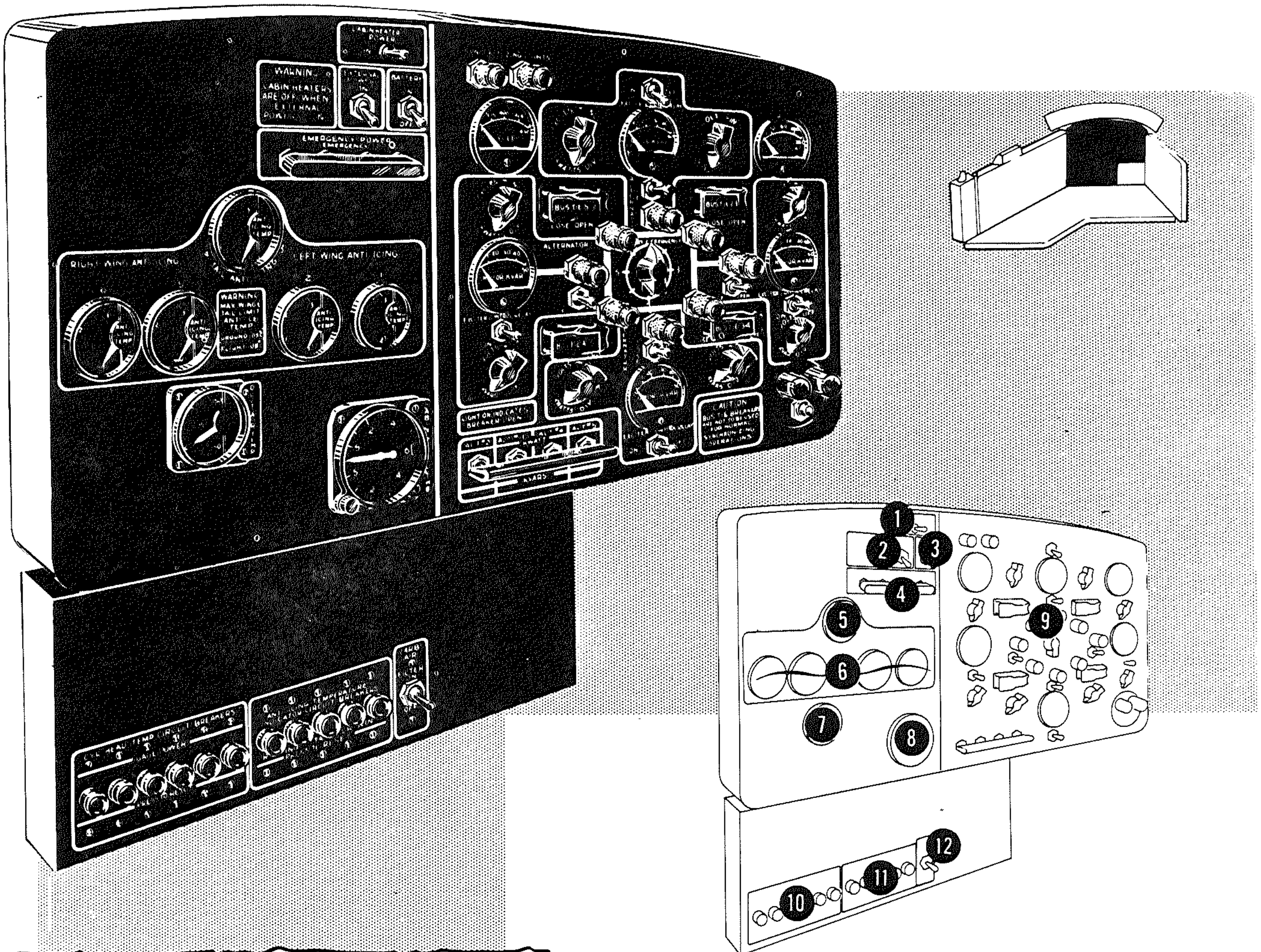
72-132-A

Figure 1-17.

trol for the electrically operated engine air plugs. The switches have full-on positions marked OPEN and CLOSE and a neutral OFF position. The switches receive 28-volt direct current from a single circuit breaker to close relays which supply 115-volt a-c power to the air plug actuators. In the event of a short in one air plug control circuit, placing the switch of the defective circuit in the OFF position and resetting the circuit breaker will allow continued operation of the other three circuits. The neutral OFF position can also be used for intermediate positioning of the air plugs.

ENGINEER'S *Auxiliary Instrument Panel*

(GROUP 1 AIRPLANES)



72-131-A

1. Cabin Heater Power Switch
2. External Power Supply Switch
3. Battery Switch
4. Emergency Power Switch
5. Cabin Heat and Tail Anti-Icing Temperature Indicator
6. Wing Anti-Icing Temperature Indicators
7. Duct Air Temperature Indicator (Fwd. Cabin Pressure)
8. Cabin Rate-of-Climb Indicator
9. A-C Power Control Panel
10. Cylinder Head Temperature Circuit Breakers
11. Anti-Icing Temperature Indicator Circuit Breakers
12. Carburetor Air Filter Switch

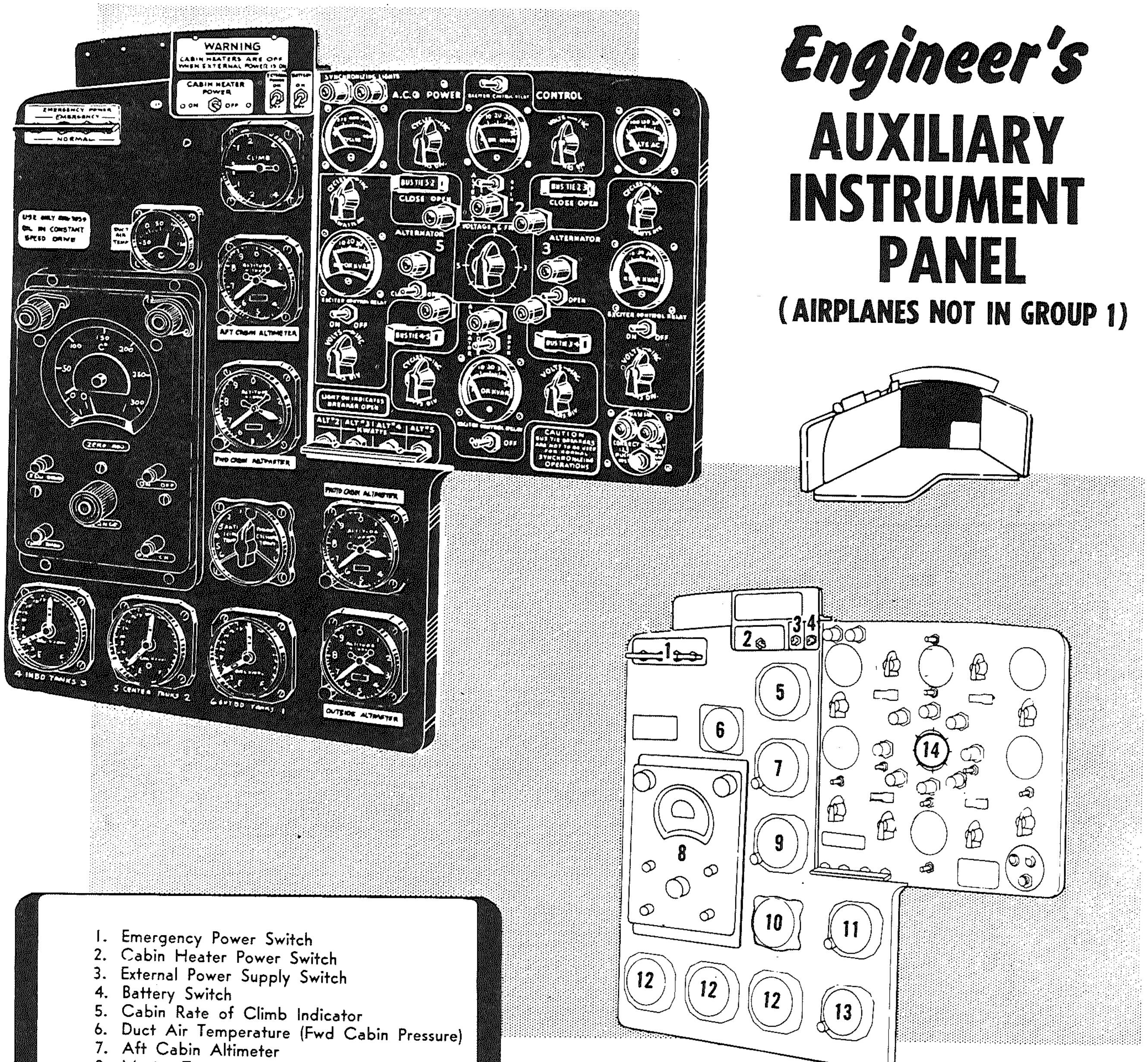
Figure 1-18.

IGNITION SYSTEM.

Ignition start switches supply electrical energy to ignition electrodes which are mounted in combustion chambers No. 3 and 7 of each jet engine. Complete combustion is carried out by flame propagation between the chambers through the crossfire tubes. Ignition is used only for starting as combustion in the chambers is self-sustaining once it has been started, except when flame-out conditions occur.

Ignition Start Switches.

Four three-position switches (16, figure 1-15), located on the overhead control panel, are provided for starting the engines during flight. Each switch has a neutral OFF position, a NORMAL position, and a spring-loaded ALT position. With the switches in the NORMAL position, ignition occurs when the starter switch-



1. Emergency Power Switch
2. Cabin Heater Power Switch
3. External Power Supply Switch
4. Battery Switch
5. Cabin Rate of Climb Indicator
6. Duct Air Temperature (Fwd Cabin Pressure)
7. Aft Cabin Altimeter
8. Master Temperature Indicator
9. Forward Cabin Altimeter
10. Master Temperature Selector Switch
11. Photo Cabin Altimeter
12. Fuel Quantity Gages (Wing Tanks)
13. Outside Altimeter
14. A-C Power Control Panel

Figure 1-19.

72-134-A

es are held ON and the throttle levers are advanced from the CLOSE position. This prevents flooding the combustion chambers with raw fuel before ignition occurs which would result in a hot start. For aerial starts where the starter is not used because sufficient windmilling rpm is available, the switches are held in the ALT position and supply alternating current directly to the electrodes.

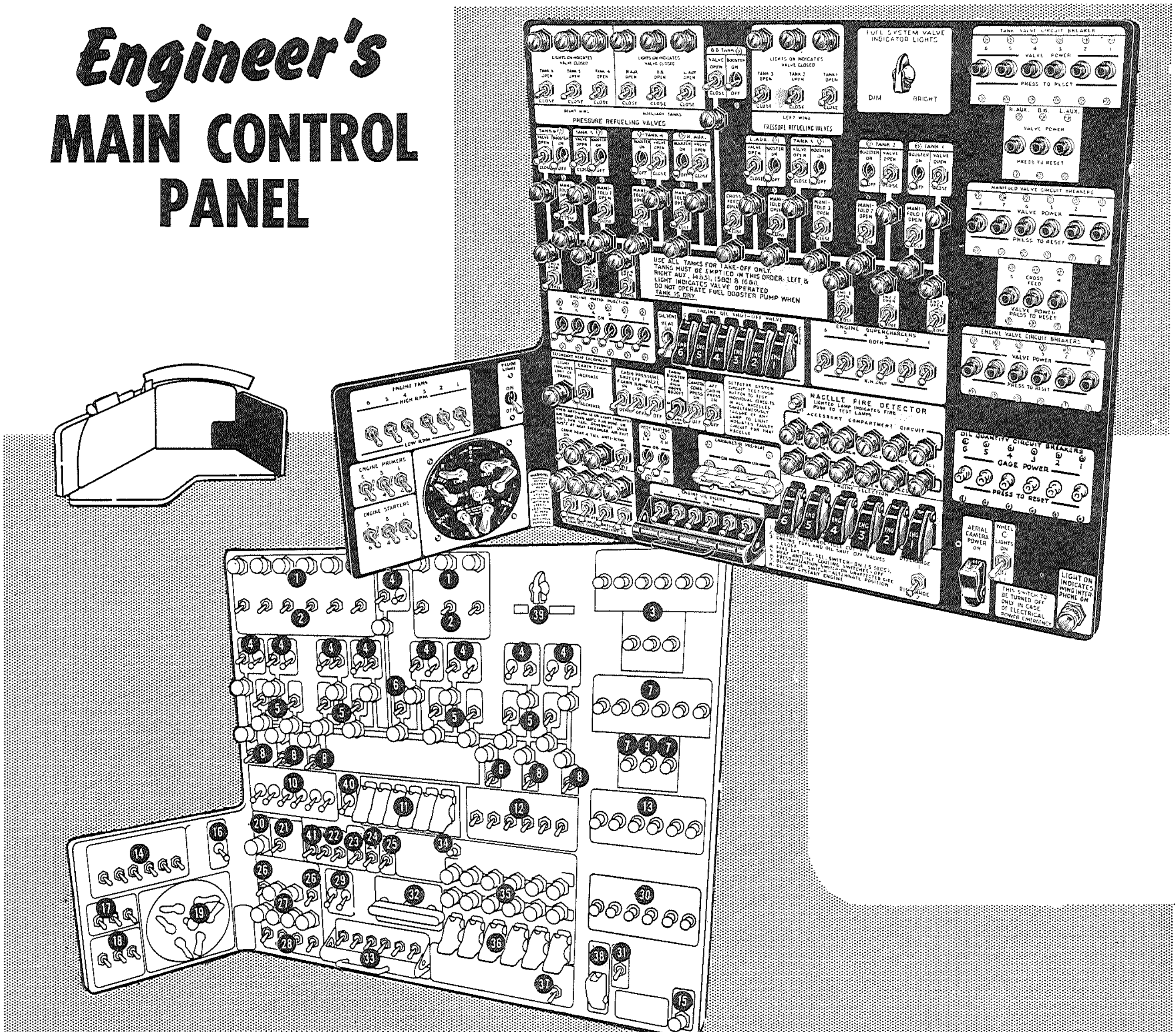
STARTING SYSTEM.

Each jet engine is equipped with an a-c starting system containing a starter switch and a starter. The starter is used for ground starts only, as the jet engine is windmilled for aerial starts. After the engine fires during ground starts, the starter is used to aid engine acceleration up to 20 to 25 per cent rpm to prevent excessive tail pipe temperatures and possible compressor stall.

Engine Starter Switches.

Four spring-loaded switches (15, figure 1-15), located on the overhead control panel, are provided for ground starting only. When the switches are held ON, 28-volt direct current closes relays to supply 208-volt a-c

Engineer's MAIN CONTROL PANEL

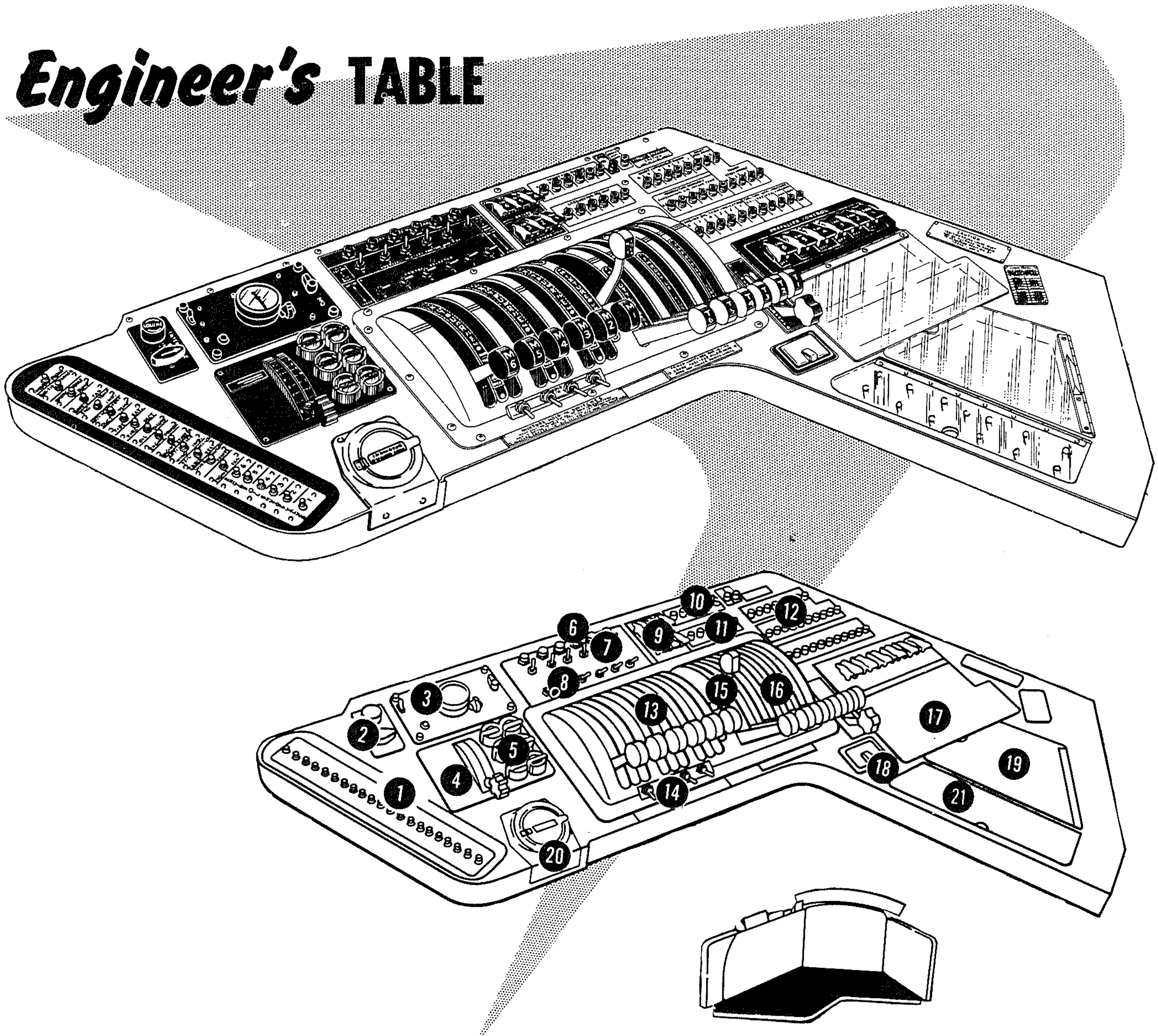


1. Pressure Refueling Valve Indicator Lamps
2. Pressure Refueling Valve Switches
3. Tank Valve Circuit Breakers
4. Tank Valve And Booster Pump Switches
5. Manifold Valve Switch And Indicator Lamps
6. Cross-Feed Valve Switch
7. Manifold Valve Circuit Breakers
8. Engine Valve Switch
9. Cross-Feed Valve Circuit Breaker
10. Water Injection Switches
11. Oil Shut-Off Valve Switches
12. Engine Supercharger Switches
13. Engine Valve Circuit Breakers
14. Fan Speed Control Switches
15. Wing Interphone Indicator Lamp
16. Fluorescent Lights Switch
17. Engine Primer Switches
18. Engine Starter Switches
19. Master and Individual Ignition Switches
20. Cabin Temperature Control Valve Indicator Lamp
21. Cabin Temperature Control Switch
22. Cabin Pressure Shut-Off Valve Switches
23. Booster Fan Switch
24. Camera Compartment Pressure Switch
25. Aft Cabin Pressure Switch
26. Cabin Heat And Tail Anti-Icing Switches
27. Cabin Heat And Anti-Icing Warning Lamps
28. Wing Anti-Icing Switches
29. Pitot Heater Switches
30. Oil Quantity Circuit Breakers
31. Wheel Lights Switch
32. Carburetor Preheat Switches
33. Oil Dilution Switches
34. Fire Detector Push-To-Test Switches
35. Fire Warning Lamps
36. Fire Extinguisher Engine Selector Switches
37. Fire Extinguisher Discharge Selector Switch
38. Camera Master Power Switch
39. Fuel Indicator Lamps Dim-Bright Knob
40. Oil Vent Line Heater Switch
41. Forward Cabin Pressure Switch

72-135-A

Figure 1-20.

Engineer's TABLE

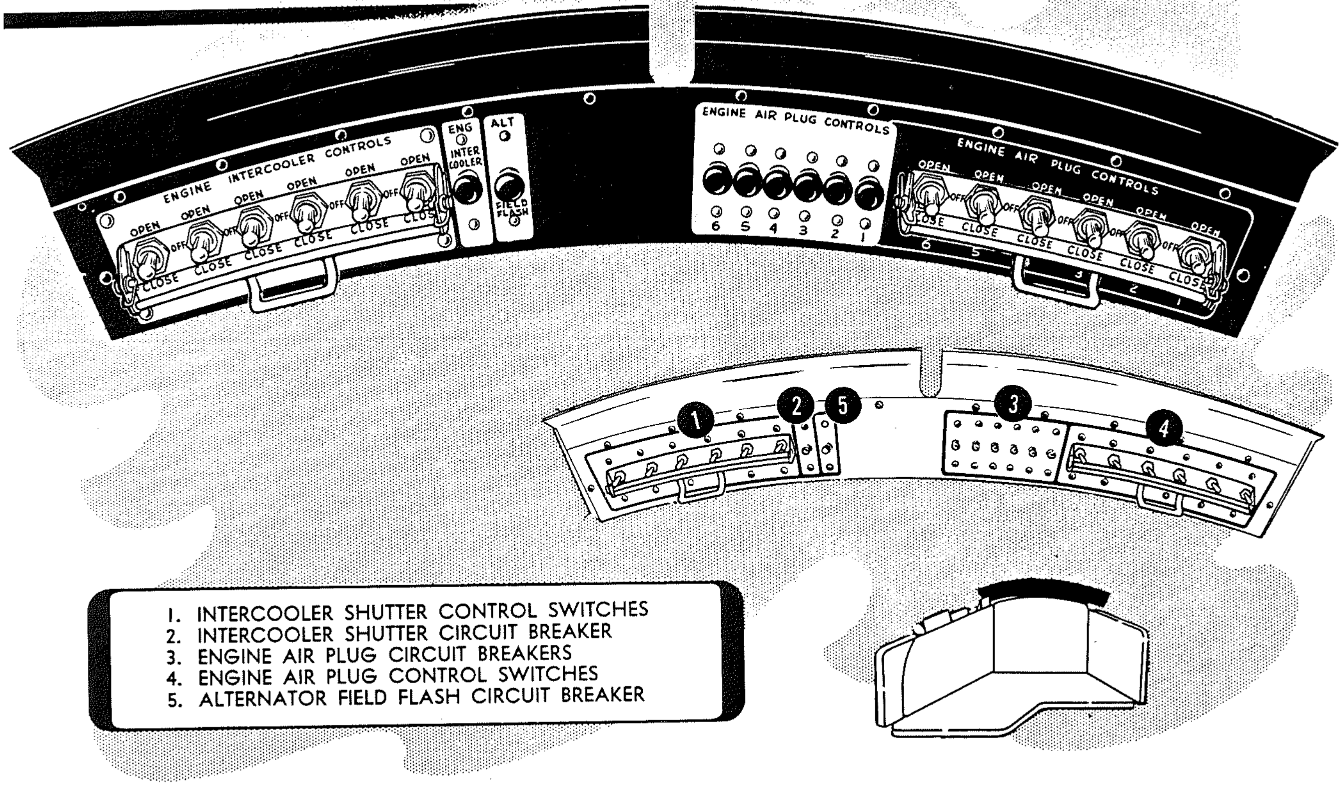


1. Circuit Breakers
   - Interphone
   - Bus Tie Breaker Control
   - Emergency Brake Pump
   - Booster Fan
   - Engine Temperature Indicator
   - Anti-Ice Duct Temperature
   - Fire Extinguisher
   - Fire Detector
   - Oil Dilution
   - Engine Primer
   - Engine Starter
   - Wing Anti-Ice
   - Tail Anti-Ice
   - Wing Shut-Off Valves
   - Engine Fan
   - Engine Oil Shut-Off Valve (6)
2. Interphone Control Panel
3. Oxygen Control Panel
4. Turbo Boost Selector Lever
5. Turbo Calibration Potentiometer Knobs
6. Normal Mixture Indicator Lamps
7. Mixture Control Override Switches
8. Mixture Control Selector Switches
9. Spark Advance Switches
10. Engine Fuel Mixture Circuit Breakers
11. Carburetor Preheat Circuit Breakers
12. Circuit Breakers
    - Cabin Duct Temperature
    - Prop Pitch Indicator
    - Engine Supercharger Selector (6)
    - Engine Spark Advance (6)
    - Carburetor Air Temperature Indicator (6)
    - Engine Oil Temperature Indicator (6)
    - Fuel Tank Level Indicator (5)
13. Mixture Control Levers
14. Alternator Breaker Hold-In Switches
15. Mixture Control Lock Lever
16. Throttle Levers
17. Propeller Control Panel
18. Ash Receiver
19. Hydraulic Control Panel
20. Engine Analyzer Indicator
21. Turbo Override Control Panel

73-151-A

Figure 1-21.

ENGINEER'S *Auxiliary Control Panel*



77-112-A

Figure 1-22.

power to the starters. Closing the switches also sets up the ignition circuits. When the switches are released, the starters are de-energized and the ignition is cut off.

JET ENGINE OIL SYSTEM.

Each jet engine has an independent oil system consisting principally of a 20-gallon supply tank, lines, pressure and scavenge pumps, a filter, an oil cooler, and an oil tank heater. The tanks, installed in the wing above the jets, will hold 13 gallons of oil with the remaining 7-gallon space reserved for oil foaming. The oil flows from the tank to a gear-driven combination pressure and scavenge pump mounted on the accessory section and is pumped to the lubrication points and to the fuel regulator. A filter mounted on the compressor case filters the oil passing through the line from the pressure pump to the aft bearings. A scavange pump in the midframe returns the oil in the aft section through the cooler to the tank. The cooler is mounted on the compressor casing and uses fuel as a cooling medium. The oil cooling is fully automatic with a thermostatically controlled bypass and relief valve regulating the flow of oil through the cooler. Lubricating oil pumped to the forward section of the engine is scavenged and returned to the supply tank by the scavenge side of the combination pressure and scavenge pump. This oil is not cooled, as temperatures are not high in the section it lubricates. Strainers within the accessory section gear case clean the oil of any large foreign particles. A combination filter and orifice filters and meters the oil supply to the fuel regulator. Some airplanes have cell-type tanks which are pressurized to prevent their collapse. This is accomplished by means of a pressure relief valve located in the oil tank vent line which maintains a 2.75 psi differential between the ambient and the oil tank pressure. Other airplanes are equipped with metal tanks which do not require pressurization. Refer to figure 1-47 for servicing information.

CONTROLS AND INDICATORS.

Oil Shutoff Valve Switches.

Four switches (18, figure 1-15), marked OPEN and CLOSE and located on the pilots' overhead control panel, are provided to control the oil shutoff valves. The valves operate on 115-volt a-c power.

Oil Pressure Gages.

Four oil pressure gages (35, figure 1-13), one for each jet engine, are located on the pilots' jet instrument panel.

FUEL SYSTEM *Schematic*

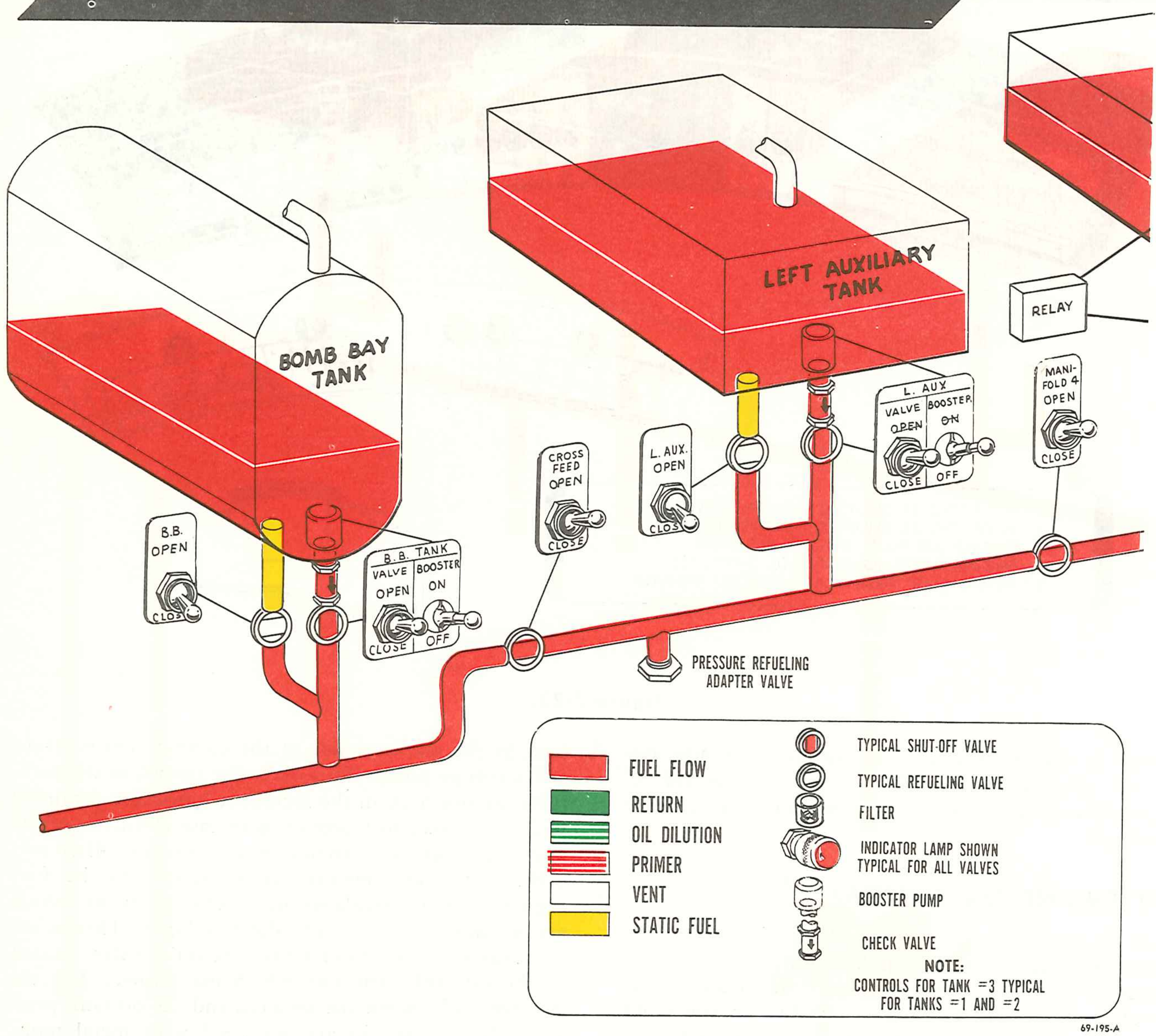


Figure 1-23. (Sheet 1 of 2)

FUEL SYSTEM.

Fuel is supplied to the reciprocating and the jet engines from six main wing tanks and two auxiliary wing tanks. An additional tank can be installed in bomb bay No. 3. The main wing tanks are formed by compartments between the front and rear spars inboard of each reciprocating engine nacelle. The auxiliary wing tanks are formed by a compartment on each side of the fuselage center line between the front and rear spars. Each auxiliary wing tank compartment contains four interconnected bladder-type cells which are nonself-sealing and are made of rubber impregnated nylon fabric. The bomb bay tank is equipped with quick-disconnect fittings so it can be dropped in flight. It is supported within the bomb bay by bomb shackles. The capacity of each tank is given in figure 1-24.

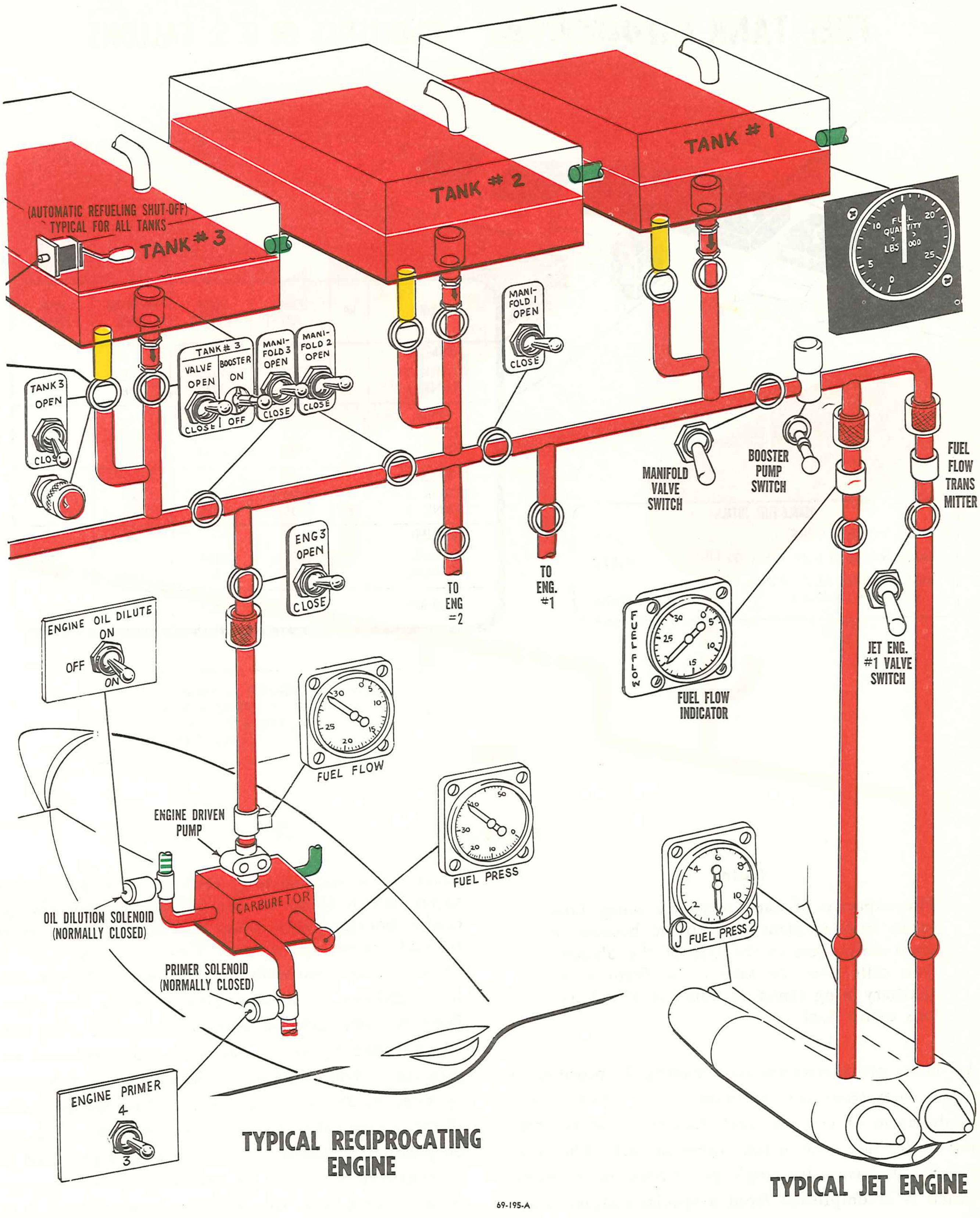
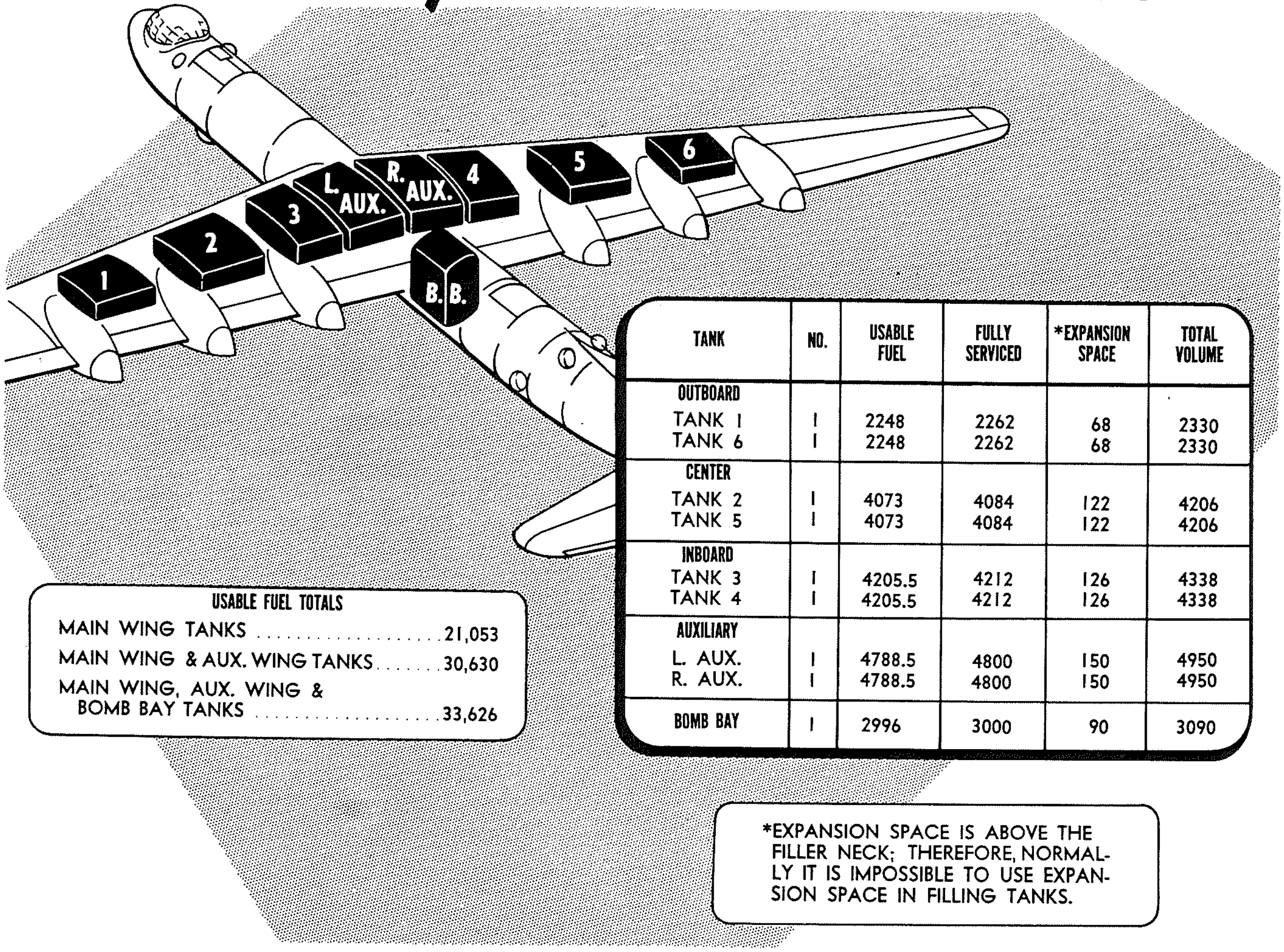


Figure 1-23. (Sheet 2 of 2)

FUEL TANK *Capacities* QUANTITIES IN U. S. GALLONS



TANK	NO.	USABLE FUEL	FULLY SERVICED	*EXPANSION SPACE	TOTAL VOLUME
OUTBOARD					
TANK 1	1	2248	2262	68	2330
TANK 6	1	2248	2262	68	2330
CENTER					
TANK 2	1	4073	4084	122	4206
TANK 5	1	4073	4084	122	4206
INBOARD					
TANK 3	1	4205.5	4212	126	4338
TANK 4	1	4205.5	4212	126	4338
AUXILIARY					
L. AUX.	1	4788.5	4800	150	4950
R. AUX.	1	4788.5	4800	150	4950
BOMB BAY	1	2996	3000	90	3090

USABLE FUEL TOTALS

MAIN WING TANKS 21,053
MAIN WING & AUX. WING TANKS 30,630
MAIN WING, AUX. WING & BOMB BAY TANKS 33,626

*EXPANSION SPACE IS ABOVE THE FILLER NECK; THEREFORE, NORMALLY IT IS IMPOSSIBLE TO USE EXPANSION SPACE IN FILLING TANKS.

Figure 1-24.

EI-169-B

Note

The capacity of each auxiliary wing tank varies from airplane to airplane because of small differences in the size of the bladder-type cells. For the sake of uniformity all auxiliary wing tanks are rated at 4788.5 gallons usable fuel.

All tanks are interconnected, making it possible to supply fuel from any combination of tanks to any combination of engines. Each fuel tank has an inlet and outlet line with a fuel valve in each. The inlet line is a provision for single point pressure refueling which is accomplished from a special adapter valve located in the left side of the fuselage between bomb bays 2 and 3. The outlet line connects the tanks to the main manifold fuel line which interconnects all of the wing fuel tanks. From this main manifold, fuel is supplied to the reciprocating and the jet engines. Fuel vapor which forms in the carburetors and the jet engine booster pump tanks is returned to the tanks through vapor return lines. The amount of fuel returned varies considerably and could possibly amount to 150 gallons for all six engines during a long flight. For fuel system arrangement, see figure 1-23. Fuel flow is controlled by tank, manifold, cross-feed, and engine fuel valves. Normally these valves are electrically operated by 28-volt direct current. With the exception of the engine valves for the jet engines, the valves can be positioned manually. Fuel pressure is provided by an engine-driven pump on each engine and a booster pump in each tank. An additional booster pump is installed in the fuel line leading to each pair of jet engines. The booster pumps operate on 208-volt alternating current. For fuel system management, refer to Section VII.

Fuel conforming to Specification MIL-F-5572 (AN-F-48), grade 115/145, is used. Grade 100/130 may be used as an alternate fuel.

CAUTION

When an alternate fuel is used, engine limitations differ from those established for the recommended fuel grade. Refer to Section V for all operating limits.

For additional fuel servicing information, see figure 1-47.

FUEL SYSTEM CONTROLS.

Tank Valve Switches.

Each tank valve is provided with a control switch (4, figure 1-20) located on the main control panel at the engineers' station. The switches have positions marked OPEN and CLOSE, and are used to open or close the fuel supply lines from the tanks.

Engine Valve Switches.

Six reciprocating engine valve switches (8, figure 1-20) are located on the main control panel. Four jet engine valve switches (14, figure 1-15) are located on the pilots' overhead control panel. Each switch operates an engine valve to control the flow of fuel to its corresponding engine. Each of these switches has an OPEN and CLOSE position.

Manifold Valve Switches.

Eight manifold valve switches (5, figure 1-20) are located on the main control panel and each switch controls a manifold valve. These manifold valves control fuel flow through the main manifold line. Two additional switches (13, figure 1-15) are located on the pilots' overhead control panel. Each of these switches operates a valve which controls the flow to each pair of jet engines. These two switches are so connected that the respective manifold valve switch must be in the OPEN position before the booster pump will operate. All manifold valve switches are marked OPEN and CLOSE.

Cross-Feed Valve Switches.

One cross-feed valve switch (6, figure 1-20) is located on the engineer's main control panel. The switch is marked OPEN and CLOSE, and is used to operate the cross-feed valve which controls fuel flow from one wing system to the other.

Booster Pump Switches.

Nine switch-type circuit breakers (4, figure 1-20) are located on the engineers' main control panel. Each switch controls a fuel tank booster pump. Two additional switch-type circuit breakers (11, figure 1-15), located on the pilots' overhead control panel, operate the booster pumps for the jet engines provided the jet engine manifold valve switches are OPEN. The booster pump switch positions are ON and OFF. Each switch controls 28-volt d-c power to a relay which controls 208-volt a-c power to the related booster pump motor.

Fuel Indicator Lamps Dim-Bright Knob.

This rheostat knob (39, figure 1-20), located on the engineers' main control panel, controls the brilliance of the fuel valve indicator lamps on the fuel control panel except those for the pressure refueling valves.

FUEL INDICATORS.

Reciprocating Engine Fuel Flow Indicators.

Six fuel flow indicators (15, figure 1-16) for the reciprocating engines are located on the engineers' main instrument panel and indicate fuel flow in pounds per hour. The system is energized from a transformer which receives 115-volt alternating current from the engineers' power panel.

Jet Engine Fuel Flow Indicators.

Four fuel flow indicators (4, figure 1-16) are located on the engineers' main instrument panel. Each indicator is connected to its related flowmeter transmitter which is located in the fuel line between the filter and the engine shutoff valve. The indicators register flow in pounds per hour.

Fuel Pressure Gages.

Three dual indicating fuel pressure gages (10, figure 1-17) for the reciprocating engines are located on the engineers' main instrument panel of airplanes not in group 1. Six single indicating fuel pressure gages (21, figure 1-16) for the reciprocating engines are located on the engineers' main instrument panel of group 1 airplanes. Four gages (36, figure 1-13) for the jet engines are mounted on the pilots' jet instrument panel. Power for the jet fuel pressure indicating system is received from a transformer which has an input of 115-volt alternating current from the jet pod power panel.

Fuel Quantity Gages.

For airplanes not in group 1, three dual indicating fuel quantity gages (12, figure 1-19) for the main wing tanks are located on the flight engineers' auxiliary instrument panel and a dual indicating gage (21, figure 1-17) for the auxiliary wing tanks is located on the flight engineers' main instrument panel. A single indicating instrument (17, figure 1-17) for the bomb bay tank is also located on the flight engineers' main instrument panel. For group 1 airplanes, three dual indicating fuel quantity gages (27, figure 1-16) for the main wing tanks and a dual indicating gage (26, figure 1-16) for the auxiliary wing tanks are located on the flight engineers' main instrument panel. A single indicating gage (25, figure 1-16) for the bomb bay tank is located on the flight engineers' main instrument panel.

The gages operate on 28-volt direct current from the engineers' circuit breaker panel.

Fuel Valve Indicator Lamps.

Fuel valve indicator lamps (5, figure 1-20 and 12, figure 1-15) are located on the engineers' main control panel and the pilots' overhead jet control panel. The lamps represent fuel control valves, and they burn continuously when the power is on and the valve gates are in either of their extreme positions. At the beginning of valve gate travel, the corresponding lamp goes out; normally relighting of the lamp indicates successful operation of the valve.

CAUTION

The light indicates motor travel and will give an erroneous indication if the motor is disconnected from the valve.

The specific position of a control valve gate is indicated by the position of the corresponding switch only.

PRESSURE REFUELING CONTROLS.

Pressure Refueling Valve Switches.

Nine pressure refueling valve switches (2, figure 1-20), one for each wing tank and one for the bomb bay tank, are located on the engineers' main control panel. Each switch has OPEN and CLOSE positions and controls the fuel valve in the inlet line of each tank. During pressure refueling, the valves will automatically close when their tanks are within 25 to 75 gallons of being full; then, the valves cannot be opened electrically until 150 to 300 gallons of fuel have been used. In this condition, the switches must first be placed CLOSE and then OPEN to obtain successful operation.

CAUTION

When pressure refueling is being carried out, someone should be stationed at the main control panel to observe the fuel level indicators and the refueling valve indicator lights. The refueling valves must be closed if they fail to operate automatically. Failure of a valve to operate is determined by the valve indicator light not coming on and the related fuel quantity gage pointer moving past the point at which the tank is full.

Note

Approximately one second is required for a refueling valve to travel from one extreme position to the other after the valve actuator has been energized.

Pressure Refueling Valve Indicator Lamps.

An indicator lamp (1, figure 1-20) for each pressure refueling valve will glow when its corresponding valve is fully closed. Each lamp will be dark when its valve is partly or fully open.

CAUTION

The light indicates motor travel and will give an erroneous indication if the motor is disconnected from the valve.

EMERGENCY FUEL CONTROL.

The fuel valves can be operated manually in the event of electrical failure. (See figure 3-12.) The valves for the auxiliary wing tanks and the bomb bay tank are accessible from the bomb bay. The jet engine fuel valves are not accessible in flight.

BOMB BAY TANK RELEASE CONTROLS.

The bomb bay fuel tank can be jettisoned by use of a bomb bay tank release selector switch on the pilots' instrument panel and the salvo switches located one each at the pilots', and the photo-navigator's staion. Refer to "Emergency Release Controls," Section IV for information on the bomb salvo switches.

Bomb Bay Tank Release Selector Switch.

This two-position switch (33, figure 1-13), marked NO SALVO and CAN SALVO, is provided on the pilots' instrument panel to either set up or de-energize a 28-volt d-c bomb bay tank salvo circuit. When the switch is in the NO SALVO position, the bomb bay fuel tank can not be salvoed. When it is in the CAN SALVO position the tank will release upon actuation of any one of the bomb salvo switches. Also, when the switch is in this position, a green indicator lamp (33, figure 1-13) adjacent to the switch will glow, indicating that the fuel tank can be salvoed. An indicator lamp is also provided on the bombing control panel.

ELECTRICAL SYSTEM.

A 3-phase, 400-cycle, a-c electrical system is employed because it permits a considerable weight saving in required wire gages, actuators, and generators. Alternating and direct current is supplied to the airplane through a primary and secondary power distribution network. The primary network is a 208/115-volt, 3-phase, 400-cycle, alternating-current power system (figure 1-25) supplied by four engine-driven alternators. The secondary network is a direct-current power system (figure 1-28) supplied by transformer-rectifier units fed from the alternating-current system. The alternating-current system supplies 400-cycle a-c power to the electronic-controlled turrets, heavy-duty motors, high speed actuators, lighting circuits, flight control equipment, and radio and radar equipment. The 28-volt direct-current system supplies power to such vital equipment as the bomb release system, radio and radar sets, propeller reverse and feathering control, fuel valves, and alarm bells.

The electrical system employs fuses and circuit breakers to protect the electrical system from faults automatically. Multicircuit feeders of three or four wires per phase are incorporated in the power distribution system. A multicircuit feeder will provide continued service after one of its conductors has been broken, causing an open circuit. To furnish the necessary protection against faults or shorts occurring on a feeder section, fuses are located on each end of the conductors. Should a conductor break and the two loose ends cause a short circuit, the fuses at each end will clear, isolating the fault and permitting continued operation of the feeder section through the remaining conductors. Any one of the four alternators can supply sufficient electrical power for necessary operations provided all unnecessary equipment is turned off.

EXTERNAL POWER SOURCE.

When the airplane is on the ground, electric power is obtained from a B-10 portable power cart on which is mounted an alternator driven by a gasoline engine. During normal operation the cart is connected to the airplane through a six-prong external power receptacle located on the under side of the fuselage below the wing. The power cart supplies 208-volt, 3-phase, 400-cycle alternating current, part of which energizes the airplane's transformer-rectifier units and furnishes 28-volt direct current. When the portable power cart is connected to the airplane, it is imperative that the 3-phase power supplied has the same phase sequence as the alternators installed in the airplane. The direction of rotation of a 3-phase electric motor is entirely dependent on the phase sequence of its power supply. If two of the three power lines to a motor are interchanged, resulting in reversed phase sequence, the direction of motor rotation reverses nullifying limit switches and causing damage to aircraft and equipment. Therefore, if the power leads from the cart are interchanged so that the phase sequence of the power output is incorrect, motors on the airplane will run in the wrong direction when energized from the portable power cart. To prevent this error, indicator lamps for determining phase sequence are provided.

CAUTION

Serious damage will result to certain types of motors and equipment on the airplane if they are operated in the wrong direction.

External Power Supply Switch.

This two-position ON-OFF switch (2, figure 1-18), when placed in the ON position, completes the circuit from the portable power cart to the airplane's electrical system. At the same time it breaks the circuits to all cabin heaters. The switch is located on the engineers' auxiliary instrument panel.

Phase Sequence Lamps.

Two lamps (14, figure 1-26) are provided on the engineers' auxiliary instrument panel to indicate phase sequence. If the phase sequence of the cart is correct, the lamp marked CORRECT 1, 2, 3 will light. If the phase sequence is incorrect, the lamp marked INCORRECT 3, 2, 1 will light.

Note

If both lamps light, the indication of the brightest lamp should be followed.

Phase Sequence Lamp Test Switch. A push-to-test switch (15, figure 1-26) is located adjacent to the phase sequence lamps to test their operation.

ALTERNATING-CURRENT SYSTEM.

The a-c power supply consists of four 40-kva, 208/115-volt, 3-phase, neutral grounded, 400-cycle alternators. One alternator each is installed on engines No. 2, 3, 4, and 5. Each alternator feeds into the main power panels in the fuselage, from where the power is distributed to the various electrical loads in the airplane. In the event of complete loss of a-c power, the reciprocating engine instruments will react as follows:

1. The fuel, oil, water, and manifold pressure gages, the fuel flow indicators, and the torquemeters will fail but will remain in the approximate positions they were in when the failure took place.
2. The master temperature indicator (some airplanes) and engine tachometers will continue to operate.
3. The fuel and oil quantity gages will continue to operate on battery power.
4. The carburetor air and oil temperature gages will continue to operate on battery power if required. The master tachometer will operate when the master motor is in use.

Alternator Controls and Indicators.

Power output of any alternator is possible only when the alternator field is excited by direct current supplied by a generator built into the alternator. This d-c flow is controlled by a three-position, spring-loaded, on-off exciter control relay switch (2, figure 1-26). Voltage output of the alternator is controlled by regulating the voltage of the exciter field. The real load ouput is measured in kilowatts. The real load output is accompanied by a reactive current during inductive load output; this reactive current is measured in kilovars.

One of the most important devices in the a-c power supply system is the unit used to drive the alternator at a constant speed throughout the range of various engine speeds. Alternator frequency varies with alternator speed; therefore, in order to generate a constant frequency, which is necessary for correct operation of much of the electrical equipment as well as being a prerequisite to parallel operation of alternators, a reliable constant-speed source is required. The constant-speed drive used is a mechanical-hydro-electric governor and drive unit. The drive unit, a variable ratio hydraulic transmission, delivers power to the alternator at a speed which is held constant through

A-C POWER DISTRIBUTION

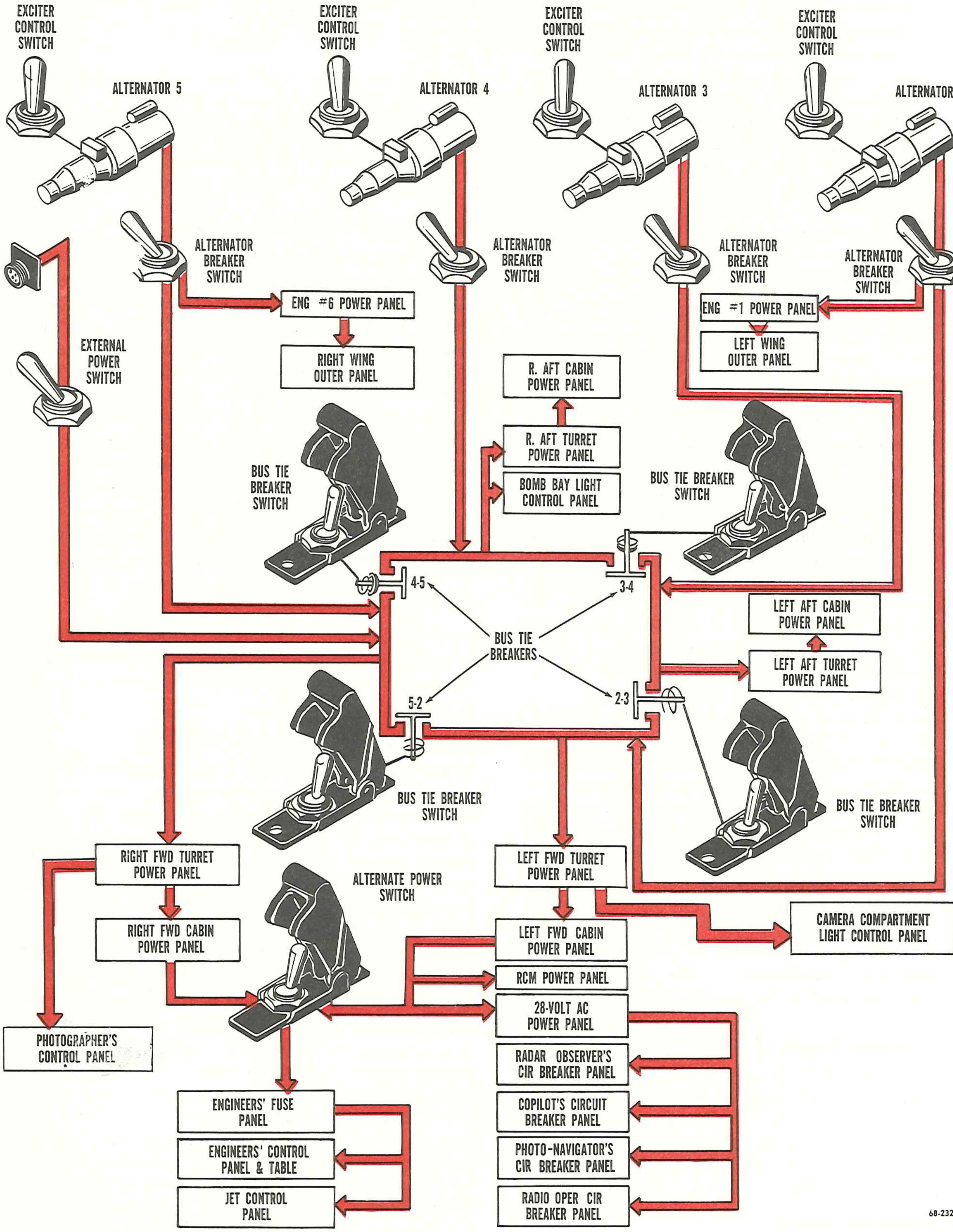
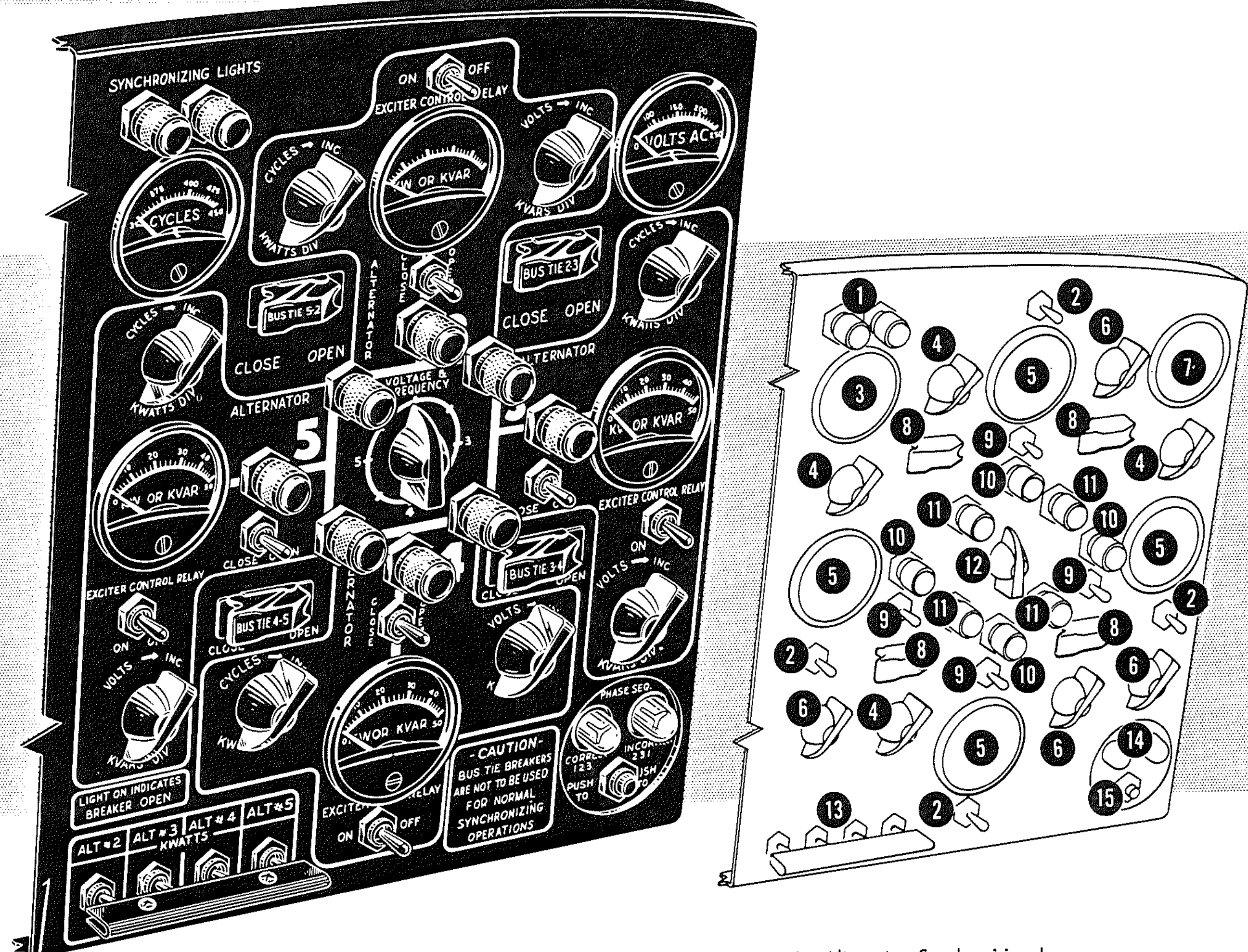


Figure 1-25.

ENGINEER'S A-C Power Control Panel



1. Alternator Synchronizing Lamps
2. Exciter Control Relay Switch
3. Frequency Meter
4. Frequency Control Knob
5. Kilowatt-Kilovar Meter
6. Voltage Control Knob
7. Voltmeter
8. Bus Tie Breaker
9. Alternator Breaker Control Switch
10. Alternator Breaker Indicator Lamp
11. Bus Tie Breaker Indicator Lamp
12. Voltage And Frequency Selector Switch
13. Kilowatt-Kilovar Selector Switches
14. Phase Sequence Lamps
15. Phase Sequence Lamps Test Switch

EI-167-B

EI-167-B

Figure 1-26.

controlling action applied to the drive by the governor equipment.

Parallel operation (more than one alternator supplying a common bus) is desirable, since it will give greater stability to the electrical system; and in the event one alternator is inoperative, the entire power supply will not be cut off. (See "The Alternators," Section VII.) One kilowatt-kilovar meter (5, figure 1-26) is supplied for each alternator to indicate its power output. Although it is desirable that the three alternators divide the load as much as possible, the free-wheeling feature of the constant-speed drive permits alternator motoring for periods up to 5 minutes without damage to the drive. (See "Alternator Motoring," Section III.)

Exciter Control Relay Switch. Holding this switch (2, figure 1-26) momentarily in the ON position excites the alternator. Holding the switch momentarily in the OFF position de-excites the alternator and discontinues its output. The OFF position is also used to flash the alternator field when the alternator field flashing switch is ON. (See "Alternator Field Flashing," Section III.)

Voltage Control Knob. Voltage output of each alternator is controlled by its associated voltage control knob (6, figure 1-26).

Frequency Control Knob. This knob (4, figure 1-26) is connected to the governor control circuit and provides a means of controlling the speed of the constant-speed drive. Controlling the speed at which the alternator is driven directly controls the frequency of its output.

Voltage and Frequency Selector Switch. An eight-position selector switch (12, figure 1-26) is located on the engineers' auxiliary instrument panel. Four of these positions are marked 2, 3, 4, and 5, with respect to the four alternators. With the switch in any of these positions, the voltmeter and frequency meter will indicate the voltage and frequency of the selected alternator. Also, the kilowatt-kilovar meter (5, figure 1-26) for each alternator will indicate the power output of the selecter alternator when its alternator breaker is closed and electric power is being used. The four unmarked positions are connected to the four main bus bars. The position between 2 and 3 is connected to bus 201, the position between 3 and 4 to bus 301, the position between 4 and 5 to bus 401, and the position between 5 and 2 to bus 501. With the switch in any of these positions, the voltmeter and frequency meter will indicate the voltage and frequency of the current on the selected bus, provided the bus tie-breakers are open. If the bus tie-breakers are closed, any of these four positions will give the voltage and frequency of the current on the connected bus bars.

Alternator Breaker Switch. Each alternator is connected to the power distribution network by an alternator breaker. A three-position switch (9, figure 1-26), spring-loaded in the OPEN and CLOSE positions, controls the breaker which is a d-c operated solenoid. Individual alternator breaker indicator lamps (10, figure 1-26) are located adjacent to each alternator breaker switch. These red lamps glow when the breaker is in the OPEN position. In the event an alternator breaker of a particular alternator is closed and the mixture control lever of that engine is moved to the IDLE CUT-OFF position, the breaker will automatically be opened.

Alternator Breaker Hold-In Switches. A hold-in switch (14, figure 1-21) for each alternator is provided to prevent the alternator breaker from opening when the corresponding mixture control lever is moved to the IDLE CUT-OFF position. The switches are used during normal engine shutdown when it is necessary to keep the alternator breaker of the last engine being shut down closed so that electrical power will be available to properly position the mixture control. The switches each have a spring-loaded HOLD IN position and a full-on NORMAL position and are located on the engineers' table.

Kilowatt and Kilovar Selector Switches. A bank of four kilowatt-kilovar selector switches (13, figure 1-26) is used to determine the power output of the alternators. These switches, which are ganged together, are used to select the desired reading by placing them in either the KWATTS or KVARS position. Indicators (5, figure 1-26) are provided for use with the kilowatt-kilovar selector switches. During parallel operation the division of real load is indicated by these meters when the selector switches are in the KWATTS position. When the switches are in the KVARS position, the meters register the reactive current measured in vars being put out by each alternator.

Alternator Field Flashing Circuit Breaker. A circuit breaker (5, figure 1-22) is provided at the engineers' station to flash the alternator exciter field. When this switch is placed in the ON position and the exciter control relay switch is held in the OFF position, a 28-volt d-c circuit, stepped down through a 50-ohm resistor, energizes the alternator exciter field circuit. This switch is to be used when alternator field reversal is encountered (as indicated by extreme fluctuation of the voltage) or when an alternator fails to excite.

Bus Controls and Indicators. When in parallel operation, the individual alternators are all interconnected to a comomn bus. This bus is divisible by means of tie-breakers. The tie-breakers are controlled by four three-position bus tie-breaker control switches (8, figure 1-26) which are spring-loaded in the OPEN and CLOSE positions. The switches have guards which identify the bus segments they interconnect. The arrangement of the main a-c power bus and the individual bus tie-breakers is illustrated in figure 1-25. A red indicator lamp (11, figure 1-26) is located adjacent to each bus tie-breaker switch and glows when the bus tie-breaker is open.

Synchronizer Lamps. The synchronization controls and indicators are provided to equalize the output and frequency of each alternator so that they may be put in parallel. Two lamps (1, figure 1-26) on the engineers' panel are used to synchronize alternators. These lamps are connected so that by means of the voltage and frequency selector switch each lamp is placed between one phase of the power bus and the corresponding phase of the alternator to be paralleled with the bus. Therefore, the lamps will light when a difference exists between the frequency of the power bus and the frequency of the alternator. If the alternator voltage does

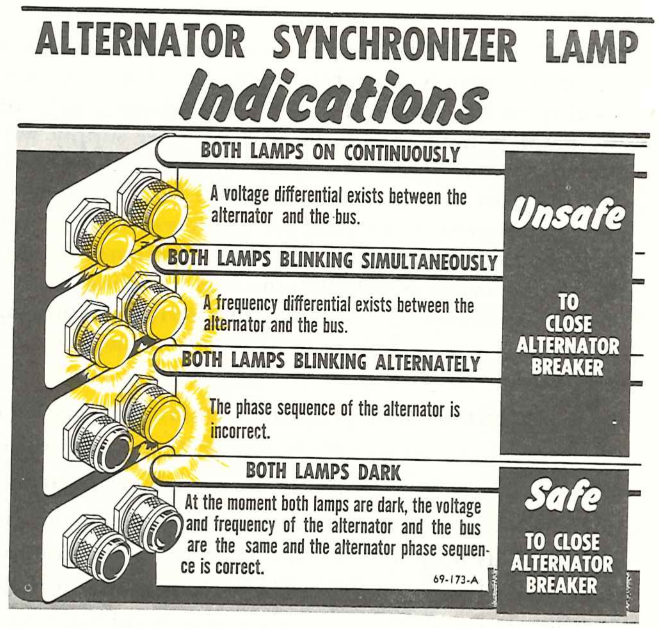


Figure 1-27.

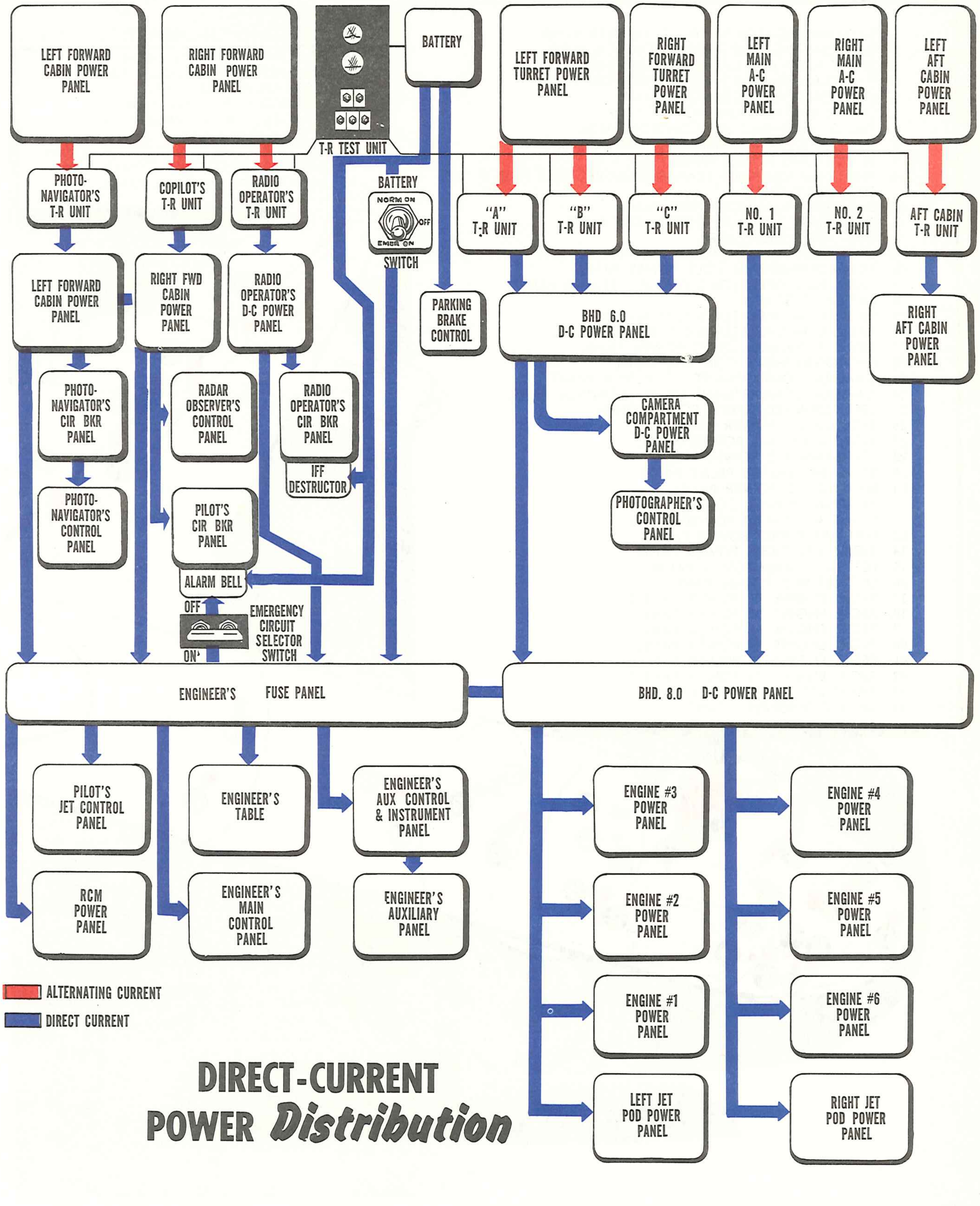

LEFT FORWARD CABIN POWER PANEL
RIGHT FORWARD CABIN POWER PANEL
T-R TEST UNIT
BATTERY
LEFT FORWARD TURRET POWER PANEL
RIGHT FORWARD TURRET POWER PANEL
LEFT MAIN A-C POWER PANEL
RIGHT MAIN A-C POWER PANEL
LEFT AFT CABIN POWER PANEL
PHOTO-NAVIGATOR'S T-R UNIT
COPILOT'S T-R UNIT
RADIO OPERATOR'S T-R UNIT
BATTERY
NORM ON
OFF
EMER ON
SWITCH
"A" T-R UNIT
"B" T-R UNIT
"C" T-R UNIT
NO. 1 T-R UNIT
NO. 2 T-R UNIT
AFT CABIN T-R UNIT
LEFT FORWARD CABIN POWER PANEL
RIGHT FWD CABIN POWER PANEL
RADIO OPERATOR'S D-C POWER PANEL
PARKING BRAKE CONTROL
BHD 6.0 D-C POWER PANEL
RIGHT AFT CABIN POWER PANEL
PHOTO-NAVIGATOR'S CIR BKR PANEL
RADAR OBSERVER'S CONTROL PANEL
RADIO OPERATOR'S CIR BKR PANEL
CAMERA COMPARTMENT D-C POWER PANEL
IFF DESTRUCTOR
PHOTO-NAVIGATOR'S CONTROL PANEL
PILOT'S CIR BKR PANEL
PHOTOGRAPHER'S CONTROL PANEL
ALARM BELL
OFF
ON
EMERGENCY CIRCUIT SELECTOR SWITCH
ENGINEER'S FUSE PANEL
BHD. 8.0 D-C POWER PANEL
PILOT'S JET CONTROL PANEL
ENGINEER'S TABLE
ENGINEER'S AUX CONTROL & INSTRUMENT PANEL
ENGINE #3 POWER PANEL
ENGINE #4 POWER PANEL
RCM POWER PANEL
ENGINEER'S MAIN CONTROL PANEL
ENGINEER'S AUXILIARY PANEL
ENGINE #2 POWER PANEL
ENGINE #5 POWER PANEL
ALTERNATING CURRENT
DIRECT CURRENT
ENGINE #1 POWER PANEL
ENGINE #6 POWER PANEL
DIRECT-CURRENT POWER Distribution
LEFT JET POD POWER PANEL
RIGHT JET POD POWER PANEL
72-112-A

Figure 1-28.

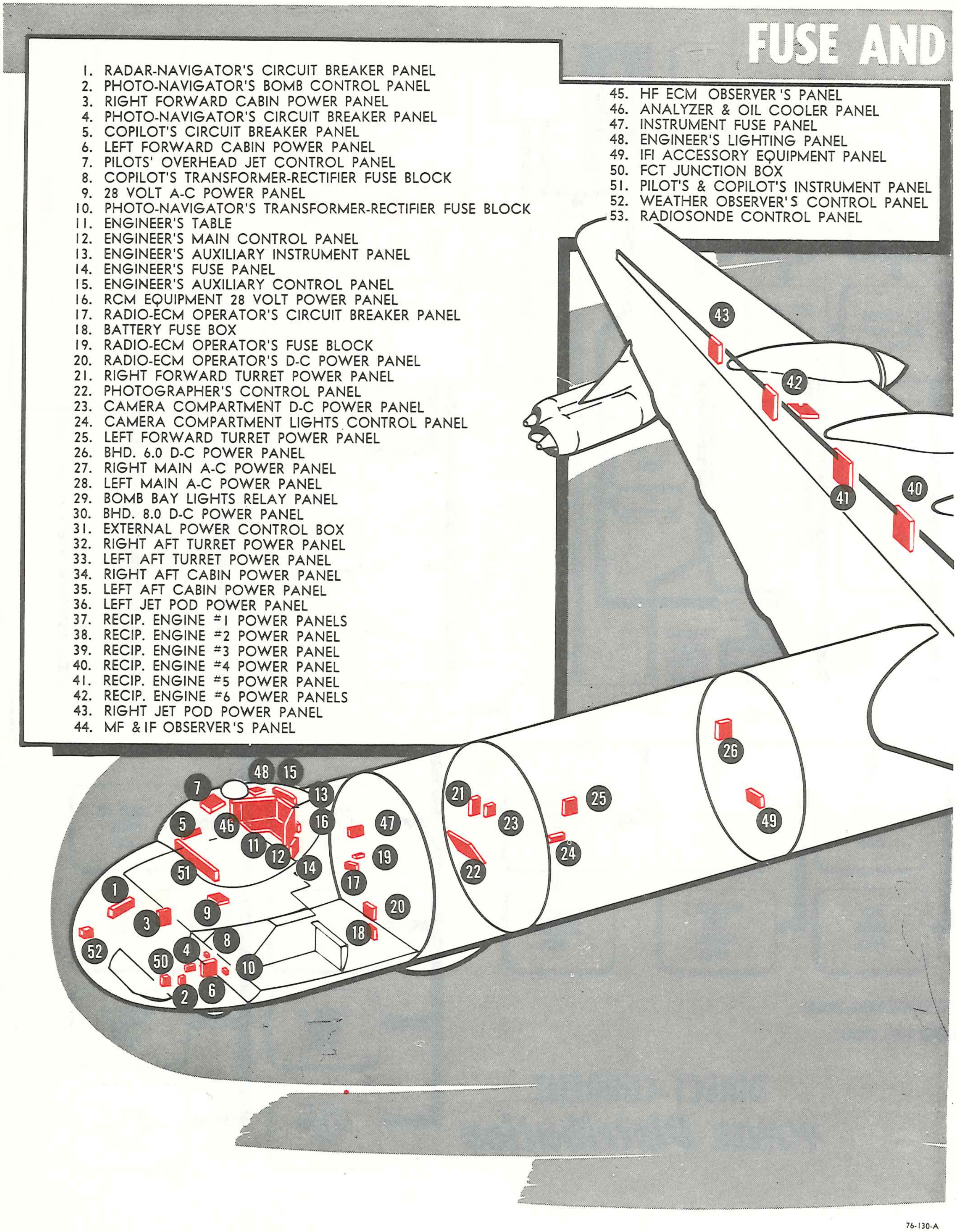


Figure 1-29. (Sheet 1 of 2)

CIRCUIT BREAKER PANEL *Locations*

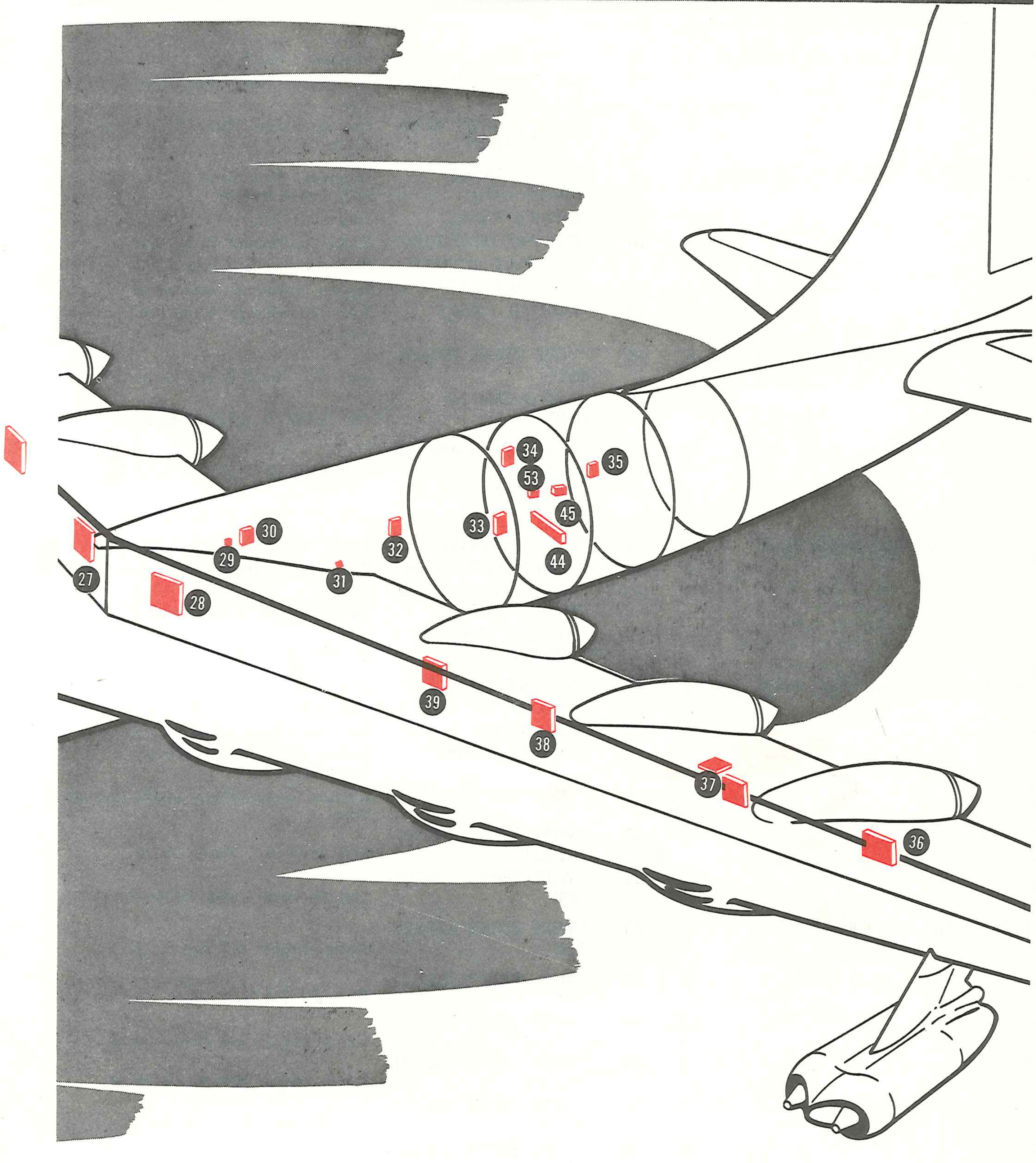


Figure 1-29. (Sheet 2 of 2)

A-C SYSTEM FEEDER FUSES

LOCATION	QUANTITY	SIZE (AMPERES)	DECAL NOMENCLATURE	CONNECTED TO
Engineer's Fuse Panel (Some Airplanes)	2	30	"ENGINEER'S PANEL"	Engineer's Table
	1	20	"MASTER TURBO"	Turbosupercharger Regulator Control
	3	30	"ENGR'S PANEL POWER INPUT"	Engineer's Fuse Panel A-C Power Switch
Engineer's Fuse Panel (Some Airplanes)	3	30	"ENGR'S PANEL POWER INPUT"	Engineer's Fuse Panel A-C Power Switch
	1	30	"ENGR'S PANEL"	Engineer's Table
	1	10	"CYL HD TEMP IND"	Engine Instrument Fuse Panel
	1	10	"INST PWR NORMAL"	Engine Instrument Fuse Panel
	1	10	"INST PWR ALT."	Engine Instrument Fuse Panel
	1	20	"MASTER TURBO"	Turbosupercharger Regulator Controls
Left Aft Cabin Power Panel	9	30	"WIRE SERIES 450-451-452"	Left Aft Turret Power Panel
	3	20	"AFT CABIN T-R UNIT"	Aft Cabin Transformer-Rectifier
Left Aft Turret Power Panel	12	40	"WIRE SERIES 400-401-402-403"	Left Main A-C Power Panel
	9	30	"WIRE SERIES 450-451-452"	Left Aft Cabin Power Panel
Left Forward Cabin Power Panel	3	20	"LH CONVERTER"	Photo-Navigator's T-R Unit
	2	40	"RCM POWER PANEL"	RCM Equipment 28 Volt Power Panel
	9	30	"WIRE SERIES 307-308-309"	Left Forward Turret Power Panel
	1	20	"28 VOLT TRANSFORMER"	28 Volt A-C Power Panel
Left Forward Turret Power Panel	3	20	"BHD. 6.0 T-R UNIT A"	Bhd. 6.0 T-R Unit "A"
	3	20	"BHD. 6.0 T-R UNIT B"	Bhd. 6.0 T-R Unit "B"
	3	30	"ECM PANEL ENGR'S STA ALT POWER"	Engineer's Fuse Panel A-C Power Switch, AND Radio Operator's Fuse Block
	1	10	"LIGHTING XFMR"	Camera Compartment Lights Control Panel
	12	40	"WIRE SERIES 300-301-302-303"	Left Main A-C Power Panel
	9	30	"WIRE SERIES 307-308-309"	Left Forward Cabin Power Panel
Left Jet Pod Power Panel	9	60	"WIRE SERIES 124-125-126"	Recip. Engine #2 Power Panel
Left Main A-C Power Panel	3	20	"BHD. 8.0 T-R UNIT #2"	Bhd. 8.0 T-R Unit #2
	12	60	"WIRE SERIES 110-111-112-113"	Recip. Engine #2 Power Panel
	12	60	"WIRE SERIES 140-141-142-143"	Recip. Engine #3 Power Panel
	12	40	"WIRE SERIES 300-301-302-303"	Left Forward Turret Power Panel
	12	40	"WIRE SERIES 400-401-402-403"	Left Aft Turret Power Panel

Figure 1-30. Fuse and Circuit Breaker List (Sheet 1 of 24)

A-C SYSTEM FEEDER FUSES (Continued)

LOCATION	QUANTITY	SIZE (AMPERES)	DECAL NOMENCLATURE	CONNECTED TO
Left Main A-C Power Panel (Continued)	12	40	"WIRE SERIES 420-421-422-423"	Right Main A-C Power Panel
	12	40	"WIRE SERIES 430-431-432-433"	Right Main A-C Power Panel
Radio Operator's Fuse Block	3	30	"ECM EQUIPMENT 115 VOLT A-C"	Left Forward Turret Power Panel
Recip Engine #1 Power Panel	12	30	"WIRE SERIES 116-117-118-119"	Recip Engine #2 Power Panel
Recip Engine #2 Power Panel	12	60	"WIRE SERIES 110-111-112-113"	Left Main A-C Power Panel
	12	30	"WIRE SERIES 116-117-118-119"	Recip Engine#1 Power Panel
Recip Engine #2 Power Panel	9	60	"WIRE SERIES 124-125-126"	Left Jet Pod Power Panel
Recip Engine #3 Power Panel	12	60	"WIRE SERIES 140-141-142-143"	Left Main A-C Power Panel
Recip Engine #4 Power Panel	12	60	"WIRE SERIES 240-241-242-243"	Right Main A-C Power Panel
Recip Engine #5 Power Panel	12	60	"WIRE SERIES 210-211-212-213"	Right Main A-C Power Panel
	12	30	"WIRE SERIES 216-217-218-219"	Recip Engine #6 Power Panel
	9	60	"WIRE SERIES 224-225-226"	Right Jet Pod Power Panel
Recip Engine #6 Power Panel	12	30	"WIRE SERIES 216-217-218-219"	Recip Engine #5 Power Panel
Right Aft Cabin Power Panel	1	20	"TRANSFORMER"	28 Volt Transformer in Right Aft Cabin Power Panel
	9	30	"WIRE SERIES 440-441-442"	Right Aft Turret Power Panel
Right Aft Turret Power Panel	12	40	"WIRE SERIES 410-411-412-413"	Right Main A-C Power Panel
	9	30	"WIRE SERIES 440-441-442"	Right Aft Cabin Power Panel
Right Forward Cabin Power Panel	3	20	"BHD. 4.0 CONVERTER"	Radio Operator's T-R Unit
	3	20	"RH CONVERTER"	Copilot's T-R Unit
	9	30	"WIRE SERIES 317-318-319"	Right Forward Turret Power Panel
Right Forward Turret Power Panel	3	20	"BHD. 6.0 T-R UNIT C"	Bhd 6.0 T-R Unit "C"
	3	30	"ENGINEER'S POWER PANEL"	Engineer's Fuse Panel A-C Power Switch
	3	30	"PHOTO PANEL"	Photographer's Control Panel
	12	40	"WIRE SERIES 310-311-312-313"	Right Main A-C Power Panel
	9	30	"WIRE SERIES 317-318-319"	Right Forward Cabin Power Panel

Figure 1-30. Fuse and Circuit Breaker List (Sheet 2 of 24)

A-C SYSTEM FEEDER FUSES (Continued)

LOCATION	QUANTITY	SIZE (AMPERES)	DECAL NOMENCLATURE	CONNECTED TO
Right Jet Pod Power Panel	9	60	"WIRE SERIES 224-225-226"	Recip Engine #5 Power Panel
Right Main A-C Power Panel	3	20	"BHD. 8.0 T-R UNIT #1"	Bhd 8.0 T-R Unit #1
	12	60	"WIRE SERIES 210-211-212-213"	Recip Engine #5 Power Panel
	12	60	"WIRE SERIES 240-241-242-243"	Recip Engine #4 Power Panel
	12	40	"WIRE SERIES 310-311-312-313"	Right Forward Turret Power Panel
	12	40	"WIRE SERIES 410-411-412-413"	Right Aft Turret Power Panel
	12	40	"WIRE SERIES 420-421-422-423"	Left Main A-C Power Panel
	12	40	"WIRE SERIES 430-431-432-433"	Left Main A-C Power Panel
Right Main A-C Power Panel	12	40	"WIRE SERIES 475-476-477-478"	External Power Control Relay
	1	20	"28 VOLT TRANSFORMER"	Bomb Bay Lights Relay Panel
28 Volt A-C Power Panel	3	20	"COPILOT'S PANEL"	Copilot's Circuit Breaker Panel
	1	30	"NAVIGATORS PANEL"	Photo-Navigator's Circuit Breaker Panel
	1	30	"RADAR OPERATOR'S PANEL"	Radar Observer's Circuit Breaker Panel
	1	30	"RADIO-ECM OPERATOR'S PANEL"	Radio Operator's Circuit Breaker Panel

D-C SYSTEM FEEDER FUSES

LOCATION	QUANTITY	SIZE (AMPERES)	DECAL NOMENCLATURE	CONNECTED TO
Battery Fuse Box	1	30	"ALARM BELL"	Copilot's Circuit Breaker Panel
	3	40	"ENGINEER'S PANEL"	Engineer's Fuse Panel
	2	30	"SCR-695 DETONATOR"	Radio Operator's Circuit Breaker Panel
Bhd 6.0 D-C Power Panel	3	50	"BHD. 8.0 D-C POWER PANEL"	Bhd 8.0 D-C Power Panel
	3	50	"BHD. 8.0 T-R UNIT A"	Bhd 8.0 T-R Unit "A"
	3	50	"BHD. 8.0 T-R UNIT B"	Bhd 8.0 T-R Unit "B"
	3	50	"BHD. 8.0 T-R UNIT C"	Bhd 8.0 T-R Unit "C"
	6	50	"CAMERA COMPARTMENT D-C POWER PANEL"	Camera Compartment D-C Power Panel
Bhd 8.0 D-C Power Panel	3	60	"AFT CABIN"	Right Aft Cabin Power Panel
	3	50	"BHD. 6.0 D-C POWER PANEL"	Bhd 6.0 D-C Power Panel
	3	50	"BHD 8.0 #1 T-R UNIT"	Bhd 8.0 #1 T-R Unit
	3	50	"BHD. 8.0 #2 T-R UNIT"	Bhd 8.0 #2 T-R Unit

Figure 1-30. Fuse and Circuit Breaker List (Sheet 3 of 24)

D-C SYSTEM FEEDER FUSES (Continued)

LOCATION	QUANTITY	SIZE (AMPERES)	DECAL NOMENCLATURE	CONNECTED TO
Bhd. 8.0 D-C Power Panel (Continued)	3	30	"FWD CABIN"	Engineer's Fuse Panel
	3	20	"LEFT WING"	Recip. Engines #1, 2, & 3 and Left Jet Pod Power Panels
	3	20	"RIGHT WING"	Recip. Engines #4, 5, & 6 and Right Jet Pod Power Panels
Camera Compartment D-C Power Panel	6	50	"BHD. 6.0 D-C POWER PANEL"	Bhd. 6.0 D-C Power Panel
	3	60	"PHOTOGRAPHER'S PANEL"	Photographer's Control Panel
Copilot's T-R Fuse Block	3	50	NONE	Right Forward Cabin Power Panel
Engineer's Fuse Panel	3	40	'BATTERY"	Battery Fuse Box
	3	30	"BOMB BAY"	Bhd. 8.0 D-C Power Panel
	3	30	"LH FWD PANEL"	Left Forward Cabin Power Panel
	3	30	"RADIO OPERATOR'S PANEL"	Radio Operator's D-C Power Panel
	3	30	"RH FWD PANEL"	Right Forward Cabin Power Panel
Left Forward Cabin Power Panel	3	30	"ENGINEER'S PANEL"	Engineer's Fuse Panel
	3	50	"LH CONVERTER"	Photo-Navigator's T-R Fuse Block
	3	30	"NAVIGATOR'S PANEL"	Photo-Navigator's Circuit Breaker Panel
	3	30	"RH POWER PANEL"	Right Forward Cabin Power Panel
Left Jet Pod Power Panel	3	10	"28 VOLT D-C POWER	Bhd. 8.0 D-C Power Panel
Photo-Navigator's T-R Fuse Block	3	50	NONE	Left Forward Cabin Power Panel
Radio Operator's D-C Power Panel	3	40	"BHD. 4.0 CONVERTER"	Radio Operator's T-R Unit
	3	30	"ENGINEER'S PANEL"	Engineer's Fuse Panel
	3	30	"RADIO OPERATOR'S PANEL"	Radio Operator's Circuit Breaker Panel
Recip. Engine #1 Power Panel	3	10	"28 VOLT D-C POWER"	Bhd. 8.0 D-C Power Panel
Recip. Engine #2 Power Panel	3	10	"28 VOLT D-C POWER"	Bhd. 8.0 D-C Power Panel
Recip. Engine #3 Power Panel	3	10	"28 VOLT D-C POWER"	Bhd. 8.0 D-C Power Panel
Recip. Engine #4 Power Panel	3	10	"28 VOLT D-C POWER"	Bhd. 8.0 D-C Power Panel
Recip. Engine #5 Power Panel	3	10	"28 VOLT D-C POWER"	Bhd. 8.0 D-C Power Panel
Recip. Engine #6 Power Panel	3	10	"28 VOLT D-C POWER"	Bhd. 8.0 D-C Power Panel
Right Aft Cabin Power Panel	3	60	"BHD. 8.0 D-C POWER PANEL"	Bhd. 8.0 D-C Power Panel
	3	40	"AFT CABIN T-R UNIT"	Aft Cabin T-R Fuse Block
	2	40	"MF ECM"	MF ECM Circuit Breaker Panel
	2	40	"IF ECM"	IF ECM Circuit Breaker Panel
	2	40	"HF ECM"	HF ECM Circuit Breaker Panel
Right Forward Cabin Power Panel	3	30	"COPILOT'S PANEL"	Copilot's Circuit Breaker Panel
	3	30	"ENGINEER'S PANEL"	Engineer's Fuse Panel
	3	30	"LH POWER PANEL"	Left Forward Cabin Power Panel
	3	20	"RADAR OPERATOR'S PANEL"	Radar/Observer's Circuit Breaker Panel
	3	50	"RH CONVERTER"	Copilot's T-R Fuse Block
Right Jet Pod Power Panel	3	10	"28 VOLT D-C POWER"	Bhd. 8.0 D-C Power Panel

Figure 1-30. Fuse and Circuit Breaker List (Sheet 4 of 24)

A-C SYSTEM EQUIPMENT FUSES AND CIRCUIT BREAKERS

*Push-Pull Type Circuit Breaker
†Switch Type Circuit Breaker

The words "Power" and "Control," in parenthesis, are used in conjunction with certain "Equipment or Circuit" designations in both the AC and DC Equipment Fuse and Circuit Breaker lists. The word "Power" is used to indicate an electrical circuit which is completed through a relay. "Control" indicates an energizing circuit for a relay. For each power circuit, or groups of similar power circuits, there is a corresponding control circuit. For example, in the a-c system you will find:

Aileron Trim Tab (Power):
Left
Right

The corresponding control circuit appears in the d-c system as:
Aileron Trim Tab (Control),
Left and Right

Normally, a-c power has d-c control. However, some equipment has d-c power with d-c control. Any equipment or circuit designation which does not contain either of the specified words, indicates a power circuit without a controlling relay.

EQUIPMENT OR CIRCUIT	LOCATION (PANEL NO.)	QUANTITY	SIZE (AMPERES)	DECAL NOMENCLATURE
A-C Phase Sequence Indicator Lights	31	3	10	"EXTERNAL POWER PHASE SEQUENCE INDICATOR FUSE"
Aileron Trim Tab (Power), Left	37	3	10	"AILERON TRIM TAB"
Aileron Trim Tab (Power), Right	42	3	10	"AILERON TRIM TAB"
Air Plug (Power)—Jet Engine #1	36	1	10	"#1 AIR SHUT-OFF DOORS"
Air Plug (Power)—Jet Engine #2	36	1	10	"#2 AIR SHUT-OFF DOORS"
Air Plug (Power)—Jet Engine #3	43	1	10	"#3 AIR SHUT-OFF DOORS"
Air Plug (Power)—Jet Engine #4	43	1	10	"#4 AIR SHUT-OFF DOORS"
Air Plug (Power)—Recip. Engine #1	37	3	10	"ENGINE AIR PLUG"
Air Plug (Power)—Recip. Engine #2	38	3	10	"ENGINE AIR PLUG"
Air Plug (Power)—Recip. Engine #3	39	3	10	"ENGINE AIR PLUG"
Air Plug (Power)—Recip. Engine #4	40	3	10	"ENGINE AIR PLUG"
Air Plug (Power)—Recip. Engine #5	41	3	10	"ENGINE AIR PLUG"
Air Plug (Power)—Recip. Engine #6	42	3	10	"ENGINE AIR PLUG"
Analyzer, Engine	46	1	† 5	"ENGINE ANALYZER"
(Some Airplanes)	27	1	10	"ENG ANAL"
(Some Airplanes)	28	1	10	"ENG ANAL"
(Some Airplanes)	38	1	10	"ENG ANALYZER"
(Some Airplanes)	41	1	10	"ENG ANALYZER"
Anti-icing Electric Heater (Power), Air Plugs—Jet Engines #1 & 2	36	3	30	"NOSE DOORS DE-ICE"
Anti-icing Electric Heater (Power), Air Plugs—Jet Engines #3 & 4	43	3	30	"NOSE DOORS DE-ICE"
Anti-icing, Tail, AND Cabin Heat	11	1	* 5	"ANTI-ICE TAIL AND CABIN HEAT"
Anti-icing, Wing	11	1	* 5	"ANTI-ICE WING IND."

Figure 1-30. Fuse and Circuit Breaker List (Sheet 5 of 24)

A-C SYSTEM EQUIPMENT FUSES AND CIRCUIT BREAKERS (Continued)

EQUIPMENT OR CIRCUIT	LOCATION (PANEL NO.)	QUANTITY	SIZE (AMPERES)	DECAL NOMENCLATURE
Autopilot Power, E6	3	1	20	"AUTOPILOT"
Brake Pump (Power)	See: "Hydraulic Pump Power, Brake"			
Cabin Heat—Thermal	See: "Anti-icing, Tail, AND Cabin Heat"			
Cabin Pressurization	11	1	* 5	"WING SHUT OFF VALVES"
Camera Door, Oblique—Left	25	1	10	"LFT. OBL. DOOR"
Camera Door, Oblique—Right	21	1	10	"R. OBL. DOOR"
Camera Door Power, Multi & Fwd Oblique	25	1	10	'MULTI & FWD. OBL. DR."
Camera Doors (Power), Split Vertical, & Vertical	21	1	10	"VERT. & SPLIT VERT. DR."
Camera Doors (Power), Trimetrogon—Left, Right, & Vertical	21	1	10	"TRI-MET DOORS"
Camera Magazine (Power)—A-14	22	1	* 5	"A-C POWER A-14"
Camera Mount—A-28	22	1	* 5	"A-C POWER A-28"
Camera Vacuum (Power)	27	3	10	"CAMERA VACUUM PUMP"
Carburetor Air Filter (Power)—Recip. Engines #1, 2, & 3	39	1	10	"CARB. AIR FLTR"
Carburetor Air Filter (Power)—Recip. Engines #4, 5, & 6	40	1	10	"CARB. AIR FLTR"
Carburetor Air Preheat (Power)—Recip. Engine #1	37	1	10	"CARB. PREHEAT"
Carburetor Air Preheat (Power)—Recip. Engine #2	38	1	10	"CARB. PREHEAT"
Carburetor Air Preheat (Power)—Recip. Engine #3	39	1	10	"CARB. PREHEAT"
Carburetor Air Preheat (Power)—Recip. Engine #4	40	1	10	"CARB. PREHEAT"
Carburetor Air Preheat (Power)—Recip. Engine #5	41	1	10	"CARB. PREHEAT"
Carburetor Air Preheat (Power)—Recip. Engine #6	42	1	10	"CARB. PREHEAT"
Compass, Slaved Gyro Magnetic	6	3	10	"GYROSYN COMP."
Control Surface Locks (Power)	27	3	10	"CONT. SURF. LOCK R.H. AIL. L.H. AIL. TAIL"
Fan, Camera Defroster—Aft	25	3	20	"AFT DEFROST FAN"
Fan, Camera Defroster—Fwd	25	3	20	"FWD. DEFROST FAN"
Fan Power Cabin Air Booster	27	6	40	"CABIN PRESSURE BOOSTER FAN"
Fans, Engine Cooling	11	1	* 5	"ENGINE FAN"
Flap (Power), Center—Left	38	3	20	"CENTER FLAPS"
Flap (Power), Center—Right	41	3	20	"CENTER FLAPS"
Flap (Power), Inboard—Left	39	3	20	"INBOARD FLAPS"

Figure 1-30. Fuse and Circuit Breaker List (Sheet 6 of 24)

A-C SYSTEM EQUIPMENT FUSES AND CIRCUIT BREAKERS (Continued)

EQUIPMENT OR CIRCUIT	LOCATION (PANEL NO.)	QUANTITY	SIZE (AMPERES)	DECAL NOMENCLATURE
Flap (Power), Inboard—Right	40	3	20	"INBOARD FLAPS"
Flap (Power), Outboard—Left	37	3	20	"OUTBOARD FLAPS"
Flap (Power), Outboard—Right	42	3	20	"OUTBOARD FLAPS"
Fuel Booster Pump (Power)—Auxiliary Tank—Left	28	3	10	"LEFT WING AUX. BOOST PUMP"
Fuel Booster Pump (Power)—Auxiliary Tank—Right	27	3	10	"RIGHT WING AUXIL. BOOST PUMP"
Fuel Booster Pump (Power)—Bomb Bay Tank	33	3	10	"BB #3 FUEL BOOST PUMP"
Fuel Booster Pump (Power)—Jet Engines #1 & 2	36	3	10	"FUEL PUMP"
Fuel Booster Pump (Power)—Jet Engines #3 & 4	43	3	10	"FUEL PUMP"
Fuel Booster Pump (Power)—Wing Tank #1	38	3	10	"FUEL BOOSTER PUMP"
Fuel Booster Pump (Power)—Wing Tank #2	39	3	10	"FUEL BOOSTER PUMP"
Fuel Booster Pump (Power)—Wing Tank #3	39	3	10	"FUEL BOOSTER PUMP"
Fuel Booster Pump (Power)—Wing Tank #4	40	3	10	"FUEL BOOSTER PUMP"
Fuel Booster Pump (Power)—Wing Tank #5	40	3	10	"FUEL BOOSTER PUMP"
Fuel Booster Pump (Power)—Wing Tank #6	41	3	10	"FUEL BOOSTER PUMP"
Fuel Mixture—Recip. Engines #1 2, 3, 4, 5, & 6	11	6	* 5	"ENGINE FUEL MIXTURE 1, 2, 3, 4, 5, & 6"
Gyro Indicators: 1. Type E-1 Vertical—Pilot's 2. Type C-5 Directional—Photo-Navigator's (Some Airplanes) 3. Gyro Horizon—Pilot's	6	3	10	"PILOTS FLIGHT INSTR."
Gyro Indicator, Type E-1 Vertical—Aft Cabin	34	3	10	"GYRO FLIGHT INST."
Gyro Indicators: 1. Type E-1 Vertical—Copilot's 2. Directional Gyro—Copilot's	3	3	10	"COPILOT'S FLIGHT INSTR."
Heater, Aft Cabin—Left	35	3	30	"CABIN HEAT"
Heater, Aft Cabin—Right	34	3	20	"CABIN HEAT"
Heater, Bomb Sight	9	1	30	"SERVO HEATER"
Heater, Camera Compartment	25	3	20	"COMPT. HEATER"
Heater, Photo-Navigator's	6	3	20	"CABIN HEAT"
Heater, Pitot Tube—Left (Some Airplanes)	12	1	† 5	"PITOT HEATER L.H."

Figure 1-30. Fuse and Circuit Breaker List (Sheet 7 of 24)

A-C SYSTEM EQUIPMENT FUSES AND CIRCUIT BREAKERS (Continued)

EQUIPMENT OR CIRCUIT	LOCATION (PANEL NO.)	QUANTITY	SIZE (AMPERES)	DECAL NOMENCLATURE
Heater, Pitot Tube—Right (Some Airplanes)	12	1	† 5	"PITOT HEATER R.H."
Heater, Radio Operator's	3	3	20	"CABIN HEAT"
Heater (Power), Oil Cell—Jet Engine #1	36	1	10	"OIL CELL HEATER #1"
Heater (Power), Oil Cell—Jet Engine #2	36	1	10	"OIL CELL HEATER #2"
Heater (Power), Oil Cell—Jet Engine #3	43	1	10	"OIL CELL HEATER #3"
Heater (Power), Oil Cell—Jet Engine #4	43	1	10	"OIL CELL HEATER #4"
Heater (Power), Oil Vent Line—Recip. Engine #1	37	1	10	"OIL VENT HEAT"
Heater (Power), Oil Vent Line—Recip. Engine #2	38	1	10	"OIL VENT HEAT"
Heater (Power), Oil Vent Line—Recip. Engine #3	39	1	10	"OIL VENT HEAT"
Heater (Power), Oil Vent Line—Recip. Engine #4	40	1	10	"OIL VENT HEAT"
Heater (Power), Oil Vent Line—Recip. Engine #5	41	1	10	"OIL VENT HEAT"
Heater (Power), Oil Vent Line—Recip. Engine #6	42	1	10	"OIL VENT HEAT"
Heating, Camera Compartment—Thermal	21	1	10	"TEMP. CONTROL VALVE"
Hot Cup Receptacle, Aft Cabin	34	1	20	"HOT CUPS"
Hot Cup Receptacle, Camera Compartment	21	1	20	"HOT CUP RECP."
Hot Cup Receptacle, Fwd Cabin	3	1	20	"HOT CUPS"
Humidity-Temperature Measuring Set AM/706/U (Some Airplanes)	52	1	* 5	
Hydraulic Pump (Power)—Brake (Early Airplanes)	27	3	40	"BRAKE PUMP"
Hydraulic Pump (Power)—Brake (Late Airplanes)	28	6	60	"BRAKE PUMP"
Hydraulic Pump (Power), #1	27	6	60	"HYDRO PUMP MOTOR"
Hydraulic Pump (Power), #2	28	6	60	"HYDRO PUMP MOTOR #2"
Ignition (Power)—Jet Engine #1 (J47-19)	36	1	10	"#1 IGN."
Ignition (Power)—Jet Engine #2 (J47-19)	36	1	10	"#2 IGN."
Ignition (Power)—Jet Engine #3 (J47-19)	43	1	10	"#3 IGN."
Ignition (Power)—Jet Engine #4 (J47-19)	43	1	10	"#4 IGN."

Figure 1-30. Fuse and Circuit Breaker List (Sheet 8 of 24)

A-C SYSTEM EQUIPMENT FUSES AND CIRCUIT BREAKERS (Continued)

EQUIPMENT OR CIRCUIT	LOCATION (PANEL NO.)	QUANTITY	SIZE (AMPERES)	DECAL NOMENCLATURE
Instruments, Reciprocating Eng. (Some Airplanes) Cylinder Head Temp Amplifier	47	6	1	"ENGINE CHT AMPLIFIER 1, 2, 3, 4, 5, & 6"
Selsyn	47	6	5	"ENGINE SELSYN INSTRUMENTS 1, 2, 3, 4, 5, & 6"
Indicator Hydraulic Pressure (Some Airplanes)	27	1	10	"HYD PRESS"
Instruments, Turbo Jet Engine (Some Airplanes)	31	2	1	"FUEL PRESS TRANS NO. 1 & NO. 2 JET"
	31	2	1	"OIL PRESS TRANS NO. 1 & NO. 2 JET"
	31	2	1	"FUEL PRESS & OIL PRESS IND NO. 1 & NO. 2 JET"
	31	2	1	"JET FUEL FLOW ENG 1 & 2"
	38	2	1	"FUEL PRESS TRANS NO. 3 & NO. 4 JET"
	38	2	1	"OIL PRESS TRANS NO. 3 & NO. 4 JET"
	38	2	1	"FUEL PRESS & OIL PRESS IND NO. 3 & NO. 4 JET"
	38	2	1	"JET FUEL FLOW ENG 3 & 4"
Intercoolers Close (Power)—Recip Engine #1	37	1	10	"INTR COOL CLOSE"
Intercoolers Open (Power)—Recip Engine #1	37	1	10	"INTR COOL OPEN"
Intercoolers Close (Power)—Recip Engine #2	38	1	10	"INTR COOL CLOSE"
Intercoolers Open (Power)—Recip Engine #2	38	1	10	"INTR COOL OPEN"
Intercoolers Close (Power)—Recip Engine #3	39	1	10	"INTR COOL CLOSE"
Intercoolers Open (Power)—Recip Engine #3	39	1	10	"INTR COOL OPEN"
Intercoolers Close (Power)—Recip Engine #4	40	1	10	"INTR COOL CLOSE"
Intercoolers Open (Power)—Recip Engine #4	40	1	10	"INTR COOL OPEN"
Intercoolers Close (Power)—Recip Engine #5	41	1	10	"INTR COOL CLOSE"
Intercoolers Open (Power)—Recip Engine #5	41	1	10	"INTR COOL OPEN"
Intercoolers Close (Power)—Recip Engine #6	42	1	10	"INTR COOL CLOSE"
Intercoolers Open (Power)—Recip Engine #6	42	1	10	"INTR COOL OPEN"
Jet Pod Preheat	7	1	* 5	"POD PREHEAT POWER"

Figure 1-30. Fuse and Circuit Breaker List (Sheet 9 of 24)

A-C SYSTEM EQUIPMENT FUSES AND CIRCUIT BREAKERS (Continued)

EQUIPMENT OR CIRCUIT	LOCATION (PANEL NO.)	QUANTITY	SIZE (AMPERES)	DECAL NOMENCLATURE
Lights: 1. Cockpit—Copilot's 2. Inter-Aircraft Signal—Pilot's	5	1	*10	"LIGHTS COCKPIT"
Lights: 1. Cockpit—Pilot's 2. Compass—B-16 Magnetic (Some Airplanes) 3. Dome—Hatch	5	1	* 5	"LIGHTS COCKPIT"
Lights: 1. Communication Tube 2. Dome—Aft Cabin	34	1	* 5	"DOME LIGHTS"
Lights: 1. Communication Tube 2. Dome—Camera Compartment 3. Dome—Camera Well 4. Fwd Turret Power Panels	24	1	*10	"LIGHTS CAMERA COMPARTMENT DOME"
Lights: (Some Airplanes)				
Engr's Lighting Transformer	3	1	10	"ENGR'S LIGHTING TRANS"
Engr's Lighting Panel Engr's Auxiliary Panel	48	1	5	"RED LIGHTS"
Engr's Lighting Panel Engr's Auxiliary Panel	48	1	5	"WHITE LIGHTS"
Jet Instrument Panel Pilot's & Copilot's Inst Panel B-16 Magnetic Compass	48	1	5	"FLOOD LIGHTS"
Jet Control Panel Periscope Sextant	7	1	* 5	"PANEL LIGHTS"
Lights, Cockpit: 1. Camera Well 2. Photographer's	24	1	*10	"LIGHTS CAMERA COMPARTMENT COCKPIT"
Lights, Cockpit: 1. Gunners', Aft 2. Gunner's, Tail	34	4	* 5	"GUNNERS' LIGHTS"
Lights, Cockpit: 1. Gunner's, Fwd 2. Radio Operator's	17	1	* 5	"A-C 28 V COCKPIT LIGHTS"
Light, Cockpit—Nose Gunner's	1	1	* 5	"COCKPIT LIGHT NOSE GUNNER"
Light, Communication Tube	17	1	† 5	"TUBE LIGHT"
Lights, Cockpit—Photo-Navigator's	4	1	* 5	"COCKPIT LIGHTS"
Lights, Cockpit—Sub-Flight Deck	17	1	† 5	"SUB. FLT. DECK LT."
Lights, Cockpit & Dome: 1. Copilot's 2. Engineer's	9	1	10	"ENGR'S DOME LIGHTS"
Lights, Cockpit & Fluorescent—Pilots' (Some Airplanes)	3	1	10	"PILOTS' LTS."
Lights, Cockpit & Table—Radar Observer's	1	1	* 5	"COCKPIT LIGHTS RADAR OPERATOR'S"

Figure 1-30. Fuse and Circuit Breaker List (Sheet 10 of 24)

A-C SYSTEM EQUIPMENT FUSES AND CIRCUIT BREAKERS (Continued)

EQUIPMENT OR CIRCUIT	LOCATION (PANEL NO.)	QUANTITY	SIZE (AMPERES)	DECAL NOMENCLATURE
Lights, Dome (Power): 1. Aft Turret Bay 2. Bomb Bay #4	29	1	*10	"BB & AFT TURRET LIGHTS"
Lights, Flight Deck Flood: 1. Copilot's Red & White 2. Engineer's Red & White 3. Pilot's Red & White	9	1	10	"FLT. DK. FLOOD LIGHTS"
Lights, Dome—Bomb Bay #2 & 3	29	1	*10	"BOMB BAY 2 & 3 LIGHTS"
Lights, Dome—Fwd Turret Bay	24	1	*10	"LIGHTS FWD. TURRET DOME"
Lights, Dome—Radio Compartment	17	1	† 5	"DOME LIGHT"
Lights, Dome—Tail Cone	34	1	* 5	"TAIL CONE DOME LIGHTS"
Lights, ECM Operator's	34	1	* 5	"ECM LIGHTS"
Lights, Fluorescent—Engineer's (Some Airplanes)	12	1	† 5	"FLUOR. LIGHTS"
Light, Fluorescent—Photo-Navigator's	4	1	* 5	"FLUOR. LIGHT"
Lights, Formation Wing Tip & Tail (White)	5	1	* 5	"LIGHTS FORM."
Lights, Indicator—Bomb Station	6	1	10	"BOMB STA. IND. LTS."
Light, Landing—Filament Power—Left	9	1	30	"L.H. LAND LIGHT"
Light, Landing—Filament Power—Right	9	1	30	"R.H. LAND LIGHT"
Lights, Position—Tail & Wing	9	1	10	"WING TIP LIGHTS"
Light, Table—Photo-Navigator's	4	1	* 5	"TABLE LIGHT"
Loran Set, AN/APN-9A	6	1	10	"LORAN REC'V'R."
Meter, Frequency & Voltage:				
1. Alternator #2	28	2	10	"A-C INST."
2. Alternator #3	28	2	10	"A-C INST."
3. Alternator #4	27	2	10	"A-C INST."
4. Alternator #5	27	2	10	"A-C INST."
Meter, Kilowatt & Kilovar—Alternator #2	38	3	10	"A-C INST."
Meter, Kilowatt & Kilovar—Alternator #3	39	3	10	"A-C INST."
Meter, Kilowatt & Kilovar—Alternator #4	40	3	10	"A-C INST."
Meter, Kilowatt & Kilovar—Alternator #5	41	3	10	"A-C INST."
Oil Cooler (Power)—Recip Engine #1	37	1	10	"ENG. OIL COOL"
Oil Cooler (Power)—Recip Engine #2	38	1	10	"ENG. OIL COOL"
Oil Cooler (Power)—Recip Engine #3	39	1	10	"ENG. OIL COOL"
Oil Cooler (Power)—Recip Engine #4	40	1	10	"ENG. OIL COOL"
Oil Cooler (Power)—Recip Engine #5	41	1	10	"ENG. OIL COOL"
Oil Cooler (Power)—Recip Engine #6	42	1	10	"ENG. OIL COOL"

Figure 1-30. Fuse and Circuit Breaker List (Sheet 11 of 24)

A-C SYSTEM EQUIPMENT FUSES AND CIRCUIT BREAKERS (Continued)

EQUIPMENT OR CIRCUIT	LOCATION (PANEL NO.)	QUANTITY	SIZE (AMPERES)	DECAL NOMENCLATURE
Oil Cooler Door Override (Power) (Some Airplanes)	46	1	* 5	"OIL COOLER"
Oil Shut-off Valves—Jet Engines #1, 2, 3, & 4	7	4	* 5	"OIL SHUT-OFF VALVE POWER ENG. 1, 2, 3, & 4"
Oil Shut-off-Valves—Recip. Engines #1, 2, 3, 4, 5, & 6	11	6	* 5	"ENGINE OIL SHUT-OFF VALVES 1, 2, 3, 4, 5, & 6"

NOTE

Either one of the following groups of RCM equipment may be installed in the aircraft.

EQUIPMENT OR CIRCUIT	LOCATION (PANEL NO.)	QUANTITY	SIZE (AMPERES)	DECAL NOMENCLATURE
Radar Countermeasures Equipment, Airplanes not in Group 4:				
Group I:				
AN/ALA-2, or AN/APA-38	16	1	10	"RACK POSIT. #5A"
AN/APR-4	16	1	10	"RACK POSIT. #2"
AN/APT-4—Rack Position #3, 4, 8	16	1	20	"RACK POSIT. #4"
AN/APT-4—Rack Position #1, 5, 7	16	1	20	"RACK POSIT. #5"
Group II:				
AN/ALA-2, or AN/ALA-38	16	1	10	"RACK POSIT. #5A"
AN/APR-4	16	1	10	"RACK POSIT. #2"
AN/APT-1—Rack Position #4, 6A	16	1	20	"RACK POSIT. #4"
AN/APT-5A—Rack Position #1, 3A	16	1	10	"RACK POSIT. #1"
AN/ARQ-8—Rack Position #5, 6B	16	1	20	"RACK POSIT. #5"
Group 4 Airplanes:				
Group I:				
AN/ART-4	16	1	10	"RACK POSIT. #2"
AN/ART-4	16	1	20	"RACK POSIT. #4"
IP-69/ALA-2	16	1	10	"RACK POSIT. #5A"
Group II:				
AN/ART-6	16	1	10	"RACK POSIT. #1"
AN/ALA-2	16	1	10	"RACK POSIT. #5A"
AN/APR-4	16	1	10	"RACK POSIT. #2"
AN/APR-4	16	1	20	"RACK POSIT. #4"
Group III:				
AN/APR-9	16	1	10	"RACK POSIT. #1"
AN/APR-4	16	1	10	"RACK POSIT. #2"
IP-69/ALA-2	16	1	10	"RACK POSIT. #5A"
AN/APR-9	16	1	20	"RACK POSIT. #5"
AN/APT-4	16	1	20	"RACK POSIT. #4"
Radar Pressurization, AN/APG-3 or APG-32	34	1	10	"RADAR PRESS. PUMP"
Radar Pressurization, ID-218/APS-23	3	1	10	"RADAR PUMP"
Radar Set, AN/APQ-24—Filter	6	1	20	"BOMB'G RADAR"
Radar Set, AN/APQ-24—Junction Box	6	1	10	"RADAR COMPUTER"
Radar Set, AN/APX-6	6	1	10	"APX-6 IFF"
Radio Altimeter (Some Airplanes) SCR-718-D	52	1	* 5	
AN/APQ-24 Blower "A & B" (Some Airplanes)	3	3	20	"APQ-24 BLOWER"

Figure 1-30. Fuse and Circuit Breaker List (Sheet 12 of 24)

A-C SYSTEM EQUIPMENT FUSES AND CIRCUIT BREAKERS (Continued)

EQUIPMENT OR CIRCUIT	LOCATION (PANEL NO.)	QUANTITY	SIZE (AMPERES)	DECAL NOMENCLATURE
Radio Compass, AN/ARN-7 (Some Airplanes)	6	1	10	"RADIO COMPASS"
Radio Compass, AN/ARN-7 (Some Airplanes)	6	1	10	"COMPASS C-1 AMPLIFIER"
Spark Advance—Recip Engines #1, 2, 3, 4, 5, & 6	11	6	* 5	"ENGINE SPARK ADVANCE 1, 2, 3, 4, 5, & 6"
Special Bombing System				
Transformer FCT Junction Box	6	1	10	"SPECIAL BOMBING"
Heater Transformer	28	1	10	"SPECIAL BOMBING"
Starter Power—Jet Engines #1, 2, 3, & 4 (Connected Direct to Bus Bars —No Fuses)				
Starter Power—Recip Engine #1	37	3	60	"STARTER"
Starter Power—Recip Engine #2	38	3	60	"STARTER"
Starter Power—Recip Engine #3	39	3	60	"STARTER"
Starter Power—Recip Engine #4	40	3	60	"STARTER"
Starter Power—Recip Engine #5	41	3	60	"STARTER"
Starter Power—Recip Engine #6	42	3	60	"STARTER"
Throttle System—Jet Engines #1, 2, 3, & 4	7	4	* 5	"THROTTLE CONTROL POWER 1, 2, 3, & 4"
Transformer, Autosyn—Jet Engine #1	36	1	10	"#1 AUT. TRANS."
Transformer, Autosyn—Jet Engine #2	36	1	10	"#2 AUT. TRANS."
Transformer, Autosyn—Jet Engine #3	43	1	10	"#3 AUT. TRANS."
Transformer, Autosyn—Jet Engine #4	43	1	10	"#4 AUT. TRANS."
Transformer, Autosyn—Recip Engine #1 (Some Airplanes)	37	1	10	"ATOSN. TRANS."
Transformer, Autosyn—Recip Engine #2 (Some Airplanes)	38	1	10	"ATOSN. TRANS."
Transformer, Autosyn—Recip Engine #3 (Some Airplanes)	39	1	10	"ATOSN. TRANS."
Transformer, Autosyn—Recip Engine #4 (Some Airplanes)	40	1	10	"ATOSN. TRANS."
Transformer, Autosyn—Recip Engine #5 (Some Airplanes)	41	1	10	"ATOSN. TRANS."
Transformer, Autosyn—Recip Engine #6 (Some Airplanes)	42	1	10	"ATOSN. TRANS."
Turbosupercharger Regulator—Recip Engines #1, 2, 3, 4, 5, & 6	14	6	10	"ENGINE 1, 2, 3, 4, 5, & 6 TURBO"
Turbosupercharger Override (Control) Engines 1, 2, 3, 4, 5, & 6	11	1	5	"TURBO BOOST OVERRIDE CONTROL"
Turbosupercharger Selector—Recip Engines #1, 2, 3, 4, 5, & 6	11	6	* 5	"ENGINE SUPERCHARGER SELECTION 1, 2, 3, 4, 5, & 6"
Turret Control, Tail	34	1	10	"TAIL TUR."

Figure 1-30. Fuse and Circuit Breaker List (Sheet 13 of 24)

A-C SYSTEM EQUIPMENT FUSES AND CIRCUIT BREAKERS (Continued)

EQUIPMENT OR CIRCUIT	LOCATION (PANEL NO.)	QUANTITY	SIZE (AMPERES)	DECAL NOMENCLATURE
Turret Door, Aft Lower	33	3	10	"LOWER TURRET DOOR MOTOR"
Turret Door, Aft Upper	32	3	10	"UPPER TURRET DOOR MOTOR"
Turret Door, Fwd Upper—Left	25	3	10	"UPPER LH TURRET DOOR MOTOR"
Turret Door, Fwd Upper—Right	21	3	10	"UPPER RH TURRET DOOR MOTOR"
Turret Radar Set, APG-3 or APG-32—Tail	34	1	40	"TAIL RADAR"
Turret (Power), Tail	34	3	40	"TAIL TURRET POWER"
Voltage Regulator—Alternator #2	38	3	10	"AC PWR. EQUIP."
Voltage Regulator—Alternator #3	39	3	10	"AC PWR. EQUIP."
Voltage Regulator—Alternator #4	40	3	10	"AC PWR. EQUIP."
Voltage Regulator—Alternator #5	41	3	10	"AC PWR. EQUIP."
Water Injection (Power)—Recip Engine #1	37	3	10	"WATER INJECTION PUMP"
Water Injection (Power)—Recip Engine #2	38	3	10	"WATER INJECTION PUMP"
Water Injection (Power)—Recip Engine #3	39	3	10	"WATER INJECTION PUMP"
Water Injection (Power)—Recip Engine #4	40	3	10	"WATER INJECTION PUMP"
Water Injection (Power)—Recip Engine #5	41	3	10	"WATER INJECTION PUMP"
Water Injection (Power)—Recip Engine #6	42	3	10	"WATER INJECTION PUMP"
Windshield Wiper (Power), Photo-Navigator's AND Fan, Ventilating —Fwd Cabin	6	3	10	"CABIN V. FAN & PHOTO-NAV. W. S. WIPER"
Windshield Wiper (Power), Pilots'	3	3	10	"COPILOT'S WINDSHIELD WIPER"

D-C SYSTEM EQUIPMENT FUSES AND CIRCUIT BREAKERS

*PUSH-PULL TYPE CIRCUIT BREAKER
†SWITCH TYPE CIRCUIT BREAKER

EQUIPMENT OR CIRCUIT	LOCATION (PANEL NO.)	QUANTITY	SIZE (AMPERES)	DECAL NOMENCLATURE
Aileron Trim Tab (Control)—Left & Right	5	1	* 5	"TABS AILERON"
Aileron Trim Tab Position Transmitter —Left	37	1	10	"AIL. TAB"
Aileron Trim Tab Position Transmitter —Right	42	1	10	"AILERON TRIM TAB"
Air Plug (Control)—Jet Engines #1, 2, 3, & 4	7	1	* 5	"AIR PLUG POWER"

Figure 1-30. Fuse and Circuit Breaker List (Sheet 14 of 24)

D-C SYSTEM EQUIPMENT FUSES AND CIRCUIT BREAKERS (Continued)

EQUIPMENT OR CIRCUIT	LOCATION (PANEL NO.)	QUANTITY	SIZE (AMPERES)	DECAL NOMENCLATURE
Air Plug (Control)—Recip Engines #1, 2, 3, 4, 5, & 6	15	6	* 5	"ENGINE AIR PLUG CONTROLS 1, 2, 3, 4, 5, & 6"
Alarm Bell	5	1	* 5	"ALARM BELL"
Alternator Exciter Relay, #2	38	1	10	"ALT. CONT."
Alternator Exciter Relay, #3	39	1	10	"ALT. CONT."
Alternator Exciter Relay, #4	40	1	10	"ALT. CONT."
Alternator Exciter Relay, #5	41	1	10	"ALT. CONT."
Alternator Field Flash (Some Airplanes)	12	1	† 5	"ALT. FIELD FLASH"
Alternator Field Flash (Some Airplanes)	15	1	* 5	"ALT. FIELD FLASH"
Anti-icing Duct High Temperature Indicator Lights	11	1	* 5	"ANTI-ICE HEAT DUCT TEMP."
Anti-icing Electric Heaters (Control) AND Anti-icing Thermal Valves (Control)—Jet Engines #1, 2, 3, & 4	7	1	† 5	"NOSE DE-ICE"
Anti-icing Heat Duct Air Temp Indicators, R. Wing Inbd , R. Wing outbd. (Some Airplanes)	12	2	* 5	"ANTI-ICING TEMPERATURE INDICATOR RH WING"
Anti-icing Heat Duct Air Temp Indicator, Tail (Some Airplanes)	12	1	* 5	"ANTI-ICING TEMPERATURE INDICATOR TAIL"
Anti-icing Heat Duct Air Temp Indicators, L. Wing Inbd , L. Wing Outbd (Some Airplanes)	12	2	* 5	"ANTI-ICING TEMPERATURE INDICATOR LH"
Anti-icing Thermal Valve (Power), Jet Pod—Left	36	1	10	"POD DE-ICE"
Anti-icing Thermal Valve (Power), Jet Pod—Right	43	1	10	"POD DE-ICE"
Autopilot (Control), E6	5	1	*10	"AUTOPILOT"
Bomb Bay Doors (Control), Pilots'	5	1	* 5	"BOMB DOORS"
Bomb Bay Doors (Control), Photo-Navigator's	4	1	* 5	"BOMB BAY DOOR"
Bomb Master Switch	2	1	†25	"MASTER POWER"
Bomb Rack Junction Box, Pneumatic Fwd Bomb Bay	26	1	†25	"PNEUMATIC BOMB RACK JUNCTION BOX"
Bomb Rack Selector	30	1	† 5	"NORMAL BOMB RELEASE"
Bomb Release (Control), Normal	4	1	* 5	"BOMB SIGHT STAB."
Bomb Release (Power), Normal	4	1	*10	"NORMAL RELEASE"
Bomb Salvo (Control), Pilot's	5	1	10	"BOMB SALVO"
Bomb Salvo (Control), Photo-Navigator's	4	1	*10	"BOMB SALVO"
Bomb Salvo (Control), Radio Operator's (Some Airplanes)	17	1	*10	"BOMB SALVO"
Bomb Salvo (Power)	26	1	†25	"BOMB SALVO"

Figure 1-30. Fuse and Circuit Breaker List (Sheet 15 of 24)

D-C SYSTEM EQUIPMENT FUSES AND CIRCUIT BREAKERS (Continued)

EQUIPMENT OR CIRCUIT	LOCATION (PANEL NO.)	QUANTITY	SIZE (AMPERES)	DECAL NOMENCLATURE
Bomb Salvo (Power)	30	1	†25	"SALVO POWER RELAY"
Bomb Sight Directional Stabilizer (Power)	4	1	* 5	"STAB. POWER"
Brake Pump (Control)	See: "Hydraulic Pump Control, Brake"			
Bus Tie Breakers	11	1	* 5	"BUS-TIE BREAKERS CONTROL"
Cabin Air Duct Temperature Indicator	11	1	* 5	"CABIN DUCT TEMP."
Camera (Control), K-38 or K-40—L-20°, L-40°, R-20°, R-40°, & Vertical—Photographer's	22	1	* 5	"MULTI- K-38 & K-40 CONT"
Camera (Control), K-38 or K-40—L-20°, L-40°, R-20°, R-40°, & Vertical—Photo-Navigator's	4	1	* 5	"CAMERAS MULTI"
Camera (Control), Split Vertical—Left & Right—Photographer's	22	1	*10	"SPLIT VERTICAL CONT."
Camera (Control), Split Vertical—Left & Right—Photo-Navigator's	4	1	* 5	"CAMERAS SPLIT VERTICAL"
Camera (Control), Trimetrogon—Left, Right, & Vertical—Photographer's	22	1	* 5	"TRIMETROGON CONT."
Camera (Control), Trimetrogon—Left, Right, & Vertical—Photo-Navigator's	4	1	* 5	"CAMERAS TRIMET"
Camera Magazine (Control)—A-14	22	1	*25	"A-14 CONT."
Camera Defroster—Emergency	22	1	* 5	"DEFROST"
Camera Doors (Control), Multi & Fwd Oblique	22	1	* 5	"DOORS FWD. OBLIQUE MULTI"
Camera Doors (Control), Split Vertical & Vertical	22	1	* 5	"DOORS SPLIT VERT. VERT."
Camera Doors (Control), Trimetrogon—Left, Right, & Vertical	22	1	* 5	"TRIMETROGON IND. LIGHTS DOORS"
Camera Doors (Control), Trimetrogon ECM—Left, Right, & Vertical	22	1	* 5	"ECM TRI-MET IND. LIGHTS DOORS"
Camera Indicator Lights, K-38 or K-40	22	1	* 5	"MULTI K-38 & K-40 IND. LIGHTS"
Camera Initiation, K-38 or K-40—L-20°, L-40°, R-20°, R-40°, & Vertical	22	1	*10	'MULTI K-38 & K-40 INIT"
Camera Initiation, O-15 (Airplanes Not in Group I)	1	1	*10	"O-15 RADAR CAMERA CONTROL"
Camera Initiation, O-15 (Airplanes Not in Group I)	4	1	*10	"CAMERAS RADAR CAMERA"
Camera Initiation, O-15 (Airplanes Not in Group I)	17	1	*10	"RADAR CAMERA"
Camera Initiation, O-15 (Airplanes Not in Group I)	44	1	*10	"O-15 CAMERA"
Camera Initiation, O-15 (Airplanes Not in Group I)	44	1	*10	"O-15 CAMERA"
Camera Initiation, O-15 (Airplanes Not in Group I)	45	1	*10	"O-15 CAMERA"

Figure 1-30. Fuse and Circuit Breaker List (Sheet 16 of 24)

D-C SYSTEM EQUIPMENT FUSES AND CIRCUIT BREAKERS (Continued)

EQUIPMENT OR CIRCUIT	LOCATION (PANEL NO.)	QUANTITY	SIZE (AMPERES)	DECAL NOMENCLATURE
Camera Initiation, Oblique—Fwd—Photographer	22	1	*10	"OBLIQUE FWD. POWER"
Camera Initiation, Oblique—Fwd—Photo-Navigator	4	1	* 5	"CAMERAS OBLIQUE"
Camera Initiation, Oblique—Left	22	1	*10	"OBLIQUE LEFT POWER"
Camera Initiation, Oblique—Right	22	1	*10	"OBLIQUE RIGHT POWER"
Camera Initiation, Trimetrogon—Left, Right, & Vertical	22	1	* 5	"TRIMETROGON INIT"
Camera Initiation, Vertical—Photographer's	22	1	*10	"VERT. CONTROL"
Camera Initiation, Vertical—Photo-Navigator's	4	1	* 5	"CAMERAS VERTICAL"
Camera Junction Box, Trimetrogon ECM	22	1	*25	"ECM TRI-MET POWER"
Camera (Power), K-38—L-20°	22	1	*10	"MULTI K-38 L-20 POWER"
Camera (Power), K-38—L-40°	22	1	*10	"MULTI K-38 L-40 POWER"
Camera (Power), K-38—R-20°	22	1	*10	"MULTI K-38 R-20 POWER"
Camera (Power), K-38—R-40°	22	1	*10	"MULTI K-38 R-40 POWER"
Camera (Power), K-38—Vertical	22	1	*10	"MULTI K-38 VERT. POWER"
Camera (Power), K-40—L-20°, L-40°, R-20°, R-40°, & Vertical	22	1	*25	"MULTI K-40 POWER"
Camera (Power), Split Vertical—Left	22	1	*10	"SPLIT VERTICAL LEFT POWER"
Camera (Power), Split Vertical—Right	22	1	*10	"SPLIT VERTICAL RIGHT POWER"
Camera (Power), Trimetrogon—Left	22	1	*10	"TRIMETROGON LEFT POWER"
Camera (Power), Trimetrogon—Right	22	1	*10	"TRIMETROGON RIGHT POWER"
Camera (Power), Trimetrogon—Vertical	22	1	*10	"TRIMETROGON VERT. POWER"
Camera Vacuum (Control)	22	1	* 5	"VACUUM"
Carburetor Air Filter (Control)	12	1	† 5	"CARB. AIR FILTER"
Carburetor Air Preheat (Controls)—Recip Engine #1, 2, 3, 4, 5, & 6	11	6	* 5	"CARBURETOR PRE-HEAT 1, 2, 3, 4, 5, & 6"
Carburetor Air Temperature Indicator—(Some Airplanes) Recip Engines #1 & 2	11	1	* 5	"TEMPERATURE INDICATORS CARBURETOR AIR 1 & 2"
Carburetor Air Temperature Indicator—(Some Airplanes) Recip Engines #3 & 4	11	1	* 5	"TEMPERATURE INDICATORS CARBURETOR AIR 3 & 4"
Carburetor Air Temperature Indicator—(Some Airplanes) Recip Engines #5 & 6	11	1	* 5	"TEMPERATURE INDICATORS CARBURETOR AIR 5 & 6"
Carburetor Air Temperature Indicators—(Some Airplanes) Recip Engines #1, 2, 3, 4, 5, & 6	11	6	* 5	"TEMPERATURE INDICATORS CARBURETOR AIR 1, 2, 3, 4, 5, & 6

Figure 1-30. Fuse and Circuit Breaker List (Sheet 17 of 24)

D-C SYSTEM EQUIPMENT FUSES AND CIRCUIT BREAKERS (Continued)

EQUIPMENT OR CIRCUIT	LOCATION (PANEL NO.)	QUANTITY	SIZE (AMPERES)	DECAL NOMENCLATURE
Chaff Dispenser				
Left	34	1	*15	"CHAFF DISPENSER LH"
Right	34	1	*15	"CHAFF DISPENSER RH"
Compass, N-1 Gyro Magnetic	4	1	* 5	"GYROSYN COMPASS"
Control Surface Locks Control	5	1	* 5	"CONTROL SURFACE LOCKS"
Cylinder Head Temperature Indicator (Some Airplanes)	11	1	* 5	"ENGINE TEMP. IND."
Fan (Control), Cabin Air Booster	11	1	* 5	"BOOST FAN"
Fan, Ventilating—Copilot's	3	1	20	"COPILOT'S FAN"
Fan, Ventilating—Pilot's	6	1	20	"PILOT'S FAN"
Fire Detection—Jet Engines #1, 2, 3, & 4	7	1	* 5	"FIRE DETECT POWER"
Fire Detection—Recip Engine #1	37	1	10	"FIRE DETECT"
Fire Detection—Recip Engine #2	38	1	10	"FIRE DETECT"
Fire Detection—Recip Engine #3	39	1	10	"FIRE DETECT"
Fire Detection—Recip Engine #4	40	1	10	"FIRE DETECT"
Fire Detection—Recip Engine #5	41	1	10	"FIRE DETECT"
Fire Detection—Recip Engine #6	42	1	10	"FIRE DETECT"
Fire Detection System (Some Airplanes)	11	1	*10	"FIRE DETECT"
Fire Extinguisher System	11	1	*15	"FIRE EXT."
Flap Control, Center—Left & Right	5	1	* 5	"FLAPS CENTER"
Flap Control, Inboard—Left & Right	5	1	* 5	"FLAPS INB'D."
Flap Control, Outboard—Left & Right	5	1	* 5	"FLAPS OUTB'D."
Flap Control, Normal & Alternate	30	1	† 5	"ALTER. FLAP CONTROL"
Flap Position Indicator	5	1	* 5	"FLAP POSITION IND."
Flap Position Transmitter, Center, Inboard, & Outboard	30	1	† 5	"FLAP TRANS."
Fuel Booster Pump Control Bomb Bay Tank	12	1	† 5	"BB TANK"
Fuel Booster Pump Control—Jet Engines #1 & 2	7	1	† 5	"L. FUEL PUMP"
Fuel Booster Pump Control—Jet Engines #3 & 4	7	1	† 5	"R. FUEL PUMP"
Fuel Booster Pumps Control, Auxiliary Tanks—Left & Right	12	2	† 5	"TANKS L. & R. AUX. BOOSTER"
Fuel Booster Pumps Control—Wing Tanks #1, 2, 3, 4, 5, & 6	12	6	† 5	"TANKS 1, 2, 3, 4, 5, & 6 BOOSTER"
Fuel Level Indicator, Bomb Bay Tank	11	1	* 5	"FUEL TANK LEVEL INDICATORS BOMB BAY"
Fuel Level Indicators, Auxiliary Tanks —Left & Right	11	1	* 5	"FUEL TANK LEVEL INDICATORS L. & R. AUX."

Figure 1-30. Fuse and Circuit Breaker List (Sheet 18 of 24)

D-C SYSTEM EQUIPMENT FUSES AND CIRCUIT BREAKERS (Continued)

EQUIPMENT OR CIRCUIT	LOCATION (PANEL NO.)	QUANTITY	SIZE (AMPERES)	DECAL NOMENCLATURE
Fuel Level Indicators—Wing Tanks #1 & 6	11	1	* 5	"FUEL TANK LEVEL INDICATORS 1 & 6"
Fuel Level Indicators—Wing Tanks #2 & 5	11	1	* 5	"FUEL TANK LEVEL INDICATORS 2 & 5"
Fuel Level Indicators—Wing Tanks #3 & 4	11	1	* 5	"FUEL TANK LEVEL INDICATORS 3 & 4"
Fuel Tank, Bomb Bay: Pressure Refueling Valve Tank Valve	12	1	* 5	"BB TANK VALVE POWER"
Fuel Tanks, Auxiliary—Left & Right: Pressure Refueling Valves (2) Tank Valves (2)	12	2	* 5	"L. & R. AUX. TANK VALVE POWER"
Fuel Tanks, Wing—#1, 2, 3, 4, 5, & 6 Pressure Refueling Valves (6) Tank Valves (6)	12	6	* 5	"1, 2, 3, 4, 5, & 6 TANK VALVE POWER"
Fuel Valve, Cross-feed	12	1	* 5	"CROSS FEED MANIFOLD VALUE POWER"
Fuel Valve, Manifold—Jet Engines #1 & 2	7	1	* 5	"FUEL VALVE POWER LEFT MANI-FOLD"
Fuel Valve, Manifold—Jet Engines #3 & 4	7	1	* 5	"FUEL VALVE POWER RIGHT MANI-FOLD"
Fuel Valves—Jet Engines #1, 2, 3, & 4	7	4	* 5	"FUEL VALVE POWER ENG. 1, 2, 3, & 4"
Fuel Valves, Manifold—#1, 2, 3, 4, 5, 6, 7, & 8	12	8	* 5	"FUEL MANIFOLD VALVE POWER 1, 2, 3, 4, 5, 6, 7, & 8"
Fuel Valves, Recip Engines, AND Oil Cooler (Control) (Flight Cooling)—Recip. Engines #1, 2, 3, 4, 5, & 6	12	6	* 5	"ENGINE VALVE POWER 1, 2, 3, 4, 5, & 6"
Gyro Indicator, Vertical—Pilot's	6	1	10	"GYRO HORIZON"
Heaters (Control), Oil Cell—Jet Engines #1, 2, 3, & 4	7	1	† 5	"OIL HEAT"
Heaters (Control), Oil Vent Line—Recip Engines #1, 2, 3, 4, 5, & 6	12	1	† 5	"OIL VENT HEAT"
Heater, Pitot Tube (Some Airplanes)				
Left	12	1	† 5	"PITOT TUBE HEATER L.H."
Right	12	1	† 5	"PITOT TUBE HEATER R.H."
Heaters Master Switch, Cabin (Some Airplanes)	13	1	† 5	"HEATER POWER"
Heating (Control), Camera Compartment	23	1	* 5	"CAMERA COMPT. HEAT"
Horn, Alert	4	1	* 5	"CAMERAS ALERT"
Humidity-Temperature Measuring Set ML-454/AMQ-7 (Some Airplanes)	52	1	*20	
Hydraulic Fluid Temp. Control	11	1	† 5	"HYD. PUMP FLUID TEMP."

Figure 1-30. Fuse and Circuit Breaker List (Sheet 19 of 24)

D-C SYSTEM EQUIPMENT FUSES AND CIRCUIT BREAKERS (Continued)

EQUIPMENT OR CIRCUIT	LOCATION (PANEL NO.)	QUANTITY	SIZE (AMPERES)	DECAL NOMENCLATURE
Hydraulic Parking Brake (Control) (Some Airplanes)	5	1	* 5	"PARK BRAKE"
Hydraulic Fluid Temperature (Control)	11	1	† 5	"HYD. PUMP FLUID TEMP."
Hydraulic Pump (Control), Brake	5	1	* 5	"BRAKE PUMP"
Hydraulic Pump (Control), Brake—Emergency	11	1	* 5	"EMERG. BRAKE PUMP"
Hydraulic Pump (Control), #2—Emergency	11	1	† 5	"HYD. PUMP OVERRIDE"
Hydraulic Pump (Controls), Brake	See: 1. "Hydraulic Pump Control, Brake" 2. "Hydraulic Pump Control, Brake Emergency"			
Hydraulic Pump (Controls), #1	See: 1. "Bomb Bay Doors Control, Pilots' " 2. "Bomb Bay Doors Control, Photo-Navigator's" 3. "Hydraulic Fluid Temperature Control" 4. "Landing Gear Extension & Retraction Control" 5. "Landing Gear—Nose Steering Control"			
Hydraulic Pump (Controls), #2	See: 1. "Hydraulic Pump Control, #2—Emergency" 2. "Landing Gear Extension & Retraction Control" (Retraction Only)			
IFI Operator's Accessory Equip Panel				
Suit Heater & Test Receptacle	26	1	†25	
Test Receptacle	49	1	†25	"TEST RECEPTACLE"
Panel Light	49	1	† 5	"WORK LIGHT"
IFF Detonation	17	1	*10	"DETNAT'R IFF"
IFF Radar Set	17	1	* 5	"RECEIVER IFF"
Ignition (Control), AND Starter (Control), AND Starter Engaging (Control)—Jet Engines #1, 2, 3, & 4 (J47-11 & -19)	7	4	* 5	"IGNITION STARTER POWER ENG. 1, 2, 3, & 4"
Ignition Switch Emergency—Recip Engines #1, 2, 3, 4, 5, & 6	11	1	*20	"IGNITION"
Instrument Approach, RC-103 & AN/ARN-5A	1	1	*10	"INSTRUMENT APPROACH"
Intercoolers (Control)—Close & Open —Recip Engines #1, 2, 3, 4, 5, & 6	15	1	* 5	"ENG. INTERCOOLER"
Interphone, Combat	17	1	* 5	"INTERPHONE"
Interphone Mixer Amplifier, Copilot's	5	1	* 5	"COPILOT INTERPHONE"
Interphone Mixer Amplifier, Pilot's	5	1	* 5	"PILOT INTERPHONE"
Interphone Mixer Amplifier, RCM	17	1	* 5	"ECM MIXER AMPLIF."
Interphone, Private—Engineer's	11	1	* 5	"INTERPHONE"
Interphone, Private	17	1	* 5	"PVT. INTER AMPLIF"
Interphone, Private IF ECM Oper	44	1	* 5	"INTERPHONE"
Landing Gear Extension & Retraction (Control), AND Oil Cooler (Control) (Ground Cooling)—Recip Engines #1, 2, 3, 4, 5, & 6	5	1	* 5	"LANDING GEAR CONTROL"

Figure 1-30. Fuse and Circuit Breaker List (Sheet 20 of 24)

D-C SYSTEM EQUIPMENT FUSES AND CIRCUIT BREAKERS (Continued)

EQUIPMENT OR CIRCUIT	LOCATION (PANEL NO.)	QUANTITY	SIZE (AMPERES)	DECAL NOMENCLATURE
Landing Gear—Nose Steering (Control)	5	1	* 5	"LANDING GEAR NOSE STEER"
Light, Inter-Aircraft Signal—Nose Gunner's	3	1	10	"ALDIS RECP."
Light, Inter-Aircraft Signal—Photo-Navigator's	6	1	10	"ALDIS RECP."
Lights, Inter Aircraft Signal—Aft Lower Gunners'	34	1	*10	"LOWER ALDIS LIGHT RECP."
Lights, Inter-Aircraft Signal—Aft Upper Gunners'	34	1	*10	"UPPER ALDIS LIGHT RECP."
Lights, Inter-Aircraft Signal—Fwd Gunners'	20	1	10	"ALDIS RECP."
Lights, Jet Control Panel	7	1	* 5	"PANEL LIGHTS POWER"
Lights, Landing—Extension & Retraction, AND Filament (Control)	5	1	* 5	"LIGHTS LANDING CONTROL"
Lights, Landing Gear Wheel Well	12	1	† 5	"WHEEL LIGHTS"
Lights, Position Fuselage & Code Flashing	5	1	*10	"LIGHTS NAVIGATION FUSELAGE"
Lights, Position—Tail (Yellow)	5	1	* 5	"LIGHTS NAVIGATION WING & TAIL"
Lights, (Control) Bomb Bay Dome	23	1	* 5	"BOMB BAY LIGHTS"
Lights, (Control) Bomb Bay Dome	34	1	* 5	"TURRET & BB LIGHTS"
Lights, Taxi (Some Airplanes)				
Left (Power)	36	1	30	"TAXI LIGHT"
Right (Power)	43	1	30	"TAXI LIGHT"
Left & Right (Control)	51	1	† 5	"TAXI LIGHTS"
Lights, Wing Internal	30	1	†10	"WING INTERNAL LIGHTS"
Loran Set, AN/APA-9A	4	1	* 5	"LORAN"
Marker Beacon Set, RC-193 (Some Airplanes)	17	1	* 5	"BEACON MARKER"
Oil Cooler Control (Flight Cooling)—Recip. Engines #1, 2, 3, 4, 5, & 6	See: "Fuel Valves, Recip Engines AND Oil Cooler Control (Flight Cooling)—Recip. Engines #1, 2, 3, 4, 5, & 6"			
Oil Cooler Control (Ground Cooling)—Recip. Engines #1, 2, 3, 4, 5, & 6	See: "Landing Gear Extension and Retraction Control AND Oil Cooler Control (Ground Cooling)—Recip. Engines #1, 2, 3, 4, 5, & 6"			
Oil Cooler Override (Control) Recip. Engines #1, 2, 3, 4, 5, & 6	46	6	† 5	"AUTO-MANUAL"
Oil Dilution Recip. Engines #1, 2, 3, 4, 5, & 6	11	1	*15	"OIL DILUTE"
Oil Level Warning Indicator Lights—(Some Airplanes) Recip. Engines #1, 2, 3, 4, 5, & 6	11	1	* 5	"OIL LEVEL LIGHTS"
Oil Quantity Indicators—(Some Airplanes) Recip. Engines #1, 2, 3, 4, 5, & 6	12	6	* 5	"OIL QUANTITY GAGE POWER 1, 2, 3, 4, 5, & 6"

Figure 1-30. Fuse and Circuit Breaker List (Sheet 21 of 24)

D-C SYSTEM EQUIPMENT FUSES AND CIRCUIT BREAKERS (Continued)

EQUIPMENT OR CIRCUIT	LOCATION (PANEL NO.)	QUANTITY	SIZE (AMPERES)	DECAL NOMENCLATURE
Oil Shutoff Valves—Jet Engines 1, 2, 3, & 4 (Some Airplanes)	7	4	* 5	"OIL SHUT-OFF VALVE POWER ENG. 1, 2, 3, & 4"
Oil Temperature Indicators—(Some Airplanes) Recip Engines #1 & 2	11	1	* 5	"TEMPERATURE INDICATOR ENGINE OIL 1 & 2"
Oil Temperature Indicators—(Some Airplanes) Recip Engines #3 & 4	11	1	* 5	"TEMPERATURE INDICATOR ENGINE OIL 3 & 4"
Oil Temperature Indicators—(Some Airplanes) Recip Engines #5 & 6	11	1	* 5	"TEMPERATURE INDICATOR ENGINE OIL 5 & 6"
Oil Temperature Indicators—(Some Airplanes) Recip Engines #1, 2, 3, 4, 5, & 6	11	6	* 5	"TEMPERATURE INDICATORS ENGINE OIL 1, 2, 3, 4, 5, & 6"
Primers—Recip Engines #1, 2, 3, 4, 5, & 6	11	1	* 5	"ENGINE PRIMER"
Propeller Feather & Reverse Pitch—Recip Engines #1, 2, 3, 4, 5, & 6	11	6	*15	"PROPELLER CONTROL 1, 2, 3, 4, 5, & 6"
Propeller Master Motor	11	1	*10	"PROPELLER CONTROL MASTER MOTOR"
Propeller Pitch Indicator Lights—Recip Engines #1, 2, 3, 4, 5, & 6	11	1	* 5	"PROP. PITCH IND."

Note

Either of the following groups of RCM equipment may be installed in the aircraft.

EQUIPMENT OR CIRCUIT	LOCATION (PANEL NO.)	QUANTITY	SIZE (AMPERES)	DECAL NOMENCLATURE
Radar Countermeasures Equipment, Airplanes not in Group 4:				
Group I:				
AN/APR-4	16	1	* 5	"RACK POSIT. #2"
AN/APT-4—Rack Position #3, #4, #8	16	1	*10	"RACK POSIT. #4"
AN/APT-4—Rack Position #1, #5, #7	16	1	*10	"RACK POSIT. #5"
Group II:				
AN/APR-4	16	1	* 5	"RACK POSIT. #2"
AN/APT-1—Rack Position #4, #6A	16	1	*10	"RACK POSIT. #4"
AN/APT-5A—Rack Position #1, #3B	16	1	* 5	"RACK POSIT #1"
AN/ARQ-8	16	1	*10	"RACK POSIT. #5"
Group 4 Airplanes:				
Group I:				
AN/APR-4	16	1	* 5	"RACK POSIT. #2"
AN/APT-4 Rack Position #1, #5, #7	16	1	*10	"RACK POSIT. #4"
Group II:				
AN/APT-6 Rack Position #1, #5	16	1	*10	"RACK POSIT. #5"
AN/APR-4 Rack Position #2, #4	16	1	* 5	"RACK POSIT. #2"
AN/APR-4 Rack Position #3, #4	16	1	*10	"RACK POSIT. #4"

Figure 1-30. Fuse and Circuit Breaker List (Sheet 22 of 24)

D-C SYSTEM EQUIPMENT FUSES AND CIRCUIT BREAKERS (Continued)

EQUIPMENT OR CIRCUIT	LOCATION (PANEL NO.)	QUANTITY	SIZE (AMPERES)	DECAL NOMENCLATURE
Group III:				
AN/APT-9	16	1	*10	"RACK POSIT. #1"
AN/APR-4	16	1	* 5	"RACK POSIT. #2"
AN/APR-9 Rack Position #5, #7	16	1	*10	"RACK POSIT. #5"
AN/APT-4 Rack Position #3, #4	16	1	*10	"RACK POSIT. #4"
Radar Set, AN/APQ-24—Filter	6	1	30	"BOMB'G RADAR"
Radar Set, AN/APQ-24—Junction Box	6	1	20	"RADAR COMPUTER"
Radio Compass, AN/ARN-7—Photo-Navigator's	4	1	* 5	"RADIO COMPASS"
Radio Range Receiver, BC-453 (Some Airplanes)	5	1	* 5	"RANGE RECEIVER"
Radio Set, AN/ARC-3—Command	20	1	30	"COMMAND AN/ARC-3"
Radio Set, AN/ARC-8—Liaison Receiver	17	1	* 5	"LIAISON REC."
Radio Set, AN/ARC-8—Dynamotor	20	3	20	"LIAISON RADIO DYN."
Radio Set, AN/ARN-14 Glide Path Receiver (Some Airplanes)	1	1	* 5	"GLIDE PATH RECVR"
Radio Set, Pilots Course Indicator (Some Airplanes)	5	1	* 5	"ARN-12 LAMP TEST"
Radio Set, VHF Navigational Test Equip. (Some Airplanes)	34	1	* 5	"ARN-14 TEST RECP."
Radio Set, ARN-14 Dynamotor (Some Airplanes)	34	1	*10	"ARN-14 NAV. RECVR."
Radio Set, AN/ARC-27 Command (Some Airplanes)	34	1	*25	"ARC-27 RECVR."
Radio Set, AN/ARC-27 Command Control (Some Airplanes)	17	1	*10	"COMMAND RADIO"
Radiosonde Dispenser (Control) (Some Airplanes) MA-1 Dispenser	53	1	*20	
Recorder, RD-15/ANQ-1A (Some Airplanes) IF ECM Operator	44	1	* 5	"ANQ-1A"
Recorder, RD-15/ANQ-1A (Some Airplanes) H.F. ECM Operator	45	1	* 5	"ANQ-1A"
Recorder, RD-15/ANQ-1A (Some Airplanes) M.F. ECM Operator	44	1	* 5	"ANQ-1A"
Recorder, AN/ANQ-1A—Weather Observer's	1	1	* 5	"WEATHER OBSERVER RECORDER"
Recorder "A," AN/ANQ-1A—L.F. ECM Oper	17	1	* 5	"WIRE RECORDER A"
Recorder "B," AN/ANQ-1A—L.F. ECM Oper	17	1	* 5	"WIRE RECORDER B"

Figure 1-30. Fuse and Circuit Breaker List (Sheet 23 of 24)

D-C SYSTEM EQUIPMENT FUSES AND CIRCUIT BREAKERS (Continued)

EQUIPMENT OR CIRCUIT	LOCATION (PANEL NO.)	QUANTITY	SIZE (AMPERES)	DECAL NOMENCLATURE
Special Bombing System				
Power Arming & Release	2	1	*25	
Release & Heater Control	2	1	* 5	
T-35	50	1	*35	
T-19	50	1	*35	
T-18	50	1	*25	
Test	50	1	*20	
FCT Junction Box (DC Feeder)	14	3	60	"AUX. BOMB RACK TEST EQUIP."
Starter Control—Jet Engines #1, 2, 3, & 4	See: "Ignition Control, AND Starter Control, AND Starter Engaging Control—Jet Engines #1, 2, 3 & 4"			
Starter Control—Recip Engines #1, 2, 3, 4, 5, & 6	11	1	* 5	"ENGINE STARTER"
Starter Engaging Control—Jet Engines #1, 2, 3, & 4	See: "Ignition Control AND Starter Control, AND Starter Engaging Control—Jet Engines #1, 2, 3, & 4"			
Starter Engaging Power—Jet Engine #1	36	1	10	"#1 STARTER ENGAGING"
Starter Engaging Power—Jet Engine #2	36	1	10	"#2 STARTER ENGAGING"
Starter Engaging Power—Jet Engine #3	43	1	10	"#3 STARTER ENGAGING"
Starter Engaging Power—Jet Engine #4	43	1	10	"#4 STARTER ENGAGING"
Test Power Terminal—Recip Engine #1	37	1	10	"TEST POWER"
Test Power Terminal—Recip Engine #2	38	1	10	"TEST POWER"
Test Power Terminal—Recip Engine #3	39	1	10	"TEST POWER"
Test Power Terminal—Recip Engine #4	40	1	10	"TEST POWER"
Test Power Terminal—Recip Engine #5	41	1	10	"TEST POWER"
Test Power Terminal—Recip Engine #6	42	1	10	"TEST POWER"
Turbosupercharger Override (Control) (Some Airplanes)	11	1	† 5	"VERNIER"
Turn & Bank Indicator, Copilot's	5	1	* 5	"TURN & BANK IND. COPILOT"
Turn & Bank Indicator, Pilot's	5	1	* 5	"TURN & BANK IND. PILOT"
Turret Sight Lead Test Receptacle, Aft	34	1	*10	"TURRET SIGHT LEAD TEST RECPT."
Turret Sight Lead Test Receptacle, Fwd	20	1	20	"GUN SIGHT CHECKER"
Turret Fire Control Interlocking Relay	30	1	† 5	"TURRET DOOR INLOCK"
Turret Radar Set, APG-3 or APG-32—Tail	34	1	*15	"APG-3 RADAR" OR "TAIL RADAR POWER"
Water Injection (Controls)—Recip Engines #1, 2, 3, 4, 5, & 6	12	6	† 5	"ENGINE WATER INJECTION 1, 2, 3, 4, 5, & 6"
Windshield Wiper (Control), Photo-Navigator's	4	1	* 5	"WINDSHIELD WIPER"
Windshield Wiper (Control), Pilots'	5	1	* 5	"WINDSHIELD WIPER"

Figure 1-30. Fuse and Circuit Breaker List (Sheet 24 of 24)

not have the same frequency as the power bus voltage, the lamps will flicker. During the period that both lamps are dark, there is no difference in the frequency between the power bus and the alternator, indicating that the polarities are the same and that it is safe to close the alternator breaker.

DIRECT-CURRENT SYSTEM.

The d-c power system consists of a 24-volt, 34 ampere-hour storage battery, and nine transformer-rectifier units. The t-r units are located as follows: two under the step in front of the nose wheel well, one under the radio operator's table, three in the forward bomb bay, two in the aft bomb bay and one on the forward bulkhead of the aft cabin. The t-r units convert 3-phase, 208-volt, alternating current into 28-volt direct current. Each unit is rated for a continuous output of 50 amperes. The units are connected through fuses to the a-c system and operate in parallel to deliver direct current when power is on the a-c bus. The total load of the system is automatically shared by the units.

The battery is located in the aft end of the nose wheel well. The battery is connected through a relay which is controlled by a battery switch at the engineers' station. Power for the relay is received directly from the battery.

Note

A direct circuit from the battery supplies continuous power to the alarm bell control switch on the pilots' instrument panel and to the destructor unit of the AN/APX-6 identification set at the radio operator's station. This feature permits operation of these units regardless of the position of the battery switch.

On airplanes not in group 1, the battery relay is controlled exclusively by the battery switch. On airplanes in group 1, the battery relay is controlled by the battery switch but is normally grounded by a relay which receives 115-volt a-c power from the engineers' fuse panel. Thus, whenever a-c power to the fuse panel is disrupted, the battery relay will open to prevent excessive drainage of battery power due to nonessential

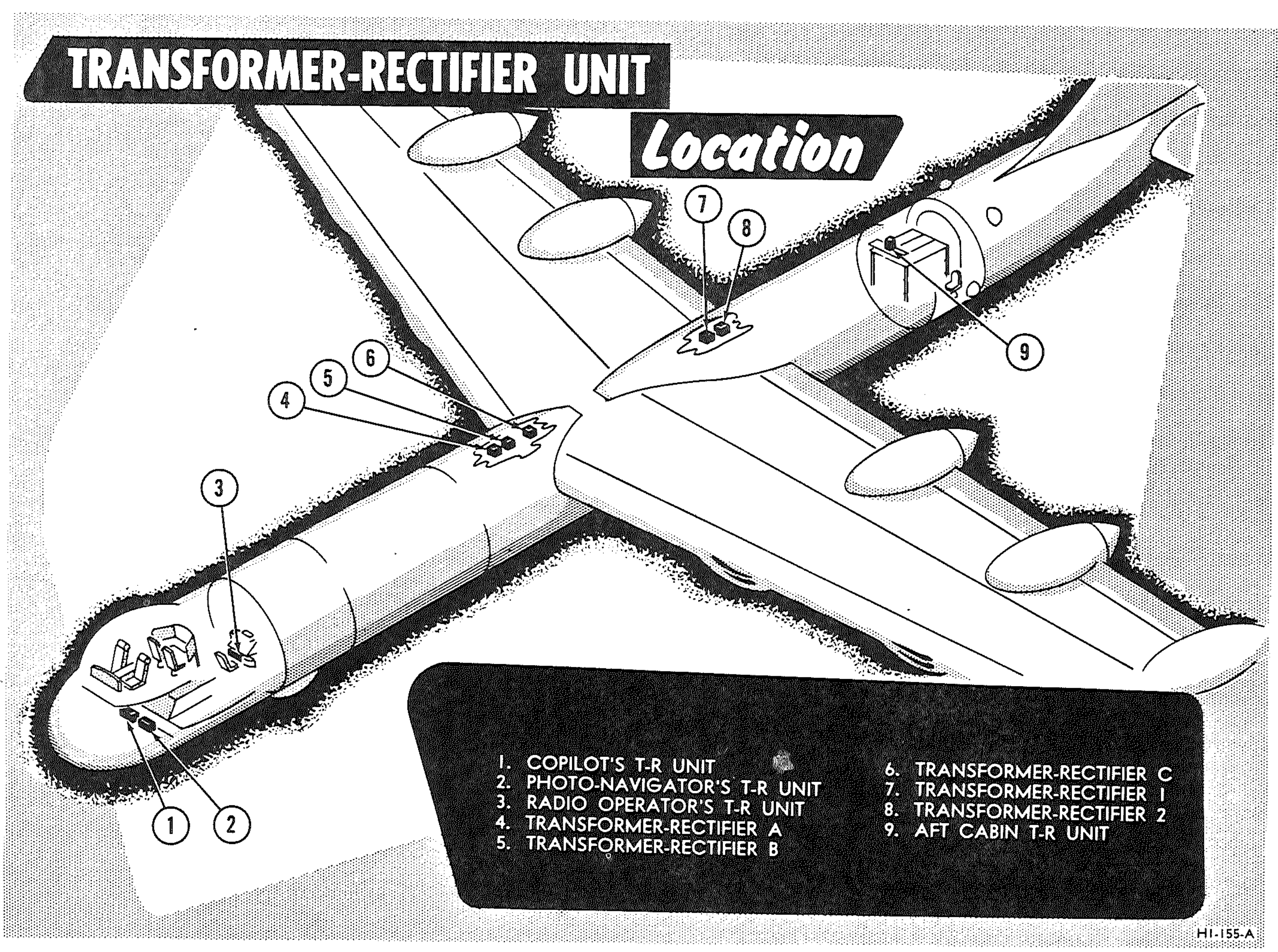


Figure 1-31.

equipment being connected to the d-c bus. Repositioning the battery switch will provide a d-c ground to close the battery relay.

A complete loss of a-c power will result in a loss of d-c power except for that stored in the battery. If a failure of this nature is encountered, it is recommended that battery power be conserved as much as conditions will allow so that systems requiring direct current, such as the propeller reverse pitch and feathering systems, can be operated in the event of an emergency. Refer to Section III for emergency electrical power operation.

Battery Switch.

This switch (3, figure 1-18) is located on the engineers' auxiliary instrument panel. On airplanes not in group 1, this switch has two positions marked ON and OFF, and controls the battery relay which connects the battery to the d-c power distribution system. On airplanes in group 1, this switch has three positions marked EMER ON, OFF, and NORM ON. When the switch is in NORM ON, the battery relay is grounded by an a-c relay when a-c power is on the airplane. When a loss of a-c power occurs, placing the switch in EMER ON will provide a d-c ground for the battery relay. A lamp, located on the cable guard opposite the forward escape hatch, is lit whenever the a-c relay is closed and goes out when the relay opens.

Transformer-Rectifier Test Unit Panel.

A transformer-rectifier test unit (figure 1-32), installed on the radio operator's equipment shelf, is provided to check the voltage and amperage output of the eight transformer-rectifier units. It is also used to check the voltage of the battery. The unit consists of selector switches, a voltmeter, and an ammeter.

Transformer-Rectifier Test Unit Selector Switches. Five selector switches are provided to select the t-r unit to be tested. Holding any one of these switches in the ON position connects the voltmeter and the ammeter to the battery or the selected t-r unit.

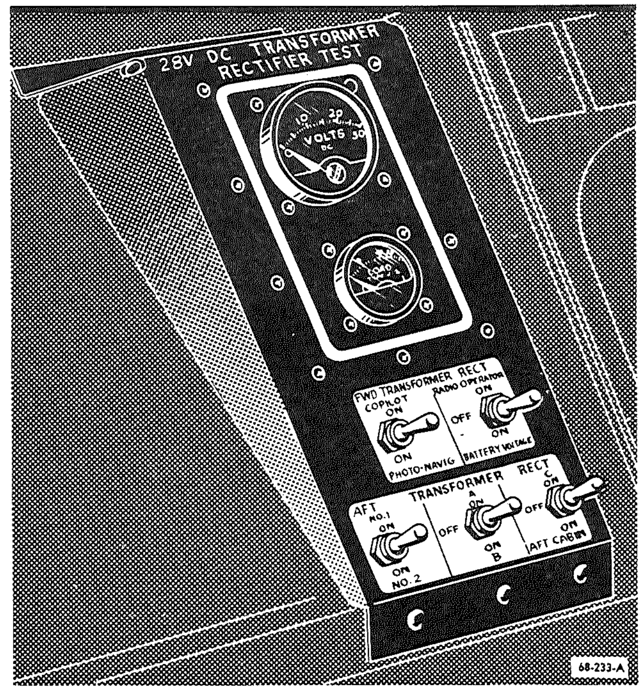
Transformer-Rectifier Test Unit Voltmeter. Voltage output of the unit being tested is indicated by the voltmeter.

Transformer-Rectifier Test Unit Ammeter. This meter is provided to indicate the amperage output load of the unit being tested. A reading of 1.0 on the meter indicates 100 per cent (50 amperes) output.

EMERGENCY ELECTRICAL SYSTEM.

In the event all alternators "jump" off the line, an emergency circuit is provided to restore enough power to operate essential electrical equipment. The emergency circuit begins at the terminals of each alternator and goes through the voltage and frequency selector switch to an emergency power switch. By use of the emergency switch, a-c power is fed to the pilots's flight instrument switch and the radio operator's transformer-rectifier; in group 1 airplanes power is also fed

T-R TEST UNIT



68-233-A

Figure 1-32.

to the turbo boost override controls. Direct-current output of the t-r unit can be used to close the alternator breaker when trying to get an alternator back on the line or, if such attempts fail, to operate essential d-c equipment. (See figure 1-33.)

WARNING

Do not permit the d-c load to exceed 1.0 (50 amperes) as indicated on the load meter of the transformer-rectifier test unit when selected to the RADIO OPER position. An overload can damage the t-r unit or blow out the a-c fuses at the respective engine distributing panels with a resulting loss of all emergency power.

Airplanes in group 1 are equipped with an additional emergency circuit. (See figure 1-33.) This circuit starts at the battery and bypasses the battery relay to feed power directly to an emergency circuit selector switch on the pilots' instrument panel. This switch connects battery power to an inverter which is installed on the flight deck just forward of the pilots' pedestal. The inverter receives battery power from the copilot's circuit breaker panel and supplies a-c power to the pilot's directional and vertical gyros. When inverter opera-

EMERGENCY ELECTRICAL POWER DISTRIBUTION

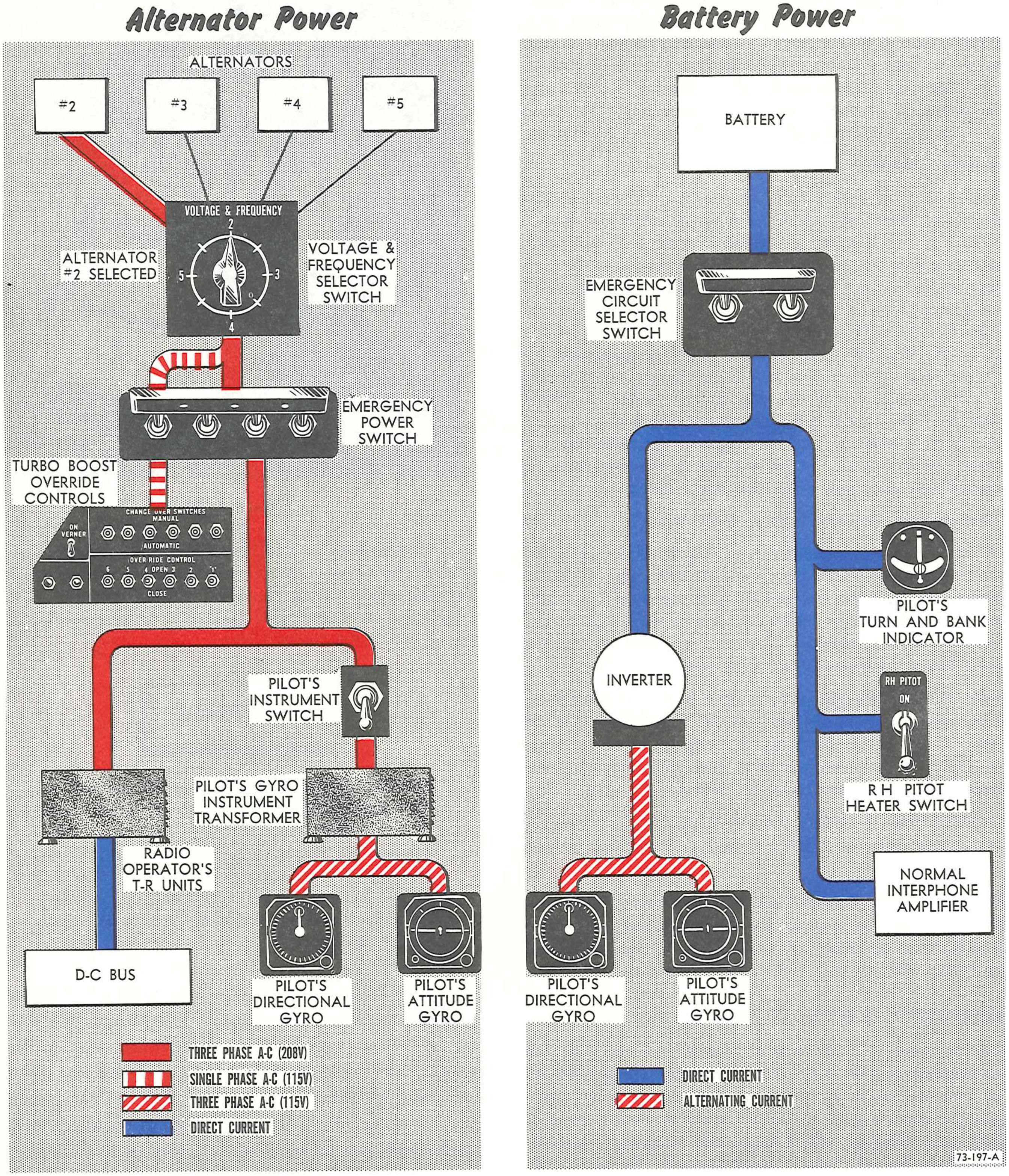


Figure 1-33.

tion is selected, the pilot's turn and bank indicator, the right hand pitot heater, and the normal interphone amplifier are disconnected from the d-c bus and are connected directly to the battery.

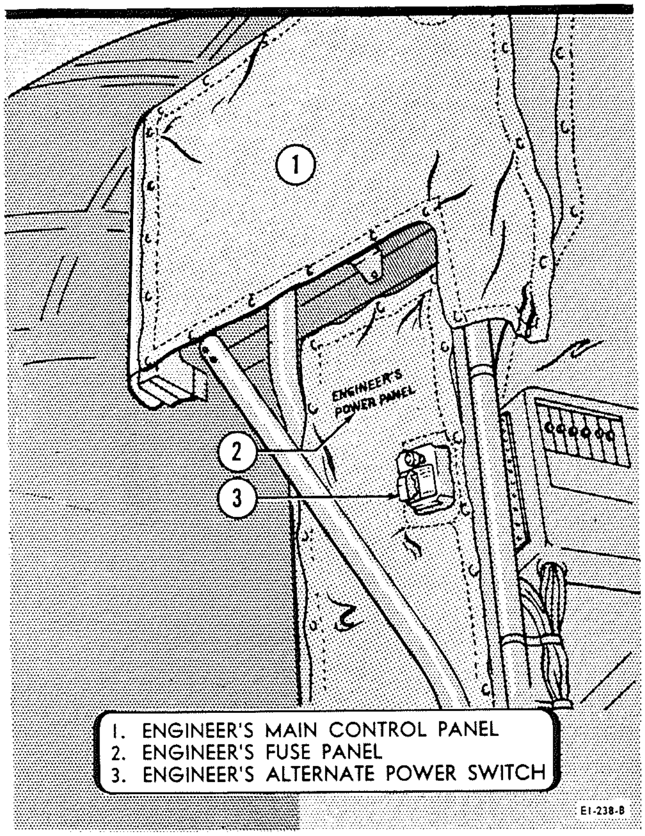
Emergency Power Control.

The emergency power control (4, figure 1-18) consists of four two-position switches ganged together on the engineers' auxiliary instrument panel. Placing the switches in EMERGENCY completes the emergency power circuit; moving the switches to NORMAL breaks the circuit. During normal operation the switches should always be in the NORMAL position.

Emergency Circuit Selector Switch (Group 1 Airplanes).

This switch (43, figure 1-13) consists of two switches ganged together on the pilots' instrument panel. The switch has two positions marked NORMAL and EMERGENCY. When all a-c power is lost, placing the switch in EMERGENCY will connect 28-volt d-c power directly from the battery to the inverter which supplies a-c power for operation of the pilots' directional and vertical gyros. The EMERGENCY position also disconnects the pilots' turn and bank indicator, the right hand pitot heater, and the normal interphone amplifier from the d-c bus and connects these units to the emergency circuit.

Alternate POWER SWITCH



EI-238-B

Figure 1-34.

ALTERNATE SOURCE OF A-C POWER TO ENGINEERS' FUSE PANEL.

A two-position switch (3, figure 1-34) is located on the engineers' fuse panel. This switch has positions marked NORMAL and ALTERNATE and is used to select one of two sources of a-c power for the engineers' fuse panel. This switch is wired in the NORMAL position, and power is supplied from the right forward turret power panel. The ALTERNATE position provides power from the left forward turret power panel. Adjacent to this switch is a lamp which indicates when power from either source is being supplied to the engineers' fuse panel.

HYDRAULIC SYSTEM.

The hydraulic system is composed of four independent systems: a main system, a brake system, and two emergency systems. Each system has its own reservoir and selector valve. Main system pressure is supplied by two electrically driven pumps. Hand pumps provide pressure for the emergency systems. The main system operates the landing gear, bomb bay doors, and nose wheel steering. Pressure from one emergency system can be used to extend the landing gear or to charge the brake system accumulators. The other emergency system can be used to open or close the bomb bay doors.

Note

Normally, brake pressure is supplied by an independent hydraulic system. For detailed information refer to "Brake System" of this section.

MAIN HYDRAULIC SYSTEM.

This system supplies fluid pressure for landing gear, nose wheel steering, and bomb bay door operation. The system consists of a reservoir, two electrically driven hydraulic pumps, and a main selector valve.

The main system reservoir, located on the wing front spar inside the fuselage, is provided with a sight level gage and filler neck. Fluid can be added during flight, provided the main reservoir pressurization line is disconnected. For servicing information, refer to figure 1-47. The main hydraulic system pumps operate whenever the associated control switch for landing gear operation, nose wheel steering, or bomb bay door operation is actuated.

Note

For information concerning these switches refer to "Landing Gear Switch" and "Steering Switch" of this section and "Bomb Bay Door Switch" of Section IV.

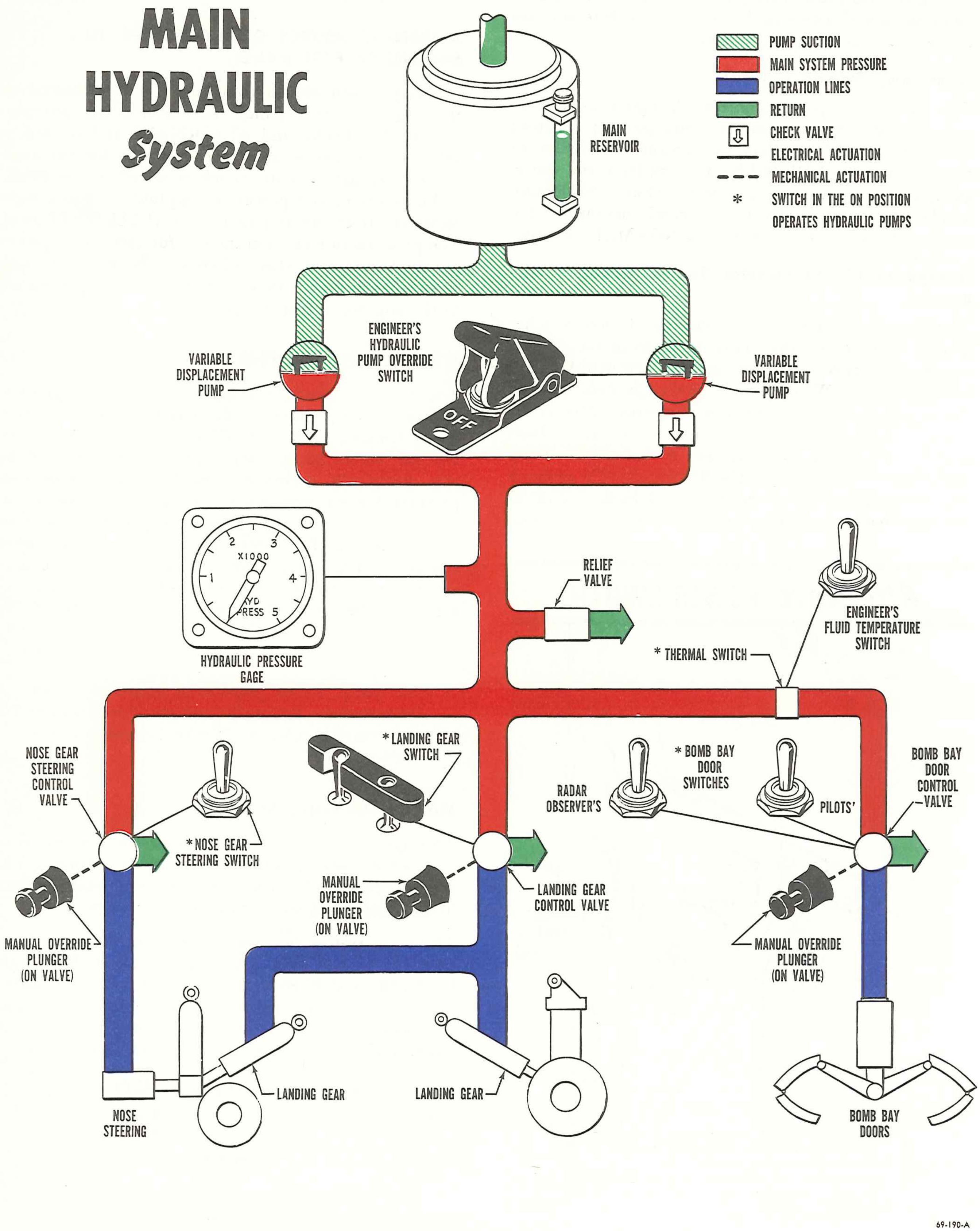

MAIN
HYDRAULIC
System
PUMP SUCTION
MAIN SYSTEM PRESSURE
OPERATION LINES
RETURN
CHECK VALVE
ELECTRICAL ACTUATION
MECHANICAL ACTUATION
* SWITCH IN THE ON POSITION OPERATES HYDRAULIC PUMPS
MAIN RESERVOIR
VARIABLE DISPLACEMENT PUMP
ENGINEER'S HYDRAULIC PUMP OVERRIDE SWITCH
OFF
VARIABLE DISPLACEMENT PUMP
RELIEF VALVE
HYDRAULIC PRESSURE GAGE
ENGINEER'S FLUID TEMPERATURE SWITCH
* THERMAL SWITCH
NOSE GEAR STEERING CONTROL VALVE
* NOSE GEAR STEERING SWITCH
* LANDING GEAR SWITCH
RADAR OBSERVER'S
* BOMB BAY DOOR SWITCHES
PILOTS'
BOMB BAY DOOR CONTROL VALVE
MANUAL OVERRIDE PLUNGER (ON VALVE)
MANUAL OVERRIDE PLUNGER (ON VALVE)
LANDING GEAR CONTROL VALVE
MANUAL OVERRIDE PLUNGER (ON VALVE)
NOSE STEERING
LANDING GEAR
LANDING GEAR
BOMB BAY DOORS
69-190-A

Figure 1-35.

Both pumps operate for landing gear retraction. Only one pump operates during landing gear extension, nose wheel steering, and bomb bay door operation. The pumps operate on 208-volt a-c power received through relays which are controlled by 28-volt direct current and deliver approximately 3100 psi fluid pressure to the system. The pumps stop operation through the action of limit switches after the bomb bay doors open or close or after the closing of the canoe doors upon completion of a landing gear operation cycle.

CAUTION

To prevent overheating of the hydraulic pump motor, limit pump operation to one retract or extend cycle in each 5-minute period.

The main system selector valve, located on the wing front spar inside the fuselage, is controlled by 28-volt direct current. The valve controls fluid pressure from the main pumps to the landing gear, nose wheel steering, and bomb bay door mechanisms. In the event of an electrical control failure, the valve for the selected system can be operated manually as directed in "Manual Operation of Main Selector Valve," Section III.

Hydraulic Pump Override Switch.

This on-off switch (2, figure 1-36), is used to control one pump motor during emergency manual operation of the main selector valve. Placing the switch in the ON position closes a relay with 28-volt d-c power and routes 208-volt alternating current to energize the No. 2 main hydraulic pump motor.

Hydraulic Fluid Temperature Switch.

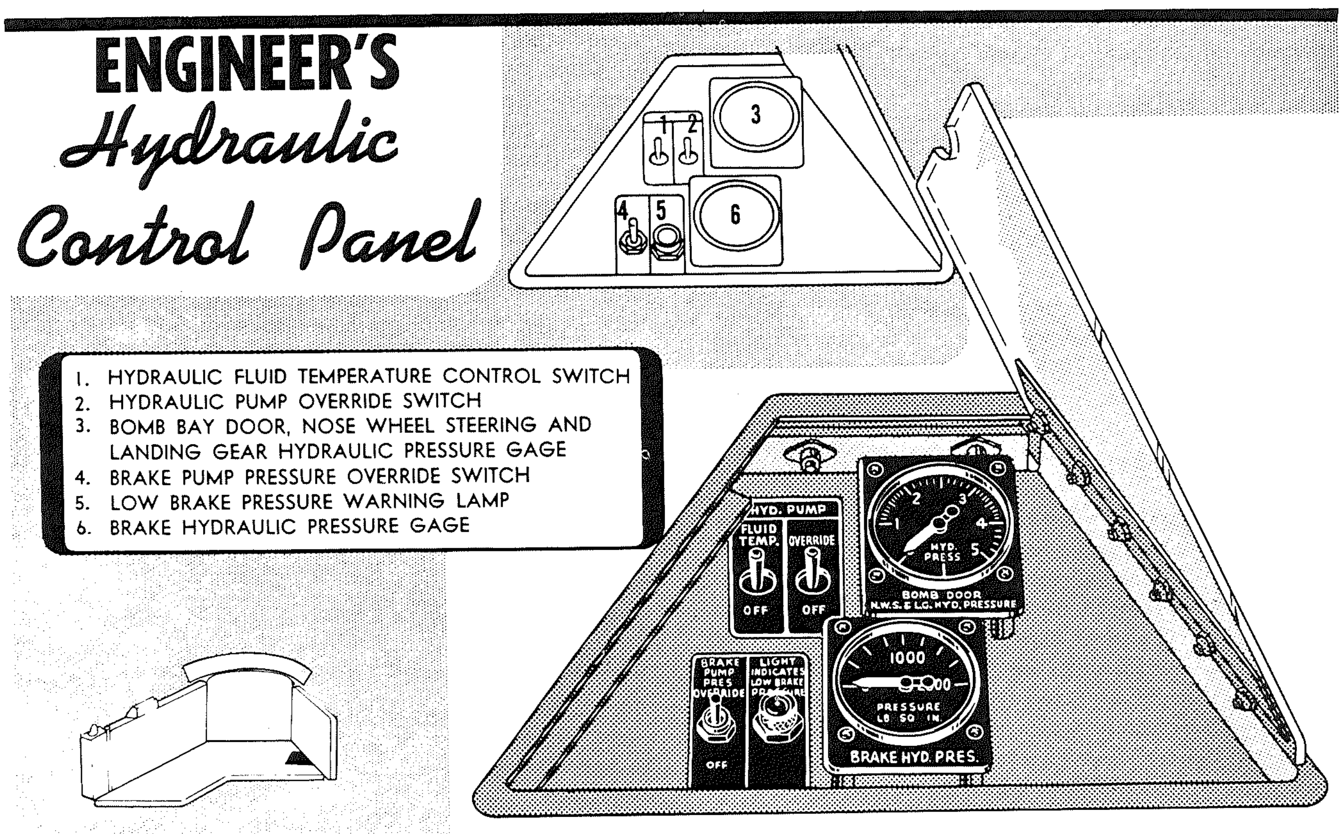
This switch (1, figure 1-36) at the engineers' station is used to set up a temperature control circuit for bomb bay door system hydraulic fluid. (Refer to "Hydraulic Fluid Temperature Control," Section IV.)

Hydraulic Pressure Gage.

A pressure gage (3, figure 1-36) at the engineers' station indicates the hydraulic pressure for the landing gear, bomb bay door, and nose wheel steering operation.

LANDING GEAR AND BRAKE EMERGENCY HYDRAULIC SYSTEM.

This system consists of a reservoir, a hand pump, and a selector valve (figure 1-35). Since the system serves for emergency operation of both landing gear and brakes, the selector valve is provided so that fluid



EI-189-B

Figure 1-36.

pressure can be directed to the proper system. The emergency system hydraulic lines are separate from the main system. Shuttle valves are installed between the normal and emergency hydraulic lines so that pressure from either side can close the other line, directing fluid pressure into the actuating units. With the selector valve in LANDING GEAR DOWN position, hand pump operation extends and locks the landing gear. Hand pump operation with the selector valve in CHARGE BRAKE ACCUMULATOR position will supply fluid pressure to charge the brake accumulator. A fully charged accumulator will provide three full brake applications. Refer to "Emergency Hydraulic Landing Gear Extension" and "Emergency Brake Pressure," Section III, for operating instructions.

Note

When the emergency hydraulic system is used for landing gear extension, the main landing gear wheel well doors will not retract after the landing gear is lowered.

Emergency Selector Valve Control.

With the emergency selector valve in the CHARGE BRAKE ACCUMULATOR or the LANDING GEAR DOWN position, operation of the hand pump produces the selected action. Normally the valve should be left in the CHARGE BRAKE ACCUMULATOR position. This permits any pressures caused by thermal expansion to be relieved in the accumulators.

BOMB BAY DOOR EMERGENCY HYDRAULIC SYSTEM.

The bomb bay door emergency hydraulic system has a separate reservoir, hand pump, selector valve, and hydraulic lines. The emergency lines are connected to the bomb bay door main actuating units through shuttle valves in an arrangement similar to that in the landing gear emergency system. For operation of this system, refer to "Operation of Bomb Bay Door Emergency Hydraulic System," Section IV.

FLIGHT CONTROL SYSTEM.

The movement of the ailerons, elevators, and rudder in response to their controls is conventional; however, the method of moving the main surfaces is unique. The controls are mechanically linked to flying servo tabs. When a control is moved to deflect a tab in one direction, the air load on the displaced tab causes the main surface to be deflected in the opposite direction. Even though an extra stage of action is involved between the control movement and the main surface movement in this method, response time is less than one-tenth of a second.

To provide control feel to the pilot, a spring-loaded piston in each main surface compresses whenever the related tab is deflected. In addition, the piston spring

CONTROL SURFACE *Deflections*

Aileron	Up 20°	Down 20°
Aileron Servo Tabs	Up 25°	Down 25°
Elevator	Up 25°	Down 20°
Elevator Servo Tabs	Up 20°	Down 20°
Elevator Trim Tabs	Up 24°	Down 12°
Flaps	Up --°	Down 30°
Rudder	Left 16°	Right 16°
Rudder Servo Tabs	Left 14°	Right 14°
Rudder Trim Tab	Left 20°	Right 20°

G1-309-A

Figure 1-37.

operates the tab to produce a damping effect when the main surface is deflected by turbulence. The tab counteracts the movement of the main surface and restores the surface to its original position. These pistons also provide for movement of the main surfaces when the airplane is on the ground and there are no air loads on the surfaces. When a tab is moved, the piston spring compresses until the spring load is sufficient to overcome the friction at the main surface pivot points; then the main surface will move.

The rudder and elevators can be locked simultaneously by means of hydraulic locks. The locks are electrically controlled and lock the surfaces at whatever position they are in. A bleed orifice permits the surfaces to travel to either full position while locked.

Six flaps are installed on the wing trailing edge. The flaps are electrically controlled and actuated and are synchronized in symmetrical pairs by an electromechanical system.

The table in figure 1-37 shows the maximum deflection of all control surfaces. The reference point for these deflections is the chord plane of the surface.

SURFACE CONTROLS.

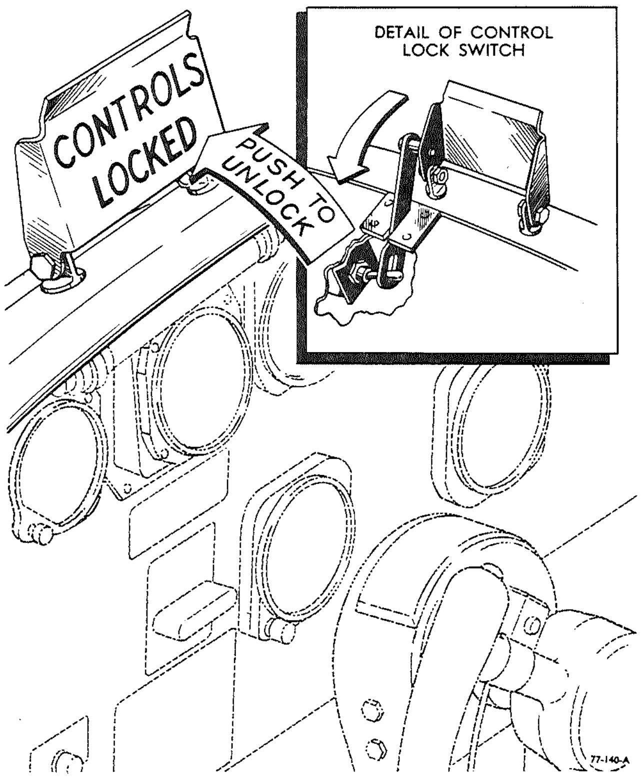
Control Columns and Rudder Pedals.

The aircraft commander's and pilot's stations are each provided with a control column and a set of rudder pedals. Operation of the columns and pedals is conventional.

Aileron Trim Tab Switch.

The aileron tab acts as a trim tab as well as a servo tab. A spring-loaded switch (21, figure 1-14), located on the

FLIGHT CONTROL LOCK SWITCH



77-140-A

Figure 1-38.

pilots' pedestal, supplies 28-volt direct current to relays which supply 208-volt a-c power to the trim tab actuators. The switch positions are LEFT WING DOWN, RIGHT WING DOWN, and neutral OFF.

Aileron Trim Indicator.

An indicator (19, figure 1-13), on the pilots' instrument panel, shows the degree of aileron trim. The indicator operates on 28-volt direct current in response to a signal from potentiometers on the trim tab actuators.

Elevator Trim Tab Control Wheels and Indicators.

The elevator trim tabs, which are independent of the flying servo tabs, are set by a pair of dual-operating control wheels (15, figure 1-14) on the pilot's pedestal. A rotable dial on the hub of each wheel indicates the trim condition of the tabs.

Rudder Trim Tab Control Knob and Indicator.

Rudder trim, which is independent of the flying servo tab, is set by a control knob (17, figure 1-14) located on the pilots' pedestal. A rotable dial around the base of the knob indicates the trim setting of the rudder trim tab.

CONTROL SURACE LOCKS.

The rudder and elevators are hydraulically locked in the position they are in when the locks are engaged.

Note

The aileron control locks have been rendered inoperative.

The locks prevent any sudden movement of the surfaces, but allow the surfaces to creep under load; therefore, locked controls will not restrict small movements of the control columns or rudder pedals. A safety switch, actuated by the movement of the right main oleo strut, automatically unlocks the controls as soon as the weight of the airplane is removed from the gear. Indicator lamps show when the surfaces are locked or unlocked.

Control Lock Switch.

The flight control lock switch (figure 1-38) is actuated by a yellow flag on the pilots' coaming. Raising the flag to its vertical CONTROLS LOCKED position locks all control surfaces. The switch supplies 28-volt direct current to relays which permit the flow of 115-volt a-c power to the control lock actuators.

Control Lock Indicators.

A red indicator lamp (11, figure 1-13) burns continuously when any one of the controls is locked. The red indicator light will go out the instant all lock actuators *start* their unlocking movement. With all controls unlocked on the ground, a green indicator lamp (11, figure 1-13) burns continuously. When the main gear is unlocked for retraction, the green lamp will go out.

WING FLAP SYSTEM.

The wing flap system consists of six slotted flaps which are mechanically and electrically synchronized in symmetrical pairs. Normally, all flaps are controlled by three ganged switches. These switches supply 28-volt direct current to close relays which supply 208-volt a-c power to the flap speed control relays. A synchronizer is connected to each pair of flaps by cables and keeps these flaps within 2 degrees of each other by operating the speed control relay. Whenever a flap gets more than 2 degrees ahead of its symmetrical flap, the speed control relay will place the lead flap motor in low speed until the lagging flap is again in synchronization at which time they will both operate at high speed. If the flaps become misaligned by 3 degrees, the normal flap control for the unsynchronized pair becomes inoperative. Emergency controls are provided for adjusting each flap individually if the normal control system fails.

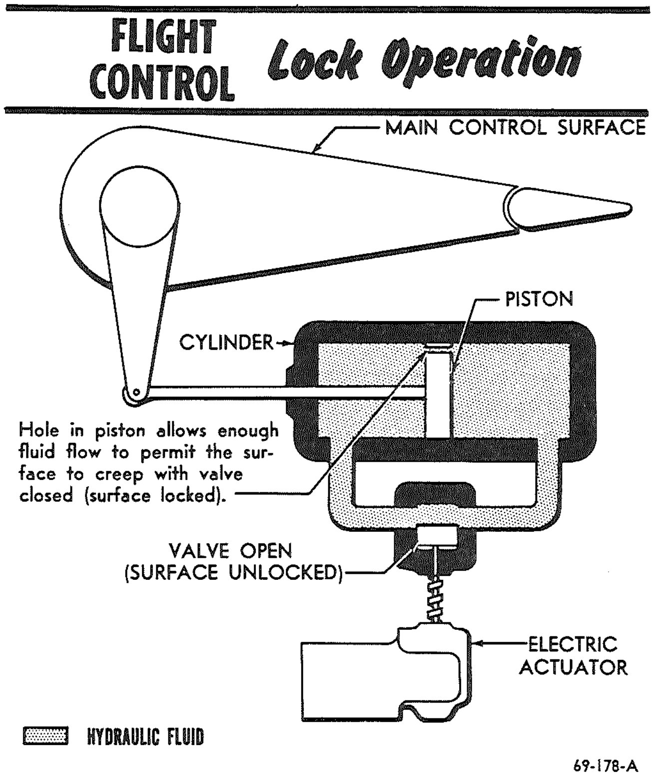


Figure 1-39.

Note

When one pair of flaps is inoperative because of misalignment, normal operation of the remaining pairs is unaffected.

Normal Controls.

Flap Switch. This switch (12, figure 1-14) is actually three switches ganged together and is located on the pilots' pedestal. The switch has spring-loaded UP and DOWN positions and a center OFF position.

CAUTION

If it is necesary to operate the flaps for more than two cycles on the ground, allow the actuators to cool for approximately 15 minutes between cycles.

Indicators.

Flap Position Indicator This indicator (21, figure 1-13) is located on the pilots' instrument panel and consists of three separate indicators. Each individual indicator reflects the position of one pair of flaps as transmitted from the associated flap synchronizer.

Warning Horn. A warning horn, which is also used for landing gear warning, is provided for the flap system. The horn is electrically connected to the synchronizers and the reciprocating engine throttles and indicates an unsafe condition of the flaps with respect to throttle position. If all throttles are advanced to take-off power and the flaps are not extended at least 20 degrees (± 4degrees), the horn will sound. No silencing button is provided for this circuit; therefore, the throttles must be retarded or the flaps extended to shut off the horn.

Emergency Controls.

An emergency flap control panel is located on the right side of the fuselage near the wing crawlway hatch. A separate 28-volt d-c source (bulkhead 8.0 power panel) is provided for this emergency panel. Three master selector switches are mounted at the top of the emergency panel, and six individual flap switches are grouped by pairs below the master switches. The individual switches supply 28-volt direct current to close the relays for the flap actuator motors.

Emergency Flap Switches. Each of these six switches has spring-loaded UP and DOWN positions and a center OFF position. Holding either of the switches in the UP or DOWN position and then holding the corresponding flap master selector switch in the ALTERNATE position will move the flap in the desired direction.

Flap Master Selector Switches. These switches are used to complete the emergency circuit for the system that has been "set up" by the individual emergency flap switches. Each master switch is marked NORMAL and ALTERNATE, and is spring-loaded to return to NORMAL when released. These switches operate the slow speed relays.

Note

When a flap is adjusted to the same position as its symmetrical flap, the synchronizer system (if operative) will maintain synchronization; therefore, any further actuation of either individual selector switch and the master selector switch for that pair will result in movement of both flaps. However, the flap which is individually selected will be operated at slow speed while the flap which is not selected by the individual switch will follow with a jerky motion at fast travel.

LANDING GEAR SYSTEM.

The airplane has a tricycle landing gear consisting of two four-wheel main gears and a two-wheel nose gear. The nose and main gear and the main gear wheel well doors are hydraulically operated. The other fairings are mechanically operated by the movement of the gear.

The main landing gear is designed so a single oleo strut on each main gear cushions the taxiing, take-off, and landing shocks. Each set of dual wheels in the tandem arrangement is attached to the bottom of the main column by a separate axle beam which permits

MAIN LANDING GEAR *Arrangement*

1. OLEO STRUT
2. FILLER PLUG
3. EQUALIZER ASSEMBLY
4. FAIRING
5. POSITIONING JACK
6. AIR VALVE
7. MAIN COLUMN
8. OUTBOARD TRUSS TUBE
9. INBOARD TRUSS TUBE
10. PIVOT SHAFT
11. MAIN DRAG STRUT
12. AUXILIARY DRAG STRUT
13. MAIN ACTUATING CYLINDER
14. AUXILIARY ACTUATING CYLINDER
15. LATCH LINK ROD
16. INDICATOR FLAG
17. LATCH LINK PIN
18. LATCH
19. SIDE BRACE
20. HYDRAULIC SNUBBER
21. FIXED LINK

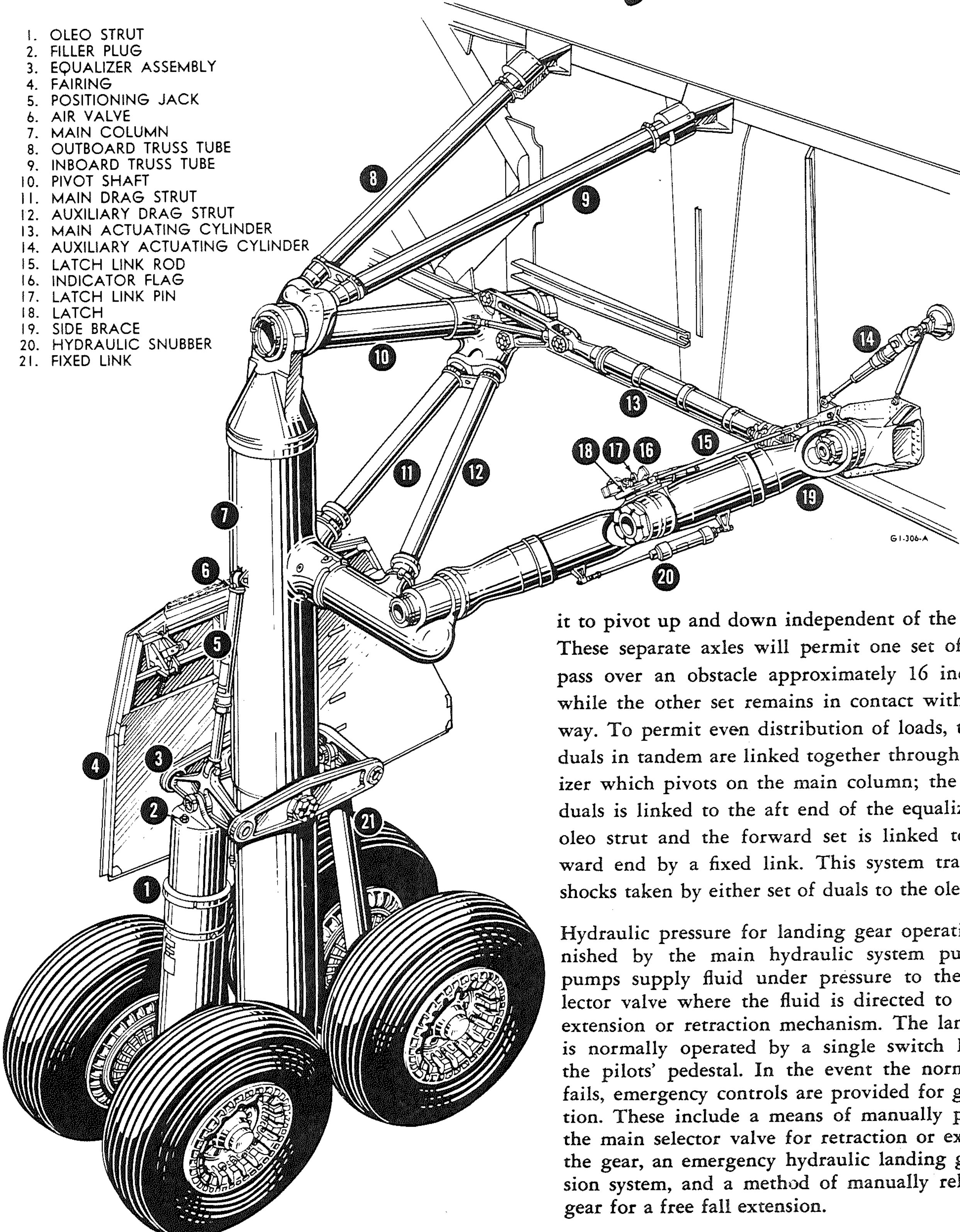


Figure 1-40.

it to pivot up and down independent of the other set. These separate axles will permit one set of duals to pass over an obstacle approximately 16 inches high while the other set remains in contact with the runway. To permit even distribution of loads, the sets of duals in tandem are linked together through an equalizer which pivots on the main column; the aft set of duals is linked to the aft end of the equalizer by the oleo strut and the forward set is linked to the forward end by a fixed link. This system transfers the shocks taken by either set of duals to the oleo strut.

Hydraulic pressure for landing gear operation is furnished by the main hydraulic system pumps. The pumps supply fluid under pressure to the main selector valve where the fluid is directed to either the extension or retraction mechanism. The landing gear is normally operated by a single switch located on the pilots' pedestal. In the event the normal system fails, emergency controls are provided for gear operation. These include a means of manually positioning the main selector valve for retraction or extension of the gear, an emergency hydraulic landing gear extension system, and a method of manually releasing the gear for a free fall extension.

A safety switch, actuated by the oleo strut on the left main gear, prevents gear retraction while the airplane is on the ground. Ground safety locks are provided in the flyaway tool kit. When installed they prevent unlatching of the gear.

NORMAL CONTROLS.

Landing Gear Switch.

The landing gear switch (5, figure 1-14) is located on the pilots' pedestal and has positions marked EXTEND and RETRACT on either side of a center OFF position. When the switch is moved from OFF to RETRACT, both main system hydraulic pumps are started and the main selector valve is positioned to retract the landing gear. When moved from OFF to EXTEND, the switch starts one hydraulic pump and positions the selector valve for landing gear extension.

Note

When the landing gear control switch is moved to EXTEND, a gang bar automatically turns on a brake pump control switch to prevent landing with low brake pressure (Refer to "Brake Pump Switch" of this section.)

The pumps stop operating through the action of the door limit switches which are actuated by the closing of the canoe doors at the completion of the extend and retract cycles. When the switch is placed in the OFF position, the electrical circuit to the pumps is disconnected and the solenoid valves in the selector valve assume their neutral position.

Note

No override switch is provided for the landing gear.

Landing Gear Indicator Lamps.

Two landing gear indicator lamps (29, figure 1-13) are located on the pilots' instrument panel. One lamp is red and the other is green, and they indicate a safe or unsafe condition of the landing gear. (See figure 1-41.)

Warning Horn.

The landing gear warning horn is also used for flap position warning. On some airplanes the horn will sound when any reciprocating engine throttle is retarded below minimum cruise and the landing gear is up and locked; however, if any gear has begun its extend cycle, the horn will not sound. On other air-

LANDING GEAR POSITION *Indications*

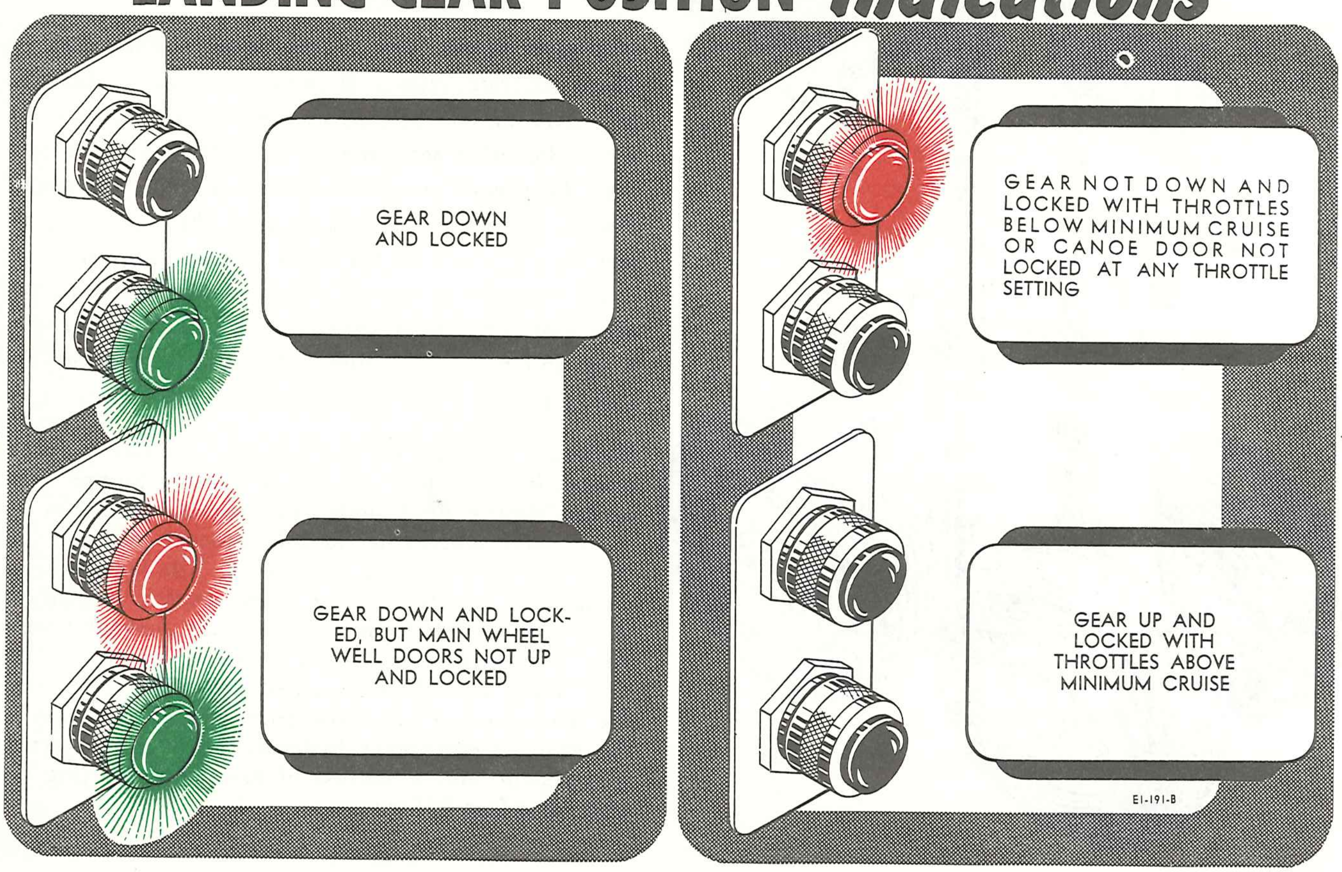


Figure 1-41.

planes the horn will sound when any engine throttle is retarded below minimum cruise and the landing gear is *not* down and locked with both main wheel well doors up and locked. The horn is located in the pilots' pedestal and may be shut off with a switch (16, figure 1-14) located on the pedestal. The sounding of the horn must be stopped each time a single reciprocating engine throttle lever is retarded below minimum cruise.

Note

The landing gear warning and the flap position warning are connected to the horn through separate circuits.

MANUAL SELECTOR CONTROLS.

The main selector valve (figure 3-14) can be operated manually in conjunction with the hydraulic pump override switch to extend or retract the landing gear. A DOWN plunger and an UP plunger are provided on the valve body. When a plunger is depressed, hydraulic pressure is directed to accomplish the selected action. Plungers are also provided for operating the bomb bay doors and nose wheel steering.

MAIN GEAR MANUAL EXTENSION CONTROL.

The main gear may be released manually for a free fall extension through the use of manual controls (figure 3-17) located in each main gear wheel well.

The main gear is locked in both the UP and DOWN positions by a side brace. The side brace pivots on each end, and has a latch-secured breaking point in the center. The breaking point is slightly off-center from the ends, making it possible for the weight of the landing gear to hold the side brace in its locked position. During normal extension the side brace is unlatched and pulled off center by linkage connected to the side brace unlatching jack. During manual extension the hoist accomplishes the same actuation. (Refer to "Manual Extension of Main Landing Gear," Section III.)

Main Gear Door Release Handle.

One of these T-handles is located at the outboard edge of each main gear wheel door. When turned, the handle will unlatch the door for a free fall extension.

WARNING

The handle is attached to the door and will fall when the door is unlatched.

Latch Link Pin.

This pin is painted red and is in the side brace unlatching linkage. Normally this linkage is operated by a hydraulic unlatching jack; however, during manual extension the unlatching linkage is disconnected by pulling out the latch link pin. This prevents the possibility of pressure in the hydraulic system interfering with manual unlatching.

Manual Hoist.

A manual hoist is located above the side brace of each main landing gear. The hoist is operated by a ratchet handle and is rigged with a cable which is attached to a hoist hook. To unlatch and raise the side brace the hoist hook is engaged with a latch release lever and the hoist is operated until the side brace is unlocked and raised.

Latch Release Lever.

A latch release lever is located on the side brace latching mechanism of each main gear. The lever has a fitting to which the manual hoist hook is engaged for unlocking the side brace.

NOSE GEAR MANUAL EXTENSION CONTROLS.

Nose Gear Release Handle.

This release handle (figure 3-19) is located on the floor near the radio operator's station, and when pulled will unlock and allow a free fall extension of the nose gear. (Refer to "Manual Extension of Nose Landing Gear," Section III.)

Nose Landing Gear Emergency Latch Hook.

This latch hook (figure 3-19) stowed on the side of the food locker, is used to operate the latch after an emergency manual extension of the nose gear has been effected.

NOSE WHEEL STEERING SYSTEM.

Nose steering is accomplished by a cable-controlled hydraulic system. (See figure 1-42.) The main components of the system are a steering switch, a 28-volt d-c control circuit, a steering wheel, a directional valve, an actuating cylinder, and control cables. Hydraulic fluid for steering operation is supplied by the main hydraulic system, and pressure is provided by one of the main system pumps. Movement of the steering wheel directs the pressure into the geared actuator which turns the nose wheel. Nose steering hydraulic pressure is indicated on the main hydraulic system pressure gage. A safety switch, installed on the nose gear scissors, renders the steering system inoperative when the nose gear is off the ground.

Note

A safety switch on the left main landing gear also prevents steering when the main gear is off the ground.

When the nose gear leaves the ground and the nose gear strut extends, centering cams are engaged to keep

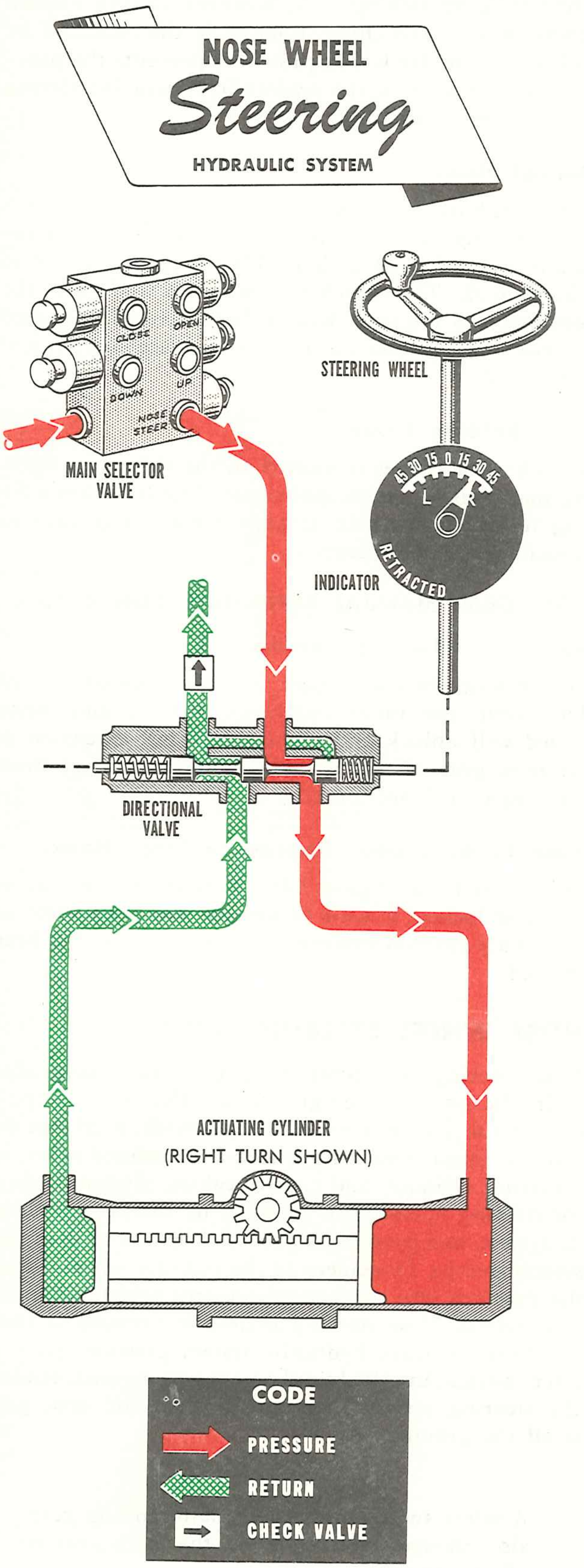


Figure 1-42.

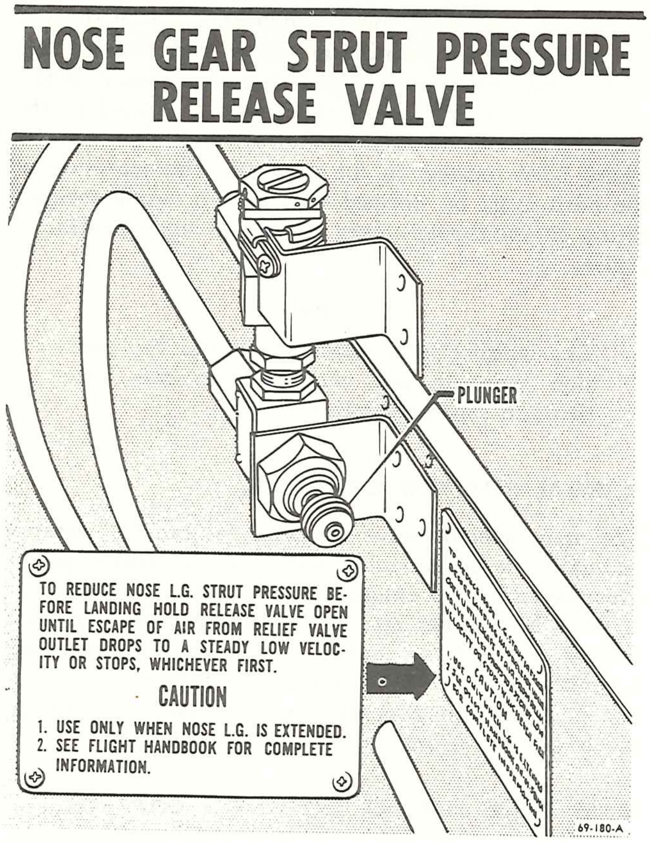


Figure 1-43.

the nose wheel straight during retraction. Upon landing, the cams disengage when the weight of the airplane compresses the strut three inches or more. If the nose gear strut has been heavily charged with air to support a high gross weight at take-off, the weight of the airplane at landing may not be sufficient to compress the strut the required three inches for disengaging the cams. In this condition, the nose gear will remain locked in its center position. Before landing, the strut must be depressurized by the nose gear strut pressure release valve located in the forward turret bay.

CONTROLS AND INDICATORS.

Steering Wheel.

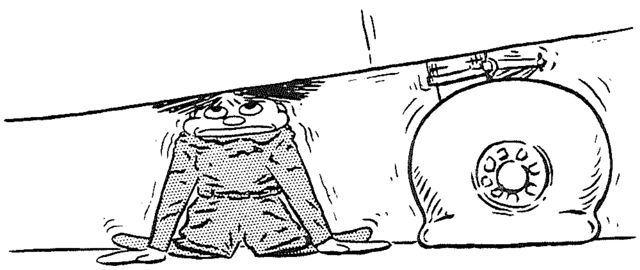
This wheel is located on the aircraft commander's fairing to the left of the aircraft commander's control column and directs the action of the nose gear.

Steering Switch.

This ON-OFF switch (4, figure 1-14) is located on the pilots' pedestal. This switch energizes one of the main hydraulic system pump motors and actuates the main hydraulic system selector valve to provide the pressure required for nose gear steering.

Nose Strut Pressure Release Valve.

The manually operated pressure release valve is provided to reduce the pressure in the nose gear strut in flight. (Refer to "Nose Gear Strut Depressurization," Section VII.) The valve is located just aft and to the right of the forward catwalk entrance hatch and is operated by means of a spring-loaded plunger on the valve body. (See figure 1-43.) When the plunger is held in, pressure will be bled from the strut. When strut pressure has dropped to a value which will permit steering, a relief valve automatically closes. This prevents depressurization below the amount necessary to sustain the weight of the airplane.



C1-246-C

C1-246-C

CAUTION

The relief valve is set to shut off the escape of air at a pressure occurring when the weight of the airplane is NOT on the nose gear. Therefore, to prevent damage to the strut, the nose gear pressure release valve must not be used for depressurizing when the airplane is on the ground. Also, to prevent the loss of hydraulic fluid, do not depressurize while the nose gear is retracted.

Note

Depressurization should be accomplished during approach after the landing gear is extended.

Nose Wheel Steering Indicator.

An indicator is provided adjacent to the nose steering wheel to indicate the direction and degree of deflection of the nose wheel from its center position.

BRAKE SYSTEM.

Each wheel of the main gear is equipped with a hydraulically operated brake. The normal brake system is an independent hydraulic system. (See figure 1-44.)

Note

Emergency brake pressure is provided by an emergency system which is also used for landing gear extension. See "Landing Gear and Brake Emergency Hydraulic System" of this section.

The brake hydraulic system consists of the main brake system and the slave brake system. The main system is the power source for the brakes, and the slave system controls the power source through a brake control valve. The slave brake system extends from the flight deck controls to the main brake system which is located in the bomb bay directly between the two main landing gears. Since the slave system operates on low pressure as compared with the high pressure main system, considerable weight saving is realized and the possibilities of leakage in the main system lines are reduced by the use of long low-pressure lines and comparatively short high-pressure lines.

The slave brake system consists of two pressure reservoirs, a master slave cylinder mechanically connected to each brake pedal, and a slave cylinder which is located in the control valve. When a brake pedal is depressed, the pressure is transmitted from the master slave cylinder to the brake control valve. The brake control valve is positioned by this pressure, allowing main system pressure to pass through the valve to the brakes. The main brake system consists of a reservoir, a pump, an accumulator, and a brake control valve. The accumulator stores pressure for the main system, and accumulator pressure is maintained by the 208-volt a-c motor-driven pump. Normal system pressure is from 850 to 1025 psi. Pump motor power is controlled by a 28-volt d-c circuit through the brake pump switch on the pilots' pedestal. A pressure switch installed in the control circuit will close the circuit to start pump operation when the accumulator pressure drops to 850 to 900 psi. In the event of a malfunction in the control circuit, the pump can be operated by the pump pressure override switch, located on the engineers' table. The pressure switch also has a set of contacts which control power to the low brake pressure warning light. These contacts close when the pressure falls below 825 psi.

BRAKE CONTROLS AND INDICATORS.

Brake Pump Switch.

This switch (5, figure 1-14) controls the normal operation of the brake pump motor. To prevent landing with low brake pressure, a gang bar will move the brake pump switch to the ON position when the landing gear control switch is placed in the EXTEND position. In flight, however, the switch must be moved to the OFF position to minimize pump wear, as the gang bar control is not effective when the landing gear control switch is moved to RETRACT.

Parking Brake Lever (Some Airplanes).

The parking brake lever is located on the pilots' pedestal and controls the parking brake valve for applying accumulator pressure to the brakes.

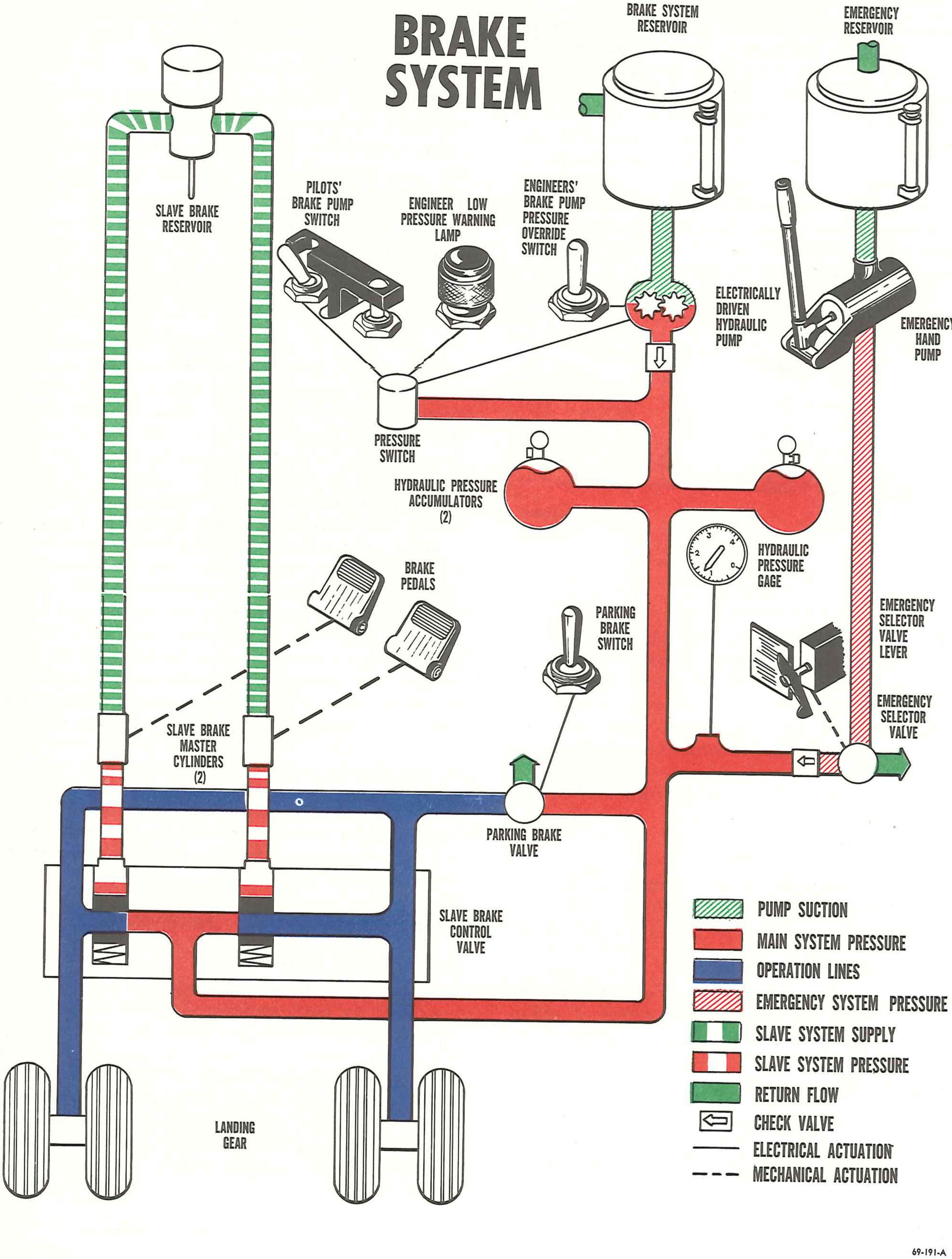

BRAKE SYSTEM
BRAKE SYSTEM RESERVOIR
EMERGENCY RESERVOIR
SLAVE BRAKE RESERVOIR
PILOTS' BRAKE PUMP SWITCH
ENGINEER LOW PRESSURE WARNING LAMP
ENGINEERS' BRAKE PUMP PRESSURE OVERRIDE SWITCH
ELECTRICALLY DRIVEN HYDRAULIC PUMP
EMERGENCY HAND PUMP
PRESSURE SWITCH
HYDRAULIC PRESSURE ACCUMULATORS (2)
BRAKE PEDALS
HYDRAULIC PRESSURE GAGE
PARKING BRAKE SWITCH
EMERGENCY SELECTOR VALVE LEVER
EMERGENCY SELECTOR VALVE
SLAVE BRAKE MASTER CYLINDERS (2)
PARKING BRAKE VALVE
SLAVE BRAKE CONTROL VALVE
LANDING GEAR
PUMP SUCTION
MAIN SYSTEM PRESSURE
OPERATION LINES
EMERGENCY SYSTEM PRESSURE
SLAVE SYSTEM SUPPLY
SLAVE SYSTEM PRESSURE
RETURN FLOW
CHECK VALVE
ELECTRICAL ACTUATION
MECHANICAL ACTUATION
69-191-A

Figure 1-44.

CAUTION

On those airplanes equipped with a brake line gage fuse, the *parking brakes* are inoperative when the fuse is blown. Pressure is available for foot brakes although no pressure is indicated on the gage.

Parking Brake Switch (Some Airplanes).

The parking brake switch (18, figure 1-14), with positions BRAKE ON and BRAKE OFF, is located on the pilots' pedestal and electrically controls the parking brake valve for applying accumulator pressure to the brakes.

Brake Pump Pressure Override Switch.

This spring-loaded switch (4, figure 1-36) is provided to energize the brake pump motor in the event the normal brake pump control circuit fails. If the brake pressure gage or warning lamp indicates low brake pressure when the brake pump switch is ON, system pressure can be brought within operating range by holding the override switch in the ON position.

CAUTION

Since the brake pump will operate continuously when the override switch is held ON, the switch must be released when the pressure is within operating range.

Pressure Gage.

Hydraulic pressure for the brake system is indicated on the hydraulic pressure gage (6, figure 1-36) located on the engineers' table. A gage is also located beneath each accumulator.

Low Pressure Warning Lamp.

A low pressure warning lamp (5, figure 1-36) is located adjacent to the brake hydraulic pressure gage and gives a warning when brake pressure falls below normal.

INSTRUMENTS.

Reciprocating engine instruments are located at the engineers' station. In addition, a master tachometer and manifold pressure gage are provided for the pilots. The pilots' manifold pressure gage is for No. 4 engine only.

Fuel pressure, water pressure, oil pressure, torque pressure, manifold pressure, and fuel flow indications are supplied by autosyn transmitters. The transmitters and indicators operate on current fed from transformers which step down 115-volt alternating current.

Autosyn-type reciprocating engine instruments on some airplanes operate on current from a transformer in the wing adjacent to each nacelle. Other airplanes are equipped with the regular type of autosyn instruments and more sensitive type. Both types operate on current supplied by a single transformer on bulkhead 4.0 adjacent to the radio operator's station.

A two-position switch marked NORMAL and ALTERNATE is located on the instrument fuse panel. This switch permits transferring to an alternate transformer, also adjacent to the radio operator's station, in case the one being used fails. The fuse panel is located on the upper right side of the radio operator's station.

On airplanes not in group 1 anti-icing air temperature readings are obtained from a battery-operated master temperature indicator located at the engineers' station. Airplanes in group 1 have five anti-icing air temperature gages located at the engineers' station. Six cylinder head temperature indicators are located on the engineers' main instrument panel.

The jet engine instruments which include an oil pressure gage, an engine tachometer, a fuel pressure gage, and a tail pipe temperature indicator for each engine are located at the pilots' station. The jet engine fuel flow indicators are at the engineers' station. The instruments are fed from transformers on the jet pod power panels.

All gyroscopic instruments are electrically powered. Control switches are provided for turning off the directional gyro at the navigator's station and the gyro horizon and vertical and directional gyros at the pilots' station. Airplanes in group 1 have a pair of ganged switches on the navigator's instrument panel for turning off the N-1 high latitude compass.

TORQUEMETER INDICATORS.

Torquemeters are located on the engineers' main instrument panel. Dual indicating instruments are provided in some airplanes; other airplanes are equipped with single indicating instruments (12, figure 1-16). These torquemeters provide a convenient and accurate bhp determination based on easily measured quantities. For further information refer to "Torquemeter," Section VII.

PITOT STATIC SYSTEM.

The airplane contains two pitot static systems. Each system consists of a pitot head, two static ports, pitot static instruments, and necessary drains. Pitot heads are located on each lower side of the forward position of the fuselage, and static pressure ports are located just forward of the camera compartment on each side of the airplane for each system. One system, with the pitot head on the right side of the airplane, contains the engineers' altimeter and air-speed indicator, the pilot's rate-of-climb indicator, altimeter, and air-speed indicator, the weather-observer's altimeter, the photographer's true air-speed indicator and altimeter, and the vertical camera altimeter. The other system, with pitot head on the left side of the airplane, contains the aircraft commander's rate-of-climb, altimeter, and air-speed indicators; the navigator's true air-speed indicator, altimeter, the aerograph equipment, the radar observer's true air-speed indicator, and the altitude control unit.

Air-Speed Indicators.

Conventional air-speed indicators are provided for the aircraft commander and the engineer. True air-speed indicators are located at the photo-navigator's and photographer's stations. The pilot is provided with a maximum allowable air-speed indicator which has two pointers. The red pointer indicates the limit dive speed in mph or the limiting Mach number, whichever is lower. These limiting air speeds are indicated by the red line in figure 6-5. The other pointer is a conventional air-speed indicator and a window in the instrument shows the Mach setting. The pointers should not be permitted to cross each other, as it would be an indication of operation in excess of safe speeds.

OUTSIDE AIR THERMOMETERS.

The following stations are equipped with type C-13B direct-reading outside air thermometers: pilots, engineer, photo-navigator, and photographer. These instruments indicate outside air temperature in degrees centigrade.

MASTER TEMPERATURE INDICATOR (AIRPLANES NOT IN GROUP 1).

A flashlight battery-operated potentiometer-type temperature indicator (8, figure 1-19) is located on the engineers' auxiliary instrument panel. This instrument is used to obtain temperature readings from anti-icing air ducts.

Master Temperature Indicator Selector Switch.

This switch is used to select the particular engine for which the cylinder head, anti-icing air, or constant-speed drive oil temperature is to be determined.

Master Temperature Indicator Switch.

This ON-OFF switch controls the power from the flashlight batteries.

Check Switch.

This two-position switch, marked CH and ON, places the galvanometer in the check circuit.

Compensating Rheostat Knob.

This rheostat marked COMP. RHEO. adjusts compensating current when the check switch is in the CH position.

Balance Knob.

The balance knob is used to zero the galvanometer pointer when the check switch is in the ON position.

Slide Wire Rheostat Knob.

This rheostat, marked SL. W. RHEO., is turned clockwise when the galvanometer cannot be zeroed with the balance knob. Normally, it is adjusted to remain as far counterclockwise as possible while still maintaining full scale balancing with the balance knob.

Galvanometer Pointer.

When the check switch is placed in the CH position, the galvanometer pointer functions as a milliammeter and measures the necessary amount of compensating current required to obtain an accurate temperature indication on the potentiometer. When the check switch is in the ON position, the galvanometer mechanism is in series with the themocouple circuit and serves as a galvanometer.

Main Indicator Pointer.

This pointer acts as a direct reading temperature gage.

Battery Receptacles.

The master temperature indicator receives its power from the flashlight batteries installed in receptacles located in the upper corners of the instrument. Two spare batteries are stored in a container in back of the indicator.

CYLINDER HEAD TEMPERATURE INDICATORS.

Six cylinder head temperature gages (11, figure 1-16) calibrated in degrees centigrade are located at the engineers' station. Resistence bulbs are located in cylinders D1 and D6 of each engine. Selection of a cylinder for a temperature reading is made by means of a rotary selector switch (28, figure 1-16) marked D1 and D6. These cylinder head temperature gages operate on 115-volt alternating current.

FLIGHT INSTRUMENT SWITCHES.

A pair of ganged on-off switches (15, figure 1-13), is located on the left side of the pilots' instrument panel, and one three-position switch (15, figure 1-13) is on the right side. When the pair of ganged switches on the left side of the panel is placed in the ON position the aircraft commander's attitude gyro is energized from a transformer which has an input of 208-volt, three-phase, a-c power. When the single switch on the right side of the panel is placed in the ON position the pilot's attitude and directional gyros are energized from a transformer which has an input of 208-volt, three-phase, a-c power. Placing the pair of

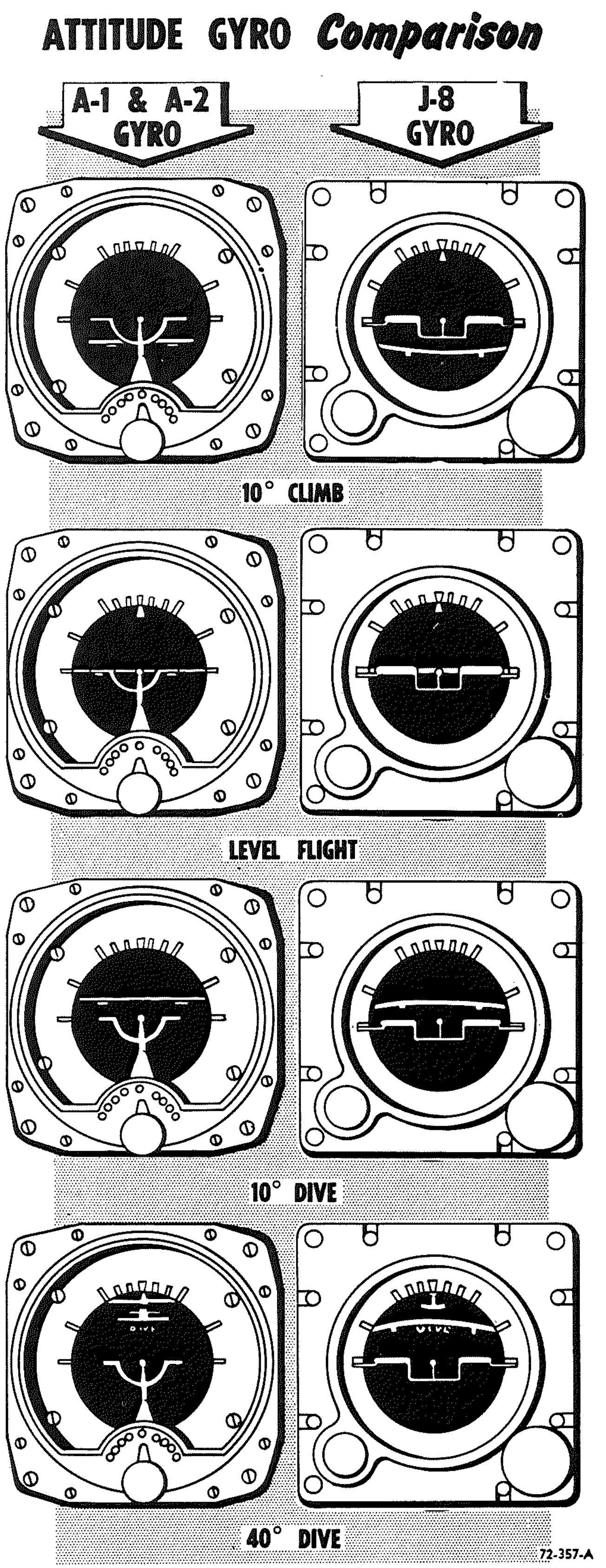


Figure 1-45.

switches or the single switch in the OFF position disconnects the related instrument from electrical power.

Note

Both turn and bank indicator needles operate automatically on 28-volt direct current through the pilot's circuit breaker panel. Fundamental flight instruments (needle, ball, and air-speed) should therefore be available during emergency power operation as long as battery power exists.

The single switch on the right side of the panel connects 208-volt ac to a transformer which routes 115-volt ac to the directional gyro and the pilot's gyro horizon. When this switch is ON the power comes through the right forward cabin power panel; when the EMERGENCY position is used, power comes through the engineers' auxiliary instrument panel. Both instruments can be disconnected by the OFF position when they are not in use.

JET ENGINE INSTRUMENTS.

Tail Pipe Temperature Indicators.

Four tail pipe temperature indicators (38, figure 1-13), one for jet engine, are located on the pilots' jet instrument panel.

Engine Tachometers.

Four engine tachometers (37, figure 1-13), one for each jet engine, are located on the pilots' jet instrument panel.

NAVIGATOR'S DIRECTIONAL GYRO CONTROL SWITCH.

This two-position ON-OFF switch (8, figure 4-40) controls the operation of the directional gyro on the navigator's instrument panel.

ATTITUDE GYRO INDICATOR.

Some airplanes are equipped with A-1 (or A-2) attitude gyros. Other airplanes have J-8 indicators. These instruments (5, figure 1-13) operate on 115-volt, 3-phase, a-c power and they provide visual indications of the pitch and roll attitude of the airplane. The gyro of these instruments is enclosed in a sphere, a portion of which is visible through the opening in the face of the instrument. On the J-8 indicator, a flag marked OFF appears at the top of the instrument when the power is off. When the instrument is turned on, the OFF flag disappears. On the A-1 or the A-2 indicator, a blinker light in a small opening of the sphere flashes about 66 times per minute to indicate power is being supplied to the unit and that the gyro is up to speed.

The indications of these two types of instruments may be confusing since the presentation of pitch differs. (See figure 1-45.)

1. On the A-1 and A-2 instruments, a horizon bar presents a conventional pitch indication—the miniature airplane appearing above the horizon bar in a climb and below the horizon bar in a dive. However, in a climb or dive exceeding 27 degrees of pitch, the horizon bar stops at the bottom or top of the instrument case and the sphere then becomes the reference.

2. On the J-8 indicator, the pitch attitude of the aircraft is indicated within a range of about 25 degrees climb or dive by displacement of the horizon bar with respect to the adjustable attitude bar. When the aircraft exceeds approximately 25 degrees in pitch, the horizon bar is held in the extreme position and the sphere becomes the reference. As the pitch angle increases, the word DIVE or CLIMB appears on the sphere at the top or the bottom (respectively) of the dial. When the DIVE or CLIMB indication intersects the attitude bar, approximately 60 degrees of pitch has been reached.

CAUTION

Allow sufficient time for the gyros to come up to speed and erect before relying on their indications. For A-1 or A-2 gyros, 8 to 13 minutes is required. For J-8 gyros about 3-1/2 minutes wait is necessary.

ENGINE ANALYZER.

Ignition Analysis.

The engine analyzer is designed to detect, locate, and identify abnormalities in the operation of the reciprocating engines. It performs these functions by presenting patterns on the screen of a cathode-ray tube, of voltages across the primary circuits of the magnetos. By use of the analyzer, the engineer can keep the reciprocating engines under constant surveillance during flight and thereby determine the severity of any engine malfunctions and make the required adjustments. He can also detect and analyze troubles peculiar to high altitude which could not be normally discovered during ground checks. Any decision on the feathering of an engine as a result of analyzer observations should include consideration of normal engine instrument indications. The engine analyzer checks the performance of the magneto coils, condensers, and break points; it checks magneto timing, breaker point synchronization, and spark advance; it checks the operation of the spark plugs and distributors; and it checks the condition of the spark plug leads and ignition harnesses. During normal operation, an ignition system establishes a characteristic pattern and any malfunction in the system will alter this pattern. Since malfunction patterns are also characteristic of the malfunction, they serve to identify the specific nature of the trouble.

The basic components of the engine analyzer consist of a synchronizing generator for each engine, a condition selector switch, a cycle switch, a power supply and amplifier, and an indicator. The analyzer control panel is located adjacent to the engineers' main instrument panel and the indicator is flush mounted in his table.

Note

Resistors are provided in analyzer electrical circuits to automatically isolate the analyzer system from the engine, so that a malfunction in the analyzer will not interfere with engine operation.

Controls.

Condition Selector Switch. A condition selector switch (19, figure 1-16) located on the engine analyzer control panel is used to select the particular engine to be analyzed and the type of analysis; ignition (left, right, or both magnetos), or engine rpm synchronization. The condition selector switch consists of a fixed index ring surrounding a dial. The index ring is divided into three general sectors which are engraved as follows:

1. The first sector is marked SYN, 2, 3, 4, 5, and 6, for selecting any of these engines to check their rpm synchronization with the rpm of engine No. 1.

2. The second sector, marked 1, 2, 3, 4, 5, and 6, is used for selecting an engine. The inner radius of this sector has designations L, B, and R opposite each engine number for selecting left, both, or right magnetos when making an ignition analysis.

3. The third sector, marked PULL BUTTON FOR VIBRATION, is not used except for this notation which refers to the push-pull knob centrally located on the dial. This knob must be pushed IN to select ignition analysis.

Cycle Selector Switch. The cycle selector switch (23, figure 1-16), located on the analyzer control panel, is marked as follows:

1. A fixed index ring is inscribed with symbols corresponding to cylinder designations of an engine.

2. A dial, with an index line labeled IGN, is divided into four quadrants representing the four strokes of a reciprocating engine. Around the periphery of the dial at specific points are designations EC, IO, IC, and EO which are abbreviations for valve operations occurring during the engine cycle. For ignition analysis, only the IGN index line is used.

3. A push-pull knob, located in the center of the dial, selects a fast sweep when pushed IN, and a slow sweep when pulled OUT. To select a cylinder for ignition analysis, place the IGN index line op-

posite the cylinder designation. If the push-pull knob is OUT for a slow sweep, all four ignition patterns for one magneto will appear. The pattern of the selected cylinder will appear first in the series followed by the others in the order of firing of that magneto. If the knob is pushed IN for a fast sweep, only the significant oscillatory portion of a single ignition pattern will appear. This pattern is expanded at the expense of eliminating some of the trailing portion of the pattern including the section at which the breaker points close.

Engine Analyzer Power Switch. This ON-OFF switch-type circuit breaker (24, figure 1-16) located on the analyzer control panel is used to turn the system ON and OFF.

Indicators.

Engine Analyzer Indicator. The engine analyzer indicator (20, figure 1-21) consists of a three-inch cathode-ray tube mounted on the engineers' table.

EMERGENCY EQUIPMENT.

RECIPROCATING ENGINE FIRE EXTINGUISHER SYSTEM.

An electrically operated fire extinguisher system is provided for combating reciprocating engine fires.

Note

The jet engines are not equipped with an extinguisher system.

The system is controlled by 28-volt direct current and uses either methyl bromide or bromochloromethane as the extinguishing agent. The controls are located at the engineer's station and consist of one discharge selector switch and six engine selector switches.

Some airplanes are equipped with a two-shot system. The extinguishing agent is stored in four metal containers, two in each main gear wheel well. Each pair of containers constitutes a discharge and a discharge can be directed to any engine. The pair of containers to be discharged is determined by the position of the discharge selector switch. Each engine selector switch discharges the selected containers and directs the discharge to the proper engine. In this system, the supply lines extend to engines No. 1 and 6. Four directional valves are provided to divert the discharge to engines No. 2, 3, 4 and 5. Normally, the supply line to the left wing is open; therefore when engines No. 4, 5 or 6 is selected, an additional directional valve opens the line to the right wing and closes the line to the left wing.

Other airplanes have an improved extinguisher system. (See figure 1-46.) This system consists of two separate systems — one for the left wing and one for the right. Two containers are installed between the inboard and center engines in each wing. Each pair of bottles is connected to the three engines in its related wing. One bottle constitutes a discharge. Each wing system has two directional valves which divert the discharge to the inboard and center engines. A wing selector relay is provided in the control circuit. When the relay is unenergized, a left wing container is selected for discharge. If engine No. 4, 5 or 6 is selected, the relay is energized to select a right wing container.

Note

All of the directional valves in both the two-shot system and the improved system are spring-loaded. During operation they are positioned electrically at first; then they are held in position by discharge pressure. For this reason, the engine selector switch should be held for approximately 5 seconds to insure pressure at the affected valve. A relay is provided to delay the discharge for about 1/10 second to allow time for positioning of the affected directional valve.

Discharge Selector Switch.

The discharge selector switch is marked DISCHARGE 1 and DISCHARGE 2. On airplanes with a two-shot system, this switch permits the selection of either of the two banks of extinguishing agent containers for discharge. On airplanes with the improved system, the switch selects one container in each wing for discharge; however, only the selected container in wing of the affected engine will be discharged.

Reciprocating Engine Selector Switches.

Six reciprocating engine selector switches are located on the engineer's control panel. On airplanes with a two-shot system, the switches are used to discharge the selected containers and, at the same time, to position the directional valves to direct the flow of extinguishing agent to the proper reciprocating engine. On airplanes with the improved system, this switch discharges the bottle selected in the affected wing.

RECIPROCATNG ENGINE FIRE DETECTOR SYSTEM.

Each reciprocating engine nacelle is furnished with equipment for detecting the presence of fire. On some airplanes, thermocouples located in potential fire areas of the nacelle are the fire-sensitive units of the system. If a thermocouple is subjected to an abnormally rapid rise in temperature, it generates a very low voltage. This voltage energizes a relay which connects 28-volt direct current to an indiactor lamp on the engineers' panel, lighting the lamp. Since the thermocouples are sensitive only to rapid rates of change in temperature, gradual temperature increases resulting from engine warm up or power runs will not cause a warning indication.

Some airplanes are equipped with a continuous cable-type detector system. A continuous cable is routed in loops through the engine, exhaust, and accessory areas

RECIPROCATING ENGINE FIRE EXTINGUISHER *System*

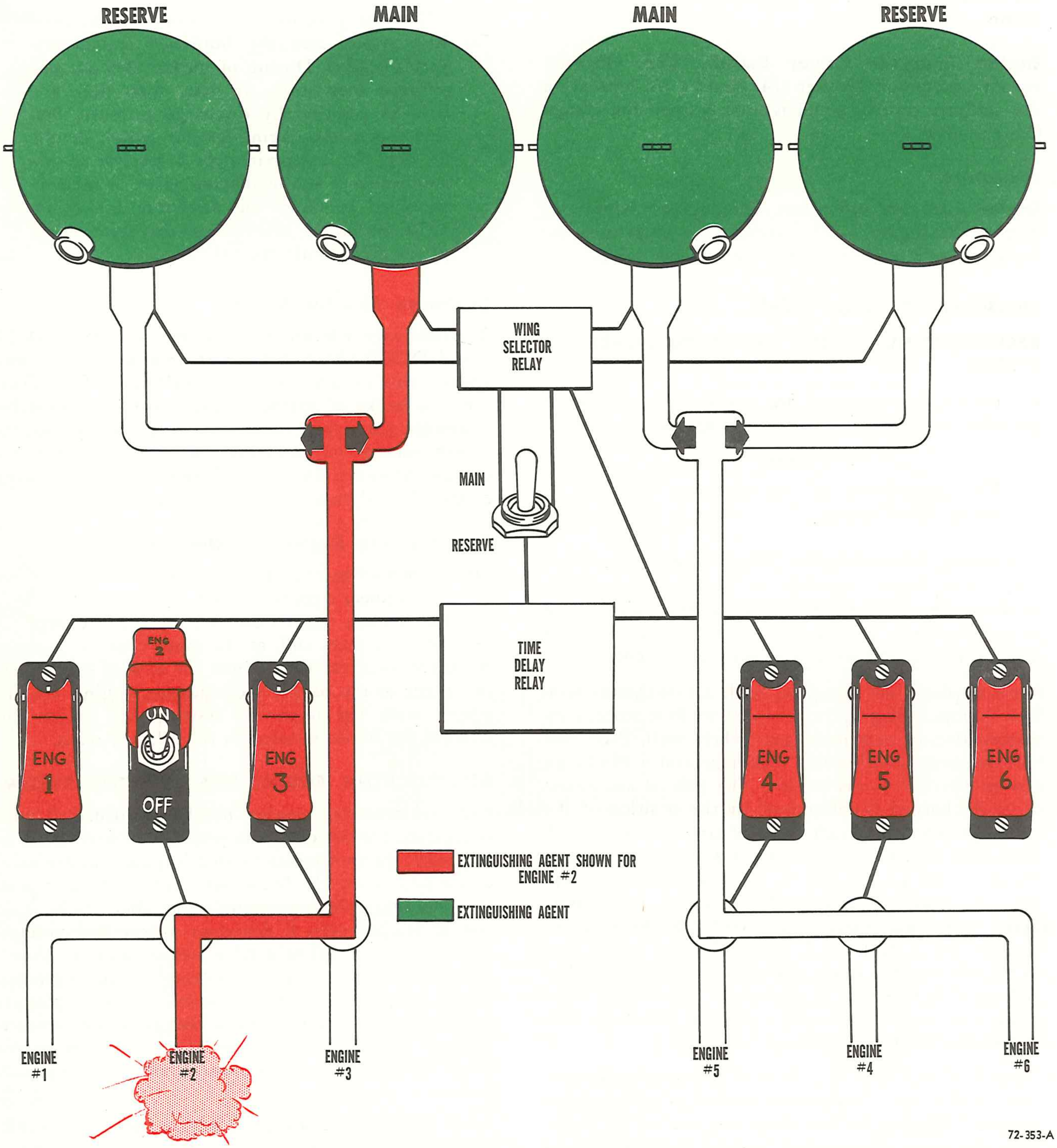


Figure 1-46.

of each reciprocating engine nacelle. The cable serves as the sensing element and it reacts to temperature changes of a critical value anywhere along its route. Whenever a temperature change of this type occurs, the compound in the cable at the affected point decreases in resistance allowing single phase, 115-volt a-c power to flow from the cable core to the cable casing which is grounded. This flow of current closes a relay to light the corresponding fire warning lamp.

Reciprocating Engine Fire Warning Lamps.

On airplanes with thermocouple-type detector equipment, twelve fire warning lamps (35, figure 1-20), two for each nacelle, are provided on the engineers' control panel to give the engineer visual indication of a nacelle fire. An identical set (2, figure 1-16) of lamps is also located on the pilots' main instrument panel. A push-to-test fire detector switch is provided to test the continuity of the detector circuit in each nacelle to the fire warning lamps.

Airplanes with a cable-type detector system have six warning lamps, one for each nacelle, located on the engineers' main instrument panel. A push-to-test switch, provided adjacent to the lamps, is used to check the continuity of all six detector circuits simultaneously.

WARNING

Never ignore an alarm indication. Inability to obtain a warning during test proves only that the system is not in perfect condition, but not that it is completely inoperative.

JET ENGINE FIRE DETECTOR SYSTEM.

The fire detector system on each jet engine consists of ten cartride-type detector units strategically located in potential fire zones. The units are calibrated to close electrical contacts when subjected to a predetermined temperature. In event of a fire, when this temperature is reached, the 28-volt d-c circuit to a warning lamp on the jet control panel will be completed and the lamp will light.

Jet Engine Fire Detection Switches.

Two two-position switches (27, figure 1-15), one for each pair of jet engines, are located on the pilots' overhead control panel. When the switches are in the ON position, the fire detector circuits to the jet nacelles are set up. Placing the switches in the TEST position checks the continuity of the circuits from the nacelles to the warning lamps.

Jet Engine Fire Warning Lamps.

Four fire warning lamps (26, figure 1-15), one for each jet engine, are located on the pilots' overhead jet control panel. The lamps give a visual indication of jet engine fires. An additional set of jet engine fire warning lamps (39, figure 1-13) is located on the pilots' instrument panel.

ALARM BELLS.

An alarm bell is located in each crew compartment. The bells are controlled by an ON-OFF switch (20, figure 1-13) on the pilots' instrument panel and use 28-volt d-c power from the airplane's battery.

PARACHUTE STATIC LINES.

Parachute static lines are located as follows: one forward of the left lower emergency exit hatch in the forward cabin, one near the entrance hatch in the camera compartment, and one forward of the main entrance hatch in the aft cabin.

EMERGENCY HATCHES.

Ten emergency escape hatches are provided in the airplane—six in the forward cabin and four in the aft cabin. Refer to "Forced Landings," Section III, for their location and method of removal. Also see "Bail-Out," Section III, for recommended bail-out exits. In addition to the escape hatches, provisions are made for opening the forward turret bay doors for use as an emergency exit.

Forward Turret Bay Door Switch.

This switch is provided to operate the forward turret bay doors and is located on the equipment shelf adjacent to the catwalk entrance hatch in the radio operator's compartment. The switch has an OPEN position, an OFF position, and a spring-loaded CLOSE position. Placing the switch in the OPEN position or holding it in the CLOSE position supplies 28-volt direct current to the turret door motor reversing relays. These relays supply 208-volt a-c power to the turret door motors which move the doors to the position selected.

Forward Turret Bay Door Close Indicator Lamps.

Two turret bay door close indicator lamps, one for each door, are located adjacent to the turret door switch. The lamps will light when the doors reach their full-closed position and will go out when the turret door switch is released. The lamp will glow any time the doors are fully closed and the switch is held in the CLOSE position.

EMERGENCY ESCAPE ROPES (SOME AIRPLANES).

Emergency escape ropes are located in the crew compartment of some airplanes to provide a means for emergency escape of personnel to the ground after crash landings. The ropes are located at the left forward escape hatch in the forward compartment, at the right and left lower scanners' stations and the entrance hatch in the aft cabin, and at the emergency escape hatch in the camera compartment.

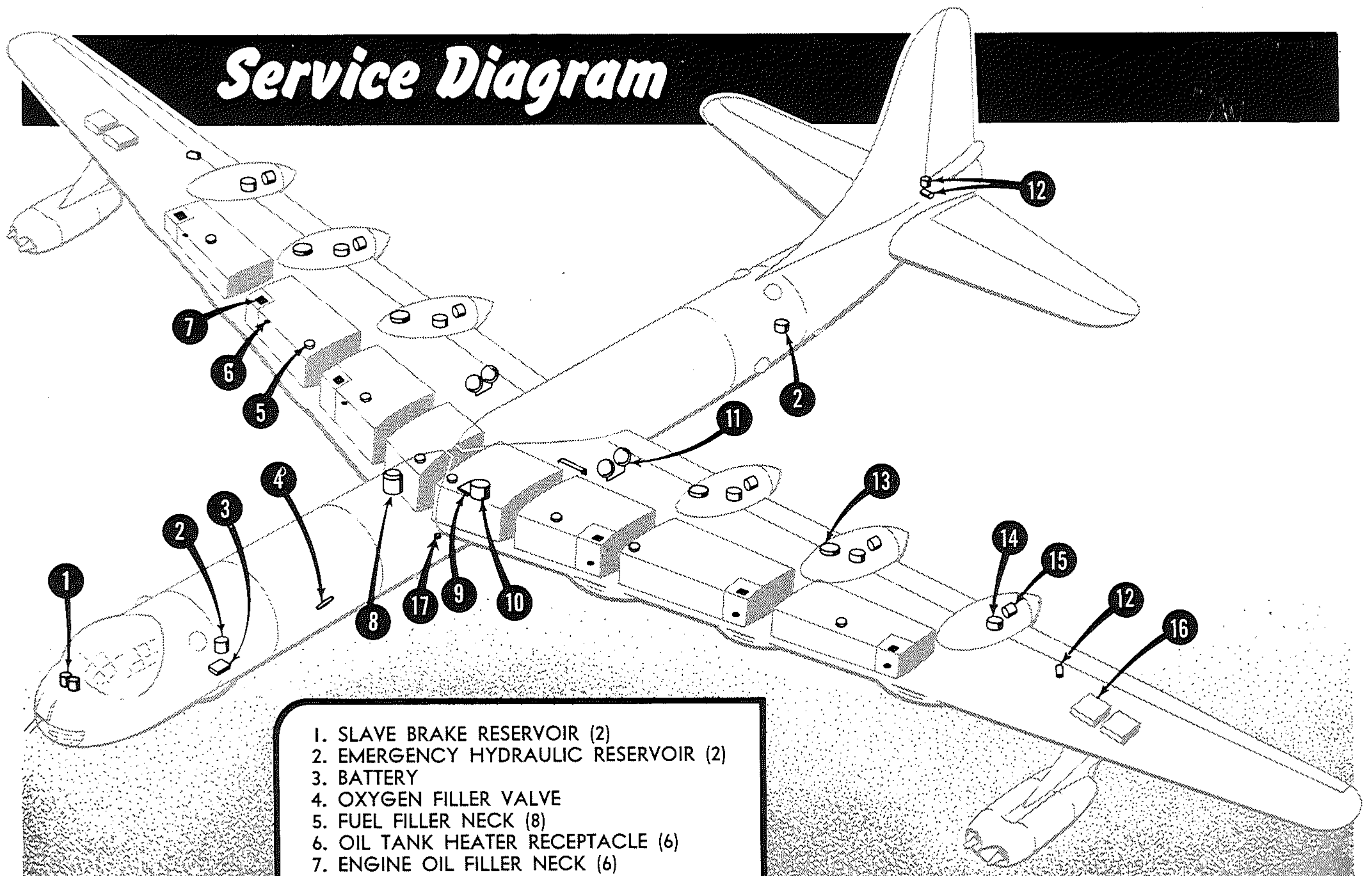
SURVIVAL SUITS.

Hooks are provided at each crew station for the stowage of survival suits.

LIFE RAFTS.

No emergency sea equipment is provided. When the

Service Diagram



1. SLAVE BRAKE RESERVOIR (2)
2. EMERGENCY HYDRAULIC RESERVOIR (2)
3. BATTERY
4. OXYGEN FILLER VALVE
5. FUEL FILLER NECK (8)
6. OIL TANK HEATER RECEPTACLE (6)
7. ENGINE OIL FILLER NECK (6)
8. MAIN HYDRAULIC RESERVOIR
9. EXTERNAL POWER RECEPTACLE
10. BRAKE SYSTEM RESERVOIR
11. FIRE EXTINGUISHING CONTAINER (4)
12. LOCK CYLINDER RESERVOIR (4)
13. CONSTANT SPEED DRIVE OIL RESERVOIR (4)
14. TURBO OIL RESERVOIR (6)
15. WATER INJECTION WATER TANK (6)
16. JET ENGINE OIL TANK (4)
17. PRESSURE REFUELING VALVE

FLUID	SPEC NO.	GRADE
FUEL		
RECIPROCATING AND JET ENGINES	MIL-F-5572	115/145
OIL		
RECIPROCATING ENGINES	MIL-L-6082	*1100 OR 1120
JET ENGINES & TURBOSUPERCHARGERS		
FOR OAT. ABOVE – 20°F	MIL-O-6081	1010 OR 1005
FOR OAT. BELOW – 20°F	MIL-O-6081	1005
CONSTANT SPEED DRIVE	MIL-L-6387	
*USE 1120 ONLY AS AN EMERGENCY PROCEDURE WHEN 1100 IS NOT AVAILABLE		
HYDRAULIC FLUID		
ALL HYDRAULIC SYSTEMS	MIL-O-5606	——
WATER INJECTION		
OAT. ABOVE –40°F 50% ALCOHOL 50% DISTILLED WATER	MIL-A-6091	——
OAT. BELOW 40°F 60% ALCOHOL 40% DISTILLED WATER	†O-M-232	A
†USE MIL-A-6091 ONLY WHEN 0-M-232 IS NOT AVAILABLE		
FIRE EXTINGUISHING AGENT		
METHOL BROMIDE	O-M-261	——
BROMOCHLOROMETHANE	MIL-B-4394	——

FLUID CAPACITIES (GALS.)

SYSTEMS	RESERVOIR	TOTAL SYSTEM
BOMB DOOR, LANDING GEAR & NOSE STEERING	6.70	20.28
BOMB DOOR EMERGENCY	.87	1.93
BRAKE (MAIN)	4.00	8.66
BRAKE (SLAVE)	.03	1.36
BRAKE & LANDING GEAR EMERGENCY	2.30	2.86
CONSTANT SPEED DRIVE	——	3.75
CONTROL LOCKS	.33	.37
TURBO	——	3.00

73-160-A

Figure 1-47.

mission requires such equipment, life rafts will be issued to the crew.

HAND FIRE EXTINGUISHERS.

The airplane is equipped with six hand fire extinguishers. In the forward cabin one type 4-TB extinguisher is left of the engineers' station and one type A-20 is to the right of the ECM equipment. In the camera compartment one type 4-TB extinguisher is mounted on the right aft side and one type A-20 on the left side of the compartment. In the aft cabin a 4-TB extinguisher is mounted on the left side and a type A-20 on the right side of the cabin.

The A-20 extinguishers are charged with bromochloromethane and can be used on any type of fire.

WARNING

Repeated or prolonged exposure to high concentrations of bromochloromethane (CB) or decomposition products should be avoided. CB is a narcotic agent of moderate intensity but of prolonged duration. It is considered to be less toxic than carbon tetrachloride, methyl bromide, or the usual products of combustion. It is safer to use than previous fire extinguishing agents; however, normal precautions should be taken including the use of oxygen when available.

HAND AXES AND KNIVES.

Provisions have been made for installing a panel containing a hand axe and a knife in each crew compartment. One location is above the food locker in the forward cabin, one is on the left side of the camera compartment, and one is on the right side of the aft cabin.

FIRST AID KITS.

The airplane is equipped with eleven first aid kits. In the forward cabin the kits are located as follows: one near the food locker, one above the photo-navigator's table, one near the left escape hatch, one near the ECM equipment racks, and one under the flight engineers' table. Two kits are located on the left side of the camera compartment. The aft cabin contains four kits, three under the sighting platform and one on the forward bulkhead.

BATTLE SPLINT AND BLOOD PLASMA KITS.

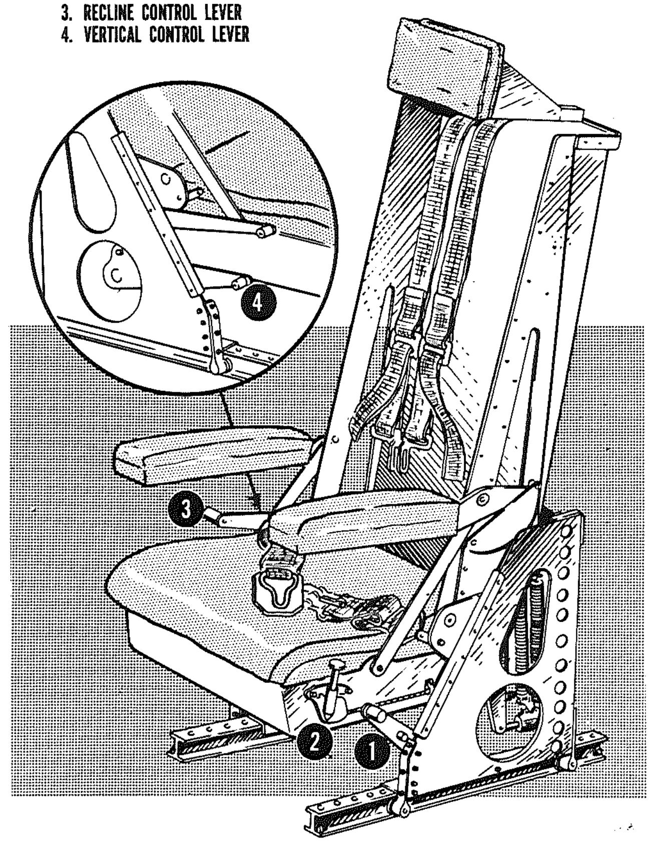
Four battle splint and four blood plasma kits are located as follows: one each near the left escape hatch in the forward cabin, one each on the left side of the camera compartment, and one each under each upper sighting station in the aft cabin.

PILOTS' SEATS.

The pilots' seats (figure 1-48) are provided with fore-and-aft, vertical, and angular adjustments and have arm rests which retract to permit easy movement into and out of the seats. In addition each seat is equipped with an inertia reel lock-type shoulder harness for the protection of the occupant.

Pilots' SEAT

1. FORE AND AFT CONTROL LEVER
2. SHOULDER HARNESS LOCK LEVER
3. RECLINE CONTROL LEVER
4. VERTICAL CONTROL LEVER



77-141-A

Figure 1-48.

Shoulder Harness Control.

A two-position LOCKED-UNLOCKED shoulder harness inertia reel lock control is located on the left side of the pilots' seats. A latch is provided for positively retaining the control handle at either position of the quadrant. By pressing down on the top of the control handle, the latch is released and the control handle may then be moved freely from one position to another. When the control is in the UNLOCKED position, the reel harness cable will extend to allow the pilot to lean forward; however, the reel harness cable will automatically lock when an impact force of 2 to 3 g's is encountered. When the reel is locked in this manner, it will remain locked until the control handle is moved to the LOCKED and then returned to the UNLOCKED position. When the control is in the LOCKED position, the reel harness cable is manually locked so that the pilot is prevented from bending forward. The LOCKED position is used only when a crash landing is anticipated. This position provides an added safety precaution over and above that of the automatic safety lock.

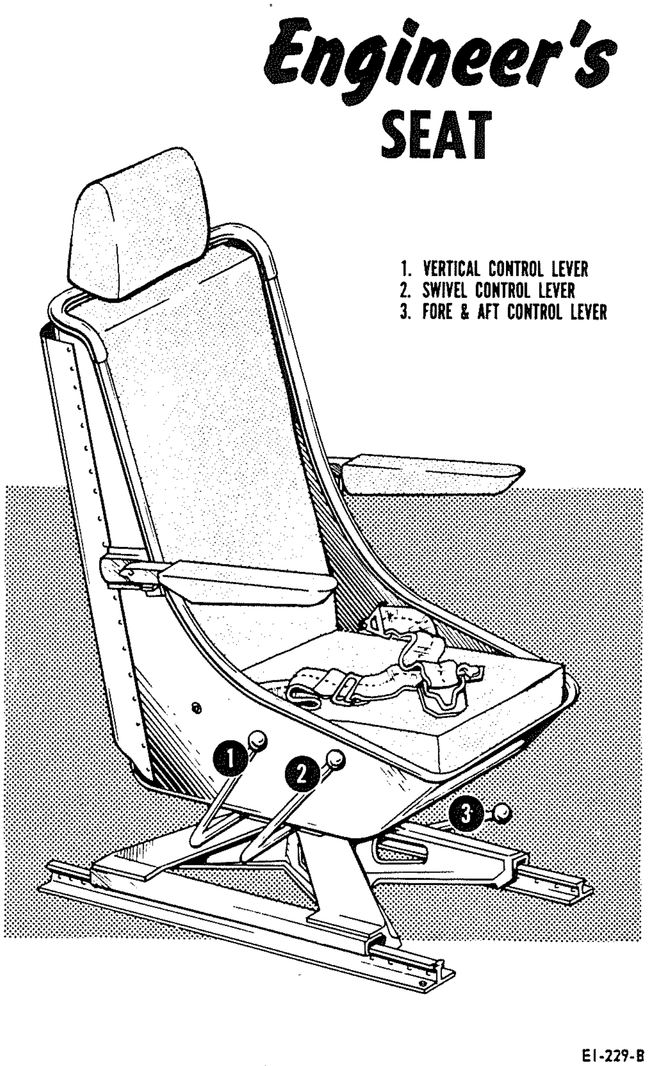


Figure 1-49.

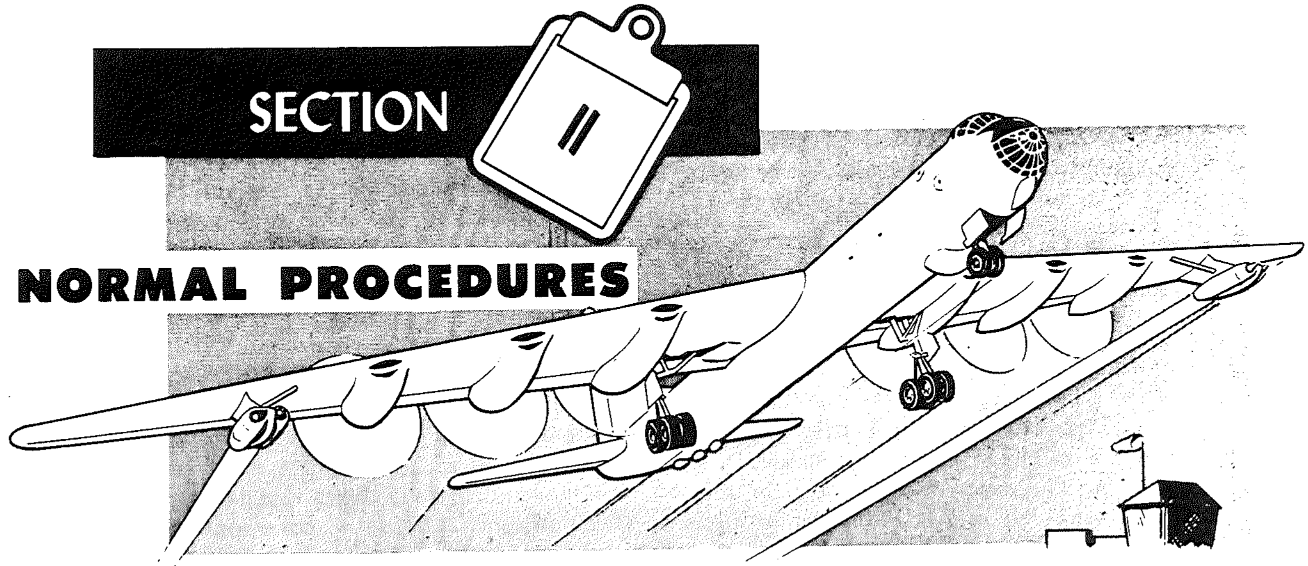
ENGINEER'S SEAT.

A swivel-type seat (figure 1-49) which has fore-and-aft and vertical adjustments, is provided for the engineer. Vertical and swivel movements are controlled by two levers on the right side of the seat support. A lever on the left side of the support controls fore-and-aft movement. The seat is equipped with folding arm rests and a safety belt. No shoulder harness is provided.

AUXILIARY EQUIPMENT.

Information concerning the following equipment and systems is given in Section IV.

1. Heating and Anti-Icing System.
2. Pressurization System.
3. Cabin Ventilating Equipment.
4. Auxiliary Cabin Heaters.
5. Jet Pod Heating and Anti-Icing System.
6. Pitot Tube Heaters.
7. Oil System Heaters.
8. Communication and Associated Electronic Equipment.
9. Lighting System.
10. Oxygen System.
11. Autopilot.
12. Navigation Equipment.
13. Meteorological Equipment.
14. Gunnery Equipment.
15. Bombing Equipment.
16. Photographic Equipment.
17. Miscellaneous Equipment.



72-125-A

INTRODUCTION.

In general, the purpose of this section is to establish a proper sequence of events and to set forth those procedures and techniques which must be performed in a prescribed manner during a complete flight under normal conditions. The scope has been expanded to include as much training information and normal operating procedures as practical. The sequence begins when the flight is conceived and does not end until the crew has completed their postflight duties. This provides a comprehensive picture of the requirements of a typical mission.

The arrangement of the data presented in this section has been devised by experienced personnel. It reflects the best information obtainable from all available sources including the using tactical organizations. It is only natural to expect that, from time to time, new and revised procedures will be necessary due to modifications of the systems and the development of new techniques. Revisions will be published from time to time to cover these changes.

To prevent undue complication of this section it will only include normal operating procedures applicable to the aircraft commander, pilot, copilot, first engineer, and second engineer. Procedures for other crew members will be dealt with only so far as coordination requires to properly execute a particular function. For the specific duties of other crew members see Section VIII, "Crew Duties." For emergency procedures refer to Section III, "Emergency Procedures." Other sections in this publication will deal with various aspects of the aircraft and equipment from the standpoint of basic operation and peculiarities characteristic of the equipment under various conditions. If information is desired on any particular phase of operation not covered in this section, reference to the other sections should provide the answer. If any question should arise that is not covered in this handbook, check with the standardization boards. They will help you evaluate the situation and submit recommended changes to this publication through the proper channels.

The phases of operation covered in this section will follow a normal sequence as though you were actually planning and flying the mission. The sequence recommended is based upon the experience of tactical organizations in actual operation and constitutes the best compromise to reduce mission failures, crew fatigue, and maintenance to an acceptable minimum. Certain local considerations may require that the exact sequence be varied to meet the situation. However, the amplified procedures and techniques described herein are mandatory to provide a complete check and must be performed in the prescribed manner.

A unique innovation in normal operating procedures of the complex B-36 might be called a dual preflight run-up system. The first preflight run-up is called a "Preflight Operational Equipment Check" and is designed to check equipment aboard the aircraft from the safety standpoint as well as reasonably assuring its successful operation during any phase of the mission. This is a *complete* check of all operational equipment and normally is accomplished as early as possible within a 24-hour period; however, it may be accomplished up to and including 72 hours prior to estimated take-off time. The second preflight run-up occurs just prior to the actual take-off and is known as a minimum safety check. Experienced B-36 units have found that this system, coupled with good maintenance, has reduced their mission failure rate from very excessive to almost negligible. It has also reduced the ground time required on the reciprocating engines, although an unqualified inspection of the dual run-up system would not make this fact apparent. The times shown in figure 2-1 represents the amount of time that is generally required to perform each phase or event.

GENERAL MISSION PLANNING.

The mission may be conceived at any level of command. Each lower level of command must do a certain amount of planning upon receipt of the operations order. However, the final details of any mission plan and the execution of the individual mission is always up to the individual crew. The exact requirements for mission planning are set forth in Air Force, major command, and local directives with which the crew should be familiar. Receipt of an operations order dictates a multitude of tasks that must be performed by the combat crew as a team with time being a limiting factor. The crew should be assembled by the aircraft commander and notified of the impending flight. At this time the crew learns which aircraft is to be flown and approximately what is to be accomplished on the mission. Since time is a limiting factor and crew fatigue must be held to a minimum prior to a lengthy mission, a logical sequence of events must take place to make sure that everything required is accomplished with absolute efficiency. The responsibility for insuring efficient team work is the aircraft commander's. Through coordination with the engineering section, it should be determined when the assigned aircraft will be ready for preflight. If there is to be some delay, notify the

Typical TIME SCHEDULE

PHASE OR EVENT	AVERAGE ELAPSED TIME
GENERAL MISSION PLANNING	2:00
PREFLIGHT OPERATIONAL EQUIPMENT CHECK	5:00
DETAILED MISSION PLANNING	3:00
FORMAL BRIEFING	0:45
CREW INSPECTION	0:25
VISUAL PREFLIGHT INSPECTION	1:00
FINAL CREW BRIEFING	0:10
BOARDING AIRCRAFT	0:05
STATION TIME	0:10
STARTING RECIPROCATING ENGINES	0:05
COMPLETE ENGINE RUN-UP	0:25
TAXI	0:10
STARTING JET ENGINES	0:00 (INCLUDED IN OVER-ALL TIME)
CLEARANCE, LINE-UP, TAKE-OFF CONFIGURATION, SET POWER	0:05

69-141-A

69-141-A

Figure 2-1.

crew so that they may continue with the next phase, "Detailed Mission Planning" while standing by for the "Preflight Operational Equipment Check." As soon as each component system is declared ready, see that those crew members concerned proceed directly to the aircraft to perform their portion of the "Preflight Operational Equipment Check." This will allow maintenance maximum time to correct any discrepancies noted during this check and assures the crew that their aircraft is prepared to perform the anticipated mission before they proceed with other time-consuming requirements.

PREFLIGHT OPERATIONAL EQUIPMENT CHECK.

This preflight check is designed to be a thorough, comprehensive, and complete check of each crew member's operational equipment. This check constitutes the first of two preflight run-ups for all crew members. Many items not directly affecting safety of flight, but promoting successful accomplishment of the mission, need not be rechecked during the second preflight run-up just prior to take-off, unless a recheck is dictated by inclement weather conditions, additional repairs after the preflight operational check, or an unusual delay before take-off. This operational equipment check is amplified and aligned in such a manner that all crew members except the engineers can use their standard and preflight check lists to accomplish this complete check. A "Standard Check List" for the engineer is provided to insure that a complete, comprehensive preflight is accomplished as required for an "Operational Preflight Equipment Check." It can also be used to replace both run-ups and still provide a complete check in event only one run-up is desired due to the nature of the mission such as aircraft ferry flights, maintenance test flights, or due to the time factor. The pilots will accomplish a visual inspection in accordance with the visual preflight as outlined in this section.

The aircraft commander should coordinate his mission planning with all sections concerned and order the necessary equipment for accomplishment of the mission. It is impractical for other crew members to safely accomplish their respective preflights during the reciprocating engine preflight. This will necessitate the aircraft commander's scheduling crew members to accomplish their individual preflights as soon as their respective component systems are declared in commission. The following time allocations are recommended; however, they may be modified as required by experience and local conditions:

1. Observers, photographers, and radio operators (simultaneously) 2 hours.
2. Pilots and engineers (simultaneously) 2 hours.
3. Tail gunner (actual gunnery) 1 day.

Each crew member will accomplish his respective preflight as outlined in his handbook and/or other handbooks governing the operation of this aircraft. A preflight check list will be utilized at all times to insure the accomplishment of every item.

On completion of his preflight the crew member should immediately notify his aircraft commander and record any discrepancy in the AF Form 781 (Form 1). Auxiliary equipment to be checked includes all operational systems that are to be utilized during the forthcoming mission and items pertaining to safety of flight. *Wing flaps, hydraulic system, jet engine starter operation, and any other equipment demanding high electrical loads will not be operated during the radar preflight operational equipment check.*

In addition to an operational check of normal and special equipment, this preflight includes a complete reciprocating engine run-up. The jet engines should only be run to make sure that known deficiencies have been cleared since the preceding flight. All newly installed jet equipment must be thoroughly checked. Since this preflight is an operational check of all equipment, it should be accomplished as soon as possible. The necessity of the aircraft commander and pilots to accomplish the "Visual Preflight Inspection" twice is to insure that the aircraft is ready for engine run-up (cowling, stands, etc.) and also to check all systems for operation. There will of necessity be some duplication of effort with this system; however, those preflight procedures which are duplicated are necessary to insure the best interests of flying safety.

Before deciding where the aircraft is to be parked for run-up, check the wind direction and velocity. If practical, the aircraft should be headed directly into the wind for several reasons. Considerable difficulty may be experienced in moving the rudder in strong cross winds. Tailwinds can cause excessive or erratic tail pipe temperatures during jet engine starting and operation. A direct headwind provides maximum ground cooling and even propeller loading during engine run-up and single magneto check. Wind velocity affects the idle speed setting of the reciprocating engines. Other considerations also affect the choice of a proper parking spot for run-ups. Park the aircraft on a clean, hard surface to prevent pick-up and throwing of gravel and debris by the jet intakes or propeller blast. Avoid tailing the aircraft toward other aircraft, buildings, close taxi strips, or runways to prevent damage from propeller or jet engine blast and to allow the run-up to progress as rapidly as possible without interruptions. If possible, maintain a minimum of 250 feet frontal clearance during the run-up.

Note

Before boarding the aircraft, the engineers will check the following:

1. Contact the crew chief and determine what maintenance has been performed, and that the

bomb bay and wing crawlway inspection has been completed (fuse panels, fuel leaks, etc.) as outlined in present mtaintenance regulations.

2. Proper status of the aircraft as reflected in AF Form 781 (Form 1).

3. Bomb bay doors open and safety locks installed. If the bomb bay doors are closed, they will be pumped open and safety locks will be installed prior to starting the auxiliary power unit.

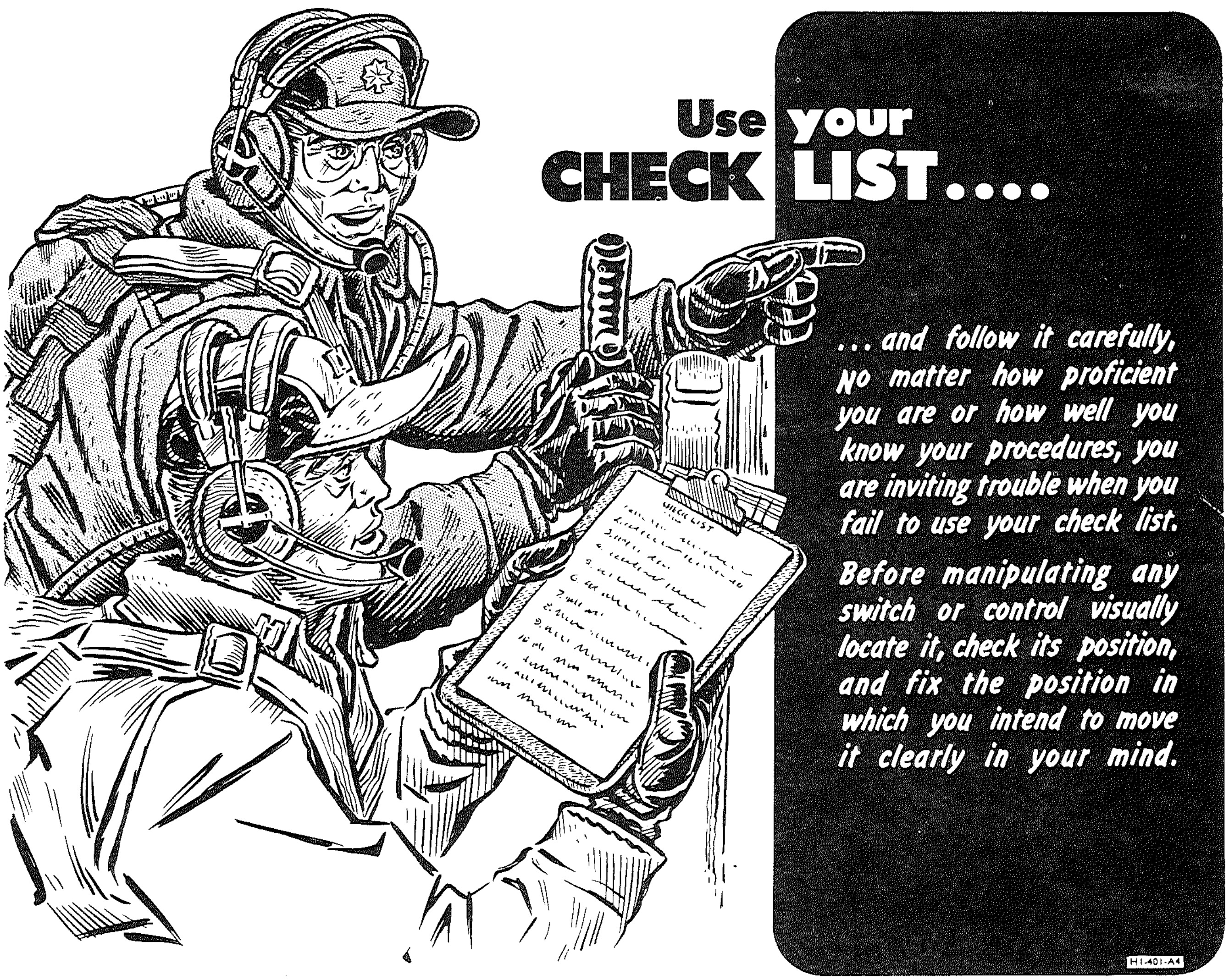
4. Make certain that the ground observer who will operate the ground interphone understands proper ground reporting procedures on engine starts, control checks, propeller checks, etc.

5. Insure that the auxiliary power unit is as far upwind from the aircraft as the electrical cord will permit.

CAUTION

Before the APU is plugged in, make certain that the external power switch is OFF.

The aircraft commander, pilot, and engineers proceed to their stations with their headsets and microphones and the pilot will read the check list to the aircraft commander, who will complete the checks. In the same manner, the second engineer will assist the first engineer. Coordination items between the aircraft commander and the first engineer are indicated on the check list and must be checked as indicated in the amplified check list.



RB-36D & E-III PILOTS' STANDARD CHECK LIST

BEFORE STARTING ENGINES

1. Landing Gear Control Switch .... EXTEND
2. Visual Inspection—Forms 781 (Form 1), F, and Loading List .... COMPLETED
3. Pitot Covers and Ground Locks .... REMOVED
4. Nose Wheel Scissors .... CONNECTED
5. Personal Equipment .... CHECK IN PLACE
6. Seats and Pedals .... ADJUSTED
7. All Circuit Breakers (Except Bomb Bay Door and Bomb Salvo) .... IN
8. All Indicator Lamps .... PUSH TO TEST
*9. Tower Call .... COMPLETED
10. Propeller Reverse Selector Switches ...... SAFE, LIGHTS OUT
11. Flight Instrument Switches .... ON
*12. Nose Steering and Brakes .... CHECKED AND SET
13. Bomb Bay Door Locks .... REMOVED
14. Fire Equipment .... IN PLACE
15. Emergency Ignition Switch .... IN
*16. Receive Engineer's Report and Notify Engineer, "Brakes Set, Fire Guard Standing By, Start Engines."

STARTING RECIPROCATING ENGINES

A/C Observes Engineer's Reciprocating Engine Starts and Handles Throttles On Idling Engines. Maintain Approximately 1100 RPM.

DURING ENGINE WARM-UP

1. Bomb Bay Door and Salvo Circuit Breakers .... IN
2. Bomb Bay and Camera Doors .... CLOSED
3. Flaps and Indicators .... CHECKED
*4. Propeller Reverse Check, Idle Rpm .... COMPLETED (IF REQUIRED)

ENGINE RUN-UP

1. Parking Brake Control .... ON
2. Propeller Reverse Selector Switches ..... SAFE (LIGHTS OUT)
3. Nose Wheel Steering Switch .... OFF
4. Pilot's Manifold Pressure Gage .... CHECKED
5. Master Tachometer .... CHECKED
*6. Propeller Reverse Check .... COMPLETED

TAXIING

1. Nose Wheel Steering Switch .... ON
2. Engineer's Taxi Configuration .... CHECKED
3. Receive Ground Man's Report, "Nose Wheel Doors Full Open, All Static Wires Removed, Wheel Chocks Removed, External Power Unit Cleared, Disconnecting."
4. Interphone, Alarm Bell Check .... COMPLETED
5. Call Control Tower .... "TAXI INSTRUCTIONS"
6. Inboard Propeller Reverse Selector Switch .... READY
7. Taxiing .... ANNOUNCE "TAXIING" OVER INTERPHONE

STARTING JET ENGINES (GROUND)

*1. Notify Engineer ... "SET UP JET START CONFIGURATION."
2. All Circuit Breakers .... IN
3. Fire Detection Test Switches .... TEST AND RELEASE
4. Throttle Selector Switches .... LEVER
5. Throttles .... CLOSED
6. Pod Preheat Switch .... AS REQUIRED
7. Nose De-Ice Switch .... AS REQUIRED
8. Oil Heater Switch .... AS REQUIRED
9. Oil Shutoff Valve Switches .... OPEN
10. Danger Area Clear and Fire Equipment Standing By
11. Jet Air Plug Switches .... OPEN
12. Jet Manifold Valve Switches (L and R) .... OPEN
13. Booster Pump Switches (L and R) .... ON
14. All Ignition Start Switches .... NORMAL
15. Throttle Position Indicator Selector Switch (Some Airplanes) .... SELECT J-1 ENGINE
16. J-1 Engine Fuel Valve .... OPEN
17. J-1 Fuel and Oil Pressure Gages .... NOTE READING
18. Notify Aft Scanner .... "STARTING J-1."
19. J-1 Starter Switch .... HOLD ON
20. J-1 Throttle ...... OPEN AT 6 PER CENT RPM TO OBTAIN 25 to 30 PSI FUEL PRESSURE

CAUTION

WHEN IGNITION OCCURS ADJUST THROTTLE TO MAINTAIN A CONSTANT TAIL PIPE TEMPERATURE. DO NOT EXCEED 690°C TPT.

21. J-1 Oil Pressure ... REPORT INDICATION ON INTERPHONE
22. J-1 Starter Switch .... RELEASE AT 20 PER CENT RPM
23. J-1 Throttle .... ADJUST TO MAINTAIN IDLE RPM
24. J-2, J-3, J-4—Repeat Steps 15 thru 23
25. All Ignition Start Switches .... OFF

BEFORE TAKE-OFF

1. Landing Lights .... AS REQUIRED
2. Flaps and Indicator .... SET AT 20° AND CHECKED
3. Trim Tabs .... SET
4. Abort Procedure and Take-Off and Landing Data .... BRIEFED AND REVIEWED
5. Safety Belts and Safety Harnesses .... FASTENED
6. Salvo Safety Switches .... AS REQUIRED
*7. Engineer's Take-Off Configuration—ENGINEER READS, "Take-Off Configuration Completed; Standing by for Propeller Reverse Safety Check and Take-Off Power."
8. Tower Clearance .... RECEIVED

NOTE

THE FOLLOWING STEPS MUST BE ACCOMPLISHED AFTER THE AIRCRAFT IS ALIGNED WITH THE RUNWAY.

9. Parking Brake Control .... ON
10. Propeller Reverse Selector Switches ...... SAFE, LIGHTS OUT
11. Pitot Heat .... AS REQUIRED
12. All Compartments ..... ENTRANCE LADDERS, WINDOWS, AND HATCHES, READY FOR TAKE-OFF
13. Gyros .... SET AND UNCAGED
14. Nose Wheel Steering Switch .... ON
15. Surface Controls .... UNLOCKED AND CHECKED
16. Read Pilots' Take-Off Configuration: .... "Controls—UNLOCKED; Flight Instrument Switches—ON; Flaps—20 DEGREES; Trim Taps______DEGREES (UP OR DOWN); Autopilot—OFF; Nose Steering—ON; Propellers—SAFE, LIGHTS OUT."

TAKE-OFF

1. Parking Brakes .... RELEASED
*2. Set Take-Off Power .... JETS TAKE-OFF RPM

AFTER TAKE-OFF

1. Foot Brakes .... APPLY TO STOP WHEEL ROTATION
2. Nose Steering Switch .... OFF
*3. Landing Gear Control Switch .... RETRACT
4. Landing Lights .... RETRACTED & OFF
5. Flap Switch .... UP

INITIAL CLIMB

*1. Power Condition No. 2 .... JETS 96 PER CENT RPM
*2. Landing Gear and Brake Pump Switch .... OFF WHEN PRESSURE IS RELIEVED
3. Hold Best Climb IAS .... REFERENCE TAKE-OFF AND LANDING DATA CARD
4. Bomb Bay Area .... CHECKED

*PILOT-ENGINEER COORDINATION ITEM

Figure 2-2. (Sheet 1 of 2)

RB-36D & E-III PILOTS' STANDARD CHECK LIST (Cont'd)

STARTING JET ENGINES (AIR)

*1. Notify Engineer ...."SET UP JET START CONFIGURATION."
2. All Circuit Breakers ....IN
3. Fire Detection Test Switches ....TEST AND RELEASE
4. Throttle Selector Switches ....LEVER
5. Throttles ....CLOSED
6. Pod Preheat Switch ....AS REQUIRED
7. Nose De-Ice Switch ....AS REQUIRED
8. Oil Heater Switch ....AS REQUIRED
9. Oil Shutoff Valve Switches ....OPEN
10. Jet Air Plug Switches ....OPEN
11. Jet Manifold Valve Switches (L and R) ....OPEN
12. Booster Pump Switches (L and R) ....ON
13. Throttle Position Indicator Selector Switch SELECT J-1 ENGINE
14. J-1 Engine Fuel Valve ....OPEN
15. J-1 Fuel and Oil Pressure Gages ....NOTE READING
16. Notify Aft Scanner ...."STARTING J-1."
17. J-1 Ignition Start Switch ....HOLD IN ALT
18. J-1 Throttle ....OPEN TO OBTAIN 16 to 20 PSI FUEL PRESSURE (10 to 15 PSI ABOVE 40,000 FT)
19. J-1 Oil Pressure ...REPORT INDICATION ON INTERPHONE
20. J-1 Ignition Switch ....RELEASE AT IDLE
21. J-1 Throttle ....ADJUST TO MAINTAIN IDLE RPM
22. J-4, J-3, J-2 ....REPEAT STEPS 13 thru 21

STOPPING JET ENGINES (GROUND-AIR)

1. Throttles ....IDLE THREE MINUTES, THEN CLOSE
2. Booster Pumps ....OFF
2A. (Air) Jet Air Plugs ....CLOSED AT OR BELOW 100°C TPT AND 30 PER CENT RPM
3. Engine Fuel Valves ....CLOSED BELOW 10 PER CENT RPM
4. Nose De-Ice ....AS REQUIRED
5. Pod Preheat ....AS REQUIRED
6. Oil Heater Switch ....AS REQUIRED
7. Oil Shutoff Valves ....ALWAYS OPEN DURING FLIGHT
8. Throttle Circuit Breakers ....OUT
9. (Ground) Jet Air Plugs ....CLOSE AFTER 30 MINUTES
9A. (Air) Jet Air Plugs ....ADJUST TO WINDMILL 5 TO 7 PER CENT RPM

BEFORE LANDING

1. Notify Crew ...."PREPARE TO LAND."
2. Bomb Bay Area ....CHECKED
3. Autopilot ....OFF
4. Jet Air Plugs ....OPEN
5. Jet Engines ....AS REQUIRED
*6. Engineer's Landing Configuration ....ENGINEER READS, "Before Landing Check List Complete, Standing by for RPM, Landing Gear and Brake Check, Gross Weight________."
7. Stalling Speeds and Take-Off and Landing Data ....CHECKED & REVIEWED
8. Master Tachometer ....2550 RPM
9. Landing Gear Control Switch ....EXTEND
   a. Receive Aft Scanner's Visual Report, "Gear Down and Locked."
   *b. Receive Engineer's Report, "Hydraulic Pressure Relieved."
   c. Receive Radio Operator's Visual Report, "Nose Gear Down and Locked."
   d. Landing Gear Lights ....CHECKED GREEN
   e. Nose Wheel Steering Indicator ....ZERO
10. Parking Brake Control ....OFF
*11. Left and Right Brakes ....CHECKED
12. Nose Gear Strut ....BLED IF REQUIRED
13. Nose Steering Switch ....ON
14. Pilot—Recheck Gear Down and Locked, Autopilot Off, Nose Wheel Steering Switch On and report to A/C, "Gear Down and Locked, Landing Configuration Complete."
15. Flaps ....10 DEGREES

BASE LEG

1. Flaps ....20 DEGREES
2. Jet Air Plugs ....CLOSE
3. Landing Lights (If Required)....EXTENDED AND CHECKED

FINAL APPROACH

At High Gross Weights, High Field Elevation, and in Emergencies 2700 RPM and No. 7 TBS Setting May Be Used.

1. Flaps ....30 DEGREES

LANDING

1. Propeller Reverse Selector Switches....READY ON MAIN GEAR CONTACT
2. Propeller Reverse Pitch Switch ....DEPRESS ON A/C's COMMAND
3. Control Surfaces ....LOCKED AT APPROXIMATELY 50 MPH
4. Propeller Reverse Selector Switches ....SAFE
5. Flaps ....RETRACTED
6. Jet Oil Shutoff Valve Switches ....CLOSED AT ZERO PER CENT RPM

POSTFLIGHT ENGINE RUN-UP

1. Parking Brake Control ....ON
2. Propeller Reverse Selector Switches....SAFE (LIGHTS OUT)
3. Nose Wheel Steering Switch ....OFF
4. Notify Engineer...."START POSTFLIGHT ENGINE RUN-UP."

STOPPING RECIPROCATING ENGINES

1. Parking Brake Control ....ON
2. Propeller Reverse Selector Switches ....SAFE (LIGHTS OUT)
3. Nose Wheel Steering Switch ....OFF
4. Flight Instrument Switches ....OFF
5. Contact Engineer ...."READY TO STOP ENGINES"
6. Radio Equipment ....OFF

BEFORE LEAVING AIRCRAFT

1. All Control Switches ....PROPERLY POSITIONED
2. Wheel Chocks ....IN PLACE
3. Parking Brake Control ....OFF AFTER WHEELS ARE CHOCKED
4. Postflight Visual Inspection ....COMPLETED

*PILOT-ENGINEER COORDINATION ITEM

Figure 2-2. (Sheet 2 of 2)

RB-36D & E-III ENGINEER'S STANDARD CHECK LIST

BEFORE STARTING ENGINES

1. Required Forms .... ABOARD AND CHECKED
2. All Circuit Breakers and Control Switches .... PROPERLY POSITIONED
3. Emergency Power Switch .... NORMAL
4. Cabin Heater Power Switch .... OFF
5. External Power Supply Switch .... OFF
6. Battery Switch .... ON
7. Alternator Panel Configuration .... CHECKED
8. External Power .... PLUGGED IN
9. Correct A-C Phase Sequence Lamps .... LIGHTED
*10. External Power Supply Switch .... ON
11. Master Ignition Switch .... PULL OFF
12. Liquid Lock Check (With Ignition Switches OFF) .... COMPLETED
13. Mixture Control Check .... COMPLETED
14. Throttle Lever and Flap Warning Horn Check .... COMPLETED
15. Fuel Panel Configuration .... CHECKED
16. Intercoolers and Air Plugs .... AS REQUIRED
17. Oil Cooler Door Manual Operation (Some Airplanes) .... CHECKED
18. Water Injection Switches .... OFF
19. Oil Vent Heater Switch .... AS REQUIRED
20. Oil Shutoff Valve Switch Guards .... DOWN
21. Engine Supercharger Switches .... BOTH
22. Cabin Temperature Control Switch .... FULL DECREASE UNTIL LAMP LIGHTS
23. Cabin Pressure Wing Shutoff Valve Switches .... OFF
24. Cabin Booster Fan Switch .... AS REQUIRED
25. Aft Cabin Pressure Switch .... ON
26. Wing, Cabin Heat and Tail Anti-Ice Switches .... OFF
27. Pitot Heat Switches .... OFF
28. Carburetor Preheat Switches .... OFF
29. Nacelle Fire Detector and Extinguisher .... CHECKED
29A. Aerial Camera Master Power Switch .... ON
30. Wheel Well Lights Switch .... AS REQUIRED
31. Turbo Override Control Panel (Group I Airplanes) .... CHECKED
*32. Hydraulic Control Panel .... CHECKED
33. Propeller Control Panel .... CHECKED
34. Fan Speed Control Switches .... LOW RPM
35. Carburetor Air Filter Switch .... AS REQUIRED
36. Panel Lights .... AS REQUIRED
37. Spark Advance Switches .... RETARD (GUARDS DOWN)
38. Turbo Boost Selector .... ZERO
39. Turbo Calibration Knobs .... INDEXED TO THE FULLY COUNTERCLOCKWISE POSITION
40. Engine Analyzer Power Switch .... OFF
41. Master Temperature Indicator (Some Airplanes) .... ON AND COMPENSATED
42. Instrument Check .... NORMAL
43. Master Ignition Switch .... ON
*44. Report to A/C, "Check List Completed, Master Ignition In, Ready to Start Engines."

STARTING RECIPROCATING ENGINES

1. Engine Analyzer Power Switch .... ON
2. Fuel Tank Valve Switches .... OPEN
3. Booster Pumps of Tanks Being Used .... ON
4. Voltage and Frequency Selector Switch .... NO. 4 POSITION
5. Throttle Levers .... AS REQUIRED
6. Inform Ground Observer, "Ready to Start Engines, Clear No. 4."
7. Engine No. 4 Starter Switch .... ON
8. Engine No. 4 Ignition Switch .... BOTH
9. Engine No. 4 Primer Switch .... AS REQUIRED
10. No. 4 Mixture Control Lever .... NORMAL
11. Report, "Alternator Normal, Oil and Fuel Pressure Normal."
12. Repeat Steps 4 thru 11 for Starting Engines 5, 6, 3, 2, and 1.

DURING ENGINE WARM-UP

(PREFLIGHT OPERATIONAL EQUIPMENT CHECK)

1. Ignition Switch Check .... IDLE RPM
2. Engine-Driven Fuel Pumps .... CHECK
3. Heat and Anti-Icing Check .... COMPLETED
4. Alternator Checks .... COMPLETED
5. Engine Oil-In Temperature .... MINIMUM 40°C
6. Propeller Reverse Check, Idle Rpm .... COMPLETED (IF REQUIRED)

ENGINE RUN-UP

(PREFLIGHT OPERATIONAL EQUIPMENT CHECK)

1. Inflight Oil Cooling Doors .... CHECKED
*2. Propeller Control System .... CHECKED
3. Cabin Pressure Wing Shutoff Valve and Carburetor Preheat Checks .... COMPLETED
4. Barometric Pressure Checks .... COMPLETED
5. Ignition System Check .... COMPLETED
6. Full Power No Boost Checks .... COMPLETED
7. Turbo Override and Single Turbo Check .... COMPLETED
8. Full Power With Boost Checks .... COMPLETED

DURING ENGINE WARM-UP

(DAY OF FLIGHT)

2. Engine-Driven Fuel Pumps .... CHECK
4d. Alternators on Line .... MINIMUM OF TWO
5. Engine Oil-In Temperature .... MINIMUM 40°C
6. Propeller Reverse Check, Idle Rpm .... COMPLETED (IF REQUIRED)

ENGINE RUN-UP

(DAY OF FLIGHT)

*2. Propeller Control System .... CHECKED
5. Ignition System Check .... COMPLETED
6. Full Power No Boost Checks .... COMPLETED
8. Full Power With Boost Checks .... COMPLETED

TAXIING

1. Taxi Configuration, "Alternators on the Line and Paralleled, Brake and Nose Steering Pressure Normal, Ready to Taxi."

STARTING JET ENGINES (GROUND-AIR)

*1. Jet Start Configuration .... CHECKED AND REPORT "Standing by for Jet Engine Start."

BEFORE TAKE-OFF

1. Engine Supercharger Switches .... BOTH
2. Fuel Panel Checked .... BOOSTER PUMPS ON
3. Oil Vent Heater Switch .... ON, IF 0°C OAT. IS ANTICIPATED
4. Carburetor Preheat Switches .... OFF
5. Cabin Pressure Wing Shutoff Valve Switches .... OFF
6. Cabin Booster Fans Control Switch .... AS REQUIRED
7. Pitot Heater Switches .... AS REQUIRED
8. Wing and Cabin Heat and Tail Anti-Icing Switches .... OFF
9. Engine Fan Speed Switches .... LOW RPM
10. Three Alternators Paralleled on the Line, One Excited and Standing by.
11. Air Plugs and Intercoolers .... AS REQUIRED
12. Cabin Heater Power Switch .... OFF

*PILOT-ENGINEER COORDINATION ITEM

Figure 2-3. (Sheet 1 of 2)

RB-36D & E-III ENGINEER'S STANDARD CHECK LIST (Cont'd)

BEFORE TAKE-OFF (Cont'd)

13. Temperatures ....CHECKED AND WITHIN LIMITS
14. Mixture Control Selector Switches ....LEVER
15. Mixture Control Levers ....NORMAL
16. Spark Advance Switches ....RETARD (GUARDS DOWN)
17. Propeller Selector Switches ....AUTOMATIC OPERATION (TEL-LAMPS LIGHTED)
18. Propeller Normal Pitch Indicator Lamps ....LIGHTED
19. Brake Pressure and Nose Steering Pressure ....NORMAL
20. Turbo Control Change-Over Switches (Group I Airplanes) ....AUTO
21. Turbo Control Vernier Switch (Group I Airplanes) ....OFF
22. Hydraulic Fluid Temperature Control Switch ....OFF
23. Oil Cooler Door Mode Selector Switches ....AUTO
24. Safety Belt ....FASTENED

*25. Engineer's Take-Off Configuration ....ENGINEER READS, "Take-Off Configuration Completed, Standing by for Propeller Reverse Safety Check and Take-Off Power."

TAKE-OFF

*1. Propeller Reverse Safety Check and Set Take-Off Power Corrected for Humidity.
2. Report, "Power Stabilized," Prior to Nose-Up Speed.

AFTER TAKE-OFF

*1. Observe Main Hydraulic Pressure Normal.
2. Report, "Main Hydraulic Pressure Relieved," After Gear Retraction is Completed.

INITIAL CLIMB

*1. Power Condition No. 2 ....UPON PILOT'S REQUEST
2. Turbo Boost Selector ....REDUCE M.P.
3. Water Injection Switches ....OFF
4. Reduce Power to Predicted Climb Schedule.
5. Torque, Fuel Flow, CHT, CAT. and M.P.......WITHIN LIMITS
6. Anti-Icing Duct Temperatures .....INCREASE AS REQUIRED

CRUISE

For Specific Cruise Data See Appendix I and Amplified Check List.

BEFORE CLIMB (HIGH POWER OPERATION, AFTER A MANUAL LEAN SPARK ADVANCE CRUISE)

1. Air Plugs and Intercoolers ....OPEN
2. Spark Advance Switches ....RETARD
3. Mixture Controls ....NORMAL (LIGHTS ON)
4. Engine Supercharger Switches ....BOTH
5. Desired Power ....SET
6. Anti-Icing Duct Temperature ......INCREASE AS REQUIRED

BEFORE LANDING

1. Inflight Engine Checks ....COMPLETED, IF DESIRED
2. Engine Supercharger Switches ....BOTH
3. Fuel Panel Checked ....BOOSTER PUMPS ON
4. Oil Vent Heater Switch ....AS REQUIRED
5. Carburetor Preheat Switches ....AS REQUIRED
6. Cabin Pressure Wing Shutoff Valve Switches ....OFF
7. Booster Fan Switch ....AS REQUIRED
8. Pitot Heater Switches ....AS REQUIRED
9. Wing and Cabin Heat and Tail Anti-Icing Switches ......OFF
10. Engine Fan Speed Switches ....LOW RPM
11. Electrical System ....CHECKED
12. Air Plugs and Intercoolers ....AS REQUIRED
13. Cabin Heater Power Switch ....OFF
14. Temperatures ....CHECKED AND WITHIN LIMITS
15. Mixture Control Selector Switches ....LEVER
16. Mixture Control Levers ....NORMAL
17. TBS ....ZERO, CALIBRATION KNOBS INDEXED
18. Spark Advance Switches ....RETARD (GUARDS DOWN)
19. Propeller Selector Switches ....AUTOMATIC OPERATION (TEL-LAMPS LIGHTED)
20. Propeller Normal Pitch Indicator Lamps ....LIGHTED
21. Turbo Control Change-Over Switches (Group I Airplanes) ....AUTO
22. Turbo Control Vernier Switch (Group I Airplanes) ....OFF

*23. Engineer's Landing Configuration ....ENGINEER READS, "Before Landing Check List Complete, Standing by for Rpm, Landing Gear, and Brake Check, Gross Weight________."

24. Master Tachometer ....2550 RPM
25. Report ...."Hydraulic Pressure Relieved."

*26. Observe Brake Check and Report ...."Pressure Normal."

LANDING

1. Brake and Nose Steering Pressure ...NORMAL AFTER NOSE WHEEL CONTACTS GROUND
2. RPM and M.P. ....CHECKED

TAXIING

1. Alternators (Minimum of Two on the Line) ......PARALLELED
2. Brake and Nose Steering Pressure ....NORMAL

POSTFLIGHT ENGINE RUN-UP

1. All Propeller Normal Pitch Indicator Lamps ....LIGHTED
2. Master Tachometer ....2700 RPM
3. Parking Brakes ....SET, PRESSURE NORMAL
4. Nose Steering Pressure ....ZERO
5. Announce over Interphone ...."Ready for Postflight."
6. Engine Run-Up ....COMPLETED
7. Repeat Step 6 for Remaining Symmetrical Engines.
8. Shut down engine 1 & 6 after checking that CHT's are 180°C or below.
9. Report to A/C ...."Postflight Run Complete, Ready to Taxi."
10. Repeat Steps 1 thru 4 and Step 8 Before Shutting Down Remaining Engines.

STOPPING RECIPROCATING ENGINES

1. Air Plug Switches ....OPEN
2. Master Motor Speed Control Lever ....FULL DECREASE
3. Propeller Selector Switches ....FIXED PITCH
4. Booster Pump Switches ....OFF
5. Alternator Control Checks ....COMPLETED
6. Engine Analyzer Power Switch ....OFF
7. Idle Speed and Mixture Checks ....COMPLETED
8. Fuel Tank Valve Switches ....CLOSE
9. Cross-Feed, Manifold, and Engine Valve Switches ......OPEN
10. Individual Ignition Switches ....OFF
11. Master Ignition Switch ....PULL OFF
12. Intercooler Shutter Switches ....CLOSE
13. Static Propeller Feather Check ....COMPLETED
14. Oil Cooler Door Mode Selector Switches ....MANUAL
15. Battery Switch ....OFF
16. Master Temperature Indicator (Some Airplanes) ....OFF

BEFORE LEAVING AIRCRAFT

1. Fuel Dip Stick Readings ....AS REQUIRED
2. Forms and Reports ....COMPLETED

*PILOT-ENGINEER COORDINATION ITEM

Figure 2-3. (Sheet 2 of 2)

Proceed with the applicable entries of the pilots' and engineers' check lists as amplified below:

BEFORE STARTING ENGINES.

PILOTS

1. Landing Gear Control Switch—EXTEND. The landing gear control switch should be in the EXTEND position for all ground operations. With the switch in this position, a gang bar arrangement holds the brake pump switch ON.

2. Visual inspection; Forms 781 (Form 1), F, and Loading List—Completed.

Before flight the visual inspections, loading lists, and Forms 781 and F must be complete. Visual inspection should be completed to the aircraft commander's satisfaction. Discrepancies noted in the Form 781 which have been corrected should be particularly checked to insure that those items of equipment are in proper working order.

The Form F which was filled out by the engineer must be thoroughly checked for accuracy and signed by the aircraft commander. Take-off and landing data will be computed by the engineer and reviewed by the aircraft commander and the pilot prior to take-off. This information will be given to the pilot by the engineer on a take-off and landing data card. The original copy Form F must be filed with Operations. Loading list must be checked to insure that the name, rank, serial number, and organization of every person on the flight is on the loading list. One copy of the loading list must be filed with the aircraft clearance at base operations.

3. Pitot Covers and Ground Locks—Removed. The external control locks and the pitot head covers will be removed during the "Preflight Operational Equipment Check." The pitot head covers will be replaced after the pitot heat check is completed.

On the day of flight the aircraft commander will personally check just before he enters the aircraft to see that all locks (main landing gear, nose gear, and external control locks) have been removed and that the pitot covers have been removed.

4. Nose Wheel Scissors—Connected. The aircraft commander will also check just before he enters the aircraft to insure that the nose wheel scissors have been connected. The nose wheel scissors will be disconnected only when it is necessary to move the aircraft by use of a tug or towing equipment.

ENGINEERS

1. Required Forms—Aboard and checked. Check the AF Form 781 (Form 1) before any preflight or flight operations. Before flight, complete the Form F, and check the Flight Log initiated with proper headings, correct gross weight and fuel load in pounds, and predicted take-off and climb power settings indicated. Check other required forms aboard such as engineers' reports, prediction forms, or test flight reports as required by local directives.

2. All Circuit Breakers and Control Switches—Properly positioned. To make certain control circuits are connected to their respective power source and to prevent inadvertent operation of systems when power is applied to the aircraft.

3. Emergency Power Switch—NORMAL. To insure that the normal power distribution system is not partially blocked out; for example, one phase to the radio operator's t-r unit would be blocked out when the bus selector switch is in the bus position except when fed by an excited alternator which has been selected by the engineer's voltage and frequency selector switch.

4. Cabin Heater Power Switch—OFF. The circuit is automatically deenergized when the external power is ON. However, the switch will be OFF before engine starting to prevent overload of the a-c system after external power is turned off and the engine alternator is placed on the line.

5. External Power Supply Switch—OFF. To prevent inadvertent connection of the external power supply to the bus before correct phase sequence has been established and the alternator breakers checked open.

6. Battery Switch—ON. To energize the d-c bus system, providing power for the interphone indicator lamp and control circuits.

Note

On airplanes equipped with an inverter, the battery switch must be placed in EMER ON to energize the d-c bus when no a-c power is on the airplane. After alternating current is on the airplane, place the switch in NORM ON.

PILOTS ENGINEERS

BEFORE STARTING ENGINES (Cont'd)

The aircraft should be in proper taxi position when the crew boards the aircraft so that it is unnecessary to have the nose wheel scissors disconnected for any further towing operations.

5. Personal Equipment—Checked in place. (Not to be accomplished during "Preflight Operational Equipment Check.")

Oxygen equipment, headset, and mike should be in place and plugged in. Other equipment necessary for the immediate flight should be readily available at each station. All other personal equipment should be in the A-3 bag and properly stowed.

6. Seats and Pedals—Adjusted. Make certain that the seat and rudder pedals are in proper position for the most efficient use of brakes and rudder.

7. All Circuit Breakers (Except Bomb Bay Door and Bomb Salvo)—In. To make sure that various indicator lamps, instruments, and control circuits are connected to the electrical power distribution systems, including the jet panel.

8. All Indicator Lamps—Push to test. To see that the indicator lamps are not burned out.

7. Alternator Panel Configuration—Checked.

a. Frequency Control Knobs—Full decrease.

b. Bus Tie-Breaker Switches—CLOSE.

c. Alternator Breaker Switches—OPEN.

Note

The following check need only be performed following periodic inspections and whenever maintenance on the system has been performed.

Note

Any discrepancies noted during this check must be corrected.

d. Frequency Control Knobs—Full decrease. This is the normal position for these controls when the alternators are not operating. It provides a safety precaution against constant-speed drive surging and overspeeding during engine start.

e. Bus Tie-Breaker Switches—CLOSE. Check the action of these breakers by raising the switch guards and open each breaker. Lamp on indicates breaker is open. Close each breaker and place switch guards down. Lamp out indicates breaker closed. All breakers closed insures that a-c power is feeding all four bus systems. Push to test any lamps that do not appear to be operating to make sure lamp is not burned out.

f. Mixture Control Levers—Move out of IDLE CUT-OFF position. It will be necessary to move the mixture control levers from the IDLE CUT-OFF position on the alternator-equipped engines, because a microswitch behind each mixture control lever of these engines keeps the exciter relay control circuit broken.

g. Exciter Control Relay Switches—ON. Exciting the alternators prior to engine start allows the operator to see that the alternator control circuits are functioning normally as each engine is started by watching the voltage and frequency indications.

h. Alternator Breaker Switches—OPEN (lamps lighted). To insure that alternator breakers are open prior to placing the external power switch ON, thus placing a-c power on the bus system. The open position prevents motorizing of the engine-driven alternators and subsequent excessive loads on the auxiliary power unit.

CAUTION

Never close the alternator breakers while external power is ON.

PILOTS ENGINEERS

BEFORE STARTING ENGINES (Cont'd)

i. All Alternator Breaker Switches—CLOSE (lamps out).

j. All Alternator Exciter Control Relay Switches—Momentarily OFF. Observe that the alternator breaker lamps are lighted. If an alternator breaker lamp does not light, check alternator d-c fuse at the respective engine power distribution panel.

CAUTION

Do not attempt to start alternator-equipped engines until this condition is corrected.

k. All Alternator Exciter Control Relay Switches—ON.

l. All Alternator Breaker Switches—CLOSE (lamps out).

m. All Alternator Breaker Hold-In Switches—Hold in. Return each mixture control lever of the alternator-equipped engine to IDLE CUT-OFF. See that the alternator breaker lamps are still out. Then move the mixture control lever for alternator-equipped engines out of IDLE CUT-OFF and release the hold-in switches. See that the alternator breaker lamps are still out. Move each mixture control lever slowly towards IDLE CUT-OFF and observe the position of the mixture control lever when the respective alternator breaker lamp lights.

Note

Maladjustment of the microswitch and the travel of the mixture control lever towards the manual lean range will open the alternator breaker.

8. External Power—Plugged in.

The ground observer can either close the APU circuit breaker or plug in the external power, depending upon type of power unit involved. He is also standing by on interphone to make any adjustments to power found necessary by aircraft instrumentation.

9. Correct A-C Phase Sequence Lamp—Lighted. To insure that external power is in correct phase (1, 2, 3) with the aircraft wiring system. Push to test to insure that the lamps are operating and to positively assure proper phase sequence. If *incorrect phase* external power were placed on the aircraft a-c power distribution system, it would cause all three phase motors to operate in reverse, nullifying limit switches on electrical actuators and resulting in immediate damage to aircraft structure and equipment.

BEFORE STARTING ENGINES (Cont'd)

9. Tower Call—Completed.

Contact the control tower and request fire equipment. Receive OAT. and dew point and inform engineer. If instrument conditions are to be encountered immediately after take-off, have radio navigational equipment tuned to appropriate facilities. Either the aircraft commander or pilot will monitor interphone at all times.

10. Propeller Reverse Selector Switches—SAFE. Lights out. This will prevent inadvertent operation in reverse pitch. The red propeller reverse warning lamps indicate when the propellers are in reverse pitch. The lamps should go out when the propeller reverse selector switches are in the SAFE position.

11. Flight Instrument Switches—ON. These switches are provided so that the flight instruments may be spared hours of ground operation during maintenance on the airplane. These switches must be ON approximately 15 minutes before take-off so that the gyros can stabilize and so that flight instrument operation can be checked. During the preflight operational equipment check, place the pilot's flight instrument switch to EMERGENCY until the emergency electrical power system check has been completed. While the switch is in this position, check for proper operation of instruments.

Note

On airplanes equipped with an inverter, place the emergency circuit selector switch to EMERGENCY and check that the pilot's directional and attitude gyros continue to operate. This indicates proper operation of the inverter. After checking, immediately return the switch to NORMAL to conserve battery power.

10. External Power Supply Switch—ON. Check bus voltage (208V) and frequency (405 cycles ± 5). Have the ground observer adjust if necessary.

11. Master Ignition Switch—Pull off.

12. Liquid Lock Check (with ignition switches OFF)—Completed. Perform a liquid lock check at this time with the ignition switches OFF. Pull propellers through 15 blades with starters. Sequence 4, 5, 6, 3, 2, 1.

CAUTION

Energize starter continuously for 15 blades. Maintain contact with observer for reports of propeller movement. A minimum of nine blades are required to avoid possible damage from hydraulic lock; however, a total of 15 blades are necessary to provide adequate lubrication to the reduction pinion bearings during engine starting.

13. Mixture Control Check—Completed.

a. Mixture Control Levers—Move from IDLE CUT-OFF to RICH and note that the indicator lamps light and go out as the mixture control travels through NORMAL.

b. Move mixture control levers back to NORMAL—Lights on.

c. Selector Switches—SWITCH.

d. Override Switches—Hold to RICH and note that the indicator lamps go dark as mixture control travels toward RICH.

e. Override Switches—Hold to IDLE CUT-OFF and note that the indicator lamps light and go out as mixture control travels through NORMAL.

f. Selector Switches—LEVER, and note that the indicator lamps light as mixture control travels to NORMAL.

g. Mixture Control Levers—IDLE CUT-OFF and note that indicator lamps go dark as mixture control moves to IDLE CUT-OFF.

Note

Normally it will be necessary to check only the normal mixture control system on the day of flight.

14. Throttle Lever and Flap Warning Horn Check—Completed. Move the throttle levers to the full open

PILOTS ENGINEERS

BEFORE STARTING ENGINES (Cont'd)

position. Observe closely for binding to insure freedom of movement thru entire range of travel. When all six levers are full open, check sounding of the flap warning horn. Check individual throttles for cutting out of warning horn. Return throttles to closed position and check for proper cushioning at extreme limits of throttle lever movement.

15. Fuel Panel Configuration—Checked.

a. Pressure Refueling Valve Switches—CLOSE. These valves should always be closed except when fuel is being transferred. Normally closed, these valves prevent inadvertent fuel transfer.

CAUTION

> Inadvertent transfer of fuel may result in fuel tank overflow if pressure refueling valve switches are left OPEN and a malfunction exists which would prevent automatic closing of the valve. Open valves would also cause abnormally low fuel pressures during checks and operation.

b. Fuel Booster Pumps—OFF. Always OFF except when fuel is to be used from tank and respective tank valve is open.

c. Fuel Tank Valves—CLOSE. Normal position when fuel is not being used or transferred and engines are not running.

d. Engine Fuel, Manifold, and Cross-Feed Valves—OPEN. These valves are open at all times except when checking valve operation or during fuel system emergencies. In the OPEN position these valves permit any fuel tank to feed any engine plus allowing for temperature expansion of fuel in the long manifold system.

e. Fuel System Operation Check.

Note

> The following check should be made during the "Preflight Operational Equipment Check" to assure that all valves and booster pumps in the fuel system perform their designated functions. It should only be necessary to perform one complete check prior to any flight to prevent wear from added operation of these components, but additional checks may be made any time it is deemed advisable and in any case where a recheck is dictated by repair or replacement of equipment.

PILOTS ENGINEERS

BEFORE STARTING ENGINES (Cont'd)

(1) Fuel Pressure—Zero.

(2) Engine Valves—CLOSE.

(3) No. 1 Tank Valve—OPEN.

(4) No. 1 Tank Booster Pump—ON (observe zero pressure on all engines).

(5) All Engines Valves—OPEN. Check for 10 to 14 psi fuel pressure on all engines.

(6) No. 1 Manifold Valve—CLOSE.

(7) R. Auxiliary Pressure Refueling Valve—OPEN to drop pressure to zero on all engines; except No. 1; then CLOSE.

(8) No. 2 Manifold Valve—CLOSE, No. 1 Manifold Valve—OPEN. Note pressure on No. 2 engine.

(9) Continue closing and opening manifold and cross-feed valves, noting fuel pressure on engines across the panel.

(10) No. 1 Tank Booster Pump—OFF.

(11) No. 1 Tank Valve—CLOSE.

(12) No. 1 Tank Refueling Valve—OPEN. Note pressure zero, then CLOSE.

(13) Cross-Feed Valve—CLOSE.

(14) No. 1 and 6 Tank Booster Pumps—ON. Note zero pressure.

(15) No. 1 and 6 Tank Valves—OPEN. Note 10 to 14 psi fuel pressure on all engines.

(16) No. 1 and 6 Tank Booster Pumps—OFF. Note that fuel pressure remains steady.

(17) No. 1 and 6 Tank Refueling Valves—OPEN to drop fuel pressure to zero; then CLOSE.

(18) Repeat above check on each remaining symmetrical pair of tanks.

(19) Cross-Feed Valve—OPEN.

(20) No. 6 Booster Pump—ON and check for 10 to 14 psi fuel pressure on all engines.

(21) No. 6 Tank Booster Pump—OFF.

16. Intercoolers and Air Plugs—As required. Normal position for all ground and high power operation is full open. However, the desired position should be dictated by good reasoning after due consideration of such factors as weather, accelerated warmup, etc. A complete cycle of operation of these controls may be performed at this time or during the engineers' preflight inspection. A check of the left intercooler shutters may also be made at this time. This check is made by placing the turbo selector switches in R. H. ONLY

PILOTS

ENGINEERS

BEFORE STARTING ENGINES (Cont'd)

and noting that the left intercooler shutters close and then by returning the turbo selector switches to BOTH and noting that the left intercooler shutters open. It should not be necessary to check cycle of operation more than once prior to any flight. This will prevent undue wear on actuators and linkage.

17. Oil Cooler Door Manual Operation (some airplanes)—Checked—AUTO. It should not be necessary to check cycle of operation more than once prior to any flight. Check manual operation as follows:

a. Engine Fuel Valves—OPEN.

b. Request the pilot, "Pull landing gear control circuit breaker." Ask the ground observer to inform you of inflight oil cooler door operation.

c. Oil Cooler Door Mode Selector Switches—MANUAL. This sets up manual override operation. It may not be possible to operate all switches at one time due to overloading the circuit breaker.

d. Oil Cooler Door Override Switches—OPEN. Fully open all inflight cooling doors to check the control circuits and door actuators.

e. Oil Cooler Door Override Switches—CLOSE. Close all inflight cooling doors, check the control circuits and door actuators. Close doors approximately half way.

f. Oil Cooler Door Mode Selector Switches—AUTO. Inflight oil cooler doors should close. AUTO is the normal position for these switches and provides automatic oil cooling.

g. Request the pilot, "Close the landing gear control circuit breaker." This provides normal ground cooling for the oil system.

h. Engine Fuel Valves—CLOSE.

18. Water Injection Switches—OFF. To prevent operation of water injection pumps.

19. Oil Vent Heater Switch—As required. To prevent vapors from congealing, freezing, and consequently plugging the engine oil tank vent lines. This switch should be placed in the ON position for ground and flight operations when the ambient air temperature is at 0°C (32°F) and below.

20. Oil Shutoff Valve Switch Guards—DOWN. This is the normal position for these controls to prevent starvation of oil to engine when started.

21. Engine Supercharger Switches—BOTH. Normal position for all ground operation to prevent abnormal manifold pressure during run-up.

BEFORE STARTING ENGINES (Cont'd)

22. Cabin Temperature Control Switch—FULL DECREASE until lamp lights.

23. Cabin Pressure Wing Shutoff Valve Switches—OFF. This closes the wing shutoff valve and is the normal position for these valves prior to engine start. This also prevents drainage of manifold pressure during full power checks.

24. Cabin Booster Fan Switch—As required.

25. Aft Cabin Pressure Switch—ON. Sets up aft cabin for pressurization. There is no reason for this valve to be closed except when it is desired to depressurize the aft cabin during flight or to check cabin air flow.

26. Wing, Cabin Heat and Tail Anti-Ice Switches—OFF. (Push to test warning lamps.) The cabin heat and tail anti-ice switches must be held in the OFF position for approximately 8 seconds. This opens the engine dump valves and prevents heating the leading edges of wings and empennage during engine run-up. If leading edges are heated over 50°C above OAT. during ground operation, damage such as permanent wrinkling of the leading edges will probably result.

27. Pitot Heat Switches—OFF. This is the normal position for these switches except during operational checks or when icing is anticipated during flight. Leaving pitot heat switches ON on the ground will burn out the heater elements.

28. Carburetor Preheat Switches—OFF. These switches should be OFF at all times except when checking system or when icing is anticipated. If left ON, excessive carburetor temperatures will be experienced during run-up and control of cabin pressure wing shutoff valves will be lost, since these valves automatically close when carburetor preheat is ON.

29. Nacelle Fire Detector and Extinguisher—Checked.

a. Fire Extinguisher Engine Selector Switches—OFF (guards down). To prevent accidental discharge of the fire extinguisher system.

b. Fire Detector Push-to-Test Switch—Push to test circuit. This tests the complete warning circuit for continuity and normal operation from a rapid rate heat rise. If any one lamp does not light within 10 seconds, the circuit is defective and must be checked.

29A. Aerial Camera Master Power Switch—ON. This switch should be left on at all times except in case of electrical power failure.

30. Wheel Well Lights Switch—As required. This switch should be OFF except during gear operation at night, when a crew member is in the wing, or when a crew member is checking the nose gear latch. It controls lamps that shine upon the landing gear release mechanism.

BEFORE STARTING ENGINES (Cont'd)

PILOTS

12. Nose Steering and Brakes—Checked and set. This check must be made in coordination with the engineer. It includes a check of the nose steering system, a brake check, and setting of the parking brake prior to engine start.

a. Steering Control Switch—ON, and check for normal pressure.

CAUTION

Do not apply steering pressure to the nose wheel while the aircraft is static. This would cause undue stress and strain on nose gear components and scrubbing abrasions of the tires.

b. Steering Control Switch—OFF.

c. Landing Gear and Brake Pump Switch—Neutral and OFF. The brake check will be made with the brake pump switch OFF and the parking brake control OFF.

Note

Steps c, e, and f need be performed on the preflight operational equipment check only. On the day of flight a check of the automatic system is adequate, with the engineer noting pressure drop and build-up as the left and right brakes are depressed.

ENGINEERS

31. Turbo Override Control Panel—Checked (group 2 airplanes).

a. Turbo Change-Over Switches—AUTO. In this position the TBS is effective for controlling the turbo waste gates.

b. Turbo Control Vernier Switch—OFF.

32. Hydraulic Control Panel—Checked. It should not be necessary to perform a complete hydraulic control panel check more than once prior to any flight; however, nose steering pressure and automatic operation of the brake pump must be checked on the day of flight.

a. Hydraulic Fluid Temperature Control Switch—As required. Use to keep bomb bay door fluid temperatures between —18°C (0°F) and 38°C (100°F) to insure proper operation of the bomb bay door system. Turn ON when ambient air temperature is below —18°C (0°F) if bomb bay door operation is anticipated.

b. Hydraulic Pump Override Switch—OFF. Turn ON momentarily (approximately 1/4 second) and then OFF. Observe surge of main system hydraulic pressure and electrical load. Main system hydraulic pressure should return to zero with override switch OFF. The above check with the override switch assures that the override circuit and relay and No. 2 hydro pump and motor are operational.

c. Report nose steering pressure on pilot's request.

d. Brake System Check—Completed. Contact pilot and announce, "Ready for brake check." Report pressures during check.

BEFORE STARTING ENGINES (Cont'd)

PILOTS

d. Announce, "Left brake," and firmly depress left brake pedal and release. Then announce, "Right brake," and firmly depress right brake pedal and release. The engineer will check for pressure drop.

e. Depress and release both brake pedals until brake pressure drops to air charge in accumulator.

f. Landing Gear and Brake Pump Switch—EXTEND and ON.

g. Parking Brake Control—ON. Announce, "Parking brake set."

Brake pedals should be fully extended. Normal pressure on the brake pedals should not cause any depression.

If the brake pedals move spongily, the slave brake system must be bled and rechecked.

On airplanes which have a brake gage line fuse, if pressure does not force the foot pedals out, the fuse is probably blown. If this has happened, hold the aircraft with the foot brakes, have the radio operator or the second engineer place the emergency hydraulic selector valve in the CHARGE BRAKE ACCUMULATOR position, and operate the hand pump four or five strokes. This will reset the brake fuse and the parking brakes should operate normally. The aircraft must be completely stopped for normal parking brake setting because of the instantaneous locking action of the system. The foot brakes will be used to hold the airplane when releasing the parking brake. Rapid successive movement of the parking brakes on airplanes which have a brake gage line fuse will cause the fuse to move and drop the brake pressure, rendering the parking brakes inoperative. If this condition exists place the emergency selector valve in the CHARGE BRAKE ACCUMULATOR position and operate the hand pump four or five strokes. This action will position the fuse to give the proper pressure. The emergency selector valve should be allowed to remain in the CHARGE BRAKE ACCUMULATOR position at all times except during emergency hydraulic extension of the landing gear.

ENGINEERS

e. As pilot depresses and releases brake pedals, report remaining pressure, "____psi."

Note

Steps e through i need be performed on the preflight operational equipment check only. On the day of flight a check of the automatic system is adequate. After the pilot depresses the left and right brakes, the engineer will report, "Pressure drop OK, pressure normal."

f. Have ground observer report accumulator preload pressure. Accumulator pressure should be approximately 300 psi (group 7 airplanes), 450 psi (group 8 airplanes).

g. Brake Pump Pressure Override Switch—Hold ON until pressure is 500 to 600 psi; then release and announce, "____psi with override."

h. Observe low brake pressure warning lamp lighted and then pressure build-up until lamp goes out. Observe continued build-up of pressure to normal. Report, "Brake pressure normal."

i. Observe and announce, "Pressure down, building up, normal."

33. Propeller Control Panel—Checked.

a. Propeller Feather Switches—NORMAL (guards down). To prevent accidental feathering of propeller. All normal circuits pass through each propeller feather switch.

b. Propeller Circuit Breakers—In. Connects all propeller controls to d-c power distribution.

c. Propeller Selector Switches—AUTOMATIC OPERATION. Sets up system for eventual run-up and for a check on the protective relay tel-lamps as master motor speed is increased.

d. Master Motor Speed Control Lever—2700 rpm, full INCREASE rpm position. This step checks automatic increase rpm controls and the master motor protective relay circuit as indicated by the tel-lamps. The tel-lamps should go out during any rapid change of the master motor speed control lever and come on again as the master motor begins governing at this new setting. This indicates that the master motor protective relay is breaking the ground of each contactor, thus preventing undesired rpm changes in event of a master motor failure. Any time the tel-lamps are out (provided the bulbs are good), the automatic control circuit is disrupted and the propellers assume a fixed pitch position until the system is again in balance and the tel-lamps come back on.

PILOTS ENGINEERS

BEFORE STARTING ENGINES (Cont'd)

13. Bomb Bay Door Locks—Removed. Bomb bay door locks should be removed at this point so that the doors can be closed after engine start. The locks have been left on up to this point so ground crew personnel could safely observe any fuel leaks in the bomb bays and to make the interior of the bomb bays readily accessible to fire fighting equipment in the event of a fire in the bomb bays.

14. Fire Equipment—In place. A fire truck or an officially authorized equivalent will be in place accessible to the engine being started before attempting to start engines.

15. Emergency Ignition Switch—IN. When the engineer has completed his check list up to placing his master ignition switch ON, he will request the aircraft commander to push in the emergency ignition switch.

e. Propeller Tel-Lamps—Lighted. Tel-lamps indicate that contactors are properly grounded through the master motor protective relay and that control panel is set up for automatic operation.

34. Fan Speed Control Switches—LOW RPM. Normal position for all ground operation except when checking engine cooling fan. The LOW RPM position, being normal, prevents low torque readings during run-up and prevents damage to fan, cooling tunnel, accessory case, and shear couplings during full power checks.

35. Carburetor Air Filter Switch—As required. Used only under extreme dust conditions. The switch is inoperative and filters are not installed on most airplanes under normal conditions.

36. Panel Lights—As required. Check the operation of panel and overhead lights.

37. Spark Advance Switches—RETARD (guards down). This places engine ignition timing in retard position (20 degrees BTC), which is normal for all ground and high power operation except when checking ADVANCE position during engine run-up for proper operation.

38. Turbo Boost Selector—ZERO. Waste gates should be full open to prevent damage due to afterfire during starting and excessive back pressure and overheating during run-up.

39. Turbo Calibration Knobs—Indexed to the fully counterclockwise position. This prevents staggered indications and probable excessive manifold pressures when setting TBS for full take-off power.

40. Engine Analyzer Power Switch—OFF.

41. Master Temperature Indicator (some airplanes) —ON and compensated. Adjust master temperature indicator as follows:

a. Selector Switch—Select any engine.

b. Control Switch—ON.

c. Adjust slide wire rheostat to obtain full scale deflection with balance knob.

d. Turn Check Switch to CH position.

e. Adjust Comp. Rheo. Knob until galvanometer needle is directly over CH line.

f. Turn check switch to the ON position.

g. Move selector switch through all positions checking for open circuits and ambient temperature indications. Leave selector switch on first engine to be started (normally No. 4 engine).

42. Instrument Check—Normal. This can be accomplished while manipulating air plugs and intercooler.

PILOTS | ENGINEERS

BEFORE STARTING ENGINES (Cont'd)

See that all temperature indicators check against ambient air. On aircraft that have a cylinder head temperature selector switch, make sure that all positions are checked. Check rpm, torque, fuel flow indicators and turbo tachometers for zero reading, and fuel, oil, and water pressures normal. Have second engineer observe static M.P. for future use during check field barometric pressure.

43. Master Ignition Switch—ON.

16. Receive engineer's report and notify engineer, "Brakes set, fire guard standing by, start engines."

44. Report to aircraft commander, "Check list completed, master ignition in, ready to start engines."

STARTING RECIPROCATING ENGINES.

The minimum team required for engine operation during the "Operational Preflight Equipment Check" shall consist of the aircraft commander, the pilot, one engineer, two aft cabin scanners, a qualified crew member, and a qualified ground observer. During darkness or under conditions of poor visibility, an additional qualified crew member will be present.

During engine starting, the ground observer shall be in constant communication with the engineer. The other crew members will be stationed as follows: the pilots in their seats, the two scanners at their stations, and the qualified crew member standing by on interphone at the emergency brake pump. The engineer shall announce what he is going to do at all times during engine operation so that the other crew members will be able to anticipate their activities when coordination is required.

During darkness or under conditions of poor visibility, the additional crew member will be stationed in the airplane at the nose wheel well entrance hatch. He will be equipped with a headset, a microphone and an Aldis lamp and will observe through the entrance hatch for any movement of the aircraft prior to and during engine run-up. If at any time communication from this observer is broken or aircraft movement is reported, engine run-up shall cease.

The pilot and the aft scanners will maintain visual contact with reference points immediately adjacent to the aircraft and will notify the aircraft commander of any movement of the aircraft. If necessary, the pilot will use a landing light and the scanners will use the main gear wheel well lights for illumination of the reference points. Ground fire equipment of adequate capacity to combat any anticipated fire should be properly manned and standing by. See "Reciprocating Engine Fire on the Ground," Section III, for instructions on combating engine fires. As each of the engines is turned over, any observation of abnormal operation must be reported to the engineer immediately. The engine starting sequence is 4, 5, 6, 3, 2, 1. The aircraft commander will observe the engineer's procedure during reciprocating engine starts. The aircraft commander can assist the engineer during starts by handling the throttle of each engine to maintain specified idling speeds after the engineer has it started.

PILOTS | ENGINEERS

1. Engine Analyzer Power Switch—ON. This allows the analyzer time to warm up for monitoring the ignition system during starting.

2. Fuel Tank Valve Switches—OPEN. Use a minimum of two tanks containing fuel.

STARTING RECIPROCATING ENGINES (Cont'd)

3. Booster Pumps of Tanks Being Used—ON. To provide positive fuel pressure (10 to 14 psi) to engine-driven fuel pump and fuel under pressure to primer. The primer is effectively inoperative without pressure.

4. Voltage and Frequency Selector Switch—No. 4 position. See that bus voltage provided by external power source is within limits by moving the selector switch to the bus position. Then move it to the No. 4 position. This will allow you to observe voltage and frequency of engine being started.

5. Throttle Levers—As required. If it becomes necessary to restart a relatively "hot" engine, a more open throttle may be required.

6. Inform ground observer, "Ready to start engines, clear No. 4."

7. Engine No. 4 Starter Switch—ON. Energize starter continuously for nine blades. Maintain contact with observer for reports of propeller movement. This procedure is followed to minimize the possibility of damage in the event of a liquid (hydraulic) lock.

Note

Nine blades are necessary to provide an adequate liquid lock check.

8. No. 4 Engine Ignition Switch—BOTH after nine blades of propeller rotation.

9. Engine No. 4 Primer Switch—As required.

10. No. 4 Mixture Control Lever—NORMAL.

CAUTION

Maximum continuous cranking time is *1 minute*—then allow the starter to cool a minimum of *3 minutes.*

1. As the engineer starts other engines, control the throttles of the engines that have been started to maintain the recommended idle speed (1000 to 1200 rpm).

11. Report, "Alternator normal, oil and fuel pressure normal."

CAUTION

If oil pressure does not register 25 psi within 30 seconds, the engine will be shut down and the cause investigated.

Note

Minimum oil pressure at ground idle speed after oil has reached operating temperature is 25 psi.

PILOTS ENGINEERS

STARTING RECIPROCATING ENGINES (Cont'd)

Adjust voltage to 208 volts and check frequency for normal indication to allow control circuits to stabilize. Move the voltage and frequency selector switch to the number of the next alternator-equipped engine to be started.

Note

The frequency will increase with the temperature of the control circuit resistor.

Do not move the frequency control knob beyond the mechanical stop during ground operation. If the mechanical limit is exceeded overspeeding may occur.

CAUTION

a. If excitation of the alternator is not immediately apparent, the field will be flashed. If flashing the field fails to excite the alternator, shut down the engine. With no meter indication, malfunctions which might cause alternator damage would not be evident.

b. Alternators must be excited and properly governed before advancing the throttles above 1400 rpm. This is necessary so that the alternators can be checked when the engines are run up. If the frequency of any alternator increases with an increase in engine rpm and cannot be adjusted, then the affected engine must be shut down and the constant-speed drive unit checked. Otherwise an overspeed condition may be reached, causing the units to disintegrate and cause a serious fire.

12. Repeat steps 4 through 11 for starting engines 5, 6, 3, 2, and 1. Since No. 1 and No. 6 engines are not alternator-equipped, references to alternators in the starting procedure should be disregarded.

Note

If the engine stops running with the mixture control in NORMAL, the lever should be returned to the IDLE CUT-OFF position. After the starter has been allowed to cool, the starting procedure may be repeated.

RECIPROCATING ENGINE GROUND OPERATION.

During darkness and under conditions of poor visibility, a designated crew member, equipped with headset, microphone, and Aldis lamp, will be stationed inside the aircraft in direct communication with the aircraft commander and engineer and will observe through the nose wheel entrance hatch for any movement of the aircraft prior to and during engine run-up. At any time that communication is broken or aircraft movement reported, engine run-up will cease. The aft scanners, by illumination from the wheel well lights, will maintain visual contact with a reference point immediately adjacent to the aircraft, and notify the aircraft commander of any movement of the aircraft. The pilot, using a landing light if necessary, will maintain visual contact with a reference point immediately adjacent to the aircraft, and will notify the aircraft commander of any movement of the aircraft.

The ground operation of each engine must be held to an absolute minimum. During idling, an attempt should me made to maintain cylinder head temperatures between 170° to 220°C by use of the air plugs. This will minimize the possibility of spark plug fouling. Normally, high idle speed will not be used to keep cylinder head temperature high. However, if these temperatures cannot be maintained with the air plugs, it may be necessary to use higher idle speeds provided oil temperatures are within limits. Engines shall be run only when it is necessary to perform the required checks. An engine should be shut down, when possible, if running unnecessarily during a prolonged check of another engine. Spark plug fouling occurs very rapidly during ground idling, particularly if the idle mixture setting is too rich. This type fouling can be minimized by using the followng procedures:

When it is necessary to run an engine on the ground for an extended time and lead fouling is suspected, it may be run up to 2200 rpm, 37 inches manifold pressure, for a 1-minute period every 15 minutes. This procedure will act to clear away the fouling deposits in their early stages.

If the above procedure does not clear the fouling, the following procedure may be used as an alternate method.

1. Operate the engine at 2000 rpm and bring the cylinder head temperatures to 200° to 220°C.
2. Increase to take-off power with water on and hold for 30 seconds.
3. At the end of 30 seconds operate for 1 minute at dry take-off power and then repeat wet take-off power for 30 seconds.
4. Reduce manifold pressure to 55 inches, turn water injection switches OFF, and reduce rpm to idle.

Note

If the above procedure does not clear the fouling, the spark plugs must be changed.

The normal operating range of the turbosupercharger tachometers is above the range obtainable during engine ground operation. Therefore, no ground checks of the turbo tachometers are recommended. However, a low rpm indication will occur during power checks with boost and water. Failure to obtain such an indication may be indicative of a malfunction and should be investigated before flight.

CAUTION

If the fuel pressure drops below the operating limits during ground operation but the engine continues to operate normally, shut down *immediately,* investigate the cause, and take corrective action.

DURING ENGINE WARM-UP.

All reciprocating engines have now been started and are operating at idle speed. Do not exceed 1400 rpm until the engine oil-in temperature reaches 40°C. Make all ground operations with the mixture controls in the NORMAL position. The engine analyzer may be used to perform the following checks:

1. Slow sweep check of all magnetos and spark plugs.
2. Ignition grounding system.
3. Breaker point synchronizer.
4. Fast sweep of ignition check pattern at magneto check power.

The following procedures call for an ignition switch check, engine-driven fuel pump check, heat and anti-icing check, and alternator checks. To reduce engine ground test time, these checks can be made on all six engines at once.

Normally, it should be necessary to perform the ignition switch check once prior to any flight provided the engine analyzer is used to determine condition of ignition system prior to the ignition system checks. Normally it will be made after engine start of the initial complete reciprocating engine run-up during the "Preflight Operational Equipment Check." *If the engine analyzer is inoperative, it is imperative that an ignition switch check be made after each engine start.*

While the engineer makes the ignition switch check, the aircraft commander should maintain idle rpm on the engines the engineer is not working on. Proceed with the checks as follows:

PILOTS **ENGINEERS**

1. Ignition Switch Check—Idle rpm.

a. Individual Ignition Switches—L, detent, R, detent, L, BOTH. Check for a slight drop in rpm and torque pressure in the L and R positions and for a return to the original settings in the detent and BOTH positions. Make this check starting with engine No. 1 and continuing with engines 2, 3, 4, 5, and 6. Use your right hand to move the ignition switch from BOTH to L and then to the detent position between L and R; then switch from the detent position to R and finally back to BOTH.

Note

If a cutout occurs with the switch in either L or R position, check the ignition system before further operation.

The L position of the ignition switches grounds out the left (exhaust side) bank of spark plugs and checks the right (intake side) bank and vice versa.

CAUTION

Never leave the ignition switches in the detent position between L and R. If they are left in this position and the pilots' emergency ignition switch or the engineers' master ignition switch is pulled out (off), the ignition relays will chatter, causing severe backfiring.

Do not investigate the OFF position with the individual ignition switches.

b. Master Ignition Switch—Momentarily OFF. Move the emergency ignition switch momentarily OFF. Place your hands over this push-pull type switch so that you can get a positive and straight "out-in" action without any side force.

CAUTION

Do not allow the switch to be cut (off) for more than a split second. If the switch remains OFF too long, *do not turn it back on* for severe backfire will occur on all engines.

2. Engine-Driven Fuel Pumps—Check. Turn all booster pumps OFF and check fuel pressures to see that they remain within limits. Erratic fuel pressure readings indicate a faulty engine-driven fuel pump or other defects which must be investigated before flight. When this check has been completed, turn booster pumps of tanks being used ON.

PILOTS ENGINEERS

DURING ENGINE WARM-UP (Cont'd)

3. Heat and Anti-Icing Check—Completed.

Note

This check need only be performed following periodic inspections and whenever maintenance on the system has been performed.

On airplanes that have a master temperature indicator, use master temperature selector switch to check wing and tail anti-icing temperatures. Zero the highest indication and turn ON all cabin heat and tail and wing anti-icing switches until temperature rise is noted; then turn OFF. Move the temperature selector switch through the anti-icing positions. A galvanometer needle deflection left to zero indicates a temperature rise. On airplanes that have individual indicators turn all cabin heat and tail and wing anti-ice switches to ON until a temperature rise occurs; then turn to OFF.

CAUTION

Do not allow temperatures to exceed 50°C above ambient air temperature.

Check a little later to see that temperatures have receded to normal, indicating that the engine dump valves have operated through one complete cycle and are in the open position.

4. Alternator Checks—Completed. No constant-speed drive oil warm-up is required. Proceed with the following check:

a. Voltage and Frequency Range—Checked.

Note

Alternator control circuits will normally take approximately 5 minutes to warm up in normal ambient temperature ranges.

(1) Voltage and frequency selector switch to desired alternator.

(2) Voltage Control Knob—Check voltage range. The voltage range should be at least 195 to 215 volts by adjustment of the engineers' voltage control knob. Reset voltage to 208 volts.

(3) Frequency Control Knob—Check frequency range. The maximum frequency should be 440 (±5) cycles. DO NOT go above 445 cycles. If the limit 440 (±5) cycles is not obtained, adjustment should be made to the frequency control rheostat located in the governor control "J" box on the respective engine distribution panel. On some airplanes, the frequency control rheostats are located in the lower left side of the forward cabin between the radio and observers' com-

PILOTS

ENGINEERS

DURING ENGINE WARM-UP (Cont'd)

partment. While adjustments are being made, the engineers' frequency control knob will be turned to full decrease to preclude the possibility of the constant-speed drive going into underdrive. After the adjustment is made, the minimum indication with the engineers' knob in the FULL DECREASE position will be approximately 375 cycles, depending upon the constant-speed drive and control circuit temperatures. Reset frequency to 405 cycles.

(4) Repeat the above steps on alternator-equipped engines.

b. Emergency Power—Checked.

Note

This check need only be performed following periodic inspections and whenever maintenance on the system has been performed.

The alternator will be checked by using the emergency method of restoring normal electrical power. The in-flight procedure is given in Section III, "Emergency Procedures." This ground check will vary slightly. Proceed as follows:

(1) Reduce a-c and d-c electrical loads to a minimum and request all crew members to turn off all unnecessary electrical loads.

(2) Deexcite all alternators.

(3) External Power Switch—OFF.

(4) Battery Switch—OFF.

(5) Turn the voltage and frequency selector switch to No. 3 alternator.

(6) Move the emergency power switch to EMERGENCY and momentarily hold the respective exciter control relay switch ON.

Pilot's Flight Instrument Switch—EMERGENCY and check instruments for proper operation. When check is completed, place the switch in the ON position.

(7) Request the pilot to move his flight instrument switch to EMERGENCY and to check that his flight instruments are functioning properly.

CAUTION

With the t-r test unit selector switch in RADIO OPERATOR position, a crew member on interphone should observe the load on the unit during the check of the first alternator. Do not permit the d-c load to exceed 1.0 (50 amperes) as indicated on the test unit. An overload can damage the t-r unit or blow out the a-c instrument fuses at the engine distribution panel with a resulting loss of all emergency power. The voltage output of

PILOTS ENGINEERS

DURING ENGINE WARM-UP (Cont'd)

the transformer-rectifier should be 24 to 28 volts. It is the characteristic of the t-r unit that as the load is increased its output voltage decreases. A d-c overload on the radio operator's t-r unit may occur when power is suddenly applied through the emergency circuit, causing the voltage to be low for a short time.

(8) Repeat steps 4b (5) thru 4b (6) for 4, 5, and 2 alternator-equipped engines.

(9) Close the alternator breaker switch of No. 2 alternator.

Note

If you find that the alternator functions normally on the line, return the emergency power switch to NORMAL and readjust voltage and frequency.

(10) Request pilot to place his flight instrument switch back to ON.

(11) Battery Switch—ON.

c. Alternate Power Check—Checked.

(1) No. 2 Alternator Breaker Switch—Momentarily CLOSE, lamp out. All other alternators off the line.

(2) Bus Tie-Breaker Control Switches 5-2 and 3-4—Momentarily OPEN, lamps on. Observe a loss of electrical power on the panel as indicated by the normal mixture indicator lamps going out or by the engine analyzer.

(3) Alternate Power Switch—ALT, observe the return of panel electrical power by the lighting of the mixture indicator lamps or by the engine analyzer.

(4) Bus Tie-Breaker Control Switches 5-2 and 3-4—Momentarily CLOSE, lamps out.

(5) Alternate Power Switch—NORM.

(6) Parallel remaining alternators as required.

d. Alternators on Line—Minimum of two.

(1) Voltage and Frequency Selector Switch—No. 4 position.

(2) No. 4 Voltage and Frequency—Adjust to 208 volts and 405 cycles.

(3) Voltage and Frequency Selector Switch—Bus position (detent between 4 and 5).

(4) External Power Supply Switch—OFF. Watch bus voltage and frequency drop-off.

(5) No. 4 Alternator Breaker Switch—CLOSE. Watch bus voltage and frequency build-up. Adjust frequency if necessary.

PILOTS — ENGINEERS

DURING ENGINE WARM-UP (Cont'd)

1. Bomb Bay Door and Salvo Circuit Breakers—In. Check that both the radar observer's and pilots' salvo circuit breakers are pushed in.

2. Bomb Bay and Camera Doors—Closed. Closing the camera doors as soon as possible will eliminate the possibility of the windows being splattered with mud, snow, or slush during taxi and engine run-up. Bomb bay doors will be closed before taxiing to prevent anything from being blown into the bomb bays by the propeller blast.

3. Flaps and Indicators—Checked. Fully extend the flaps and have the ground observer report their position. Check the flap indicators for 30 degrees. Fully raise the flaps and check ground observer's report with indicators. If it is necessary to operate flap actuators for more than two cycles on the ground, allow the actuators to cool for approximately 10 minutes between cycles.

Note

This check should be made on the preflight operational equipment check only.

4. Propeller Reverse Check, Idle Rpm—Completed (if required). If it is necessary to move the aircraft to a run-up area, a propeller reverse check must be made before taxiing to assure a means of stopping the aircraft in the event of brake failure. This check may be made at idle rpm.

(6) Voltage and Frequency Selector Switch—No. 5 position.

(7) No. 5 Voltage and Frequency—Adjust to 208 volts and 405 cycles. Make fine adjustment on frequency until alternator synchronizing lamps blink at slowest rate possible.

(8) No. 5 Alternator Breaker Switch—CLOSE. (When alternator synchronizing lamps are out.) The synchronizing lamps indicate three things. First, when both lamps are blinking simultaneously, they indicate correct phase sequence. Second, alternately blinking lamps indicate a crossed phase sequence; very serious damage will result if two alternators with opposing phase sequences are paralleled. It would amount to a direct short of the total output of both units. Third, the lamps indicate when two alternators of correct phase sequence are in or out of step. Lamps out indicate "in step" and lamps on indicate "out of step."

(9) Adjust the kilowatt and kilovar load division as indicated on the kilowatt-kilovar meters. These meters read kilowatts when the kilowatt-kilovar selector switches are in the KWATTS position. Use the frequency control knobs to divide the kilowatt load. Move the kilowatt-kilovar selector switches to the KVAR position and use the voltage control knobs to divide the kilovar load.

(10) Repeat steps (6) thru (9) to parallel No. 3 and 2 alternators.

(11) Voltage and Frequency Selector Switch—Detent position between any two alternator positions. This will allow you to read bus voltage on the voltmeter. Selections of any alternate position enables you to read individual frequency and voltage of alternators on standby.

(12) Instruct ground crew to unplug the external power supply if the aircraft is to be taxied. When it is unplugged, the CORRECT-INCORRECT phase sequence lamps will go out.

5. Engine Oil-In Temperature—Minimum 40°C. Check all engine temperature in limits, paying particular attention to oil-in temperatures prior to advancing throttles for engine run-up. CHT must be above 120°C before exceeding 1400 rpm.

6. Propeller Reverse Check, Idle Rpm—Completed (if required). Observe that propeller pitch indicator lights go out during check.

TAXIING.

If it is necessary to move the aircraft to a run-up area, taxiing will be accomplished in accordance with the instructions given in "Taxiing" of this section.

ENGINE RUN-UP.

The operational preflight procedures call for propeller checks, ignition system checks, and power checks. Power checks include full power no boost and full power with boost. A complete check will be accomplished on the following systems after a periodic inspection or whenever maintenance on the system has been performed: inflight oil cooling doors, cabin pressure wing shutoff valve and carburetor preheat checks, and turbo override and single turbo checks. After power checks are completed on any engine it should be shut down as soon as its cylinder head temperature cools to 180°C, provided take-off is not to follow and provided it is not needed for taxiing or for jet engine starting or operation. Run-up procedures are as follows:

PILOTS

1. Parking Brake Control—ON. The aircraft commander will set the parking brakes and both he and the pilot will stand by on the foot brakes in case the aircraft creeps forward during engine run-up or in case of parking brake failure.

2. Propeller Reverse Selector Switches—SAFE (lights out). When the aircraft commander has the aircraft in position for engine run-up he should announce over interphone, "Nose steering switch off, all propeller reverse selector switches safe, parking brakes set, ready for engine run-up." As each item is announced, the aircraft commander should check each one by putting his hand on the item being checked. The propeller reverse selector switches have a gang bar to move all three switches to the READY position, but in order to place them in the SAFE position, each of the three switches must be moved individually.

Note

Pull the pilot's landing gear control circuit breaker upon the engineer's request. Close the circuit breaker as soon as the engineer requests it.

3. Nose Wheel Steering Switch—OFF. This switch must be in the OFF position during all ground operation—except when you are taxiing—to eliminate unnecessary hydraulic pump operation.

4. Pilots' Manifold Pressure Gage—Checked. This is a check to insure that the instrument is functioning normally by cross checking the indicaton on the engineers' No. 4 engine manifold pressure gage with the pilots' manifold pressure gage. The pilots' manifold pressure gage gives an indication of No. 4 engine only and is used as master indicator for the pilots' observation.

5. Master Tachometer—Checked. Cross check the pilots' master tachometer setting with the setting on the engineers' master tachometer during all propeller

ENGINEERS

1. Inflight Oil Cooling Doors—Checked.

Note

On airplanes equipped with manual override controls, this check need only be performed following periodic inspections and whenever maintenance on the system has been performed.

Request the pilot, "Pull landing gear control circuit breaker." Ask the ground observer to let you know when all inflight oil cooling doors are open. Keep a close watch on oil temperatures during this check. While the oil temperature is increasing you can continue with your other checks. The doors will be visibly open at approximately 86°C oil-in temperature. Ask the pilot, "Close the landing gear circuit breakers," as soon as the ground observer reports or as soon as the oil-in temperature reaches 98°C.

PILOTS

ENGINEERS

ENGINE RUN-UP (Cont'd)

automatic checks. This check should be made when the engineer sets 1700 rpm with the propeller master motor. When this check is complete, stand by for a propeller reverse check.

6. Propeller Reverse Check—Completed, lights out. The propeller reverse check will be made at the same time as the engineer's propeller control system check. The engineer will notify the aircraft commander when he has 1700 rpm set and ready to check propeller reversing.

Propellers will be checked in symmetrical pairs (inboards, centers, outboards) in that order. This will minimize flutter of the aileron tabs.

a. After the engineer reports that engines are ready for propeller reverse check, place the inboard reverse selector switch in READY.

b. Announce over the microphone, "Reversing inboards." This alerts the engineer. Then depress the propeller reverse pitch switch, thereby energizing the circuit and reversing the selected pair of propellers. After the circuit has been energized, it is not necessary to depress the reverse pitch switch again as long as one pair of propellers remain reversed. As each pair of propellers is reversed, check to see that the corresponding red propeller reverse warning lamps light.

c. Announce, "Reversing centers," and place the center reverse selector switch in READY. Check corresponding red propeller reverse warning lamps.

d. Announce, "Reversing outboards," and place the outboard reverse selector switch in READY. Check corresponding red propeller reverse warning lamps.

CAUTION

Do not allow outboard propellers to remain in reverse pitch longer than 5 seconds because of possible aileron damage due to aileron flutter.

e. The propellers will be brought out of reverse in symmetrical pairs (outboards, centers, and inboards) in that order. Move outboard reverse selector switch to SAFE and announce, "Outboards safe, lights out."

f. Move center reverse selector switch to SAFE and and announce, "Inboards safe, lights out."

2. Propeller Control System—Checked. This is to provide a complete operational check of the automatic, reversing, manual increase and decrease, and feather control circuits.

a. Throttle Levers—Set to obtain approximately 1900 rpm.

b. Master Motor Speed Control Lever—Decrease until engine tachometers indicate an average of 1700 rpm. The rpm on the master tachometer should read 1700 (±50).

This step checks automatic decrease rpm controls and resets propeller low limit blade angle limit switches.

c. Advise aircraft commander, "Ready for propeller reverse check."

d. Observe propeller reversing in symmetrical pairs. Note for definite increase in engine rpm and then the decrease back to the original rpm. This is a definite indication that the propellers are governing in reverse. Also note that normal pitch lamps go dark.

e. After propellers are reversed, report to aircraft commander, "Propellers reversed, lights out."

f. As propellers return from reverse, obtain definite increase in engine rpm and then decrease back to the original rpm. Also note that normal pitch lamps light.

ENGINE RUN-UP (Cont'd)

PILOTS

g. Move inboard reverse selector switch to SAFE and announce, "Inboards safe, lights out."

h. Receive engineer's report, "Propellers normal, lights on," after reverse check.

ENGINEERS

g. After propellers return to normal pitch report to aircraft commander, "Propellers normal, lights on."

h. No. 1 and 6 Propeller Selector Switches—DEC. RPM until engine speed drops to 1400 rpm, then INC. RPM until engine speed reaches 1500 rpm. Finally, place selector switches in AUTOMATIC OPERATION. Engine speed should return to original rpm. Repeat this procedure on remaining engines, working inboard on symmetrical pairs—i.e., 2 and 5, 3 and 4. Rpm's quoted are approximate. You are looking for direction of control primarily and not for specific rpm. However, when switches are released, pitch change must stop and rpm should not overshoot over 100 rpm unless the propeller selector switches are sticking. Anticipate instrument lag, power build-up, and power drop; release the switches about 50 to 100 rpm shy of the value you are shooting for. All engine rpm's should return to their original value after this check.

i. Momentary Feather Check—Completed. Perform check in this order: Engines 1, 2, 3, 4, 5, and 6. All engines should return to their original rpm after this check. Raise the propeller feather switch guard. Place your fingers behind the switch guard, actuate the switch with your thumb, and immediately slap the guard down with your fingers. Shoot for a 100-rpm dropoff and automatic return to the original rpm. This checks the fast rate feather operation.

CAUTION

Do not leave the propeller feather switch in FEATHER longer than 1/4 of a second, or the propellers will go into full feather.

Stand by on the mixture control levers and, in the event of a malfunction, move to IDLE CUT-OFF immediately to lessen the possibility of a fire.

j. Master Motor—2700 rpm.

Note

If you are proceeding with the cabin pressure wing shutoff valve and carburetor preheat checks, the master motor should remain at 1700 (±50) rpm.

3. Cabin Pressure Wing Shutoff Valve and Carburetor Preheat Checks (all six engines at one time)—Completed.

PILOTS ENGINEERS

ENGINE RUN-UP (Cont'd)

Note

These checks need only be performed following periodic inspections and whenever maintenance on the system has been performed.

a. Aft Cabin and Camera Compartment Shutoff Valve Switches—OFF.

b. Turbo Boost Selector Lever—10 position.

c. Throttle Levers—Adjust to obtain 35 inches M.P.

d. Cabin Pressure Wing Shutoff Valve Switches—L. WING ON and R. WING ON.

e. Carburetor Preheat Switches—ON and check the following:

(1) Ceasing of cabin pressure airflow into the cabin.

(2) M. P. drop of 2 to 4 inches.

(3) Rapid increase in carburetor air temperature.

CAUTION

Do not allow CAT. to exceed 43°C.

f. Carburetor Preheat Switches—OFF and check the following:

(1) Resumption of cabin pressure airflow into the cabin.

(2) Rise in M. P.

(3) Decrease in carburetor air temperature.

g. Aft Cabin and Camera Compartment Pressure Shutoff Valve Switches—ON.

h. Cabin pressure wing shutoff switches—L. WING OFF and note decrease in airflow; then R. WING OFF and note further decrease in airflow.

i. Turbo Booster Selector Lever—ZERO.

j. Throttles—Idle.

k. Master Motor—2700 rpm.

4. Barometric Pressure Checks—Completed. Set throttles to manifold pressure values observed by second engineer prior to engine start. Observe the rpm, torque, and fuel flow of all engines while you are making this check in order to insure a positive check of return from the high fan drive and spark advance checks before proceeding to higher powers. Proceed with the following checks:

a. Engine Cooling Fan Speed Check.

Fan Speed Control Switches—HIGH RPM and check torque pressure and rpm drop (approximately 100 rpm). Normal torque pressure drop is 10 to 20 psi.

PILOTS ENGINEERS

ENGINE RUN-UP (Cont'd)

Fan Speed Control Switches—LOW RPM and check torque pressure and rpm return to normal. After return to normal, check the anti-icing temperature again to see that the dump valves are open and temperatures have receded. On aircraft that have a master temperature indicator, return the selector switch to the number of the engine with highest CHT. Torque pressure and rpm should now be stabilized, so proceed with the next check.

b. Spark Advance Check.

Spark Advance Switches—ADVANCE and check for a definite rise in torque pressure up to 6 psi and an rpm increase of 25 to 50.

Note

If a definite rise in torque pressure is not noted, either a malfunction of the spark advance system or improper spark timing exists. A torque pressure rise in excess of 6 psi may be indicative of an engine out of time. Although an engine slightly out of time will operate satisfactorily, engine efficiency (maximum economy) will be affected.

Spark Advance Switches—RETARD and check for a drop in torque pressure to normal.

Note

In the event that the torque indicating system does not determine proper spark advance operation, use the engine analyzer as follows:

(1) Index the cycle selector switch to D1 cylinder and select the desired engine on the condition selector switch.

(2) Mark the scope at the normal firing event with a soft pencil.

(3) Move the spark advance switch to ADVANCE. The scope pattern will shift to the left approximately 5/16 inch in a proper spark advance operation.

(4) Return the spark advance switch to RETARD. If proper operation occurs, the pattern will shift back to its original position.

CAUTION

Spark must be retarded before going to higher power. If in doubt of spark position, make a single ignition check. If the spark is still advanced, the rpm drop will be negligible.

PILOTS ENGINEERS

ENGINE RUN-UP (Cont'd)

Note

Note oil, carburetor air, and cylinder head temperatures before proceeding with the next check.

5. Ignition System Check—Completed. This check should be performed first on engines 1 and 6, recording rpm drop, then retarding throttles to idle; second, engines 2 and 5, recording rpm drop, then retarding throttles to idle; and third, engines 3 and 4, recording rpm drop, then retarding throttles to idle. Keep your left hand on the throttle of the engine being checked so that it may be retarded in the event of "cutting out" of the engine due to a faulty ignition system or inadvertent turning off of the ignition switch. If either occurs, retard the throttle immediately, move the mixture to IDLE CUT-OFF, and allow the engine to stop. Clear the engine and restart.

Use your right hand to manipulate the ignition switches. Normal engine drop-off when operating on one magneto is 35 to 75 rpm; maximum permissible is 100 rpm. Normal torque drop is 10 to 15 psi.

CAUTION

Drop-offs *lower* or *higher* than these indications must be corrected prior to take-off.

Note

When altitudes above 34,000 feet are anticipated, maximum rpm drop-off is 60.

Use the following procedure to check individual engines in the recommended sequence:

a. No. 1 Ignition Switch—L and note rpm drop-off.

b. No. 1 Ignition Switch—To detent between L and R and note rpm return to normal.

c. No. 1 Ignition Switch—R and note rpm drop-off.

d. No. 1 Ignition Switch—Detent L, and back to BOTH and note rpm return to normal. Do not switch from R back to BOTH too rapidly or the ignition relays will chatter causing violent backfiring.

e. Repeat steps a thru d on remaining engines in the recommended sequence. When the above procedure is completed on the last symmetrical pair of engines, the first pair that was checked will be cool enough to continue with the next check.

6. Full Power No Boost Checks—Completed. These checks may be performed on one engine at a time or in symmetrical pairs as conditions, time, or engine tem-

PILOTS ENGINEERS

ENGINE RUN-UP (Cont'd)

peratures permit. Use the following procedure to check engines:

a. Intercooler Shutter Switches—OPEN.

b. Advance throttle lever (or levers) of coolest engine to full open and check for proper acceleration. Allow this full throttle no boost power to stabilize for approximately 30 seconds. Observe rpm, M.P., torque, and fluel flow. If manifold pressure varies more than 3 inches between engines with a corresponding variation in torque reading (11 psi), the engine is not operating correctly or the propeller low pitch stop setting is incorrect. However, if the manifold pressure spread is greater than 3 inches and the torque pressure is greater than 11 psi, there is a malfunction in the system which must be corrected prior to flight.

7. Turbo Override and Single Turbo Check—Completed.

Note

This check need only be performed following periodic inspections and whenever maintenance on the system has been performed.

Note

Do not operate the turbo override system on more than two engines at a time. The turbo waste gate has a fast rate of travel when the vernier switch is OFF.

a. Turbo Control Change-Over Switches—MANUAL, on the engines being checked.

b. Turbo Control Vernier Switch—ON.

c. Turbo Control Override Switches—Jiggle in the CLOSE position until a rise of 3 to 5 inches M. P. is obtained.

d. Turbo Vernier Switch—OFF.

e. Turbo Control Override Switches—Momentarily hold in the OPEN position until a drop of 1 to 2 inches M. P. is obtained.

f. Turbo Control Change-Over Switches—AUTOMATIC and check that M. P. returns to the original value.

g. Engine Supercharger Switches—R. H. ONLY. Check manifold pressure rise (approximately 6 inches).

h. Engine Supercharger Switches—BOTH and check M. P. drop to original value.

i. Intercooler Shutter Switches—OPEN. Check positions with scanners or ground observer.

ENGINE RUN-UP (Cont'd)

Note

If engine temperatures permit, continue on to next check. If not, retard throttles to allow engines to cool and repeat steps 6a thru 7i on remaining engines.

8. Full Power With Boost Checks—Completed.

a. Turbo Boost Selector—Advance smoothly to position 7. To avoid sudden overboost of engines, always exercise due caution when moving turbosupercharger controls or when moving throttles of an engine if turbosupercharger controls are set.

b. Turbo Calibration Knobs—Trim M. P. to 55 inches.

c. Water Injection Switches—ON and note decrease in fuel flow and an increase in water pressure to 23 to 27 psi.

Note

If there is not a proper rise in water pressure, the water injection switches must be turned OFF immediately.

d. Turbo Calibration Knobs—Trim to 60 inches M. P. and note rpm, torque, and fuel flow.

Note

If desired, full take-off power may be set up in lieu of the 60-inch check.

e. Water Injection Switches—OFF and note rise in fuel flow. To prevent flooding the engines when reducing power, water injection must be turned OFF before reaching 55 inches M.P.

f. Turbo Boost Selector—Zero and note M.P. drop.

g. Throttle Levers—Retard to idle.

h. Repeat steps 6a thru 8g on remaining engines.

Note

After all reciprocating engines have been checked and trimmed to 60 inches M.P. with water injection ON, check that the index marks on the knobs are in the same relative position with each other. If the index mark of an individual knob is not in the relative position of the index marks of the other knobs, that engine must be checked for turbo system malfunction or induction system leaks. Upon completion of the check, realign the index mark on each knob with the index mark on its housing without disturbing the screwdriver adjustment.

TAXIING.

PILOTS

CAUTION

When any malfunction of the hydraulic system or related electrical circuits is indicated during taxiing, e.g., if the canoe doors creep open during taxiing and do not return to and remain in the closed position with the landing gear control switch in the EXTEND position, the aircraft must be brought to a smooth stop as soon as possible. *Do not* stop the aircraft suddenly since doing so would cause the aircraft to rock and, in the event that the nose gear is unlocked, this rocking action could cause the nose gear to retract. After the aircraft is stopped, install the landing gear down locks and investigate and correct the malfunction prior to further taxiing.

1. Nose Wheel Steering Switch—ON. This switch energizes the main hydraulic system pump motor and actuates the main hydraulic system selector valve to provide pressure for nose wheel steering. This pressure is indicated on the engineers' hydraulic pressure gage and is indicated only when the airplane is on the ground.

2. Engineer's Taxi Configuration—Checked. Check the pressure in the brake system and nose wheel steering hydraulic system. These readings are obtained from the engineer. Never release the parking brake before checking for normal brake pressure. Never start to taxi until the engineer says he is prepared. Request, "Engineer's taxi configuration," over interphone.

3. Receive Ground Man's Report, "Nose wheel doors full open, all static wires removed, wheel chocks removed, external power unit cleared, disconnecting." After all checks are completed on the "During Engine Warm-up" check list and the engineer is ready to taxi, have the ground observer check to be certain that all obstructions have been removed and that the aircraft is clear. Before the aircraft commander clears the ground observer off interphone, the ground observer will give his report. He will then pass the ground communications cord into the camera compartment, come forward, and signal to the aircraft commander that he is clear to taxi.

ENGINEERS

1. Taxi Configuration. "Alternators on the line and paralleled, brake and nose steering pressure normal, ready to taxi."

a. A minimum of two alternators must be on the line and in parallel.

b. Note and report brake and steering pressures at frequent intervals during all taxi operations in congested areas and prior to turns.

Note

It is permissible to taxi with the master motor set at 2000 rpm.

PILOTS ENGINEERS

TAXIING (Cont'd)

4. Interphone and Alarm Bell Check—Completed. The aircraft commander will announce on private interphone, "Crew, this is Aircraft Commander. All crew members switch to normal interphone for interphone and alarm bell check." The aircraft commander will then ring the alarm bell. All compartment commanders will report, "Normal interphone and alarm bell loud and clear, ready to taxi." This check will be made by compartments, progressing from tail to nose.

5. Call Control Tower—Taxi instructions. While the aircraft commander is clearing with the ground observer, the pilot will contact the control tower and receive taxi instructions and clearance to taxi.

6. Inboard Propeller Reverse Selector Switch—READY. Propeller reverse thrust will be used to aid in controlling taxi speed. This reduces the use of brakes and increases their usefulness. Continuous cycling of the propellers will not be used; slight adjustments of throttle to control the forward speed will

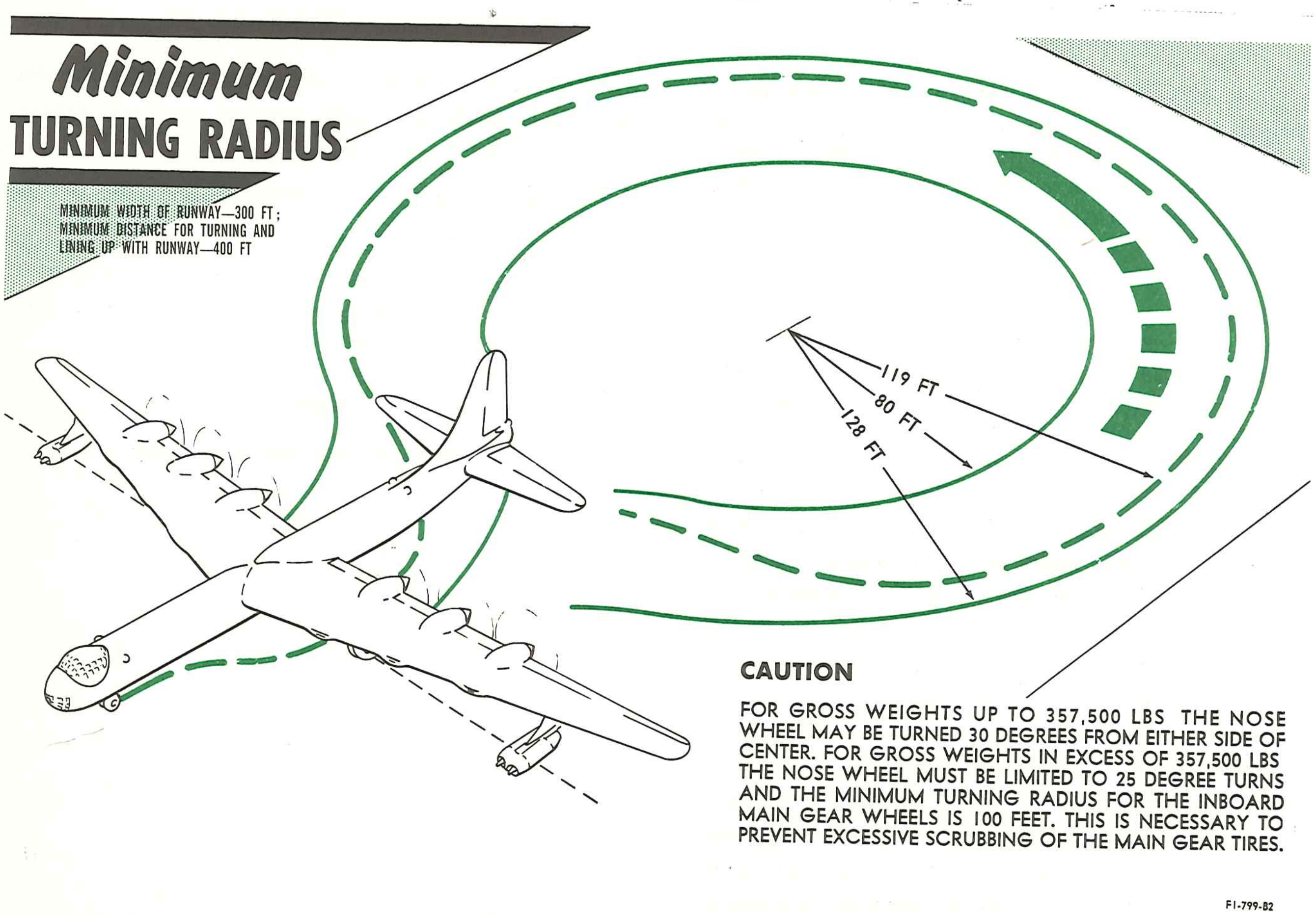


Figure 2-4.

TAXIING (Cont'd)

be used instead. For normal taxi operation, No. 3 and 4 propellers will be used in reverse pitch. When taxiing with tailwinds or when taxiing down slopes, it may be necessary to have two pairs of propellers in reverse. The aircraft commander will move the inboard propeller reverse selector switch to READY and stand by to reverse.

Note

Outboard propellers should not be reversed during normal taxiing except in an emergency. Reversing outboard propeller below 40 mph IAS results in sudden aileron movement which could cause aileron damage.

7. "Taxiing." Announce, "Taxiing," over the interphone. Allow the aircraft to roll forward from its parked position and check braking action before pushing the reverse pitch switch to reverse the inboard propellers. This will eliminate the necessity for additional power on the center and outboard engines in order to get the aircraft in motion.

Note

The aft cabin scanners will be on interphone during all taxi operations. At night they will be equipped with Aldis lamps.

The control surfaces must be locked at all times during taxiing. The B-36 has a normal nose-down attitude while on the ground. Don't let this attitude bother you, you'll become accustomed to it. Directional control while taxiing is accomplished hydraulically through the use of the steering wheel.

CAUTION

In order to minimize drag loads on the main gear, steer with the nose gear and avoid steering with the brakes; avoid braking over ice-spotted surfaces as much as possible; minimize the sudden application of brakes while taxiing, especially at low speeds and when the brakes are cold; and reduce taxiing as much as feasible.

Jet air plugs should be closed during taxi operations. This will expose the jet engines to a minimum amount of foreign material while propellers are in reverse.

CAUTION

If the jet engines have been running, the 30-minute cooling period with jet air plugs open will apply.

PILOTS ENGINEERS

TAXIING (Cont'd)

This airplane is the largest that you have yet encountered, and several new techniques must be learned before becoming adjusted to its size. One of these is the procedure used to make turns. Because of the make-up of the main gear "skate," the aircraft must be turned with caution to prevent skidding of tires. The airplane must be in motion before executing turns; use the largest turning radius possible and limit taxi speed to approximately 12 mph while turning in order to minimize tire wear and landing gear stress. Make alternate right and left turns, when practical, to equalize tire wear. Make a visual check of all gyros during taxiing. The minimum turning radius recommended for the nose gear is 119 feet for gross weights up to 357,500 pounds. The pivot point is about two-thirds from the outboard engine toward the wingtip. It must be remembered that you are about 50 feet in front of your main gear so that when lining up with the runway you must over turn and then bring the nose wheel back to the center line. A runway width of 300 feet is adequate for executing normal turns. After making a turn allow a short roll and stop with the nose wheel in line with the fuselage center line, thereby reducing nose wheel stresses at the start of take-off. Aircraft clearances are especially important during taxiing. The B-36's wing span of 230 feet will, in many cases, overlap on both sides of the taxi strip. Along taxi strips be careful to avoid damaging obstacles such as boundary lights, vehicles, etc. Use particular care at night; all crew members must be alert to avoid any obstructions. Use your taxi and landing lights and have your scanners observe for obstructions while taxiing. (For aircraft equipped with blisters at the lower aft sighting stations, the scanners will use Aldis lamps.) Partial retraction and extension of landing lights will throw some light in the desired direction when trying to see obstructions on the sides of the taxi strips. When in doubt about aircraft clearance, send out crew members with flashlights to act as "wing walkers." A tip is to use shadows cast by the aircraft to judge aircraft clearance while taxiing. Remember, be safety-conscious while taxiing as well as when flying.

CAUTION

The aircraft should not be taxied without brakes except in an extreme emergency.

STARTING JET ENGINES.

Jet engines are considered to be supplementary power for the B-36. They provide an ease of operation never before experienced in heavy gross weight take-offs and high altitude performance of a basically reciprocating engine-powered aircraft. Due to their relatively high specific fuel consumption, the jet engines should not be used unwisely.

Unlike the complex reciprocating engines, your jet engines are mechanically simple. Although a preflight runup of the jets cannot be omitted, they need not be run during the "Preflight Operational Equipment Check" except to ground-check a new installation or to clear previous discrepancies. Ordinarily, if your jet engines were satisfactory on the last flight and the required visual inspections reveal nothing of any consequence, they may be started immediately prior to take-off with a power check constituting the preflight runup.

Consult the maintenance records and the crew chief to find out which jet engines, if any, must be checked. Let your engineer know before engine start whether or not any jet engines are to be run so that he may arrange his runup accordingly.

Once the engineer starts his reciprocating engine run-up, it will be necessary for him to utilize the interphone and the ground observer if ground time is to be held to a minimum. Therefore, the best time to start the jet engines is probably after the engineer has finished his power checks and has shut down No. 1 and 6 engines. After the jets are started and are idling satisfactorily, all but two alternator-equipped engines which have their alternators on the line may be shut down.

Record the starting times, temperature of each hot start, and the number of minutes at each power setting. The "Time Today" and "Hot Starts" are recorded in the Form 781 (Form 1), along with other noted discrepancies. The number of minutes at each power setting affects fuel consumption and should be given to your engineer.

By the time you have taxied into position for reciprocating engine run-up, the control tower should have dispatched a fire truck to the area so that you can start your jet engines.

Before starting jet engines, make certain that the danger areas, as shown in figure 2-5, are clear of personnel and ground equipment. When a jet engine instrument is read during starting or during changes of power and rpm, the instrument panel may be vibrated to get accurate readings from the instruments.

Cautions To Observe During Jet Engine Starting.

Throttle Sensitivity. The throttles are very sensitive to throttle lever movement; therefore, extreme care must be used when operating the throttle levers.

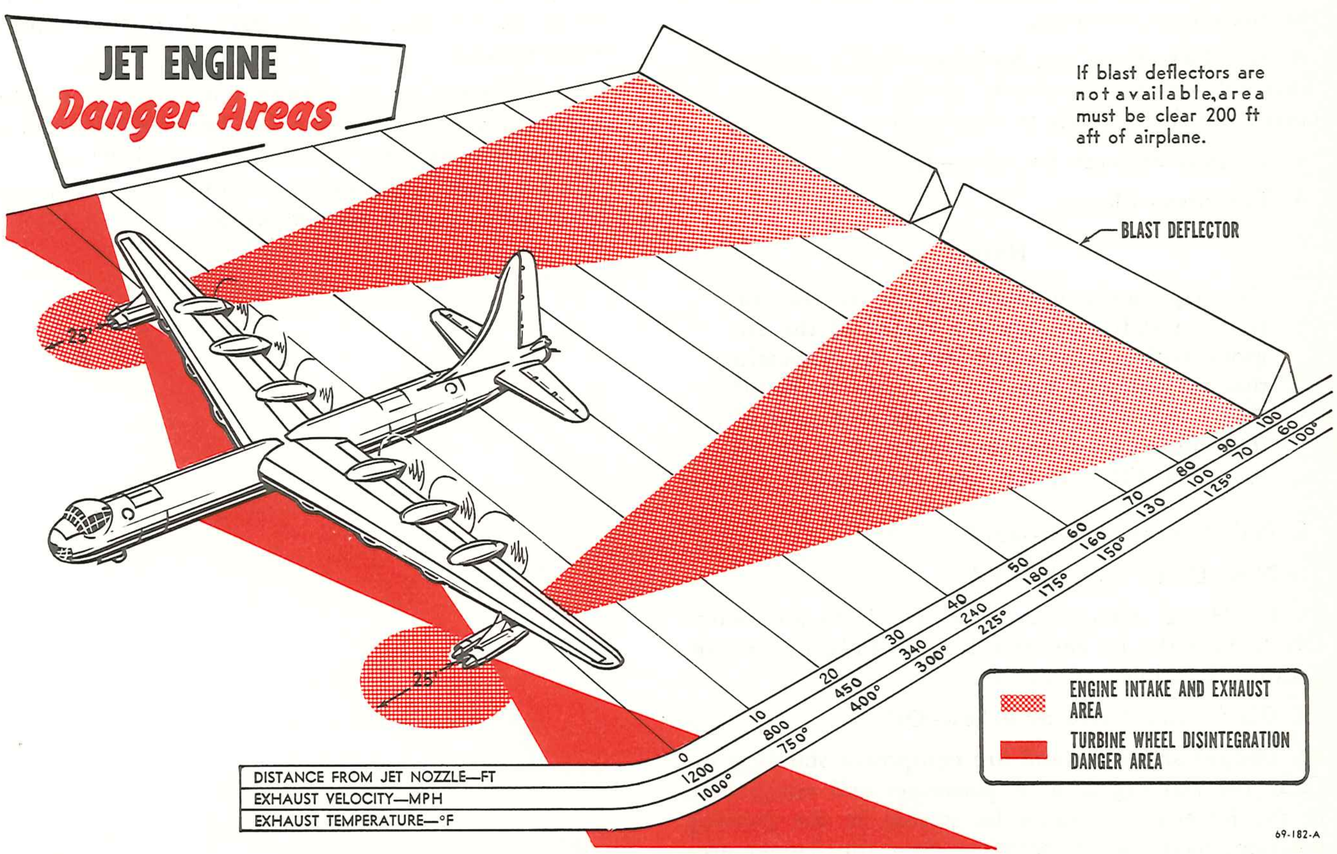


Figure 2-5.

Hot Starts. For information on hot starts, refer to "Jet Engines," Section V.

Failure to Start. If the engine fails to start before 11 per cent rpm is reached, close the throttle, close the engine fuel valve, and release the starter switch. Allow 3 minutes for fuel to drain from the combustion chambers before attempting another start.

Engine Starter Limitations. Operation of the engine starter is limited to three starting attempts of 45 seconds duration each. If more than three attempts are required, allow the starter to cool 1 hour. Do not attempt a start until the engine has come to a complete stop.

In the event false starts are experienced, operation of the starter is limited to two false starts of 20 seconds duration each and one actual start during a 30-minute period. If necessary this cycle may be repeated immediately; however, after the second cycle a 1-hour cooling period will be required before any further attempt is made to start the engine.

Accelerations and Decelerations. The engine should accelerate from 50 to 100 per cent rpm in approximately 12 seconds. When 100 per cent rpm is obtained, the high rpm stop should prevent overspeeding. If time permits, accelerations and decelerations should be slow in order to prevent unnecessary wear and tear on the engine. If time does not permit, then rapid throttle movements can be accomplished and the fuel regulator will control the acceleration rate. The exhaust temperature during rapid acceleration may climb momentarily to a value over 690°C but not over maximum allowable for take-off and acceleration.

Starting Procedure.

The jet engines are simple to start and easy to operate, but always use your check list and complete it in the following sequence:

PILOTS

1. Notify engineer, "Set up jet start configuration."
2. All Circuit Breakers—IN. Push in all circuit breakers on the pilots' jet control panel. Don't forget the throttle circuit breakers.
3. Fire Detection Test Switches—TEST and release. This will test the continuity of the fire detection circuits from the jet pods to the lamps.
4. Throttle Selector Switches—Lever.
5. Throttles—Closed.

Note

On airplanes equipped with a jet throttle position indicator, make a sweep of the engines with the selector switch to ascertain that the throttles are closed. If the indicator shows that a throttle is not closed, a start of that engine must not be attempted until the source of difficulty has been corrected.

6. Pod Preheat Switch—OFF.
7. Nose De-Ice Switch—OFF.
8. Oil Heater Switch—As required. Turn this switch ON to heat the jet engine oil if the ambient air temperature is below 5°C (41°F).
9. Oil Shutoff Valve Switches—OPEN.
10. Danger area clear and fire equipment standing by. Clear the starting area of personnel and equipment. If the jet engines cannot be started in the parking position, have the aft scanners clear the danger area and have a fire truck proceed to the starting position.

ENGINEERS

1. Jet Start Configuration—Checked and report, "Standing by for jet engine start."

a. At least two alternators paralleled on the line (three on the line and one excited and standing by recommended).

b. Engines with alternators, which are on the line, operating above 1200 rpm for heavy electrical loads to minimize wear on the constant-speed drives.

c. Two tank valve switches OPEN and two booster pump switches ON in each wing.

PILOTS

ENGINEERS

STARTING JET ENGINES (Cont'd)

11. Air Plug Switches—OPEN. Check doors visually. The aircraft commander will make a visual check of J-1 and J-2 while the pilot is visually checking J-3 and J-4 to see if the doors are open.

12. Manifold Valve Switches (L and R)—OPEN.

13. Booster Pump Switches (L and R)—ON. No pressure will be indicated on the fuel pressure gage until the throttles are advanced to open the stopcock.

14. Ignition Start Switches—NORMAL.

15. Throttle Position Indicator Selector Switch (some airplanes)—Select J-1 engine.

16. J-1 Engine Fuel Valve—OPEN.

17. J-1 Fuel and Oil Pressure Gages—Note reading.

18. Notify ground observers or aft scanner, "Starting J-1." If a ground observer is present he will move to a position where the engine being started can be seen and will report any unusual conditions.

19. J-1 Starter Switch—Hold ON until the engine attains 20 per cent rpm.

20. J-1 Throttle—OPEN at 6 per cent rpm to obtain 25 to 30 psi fuel pressure. Move the throttles slowly to prevent overshooting due to the lag in the pressure indication. On airplanes equipped with a throttle position indicator, observe the throttle opening during this phase of the starting. Maintain 25 to 30 psi during initial acceleration to avoid excessive temperatures in the tail pipe and around the shroud ring and shroud ring binding which are caused by higher fuel pressures.

Although the engines will probably start at 6 to 11 per cent rpm, the starter switch should be held ON to aid engine acceleration until 20 per cent rpm has been reached. This reduces the possibility of excessive tail pipe temperatures during the initial acceleration period. During a normal start, combustion will occur immediately after fuel pressure is indicated.

21. J-1 Oil Pressure—Report indication on interphone. This precludes the possibility of operating an engine with no oil pressure and also permits the crew member keeping the jet engine log to maintain an accurate record of operating time.

22. J-1 Starter Switch—Release at 20 per cent rpm.

23. J-1 Throttle—Adjust to maintain idle rpm (25 to 30 per cent) keeping the tail pipe temperature below maximum allowable used for normal flight operation.

24. J-2, J-3, and J-4—Repeat steps 15 thru 23.

25. All Ignition Start Switches—OFF.

STOPPING JET ENGINES (GROUND).

The pilots will stop the jet engines as follows:

PILOTS

Note

Jet engines must be stopped prior to shutting down the last two alternator-equipped reciprocating engines.

1. Throttles—Idle for 3 minutes; then CLOSE. The 3-minute idle period will stabilize temperatures throughout the engines, preventing malfunctions due to differential expansion and contraction on engine parts. Remember that the tail pipe temperature indicator takes the temperature at the tail pipe only.

Note

If shroud rub is being experienced during jet engine shutdowns, the following procedure is recommended: Slowly retard the throttle to approximately 70 per cent rpm and hold this setting for 1 to 3 minutes. Then, close the throttle rapidly to the full-closed position. When the throttle is fully closed, combustion will cease immediately and the exhaust temperature will drop rapidly. The engine will coast to a stop. This short holding period at 70 per cent also permits the engine to properly scavenge the oil system.

2. Jet Booster Pump Switches—OFF.
3. Engine Fuel Valves—CLOSE below 10 per cent rpm.
4. Nose De-Ice Switch—OFF.
5. Pod Preheat Switch—OFF.
6. Oil Heater Switch—OFF.
7. Oil Shutoff Valve Switches—CLOSE after engines stop rotating.
8. Throttle Circuit Breakers—OUT.
9. Jet Air Plug Switches—CLOSE, after 30 minutes.

Jet air plugs should remain open for approximately 30 minutes after stopping jet engines to allow sufficient circulation of air through the engine to dissipate the residual heat. It will be necessary to vary this procedure as weather conditions dictate. The advisability of leaving the air plugs open during blowing snow, sand, etc. must be carefully considered by the aircraft commander. If these conditions exist, air plugs will not be closed above 100°C tail pipe temperature and zero per cent rpm.

STOPPING RECIPROCATING ENGINES.

The engineer will stop the reciprocating engines as follows:

ENGINEERS

1. Air Plug Switches—OPEN until air plugs are fully open. This will allow the engines to cool to 180°C before shutdown and will allow heat to dissipate after shutdown.
2. Master Motor Speed Control Lever—Full DECREASE.
3. Propeller Selector Switches—FIXED PITCH.
4. Booster Pump Switches—OFF.
5. Alternator Control Checks—Completed.

a. Voltage and Frequency Selector Switch—To position of alternator-equipped engine to be shut down.

b. Alternator Breaker—OPEN. Observe that the alternator breaker lamp lights.

c. Frequency Control Knob—Full decrease.

d. Repeat the above steps on alternator-equipped engines, one at a time, until only one alternator is left. After completing the above steps on the last alternator, re-establish electrical power by reclosing the alternator breaker or by placing the external power switch ON if an auxiliary power unit is available. If the correct phase sequence lamp is on, the APU is plugged in and standing by.

6. Engine Analyzer Power Switch—OFF.
7. Perform idle speed and mixture check as engines are shut down as follows:

a. Check to see that cylinder head temperature is at 180°C or below.

b. Throttle Lever—Advance to 1700 to 1800 rpm and allow engine to operate at this rpm for approximately 10 seconds for scavenging purposes. Then return to idle and allow rpm to stabilize.

c. Idle Speed—Checked. Should be set for 1100 rpm with throttles fully retarded, approximately 160°C (±10°) CHT, no wind condition, and average barometric pressure for seasonal conditions at the base at which your aircraft is primarily stationed. Allow a 30-rpm variation for each 10 mph effective headwind.

d. Mixture Control Lever—IDLE CUT-OFF. When the mixture control is moved *slowly* to IDLE CUT-OFF, check the idle mixture setting for a minimum 5-rpm rise and a maximum 10-rpm rise as indicated on the respective engine tachometer. Record the readings that do not fall within these limits so proper settings may be made at the earliest possible convenience. A minimum 5-rpm rise when leaning the mixture assures

PILOTS

ENGINEERS

STOPPING ENGINES (Cont'd)

Note

Aft scanners will observe jet engines for residual fire during all jet engine shutdowns and immediately report any fire.

DURING RECIPROCATING ENGINE SHUTDOWN.

The aircraft commander will accomplish the following during reciprocating engine shutdown:

1. Parking Brake Control—ON.
2. Propeller Reverse Selector Switches—SAFE (lights out).
3. Nose Wheel Steering Switch—OFF.
4. Flight Instrument Switches—OFF.
5. Contact engineer, "Ready to stop engines."

CAUTION

Aircraft commander, engineer, and aft scanners will remain on interphone. The pilot will have radio tuned to tower frequency until the last propeller has stopped turning.

6. Radio Equipment—OFF.

that the idle mixture is not too lean while the 10-rpm maximum rise prevents idling in the "too rich" range.

Note

When making the idle speed and mixture check on the last alternator-equipped engine, the hold-in switch must be actuated until the engine drops to 1000 rpm. Release the hold-in switch as soon as the engine drops below 1000 rpm and observe that the alternator breaker lamp comes on, indicating that the alternator breaker has opened.

CAUTION

Do not hold the alternator on the line until the engine stops. This will reduce the stress imposed on the constant-speed drive input shaft since the peak load on the shaft occurs as the engine speed drops below 1000 rpm.

8. Fuel Tank Valve Switches—CLOSE.
9. Cross-Feed, Manifold, and Engine Valve Switches—OPEN.

Note

Allowing these valves to remain open will prevent fuel expansion damage to the main manifold line.

10. Individual Ignition Switches—OFF after propellers have stopped.
11. Master Ignition Switch—Pull off.
12. Intercooler Shutter Switches—CLOSE, until intercooler shutters are fully closed.
13. Static Propeller Feather Check—Completed.

Note

The static feather check is required only after engine shutdown following completion of the "Preflight Operational Equipment Check."

a. Contact ground observer on interphone, "Ready for static feather check."

b. Propeller Selector Switches—FIXED PITCH.

c. All propeller feather switches FEATHER position for 30 seconds then return to NORMAL position (feather switch guards down).

PILOTS ENGINEERS

STOPPING ENGINES (Cont'd)

Note

If longer than 30 seconds is required to feather any propeller (i.e., cold weather operation), wait at least 2 minutes before attempting to complete the feather operation. Allow feather motors to cool a minimum of 2 minutes between feather and unfeather operation. Allow a minimum of 5 minutes before attempting to complete another cycle if a recheck is required.

d. The second engineer or a qualified observer will report all blade angles in the approximate feather position. Any propeller that will not reach the feather position on this check will not feather in the air and must be repaired or changed prior to flight.

e. Propeller Selector Switch—INC RPM. Hold in INC RPM until normal low pitch position is reached.

f. The second engineer or a qualified observer will report all blade angles returning to normal low pitch position.

14. Oil Cooler Door Mode Selector Switches—MANUAL.
15. Battery Switch—OFF.
16. Master Temperature Indicator—OFF.

Note

Thirty minutes after engine shutdown, have the propellers pulled through 10 blades with the starters. Energize the starter continuously for 10 blades.

DETAILED MISSION PLANNING.

Mandatory requirements for detailed mission planning are set forth in Air Force, major command, and local directives. The purpose here is to maintain a proper sequence of events and to remind the aircraft commander that a study of the proper directives and a common sense application of the principles involved will promote better teamwork in developing good flight planning techniques.

Note

Normally the basic Form F is completed during this planning phase; however, alterations will probably have to be made after the visual preflight inspection.

FORMAL BRIEFING.

As in "Detailed Mission Planning," the requirements for a formal briefing are set forth in other directives with which you must be familiar. Again, it is mentioned here to maintain proper sequence of events, to provide ready information as to the aircraft commander's responsibilities pertaining specifically to the B-36 aircraft, and to provide helpful suggestions or hints based on principles derived from experience gained in managing the B-36 combat crew. For aircraft commander's responsibilities see "Crew Duties," Section VIII.

CREW INSPECTION.

The time for crew inspection shall be established during formal briefing. Normally, the crew will report to the airplane for this inspection.

Note

> During inclement weather, the inspection may be accomplished under any available shelter. After such an inspection, all equipment should be packed in A-3 bags, transported to the airplanes, and loaded aboard before "Final Crew Briefing."

In addition to the personal equipment required, each crew member will wear identification tags on each flight. The information on these tags must be kept current. All crew members will wear tags on a chain around their necks. Crew formation for crew inspection should be standardized so that all crew members know exactly what is expected of them. The crew will form on the left side of the aircraft and will lay out their personal equipment as shown in figure 2-6. Then the aircraft commander will accomplish the inspection as follows:

1. Give command, "Fall in," and call the roll.
2. Give commands, "Right face," "At ease," and "Inspect parachutes." Each crew member shall check the parachute of the man in front of him. The aircraft commander's parachute shall be checked by the pilot. After checking the parachutes of the men in front of them, the crew members standing next to last in each line shall turn around and check the parachute of the man on the end of each line. As each crew member completes his part of the parachute check, he shall assume the "at ease" position.

Note

> If both chest-type and back-type parachutes are used, each crew member must check his own chest pack in addition to checking the back pack as indicated in the preceding paragraph.

3. Give commands, "Attention," "Left face," and "At ease." Check each crew member's displayed equipment for completeness and condition. Spot check any crew member's equipment as desired. Each crew member will come to attention as the aircraft commander approaches to inspect his equipment.
4. Read discrepancies which are pertinent to your mission as noted in Form 781 (Form 1).
5. Have the navigator give the crew a time "hack."
6. Designate specific crew members for command of the nose, radio, camera, and aft compartments. Each of these men will command his compartment under all conditions. He will be responsible for the execution of all normal and emergency instructions affecting his compartment, and will subsequently notify the aircraft commander.
7. Give the crew any special instructions not previously covered and order any special checks necessary on preflight. Also, answer any questions the crew may have. Assign oxygen stations to extra crew members and passengers.
8. Announce the time for the final crew briefing.
9. Give commands, "Attention" and "Dismissed."

BOARDING AIRCRAFT.

All equipment will be loaded and stowed before "Final Crew Briefing" time. Each crew member will make a preflight check of his oxygen station and mask in accordance with the procedure described in "Oxygen System," Section IV. In checking his interphone, each crew member will use his oxygen mask mike and helmet, and check the normal interphone for side tone. He will then plug in his normal headset and switch to PVT INTER, checking this interphone channel in the same manner as the normal interphone check.

Compartment commanders will insure that all regulators in the compartment have been checked and that a uniform, full oxygen supply is provided. In addition each will check that all regulators are in OFF, NORMAL.

Note

> Before boarding the aircraft, the second engineer will check that the bomb bay doors are open with safety locks installed and that the auxiliary power unit has been started and is operating properly. If the bomb bay doors are closed, they will be pumped open and safety locks will be installed prior to starting the auxiliary power unit.

AIRCRAFT VISUAL PREFLIGHT INSPECTION.

HOW TO MAKE A GOOD PREFLIGHT.

The aircraft commander is responsible for performance of preflight inspections; however, the complexity of the aircraft and the detailed check lists make it necessary for the aircraft commander to delegate some of these preflight duties to the pilot and copilot as well as to other crew members. Being a teamwork airplane, close coordination and wise planning are required to effect a good preflight in a minmum amount of time. A good aircraft commander guards against fatiguing himself or his crew before starting on the mission. At the same time, he does not make a sketchy preflight inspection and risk an aircraft accident. Plan wisely and delegate responsibility.

A good aircraft commander will make the checks listed in figure 2-7 carefully and completely. Omit nothing. Follow the route shown in this figure. As your training and familiarization with the airplane progress, you

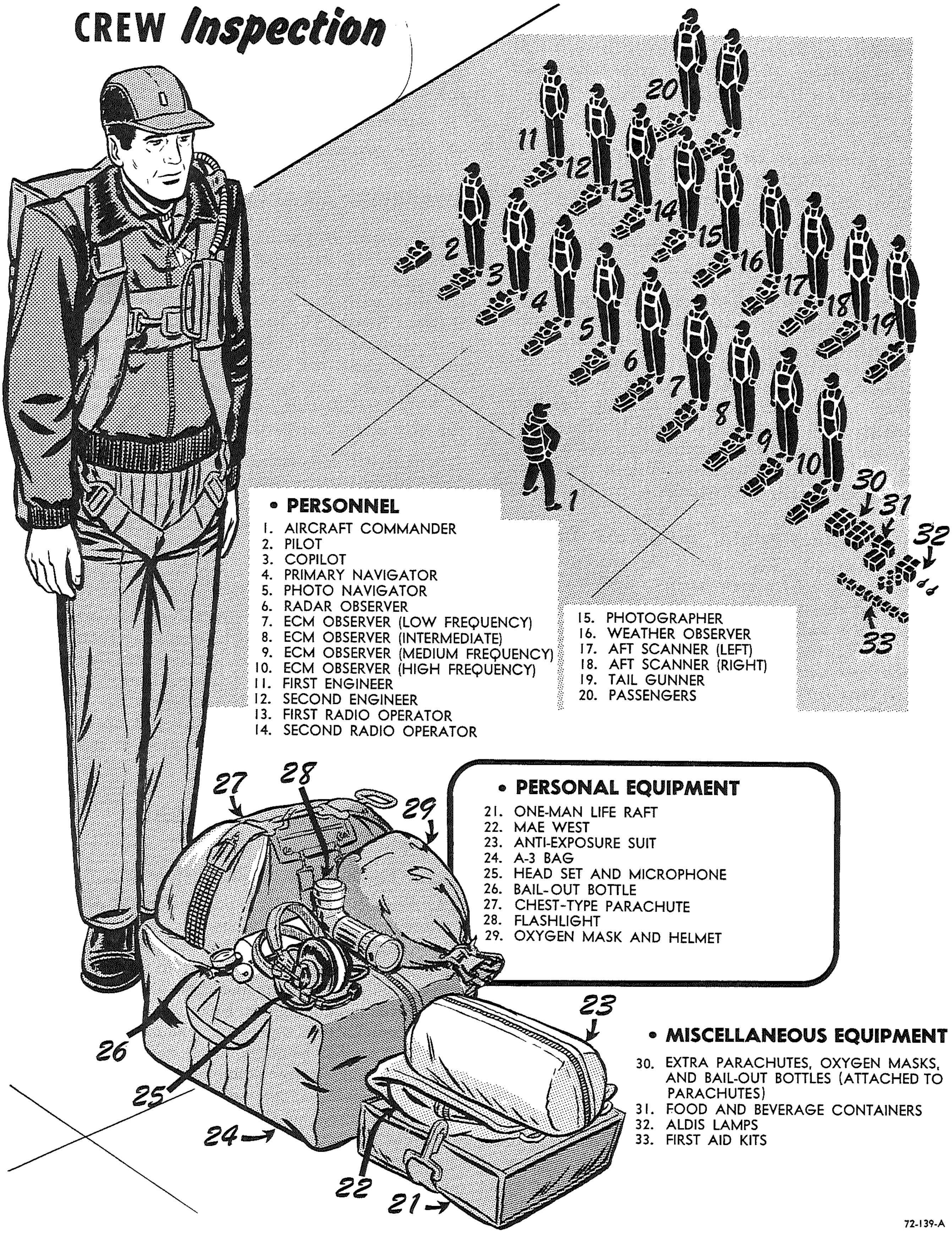

CREW Inspection
• PERSONNEL
1. AIRCRAFT COMMANDER
2. PILOT
3. COPILOT
4. PRIMARY NAVIGATOR
5. PHOTO NAVIGATOR
6. RADAR OBSERVER
7. ECM OBSERVER (LOW FREQUENCY)
8. ECM OBSERVER (INTERMEDIATE)
9. ECM OBSERVER (MEDIUM FREQUENCY)
10. ECM OBSERVER (HIGH FREQUENCY)
11. FIRST ENGINEER
12. SECOND ENGINEER
13. FIRST RADIO OPERATOR
14. SECOND RADIO OPERATOR
15. PHOTOGRAPHER
16. WEATHER OBSERVER
17. AFT SCANNER (LEFT)
18. AFT SCANNER (RIGHT)
19. TAIL GUNNER
20. PASSENGERS
• PERSONAL EQUIPMENT
21. ONE-MAN LIFE RAFT
22. MAE WEST
23. ANTI-EXPOSURE SUIT
24. A-3 BAG
25. HEAD SET AND MICROPHONE
26. BAIL-OUT BOTTLE
27. CHEST-TYPE PARACHUTE
28. FLASHLIGHT
29. OXYGEN MASK AND HELMET
• MISCELLANEOUS EQUIPMENT
30. EXTRA PARACHUTES, OXYGEN MASKS, AND BAIL-OUT BOTTLES (ATTACHED TO PARACHUTES)
31. FOOD AND BEVERAGE CONTAINERS
32. ALDIS LAMPS
33. FIRST AID KITS
72-139-A

Figure 2-6.

Aircraft Commander's *Visual Preflight* Inspection

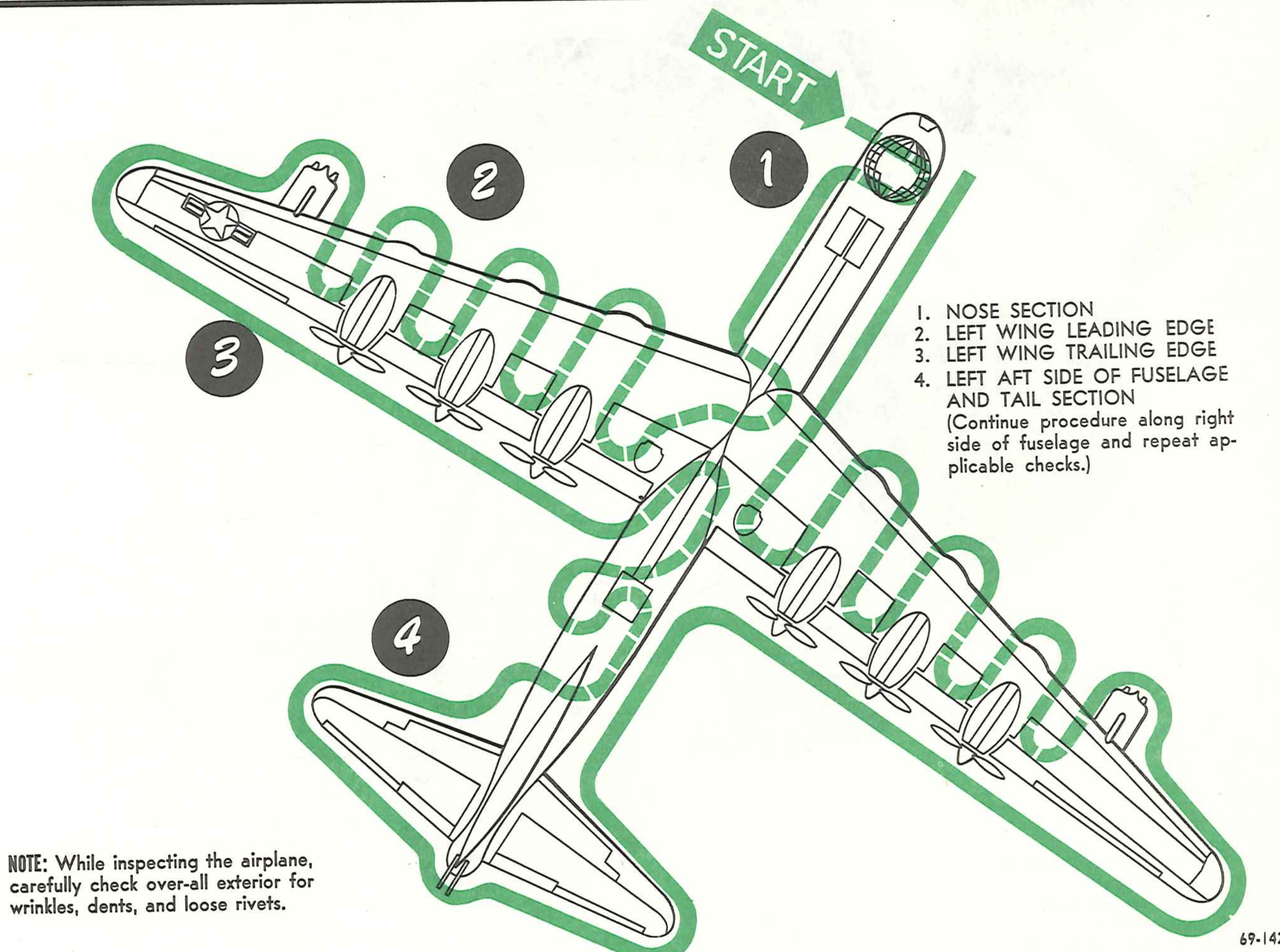


Figure 2-7. (Sheet 1 of 5)

will be able to speed up this inspection so that it does not hold up your preparation for flight, but still accomplishes its purpose. It is the aircraft commander's responsibility to see that the inspection is actually made and not just signed off on the AF Form 781 (Form 1).

Normally about 2 hours before take-off, it is necessary to complete all phases of the aircraft preflight and final crew briefing. This time will vary with the crew experience. In order to accomplish the preflight inspection in minimum time, it is well to delegate certain duties to the pilot and copilot. As aircraft commander you are personally responsible for the entire preflight inspection, but that does not mean you will accomplish the entire inspection yourself. Delegate the responsibility of certain portions of the aircraft preflight inspection to each pilot.

Have your pilots accompany you on preflight inspections until they become thoroughly familiar with inspection procedures and can be relied upon to make an inspection by themselves. Then you will be able to divide the aircraft up in sections, having one pilot inspect the top of the wings and the other pilot inspect one side of the aircraft while you inspect the other side. This will expedite the inspection and reduce the individual time and effort expended to accomplish a full preflight.

The aircraft commander, pilot, and copilot will inspect and check the aircraft as outlined in the following preflight check lists.

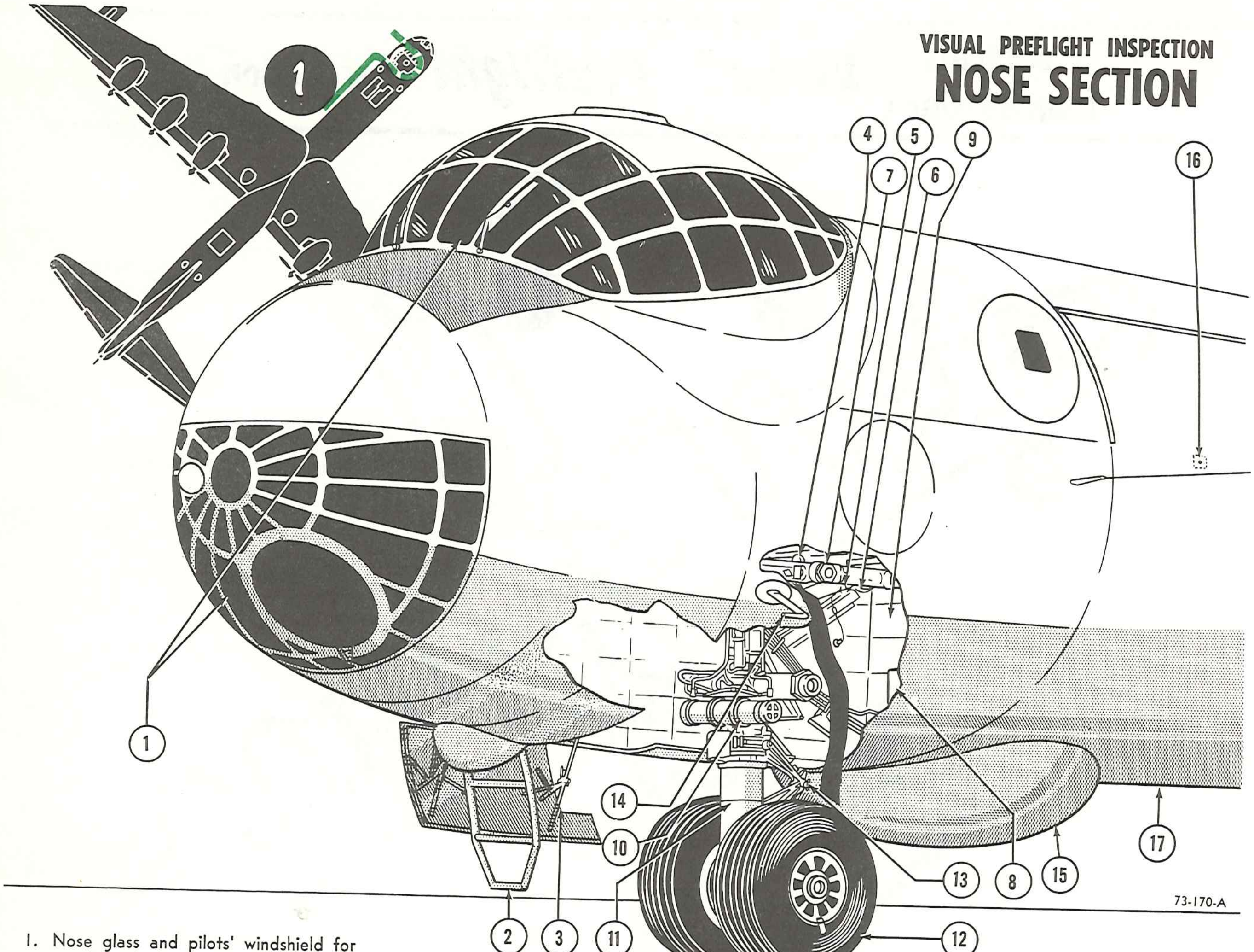
Aircraft Commander.

1. Oxygen supply and equipment checked in accordance with existing oxygen preflight procedure. Check normal interphone using helmet and oxygen mask, verifying side tone.

Note

> During the preflight operational equipment check, only the station regulator need be checked; oxygen masks are not required.

VISUAL PREFLIGHT INSPECTION
NOSE SECTION



1. Nose glass and pilots' windshield for cracks and cleanliness.
2. Condition of nose entrance ladder, linkage, and stowage provisions.
3. Condition of nose wheel well doors, linkage, and pick-up arm.
4. Nose gear ground safety lock in place.
5. Nose gear latch mechanism and latch release link and pin in place.
6. Emergency release cables and pulleys for proper rigging.
7. Nose gear latch spot light for proper operation and security at mounting.
8. Battery for mounting connections, and signs of corrosion in general area of battery.
9. Nose wheel area for hydraulic leaks
10. Nose steering unit and equipment, including cable system and nose steering safety switch.
11. Oleo strut for cleanliness, proper inflation (3 inches plus or minus 1/4 inch) and general condition.
12. Tires and wheels for general condition, cuts, blisters, proper inflation, slippage, and wear. Security of co-axial retaining plate and pick-up arm roller.
13. Nose gear scissors for condition (up and connected).
14. Pitot mast covers removed and tube clear.
15. Radar dome for cracks.
16. Static ports clear.
17. Fuselage for cracks.

Figure 2-7. (Sheet 2 of 5)

73-170-A

2. Check private interphone with regular headset, verifying side tone.

3. Assist pilot in checking control surfaces.

4. Check all lights at aircraft commander's station.

5. Visual preflight of aircraft as shown in figure 2-6.

6. Stow personal equipment.

7. Place jet air plug switches in CLOSE.

8. Conduct final crew briefing and receive preflight report.

9. Final check of aircraft (down locks, pitot covers, control locks, wing access panels, and nose scissors).

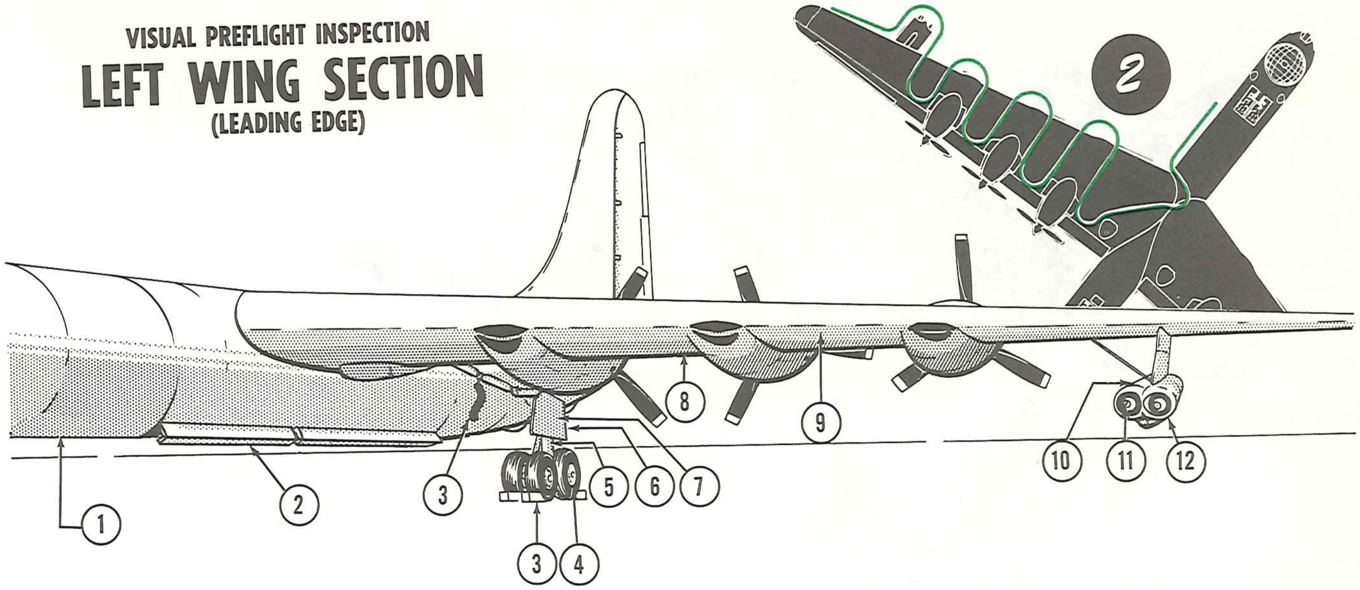
Pilot.

1. Oxygen supply and equipment checked in accordance with existing oxygen preflight. Check normal interphone using helmet and oxygen mask, verifying side tone.

Note

During the preflight operational equipment check, only the station regulator need be checked; oxygen masks are not required.

2. Check private interphone with regular handset, verifying side tone.



1. Camera compartment for general condition, stowage of equipment, cleanliness, etc.
2. Forward bomb bay and wing center section area for hydraulic and fuel leaks and for general condition.
3. M.L.G. safety lock and wheel chocks in place.
4. Inspect tires and wheels for general condition, cuts, blisters, proper inflation, slippage and wear.
5. Left main wheels hydraulic brake lines, gear struts, and positioning jacks for leaks and safety switch for condition and mounting.
6. Oleo struts for cleanliness and proper inflation (3 1/2 inches plus or minus 1/4 inch.)
7. Condition of equalizer assembly, wheel fairing, and main column.
8. Underside of wing for loose rivets, cowling, inspection plates, open vents, fuel leaks, oil leaks, and cracks.
9. Leading edge for excessive dents and warping.
10. Jet engines 1 and 2 for loose cowling and general condition.
11. Jet engines starter cooling inlet plugs removed.
12. Jet air plugs open. Intakes for foreign material.

72-140-A

Figure 2-7. (Sheet 3 of 5)

3. All circuit breakers in.

4. Check parking brake pressure on engineers' auxiliary panel and set parking brakes.

5. Surface Controls and Trim Tabs—Checked. Before unlocking the controls, check for wind velocity and directions, and if possible, head the aircraft into the wind. Considerable difficulty may be experienced in moving the rudder and elevator in strong cross winds. Under these conditions it will be necessary to head the airplane into the wind before a rudder movement check can be made. In the event ramp congestion prevents moving the aircraft into the wind, this check will be made when the aircraft is lined up into the wind prior to take-off.

Note

When the control lock switch is placed in the unlocked position, the red indicator lamp will go out the instant all lock actuators start their unlocking movement. If the green light does not come on after a slight delay, one or more control lock actuators are probably inoperative in the intermediate position. Even though the green light indicates controls unlocked, a complete freedom of movement check must be accomplished. When controls fail to unlock, check the appropriate control lock fuse in the right main power panel.

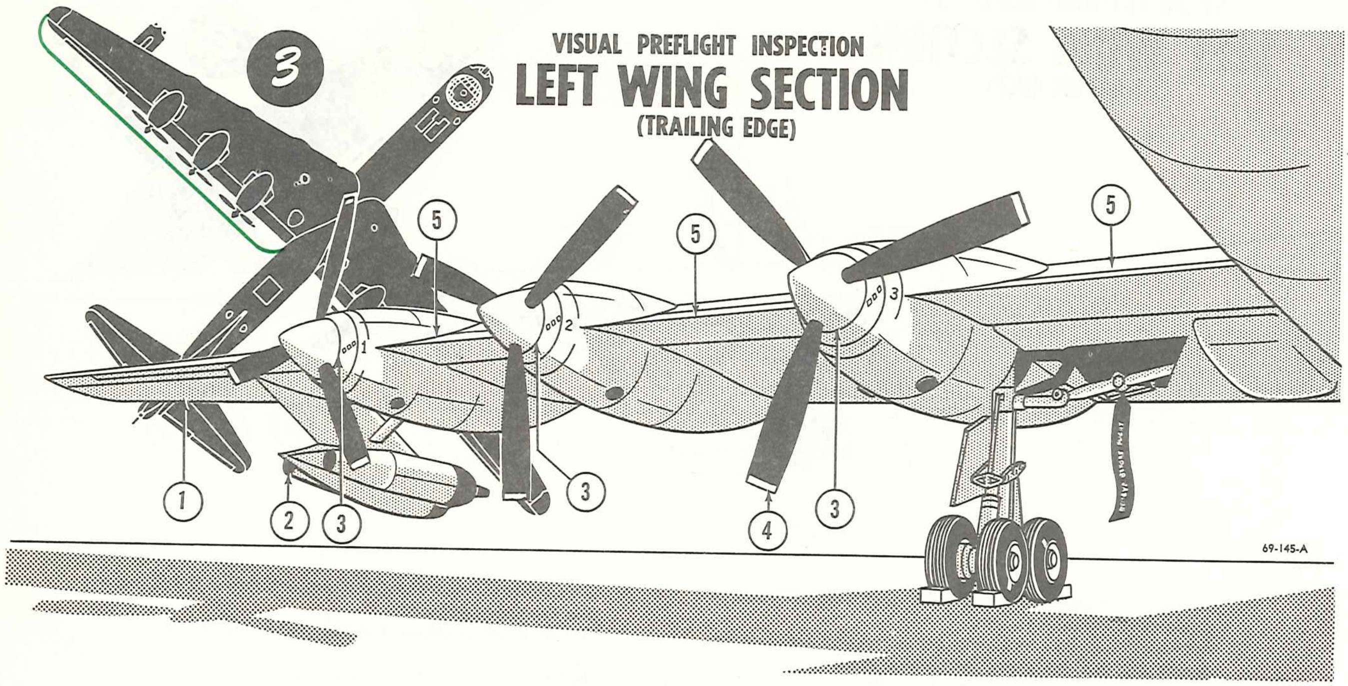
A ground observer will check proper movement of the control surfaces and tab. The controls should be checked in the following order: elevators, rudder, and ailerons. To expedite this check it is recommended that the trim control be moved in the same direction as the control surface and that the surfaces, servo tabs, and trim tabs be checked simultaneously. For example, elevator trim full nose-up and control column full back gives elevator surface up with servo and trim tab down. Aileron trim tabs are checked by operating trim tab control switch in each direction and observing proper movement of control wheel and correct indication on the indicator. It should be remembered that aileron trim tabs are electrically operated and that a few minutes cooling period should be allowed to cool the electric motor. After this check set trim tabs to neutral.

6. Surface Controls—Locked. After the surface control check is completed, the lock will be engaged. A red lamp will burn for controls in the locked position and a green lamp will burn for controls in the unlocked position. If neither green nor red lamp burns, the condition can be caused from the lamps being burned out.

7. Turn autopilot ON.

8. Check instrument panel and flight deck lights and see that spare bulbs are available.

9. Autopilot—Checked and OFF.



1. Wing tips, ailerons, and trim tabs for general condition. Aileron ground locks removed.
2. Jet tail section for general condition.
3. Air plugs and propeller after bodies for general condition.
4. Propeller blades and spinners for general condition and oil leaks.
5. Flaps for general condition.

Figure 2-7. (Sheet 4 of 5)

a. Turn autopilot on.

b. Pilot's turn control in detent.

c. Slaved gyro magnetic compass annunciator cleared.

d. Engage the autopilot when the green lamps come on. If only one green lamp burns, the other lamp is merely burned out and will not hinder operation of the autopilot.

CAUTION

Do not engage the autopilot with heavy preload on the controls due to high winds. This will result in clutch slippage with consequent overheating and burning out.

e. Turn each trim knob (aileron, rudder, and elevator) and check control movement for proper direction.

f. Turn pilot's turn control and check control movement for proper direction.

g. Turn slaved gyro magnetic compass push-to-set pointer knob and check control movement for proper direction. Controls should move to make a turn in a direction opposite to that in which the pointer moved. Only a slight movement is necessary to produce control movement.

h. In turn, disengage the aileron, the rudder, and the elevator trim knobs. The green lamps should blink when any one surface is disengaged, and normal manual control should be obtained in that axis.

i. Re-engage the autopilot and depress each autopilot release switch to ascertain proper operation. Then check for freedom of movement of the controls.

j. Turn the autopilot off.

10. Turn on landing, formation, and position lights.

a. Landing lights OFF after ground check.

b. Formation and fuselage lights will be checked by the copilot while he is inspecting the top of the wing.

c. Position lights will be visually checked in FLASH and STEADY position. (This can be accomplished during jet engine pressure check.)

11. Check pitot covers removed by ground observer and turn pitot heater switch ON.

a. Turn pitot heater switch OFF after being checked by ground observer.

12. Jet Engine Fuel System Pressure Check.

a. Jet Air Plug Switch—OPEN.

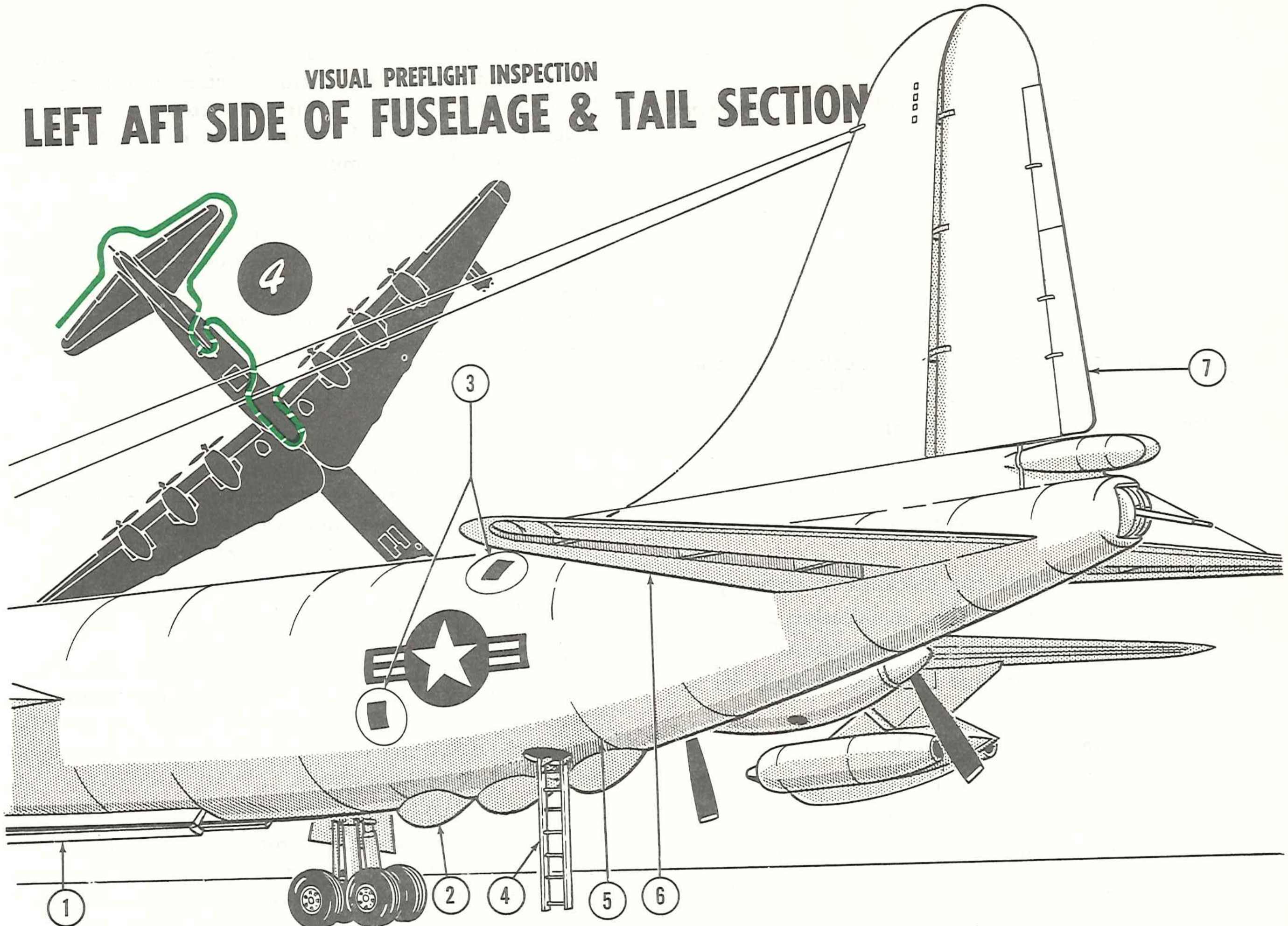
b. Throttle Selector Switches—LEVER.

c. Throttle Levers—Closed.

d. All Circuit Breakers—In.

e. Jet Manifold Valve Switches (L and R)—OPEN.

f. All Jet Engine Fuel Valve Switches—OPEN.



1. Proceed to check aft bomb bay, repeating the procedure followed for forward bomb bay. If a bomb bay tank is installed, check for leaks and general condition.
2. Radar domes for cracks.
3. Scanning windows for cleanliness and cracks.
4. Enter the aft cabin through the aft entrance hatch and check for cleanliness, stowage of equipment, and general condition.
5. Leave aft cabin and check fuselage skin for general condition.
6. Horizontal and vertical stabilizers for general condition. Rudder ground locks removed.
7. Rudder, elevator and tabs for general condition.

72-141-A

Figure 2-7. (Sheet 5 of 5)

g. Fuel Booster Pump Switches—ON.

Note

This jet panel configuration will be maintained for a minimum of 2 but no more than 5 minutes. This procedure allows an adequate fuel pressure check of the entire jet engine fuel system down to the jet engine fuel stopcock. On engines equipped with a check valve in the bypass line between the fuel pump and the flow divider, leakage from the aft drain system is not normal and an engine start must not be attempted until the source of difficulty is located and corrected. On engines not equipped with a check valve in the bypass line, slow dripping from the aft drain system is normal because of the bleed bypass. However, if the dripping appears to be excessive, disconnect the line between the aft drain and the combustion chamber drain manifold. If it is determined that fuel is leaking from the combustion chamber, an engine start must not be attempted until the source of difficulty is located and corrected. If fuel is leaking from the forward drain and it is determined to be from the flow divider, an engine start may safely be attempted provided the leak is not in excess of approximately 90cc per minute (steady flow).

h. Obtain ground observer's report—Fuel Pressure Check—Normal.

i. Jet Fuel Booster Pump Switches (L & R)—OFF.

j. All Jet Engine Fuel Valve Switches—CLOSE.

k. Jet Throttle Circuit Breakers—OUT.

l. Jet Air Plug Switches—CLOSE.

13. Check pilots' night flying curtain stowage in the forward cabin.

14. Notify aircraft commander of aircraft discrepancies.

15. Stow personal equipment.

Copilot.

Note

If a copilot is not assigned to the crew, the pilot will perform the following steps.

1. Oxygen supply and equipment check in accordance with existing oxygen preflight procedure.

2. Proceed to the left and right outer wing panels and check the following:

a. Distribution panel for security and condition.

b. Fuel and oil lines for condition, installation, and leaks.

c. Fuel and oil valves for mechanical hook up.

d. Jet booster pump tank for installation and leaks.

e. All structure for condition and security.

f. Aileron control linkage and aileron lock for security.

3. Proceed to tail cone and check the following:

a. Tail cone lights ON to check operation and OFF when tail cone inspection is complete.

b. Tail anti-icing ducts for general condition.

c. Remote interphone jackbox plugs connected.

d. Visually inspect the condition of the elevator, rudder control system, and rudder casting.

e. Check the condition and servicing of the rudder and elevator control locks, making sure that cylinders have been properly filled.

f. Check the mounting and linkage of the autopilot servos.

g. Security of loose equipment.

h. Tail cone section for breaks, cracks, and general condition.

4. Notify aircraft commander of aircraft discrepancies.

5. Stow personal equipment.

ENGINEERS' VISUAL PREFLIGHT INSPECTION.

This inspection will be accomplished on the day of flight with a minimum of two engineers. Although the first engineer will be assisted in the inspection, this in no way relieves him of the responsibility of insuring that every step is properly completed. He is expected to know the B-36 and to determine its condition before flight.

The procedure contained herein comprises an inspection route (figure 2-8) arranged in a sequence which will allow greatest efficiency. The procedure results in a thorough inspection. Various factors may force it to be modified slightly. Additional items may be inspected as warranted by local conditions and requirements; but all items must be performed.

Actually your preflight inspection begins as you and the second engineer approach the aircraft. You should have immediately noticed if any obvious maintenance was still in progress and if adequate stands, auxiliary power units, lighting, towing equipment, fire equipment, etc., are standing by for use.

Note

Insure that the wing access panels between the outboard and center engines on left and right wings have been removed in order to provide an escape route in the event of fires occurring during the wing crawlway inspection. Also check to see that the inboard jet access panels are removed.

Recheck the status of the aircraft with the crew chief as reflected by AF Form 781 (Form 1). Pay particular attention to the corrective action taken on all discrepancies noted by the crew during the preflight operational equipment check.

The AF Form 781 (Form 1) should indicate that the daily inspection has been completed; the amount of fuel, oil, and water injection fluid serviced; and the totals of fuel and oil by location.

Stand by for crew inspection. Upon completion of this crew inspection both engineers will proceed with their preflight inspection.

Note

In order to prevent an abort or late take-off, any discrepancies discovered during the preflight inspection will be reported to the crew chief immediately so that corrective action may be started as soon as possible.

FIRST ENGINEER.

Engineer's Station.

1. Required Forms—Aboard and Checked.
2. All Circuit Breakers and Control Switches—Properly Positioned.
3. Emergency Power Switch—NORMAL.
4. Cabin Heater Power Switch—OFF.
5. External Power Supply Switch—OFF.
6. Battery Switch—ON.
7. Alternator Panel Configuration—Checked.
8. External Power—Plugged In.
9. Correct A-C Phase Sequence Lamp—Lighted.
10. External Power Supply Switch—ON.
11. Master Ignition Switch—Pull Off.

12. Liquid Lock Check (with ignition switches OFF) —Completed.
13. Mixture Control Check—Completed.
14. Throttle Lever and Flap Warning Horn Check—Completed.
15. Fuel Panel Configuration—Checked.
16. Intercooler and Air Plugs—As Required.

Note

If an operational preflight was not performed, a static propeller feather check will be performed at this time. See "Stopping Reciprocating Engines" for amplification.

17. Instrument Check—Normal.
18. Altimeter—Check and set at 29.92.
19. Panel Lights—Check.
20. Wheel Well Lights Switch—ON.
21. Nacelle Fire Detection Circuit—Push to test.
22. Wing, Cabin Heat and Tail Anti-Ice Switches—Full Decrease.
23. Minimum of two tank valves OPEN and booster pumps ON (one in each wing to provide system pressure).
24. Oil Cooler Door Mode Selector Switches—AUTO.
25. Oxygen supply and equipment check in accordance with existing oxygen preflight procedure. Check normal interphone using helmet and oxygen mask, verifying side tone.
26. Engineer's Fuse Panel—Check for security of fuses.
27. Alternate A-C Power Switch—NORMAL, lamp lighted.

Radio Operator's Compartment.

1. Emergency dump valve pedal reset in untripped position and valve closed (manual modulating knob full clockwise).
2. Visually inspect condition of normally accessible control cables and pulleys.
3. T-R Test Unit—Check voltage and load output of each t-r unit and the battery.

CAUTION

Operate only one selector switch at a time to prevent burning out of the ammeter.

4. Turbo, jet throttle, and mixture control amplifiers. Check wiring, mounting, and presence of spares.
5. Inspect autosyn instrument amplifier, transformers, and fuse panel for condition, wiring, mounting, and presence of spare fuses.

Forward and Aft Bomb Bays.

1. Bomb bay lights switch ON.
2. Check general condition and security of the following:
   a. A-C and d-c fuse panels.
   b. Bomb bay for cracks, breaks, etc.
   c. Heat and pressurization ducting.
   d. Loose equipment.
3. Connect interphone at station 6.1.
4. Inspect main hydraulic panel.
5. Check aileron cross-over cables, pulleys, and autopilot servo for interference and condition.
6. Inspect emergency flap switches.
7. Connect interphone at station 7.1.
8. Inspect bomb bay 3 fuel tank quick-disconnects.
9. Inspect auxiliary spar (station 8.0) for evidence of failure.
10. Inspect transformer-rectifier units (fans operating).
11. Wing crawlway and interphone switches—ON.

Inside Right Wing.

1. Inspect the following items for general condition, security connections, routing, etc.
   a. Accessible portions of the fuel manifold lines, valves, and tanks.
   b. Wheel well and wing crawlway lights.
   c. Throttles and flap synchronizer cables for general condition.
   d. Fuel level transmitters for proper mounting and wiring.
   e. Fuel tank vent lines and vapor return lines.
   f. Pressurization ducting and flow limiters.
   g. Accessible wing bracing.
   h. Accessible wiring.
2. Fire extinguisher agent cylinders, valves, and pressure. Auxiliary spar forging for cracks.
3. Inspect condition of all hinges, levers, and actuating linkages for landing gear fairings, doors, and sequence valves.
4. Inspect the latch mechanism and main gear wheel well door limit switches for proper condition, security of mounting, proper electrical connections, and corrosion or binding of the microswitch actuating mechanism.
5. Make the following inspection of the main landing gear manual extension controls:
   a. Cable wound correctly on large drum approximately 2 turns.
   b. Hoist hook and spring properly stowed, ratchet handle for security.
6. Check the main landing gear hydraulic actuating mechanism, lines, and connections for security, condition, and evidence of leakage.
7. Check the main side brace for general condition of the latching mechanism, proper connecting and alignment of latch release arm at both ends, and security and condition of hydraulic snubber. See that the ground safety lock is in place.

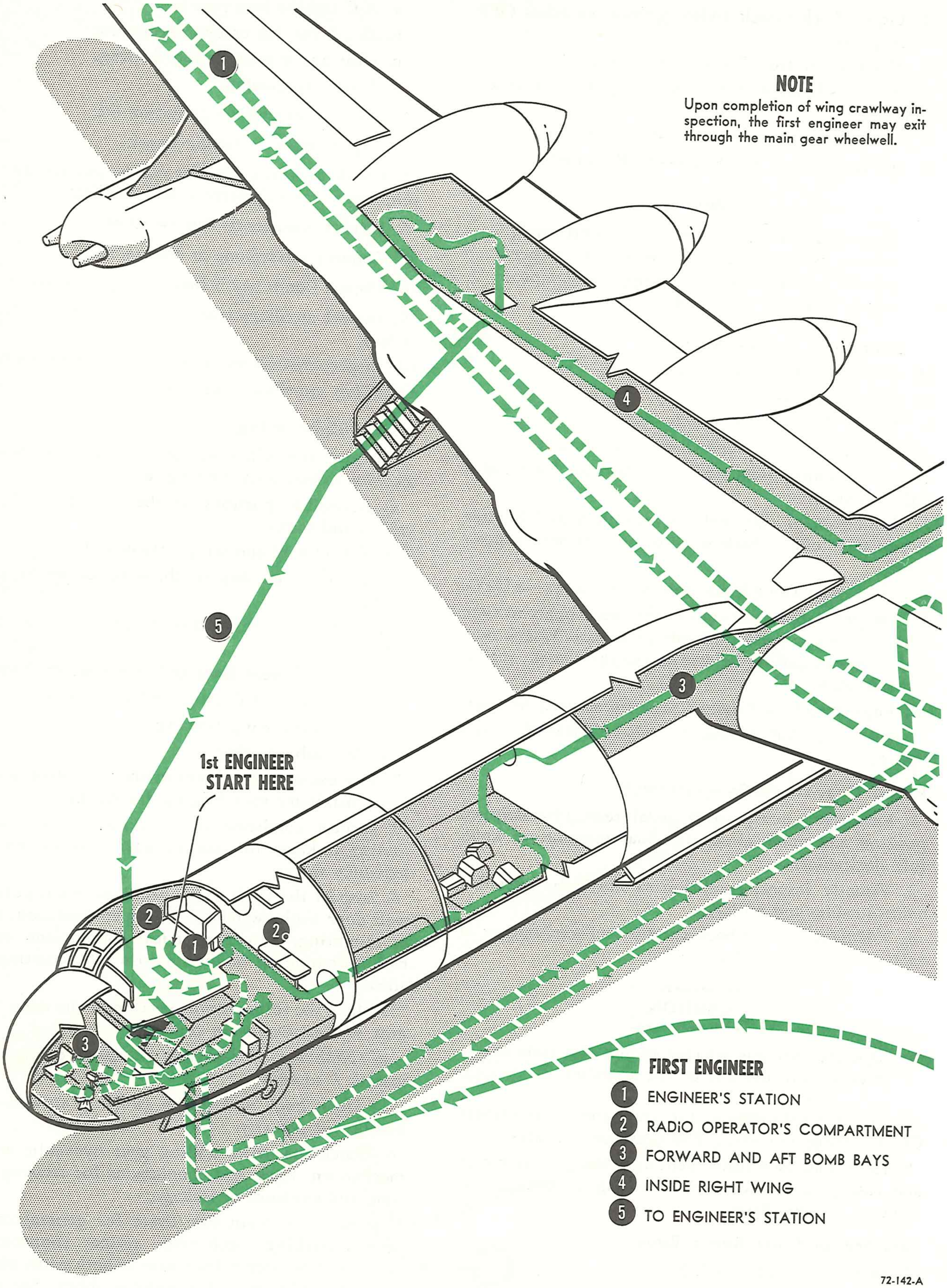


Figure 2-8. (Sheet 1 of 2)

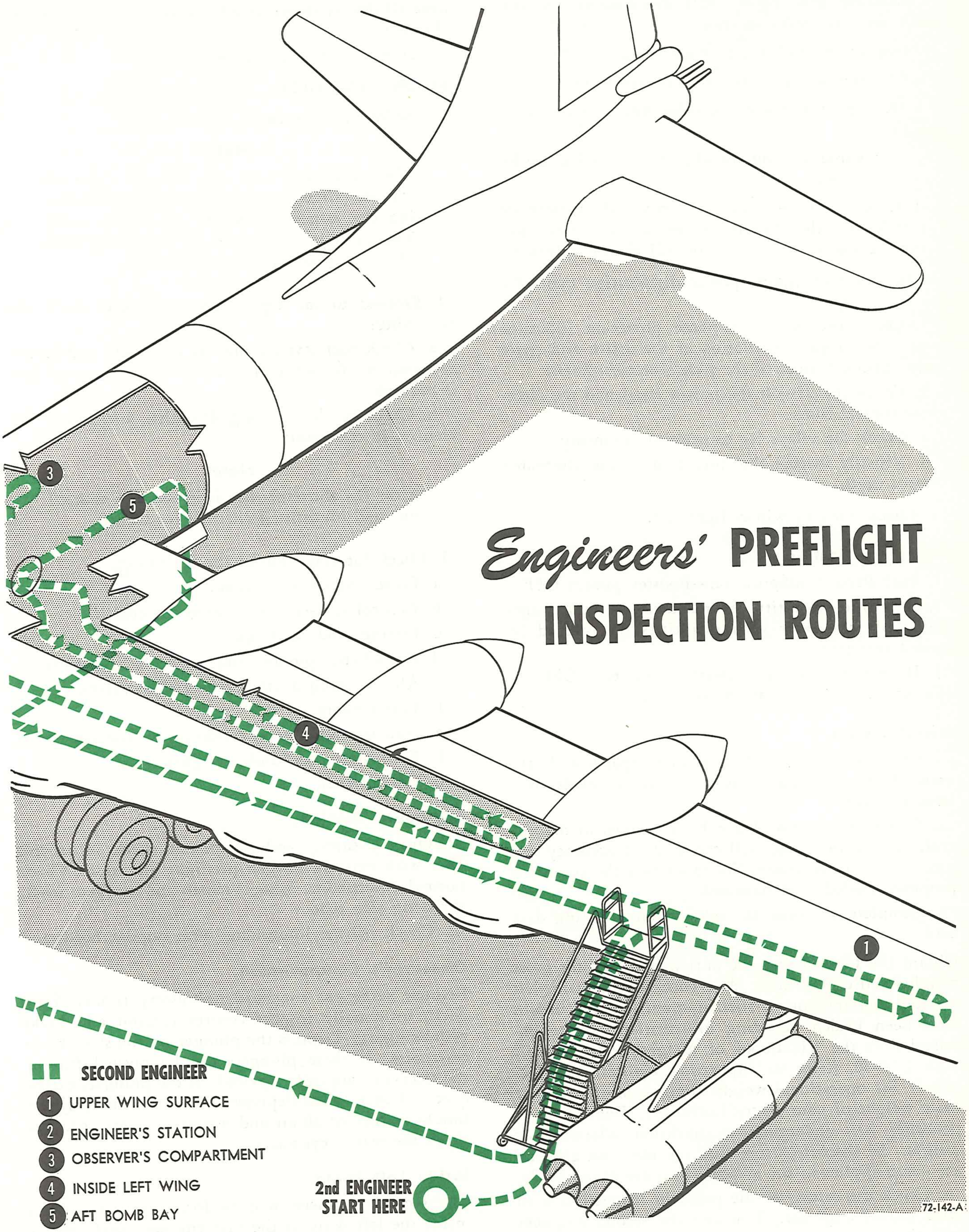


Figure 2-8. (Sheet 2 of 2)

8. Landing gear pivot shaft attachments for fuel leaks, security, and condition.

9. Inspect the following at each engine nacelle:

a. Alternator and turbo oil tanks for leaks.

b. K-truss cutout and accessible engine mounts for cracks.

c. Accessible ducting for alignment, cracks, breaks, connections, etc.

d. Check tank-to-engine oil lines and connections for leaks, oil thermostats for proper operation, and manual crank stowed on engine oil shutoff valves.

10. Inspect each engine power distribution panel for the following:

a. Check the A-, B-, C-phase power-on indicator lamps and proper installation of the active and spare fuses. Check bottom of the panel for cleanliness.

b. Check the 28-volt d-c power lamp and the alternator control fuses.

c. Check the relays for security of mounting.

d. Visually inspect the mounting of the alternator control units.

11. Check wing crawlway lights off.

Engineers' Station.

1. Fuel Panel Configuration—Booster pumps OFF.
2. Note fuel quantity as indicated on tank gages and check this later with quantities dip sticked by second engineer.
3. If no one is using external power, turn OFF the external power and battery switches.

Miscellaneous.

1. Check status of all last minute repairs with the crew chief and insure that wing access panels have been replaced.
2. Complete or revise Form F and return to the aircraft commander, who will check it for accuracy and sign. It is your responsibility to see that the aircraft is properly loaded and balanced.
3. Complete or revise the take-off and landing data card.

Obtain the take-off and the anticipated landing gross weights and cg locations. Also check to ascertain that the required amounts of fuel, ammunition, and bombs have been loaded. Loading information can be obtained from the "Handbook of Weights and Balance," T.O. 1-1B-40. Refer to "Operating Limitations," Section V for operational weight limitations. Check the basic weight of your aircraft carefully. Remember, it probably has undergone modification affecting its weight. Be absolutely sure that the basic weight you are using applies to the airplane you are going to fly.

4. Check the results of the preflight inspection with your second engineer. You and the second engineer will then meet with the aircraft commander and go over all discrepancies noted. Enter them in Form 781 (Form 1).
5. Stow personal equipment.

SECOND ENGINEER.

Upper Wing Surface.

Note

The second engineer may delegate right aft scanner (aircraft electrician) to assist him during the inspection of the top of the wing. This in no way alleviates the second engineer of being responsible for this check.

1. Proceed to the top of the wing and check the following:

a. Check fuel level, using the dip stick, and record the amount in each tank. Record temperature of fuel if required.

b. Check oil level, using dip stick, and record the amount in each tank.

Note

After the above checks, it is essential that all fuel and oil caps be checked for security.

2. Check for condition of the following:

a. Loose rivets and fasteners.

b. Control surfaces and aileron curtains.

c. Fairings and cowlings.

d. Propellers, spinners and intercooler shutters.

e. All anti-icing ducts and accessible valves.

f. Turret doors.

g. Hatches and general condition of fuselage.

h. Formation and fuselage lights.

i. Tail surfaces.

Engineers' Station.

1. Oxygen supply and equipment check in accordance with existing oxygen preflight procedure. Check normal interphone using helmet and oxygen mask, verifying side tone.
2. Check private interphone with regular headset.

Observer's Compartment.

Remove sufficient overhead upholstery (under flight deck) to visually inspect control column and brake pedal rigging. Depress the plunger on the slave brake reservoirs. If these plungers can be pushed full in, the reservoirs are fully serviced. If the plungers extend over 3/4 inch when depressed, the slave brake system should be bled of all air and reservoirs reserviced. Also check the master cylinders.

Inside Left Wing.

The second engineer will perform the same check inside the left wing as the first engineer performs inside the right wing.

Aft Bomb Bay.

1. Wing crawlway lights OFF.
2. Inspect a-c power panels.
3. Inspect auxiliary spar (station 8.0) for evidence of failure.
4. Inspect heat and pressurization ducting, accessible cables, and general condition.
5. Check oxygen bottles for condition and security.

Miscellaneous.

1. Report to the first engineer the results of your preflight inspection and submit to him the quantities of fuel and oil loaded.
2. Standby with the first engineer to assist in completing or revising the Form F and to report the results of your preflight inspection to the aircraft commander.
3. Stow personal equipment.

FINAL CREW BRIEFING.

When all crew members have completed their preflight, have stowed their equipment, and the aircraft commander is satisfied that a thorough preflight inspection has been completed, he will conduct an informal final crew briefing.

1. Call the roll, and have each crew member give preflight report. Any discrepancies will be reported.
2. Check Form 781 (Form 1) to see that specialized equipment has been signed off after preflight.
3. Brief crew on emergency signals and procedures and on oxygen, interphone, and parachute discipline. If passengers are aboard, make sure they know emergency signals; positions for take-off, landing and crash landing; oxygen outlets; primary and secondary exits for bail-out and ditching; and proper operation of their parachute, bail-out bottle, oxygen equipment, etc.
4. State time interval at which aft cabin scanners are to render visual engine check during the flight. During daylight, it will be every hour; during night, high altitude cruise, weather, and high power, it will be every 30 minutes. In addition, during the visual engine check, the right scanner will give the aft cabin altimeter reading to the engineer during pressure flight.

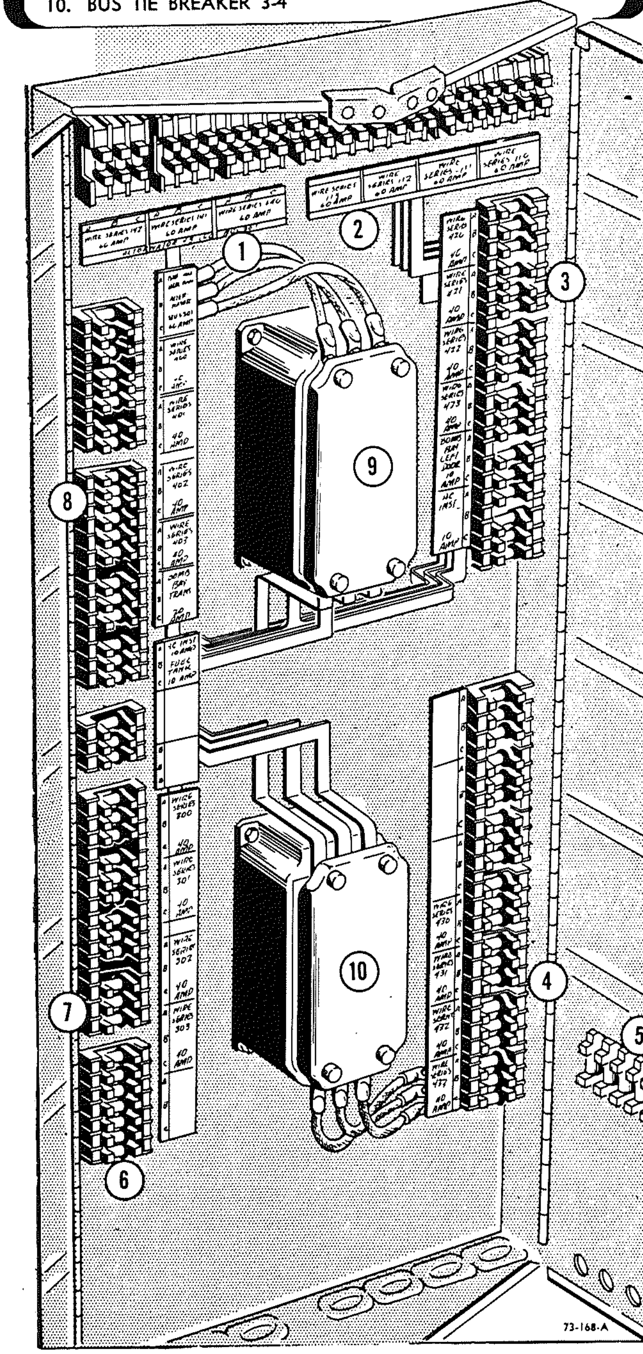
WARNING

The aft lower left and right scanning stations must be manned at all times during flight.

5. Designate an observer in the nose to aid in clearing the aircraft during flight at night, during periods of restricted visibility, and when flying through congested control areas.

LEFT MAIN A-C POWER PANEL

1. BUS 301
2. BUS 201
3. LEADS TO BUS TIE BREAKER 5-2
4. LEADS TO BUS TIE BREAKER 4-5
5. SPARE FUSES
6. FUSES
7. LEADS TO LEFT FORWARD TURRET POWER PANEL
8. LEADS TO LEFT AFT TURRET POWER PANEL
9. BUS TIE BREAKER 2-3
10. BUS TIE BREAKER 3-4



73-168-A

Figure 2-9.

6. The N-1 compass heading will be cross-checked with the magnetic heading every 30 minutes.

7. Cover route, altitudes to be flown, weather, and duration of flight. If information has not changed since formal briefing, it is unnecessary to cover it again at this point.

8. Announce station time, start engine time, and take-off time.

9. Answer any questions crew may have.

10. Have ground locks removed before boarding aircraft.

11. Crew members board the aircraft. All crew members will go on interphone and standby as soon as they board the aircraft.

RULES TO BE ENFORCED ON EACH FLIGHT.

SMOKING.

1. No smoking during ground operation, take-off, and landing.
2. No smoking at any time gas fumes are detected.
3. No smoking except in crew compartments.
4. Make sure all cigarettes are completely out before throwing away.
5. Do not attempt to throw a lighted cigarette from the airplane.
6. No smoking while wearing helmet with oxygen mask attached.

WARNING

Keep lighted cigarettes away from oxygen masks at all times that masks are connected to the airplane's supply system.

PARACHUTES.

Parachutes will be worn at all times by crew members while they are occupying the aircraft commander's, pilot's, engineer's, and scanners' positions. This is considered necessary so that these key crew members may devote complete attention to coping with an emergency situation that may arise without being distracted by the necessity of putting on parachutes prior to abandoning the aircraft.

1. All crew members will wear parachutes at all times under the following conditions:

a. When above 25,000 feet pressure altitude with the aircraft pressurized, with the exception that parachute may be removed temporarily when it is necessary for proper performance of duty.

b. During take-off, landing, formation flying, fighter passes, gunnery practice, when emergency conditions exist, when gas fumes are detected, or any time danger is imminent.

c. While occupying positions when the aircraft is pressurized and there is imminent danger of explosive decompression.

2. At all other times parachutes need not be worn, but will be kept close by at all times.

3. Stow an extra parachute with bail-out bottle attached in each pressurized compartment.

4. Make sure all parachutes have been properly inspected and packed before take-off.

SAFETY BELTS.

1. One pilot, the engineer, and the scanners will have safety belts fastened at all times.

2. Above 25,000 feet altitude aircraft commander, pilot, engineer, and the scanners will have safety belts fastened when the cabins are pressurized.

OXYGEN.

(Refer to "Oxygen System," Section IV.)

STATION TIME.

Station time is designated by the aircraft commander to make sure that each crew member knows the exact time he should be at his assigned station aboard the aircraft ready for engine start, taxi, and take-off. The pilots and engineers have several duties to perform between "Station Time" and "Starting Engines" and should be allowed approximately 15 minutes between these times to make sure the remaining schedule is not interrupted. "Station Time" immediately follows "Final Crew Briefing." Since the pilot and first engineer have the most duties to perform before engine start, they should be first to enter the aircraft after dismissal from final briefing. The aircraft commander will want to be last for several reasons:

1. *To see that all personnel and equipment are aboard.*

2. To make a last visual check to see that gear-down locks, pitot covers, and control locks are removed and that the wing access panels are secured and the nose gear scissors are connected.

3. To see that the area is clear of obstructions and adequate fire equipment is available preparatory to engine start.

The aircraft commander, pilot, and engineers will recheck and complete applicable items of the "Before Starting Engines" check list and stand by for starting engines.

STARTING RECIPROCATING ENGINES.

The reciprocating engines will be started in accordance with the instructions given under "Preflight Operational Equipment Check, Starting Reciprocating Engines" of this section. An effort should be made to start the engines as close to take-off time as the situation and the experience of the crew permits in order to conserve fuel and engine life.

DURING ENGINE WARMUP.

If a complete "Preflight Operational Equipment Check" was accomplished, the only checks that must be made during this engine warmup are listed below:

1. Engine-Driven Fuel Pumps.
2. Alternators Paralleled (three on the line, one standing by).
3. Engine Oil-In Temperatures—Minimum 40°C.
4. Propeller Reverse Check—As required.

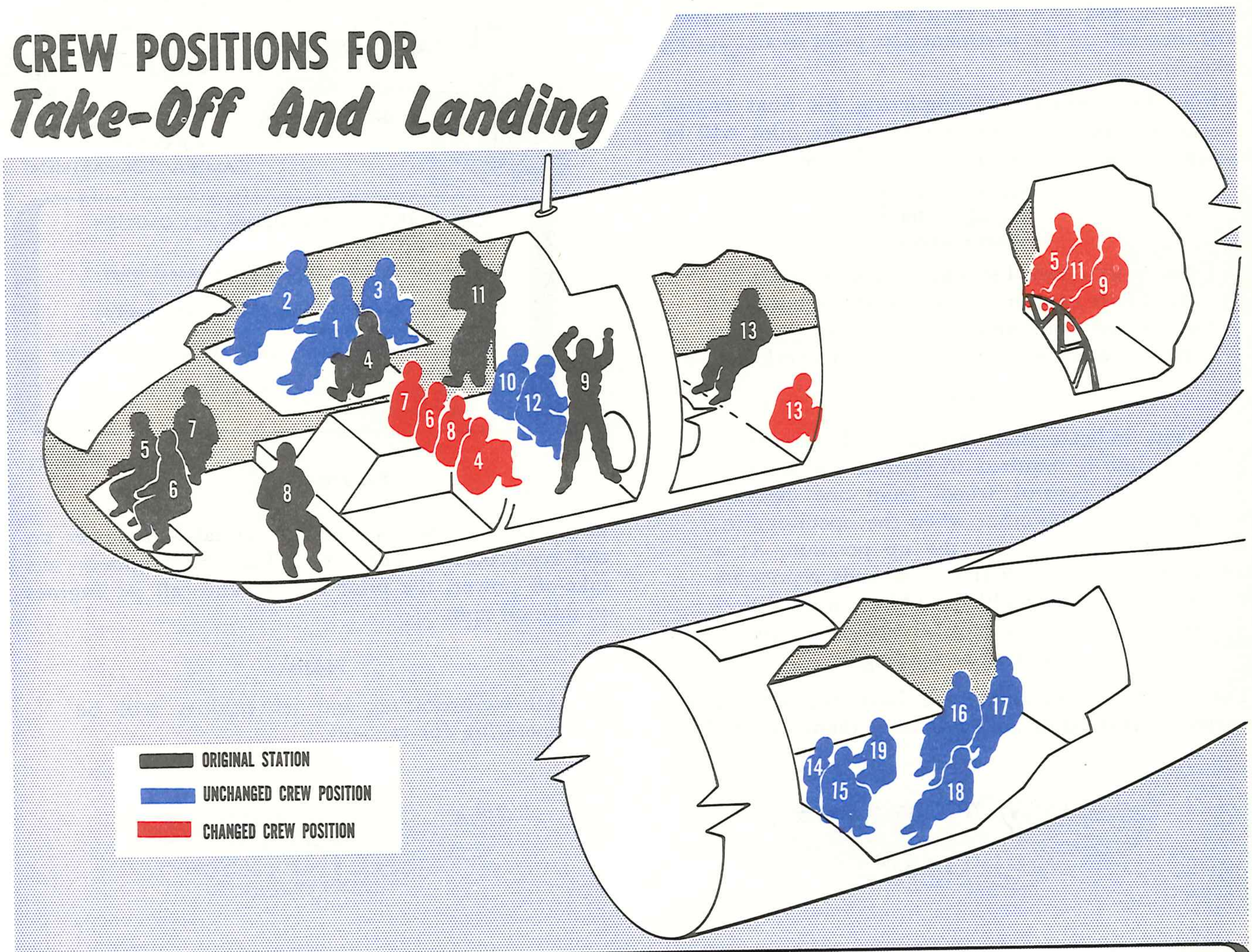
ENGINE RUNUP.

If a complete "Preflight Operational Equipment Check" was accomplished, the only checks that must be made during this engine runup are listed as follows:

1. Propeller Control System.
2. Ignition System Checks—Completed.
3. Full Power No Boost Checks.
4. Full Power with Boost Checks.

STARTING JET ENGINES.

Start the jet engines in accordance with the instructions given under "Preflight Operational Equipment Check, Starting Jet Engines" of this section. All four jets should be started as close to take-off as remaining time will allow to conserve fuel and engine life.



1. AIRCRAFT COMMANDER
2. PILOT
3. FIRST ENGINEER
4. SECOND ENGINEER
5. WEATHER OBSERVER
6. PHOTO-NAVIGATOR
7. RADAR OBSERVER
8. PRIMARY NAVIGATOR
9. COPILOT
10. FIRST RADIO OPERATOR
11. SECOND RADIO OPERATOR
12. ECM OBSERVER (LOW FREQUENCY)
13. PHOTOGRAPHER
14. ECM OBSERVER (MEDIUM FREQUENCY)
15. ECM OBSERVER (INTERMEDIATE FREQUENCY)
16. ECM OBSERVER (HIGH FREQUENCY)
17. TAIL GUNNER
18. LOWER AFT SCANNER (LEFT)
19. LOWER AFT SCANNER (RIGHT)

72-356-A

Figure 2-10.

BEFORE TAKE-OFF.

Before and during take-off your perspective will differ from that experienced on other airplanes. Your flight deck is higher, the wing is approximately 40 feet aft, and the reciprocating engines are pusher type. Therefore, you will not have the customary reference to the wings and engines. However, with a few flights you will develop the proper perspective.

When the aircraft is taxied into position for take-off, the aircraft commander will align the nose wheel on the center marker for the runway and make certain the nose wheel indicator reads zero before setting the parking brakes.

The engineer will give basic take-off information to the aircraft commander on the take-off and landing data card. The aircraft commander will study this information and pass the card to the pilot. The pilot will then call off the pertinent data prior to and during take-off.

While the engineer is completing his final engine checks, the aircraft commander and the pilot will be going through the "Before Take-Off" check list.

CAUTION

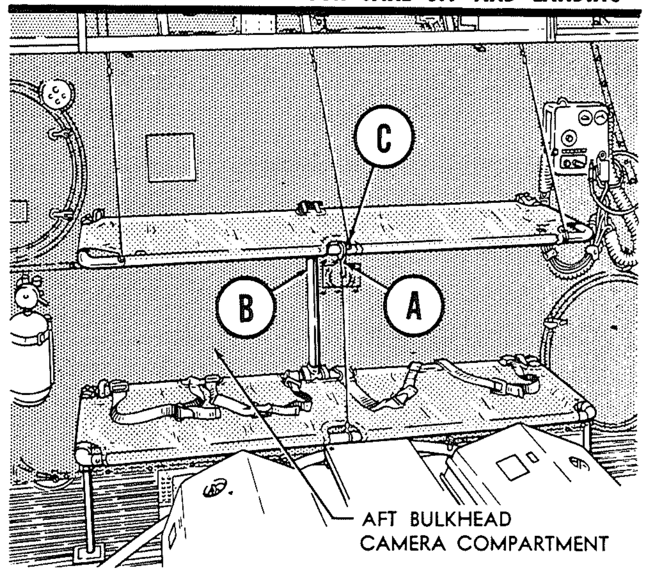
Use your check list and follow it carefully. No matter how proficient you are or how well you know your procedures, you are inviting trouble when you fail to use your check list.

Note

Tests indicate that approximately 5 seconds less time is required to operate the elevator trim tab control wheel from one extreme position to the other when the operator's inboard arm rest is in the up position. At a speed of 135 mph this 5 seconds represents 990 feet of travel which could mean the difference between a successful maneuver and a crash during take-off or landing.

The aircraft commander will have the jet engines started at this point and will keep them in stand by

***Securing* CAMERA COMPARTMENT BUNKS**
FOR TAKE-OFF AND LANDING



BEFORE TAKE-OFF OR LANDING ACCOMPLISH THE FOLLOWING:

1. Pull up on lower bunk and disconnect lower cable "A".
2. Unstow brace "B" and swing it into position on the lower bunk.
3. Disconnect the upper cable at "C" and stow the upper bunk.
4. Pull up on the lower bunk and hook the upper and lower cables.

DI-1014-C2

DI-1014-C2

Figure 2-11.

until the engineer is ready to set take-off power on the reciprocating engines. While the engineer sets take-off power, the pilot will advance all jet engines to take-off rpm.

Note

All reciprocating and jet engines will be operating for take-off.

PILOTS

1. Landing Lights—As required. Landing lights will normally be used for all night take-offs. Under conditions of restricted visibility, such as haze, fog, snow, or rain, and when the aircraft commander is of the opinion that the use of landing lights is a hindrance rather than an aid to visibility, use of the landing lights is not mandatory.

ENGINEERS

1. Engine Supercharger Switches—BOTH.
2. Fuel Panel Checked—Booster pumps ON.
3. Oil Vent Heater Switch—ON, if 0°C OAT. is anticipated.
4. Carburetor Preheat Switches—OFF.
5. Cabin Pressure Wing Shutoff Valve Switches—OFF.

PILOTS

ENGINEERS

BEFORE TAKE-OFF (Cont'd)

2. Flaps and Indicators—Set at 20 degrees and checked.

3. Trim Tabs—Set. Set trim tabs for take-off, using 30 per cent MAC. as neutral elevator; set 1 degree elevator trim for each 1 per cent variation from 30 per cent MAC. If nose is heavy (30 per cent minus), trim nose up; if tail is heavy (30 per cent plus), trim nose down.

Note

To facilitate movement of the elevator trim tab control, the inboard arm rests on the pilots' seats should be in the up position for all take-offs and landings.

4. Abort Procedure and Take-Off and Landing Data—Briefed and Reviewed. The aircraft commander will review the abort procedure and take-off and landing data with the pilot and engineers.

5. Safety Belts and Safety Harnesses—Fastened. Crew members will be in their take-off positions. Safety belts and shoulder harnesses will be fastened and inertia reel lock controls UNLOCKED.

6. Salvo Safety Switches—As required. Have salvo circuits set for salvo if heavily loaded for take-off.

7. Engineer's Take-Off Configuration—Engineer reads, "Take-off configuration completed, standing by for propeller reverse safety check and take-off power."

8. Tower Clearance—Received.

Note

The following steps must be accomplished after the aircraft is aligned with the runway.

9. Parking Brake Control—ON.

10. Propeller Reverse Selector Switches—SAFE (lights out). Observe that all propeller reverse warning lights are out, indicating all propellers are in normal pitch.

11. Pitot Heat—As required.

6. Cabin Booster Fan Control Switch—As required.

7. Pitot Heater Switches—As required.

8. Wing, and Cabin Heat and Tail Anti-Icing Switches—OFF.

9. Engine Fan Speed Switches—LOW RPM.

10. Three Alternators Paralleled on the Line, One Excited and Standing By.

11. Air Plugs and Intercoolers—As required.

12. Cabin Heater Power Switch—OFF.

13. Temperatures—Checked and within limits.

14. Mixture Control Selector Switches—LEVER.

15. Mixture Control Levers—NORMAL.

16. Spark Advance Switches—RETARD (guards down).

17. Propeller Selector Switches—AUTOMATIC OPERATION (Tel-Lamps Lighted).

18. Propeller Normal Pitch Indicator Lamps—Lighted.

19. Brake Pressure and Nose Steering Pressure—NORMAL.

20. Turbo Control Change-Over Switches (Group 1 Airplanes)—AUTO.

21. Turbo Control Vernier Switch (Group 1 Airplanes)—OFF.

22. Hydraulic Fluid Temperature Control Switch—OFF.

23. Oil Cooler Door Mode Selector Switch—AUTO.

24. Safety Belt—Fastened.

25. Engineer's Take-Off Configuration—Engineer reads, "Take-off configuration completed, standing by for propeller reverse safety check and take-off power."

PILOTS ENGINEERS

BEFORE TAKE-OFF (Cont'd)

12. All Compartments—Entrance ladders, windows, and hatches, ready for take-off. The compartment commanders are responsible to check that all crew members have assumed their take-off position (figure 2-10), and that all ladders are up, all windows and hatches are closed, all defroster nozzles are removed, and all equipment is properly stowed. After this check is completed, the compartment commanders will report to the aircraft commander, "Ready for take-off."

13. Gyros—Set and Uncaged. Observe the indications of the directional gyro, vertical gyros, turn and bank indicators, and slaved gyro magnetic compass or the N-1 high latitude compass. Set the directional gyro with the magnetic compass.

The accuracy of the turn and bank indicators should have been checked during taxiing. When setting the compass, attempt to remove the white dot or white cross from the small window at the upper right corner of the compass.

14. Nose Wheel Steering Switch—ON. This will turn on one hydraulic pump and circulate fluid through the system at approximately 600 psi.

15. Surface Controls—Unlocked and Checked. Check the control lock indicator lamps; the green lamp should be on and the red lamp out. If the green lamp is out and the red lamp is on, check the toggle switch which is actuated by the flag on the pilots' instrument panel. This switch may not have been actuated by the flag. Check controls for freedom of movement at full throw.

16. Read pilot's take-off configuration. This will insure that all checks made by the aircraft commander before take-off are completed. The pilot should recheck each item when he calls it off as follows: "Controls—Unlocked; Flight Instrument Switches—ON; Flaps—20 degrees; Trim Tabs—........degrees (up or down); Autopilot—OFF; Nose Steering—ON; Propellers—SAFE, Lights Out."

The aircraft commander will be sure the jet booster pumps are on, all jet manifold and engine valves are open, pod preheat and nose de-ice switches are off, and the jet engine oil tank heater switch is as required. It will take about 30 seconds to read and visually check the entire take-off configuration.

TAKE-OFF.

PILOTS

Note

> If high carburetor air temperatures were encountered during ground runup, use the procedures outlined in "Take-Off, Hot Weather Procedures," Section IX.

1. Parking Brakes—Released. The aircraft commander and pilot will hold the aircraft with foot brakes while setting take-off power.

2. Set Take-Off Power—Jets take-off rpm. When the aircraft commander has completed his take-off configuration (including take-off clearance from tower), he will instruct the pilot to advance the jets to take-off rpm and the engineer to advance his throttles at the same time to make propeller reverse check and set take-off power.

CAUTION

> In order to minimize drag loads on the main landing gear, the time interval for the full power checks prior to releasing the brakes should be held to a minimum.

When the foot brakes are released, directional control will be maintained by use of nose steering until the rudder becomes effective at 50 to 60 mph. As soon as power has been stabilized during take-off roll, the engineer will report this fact to the aircraft commander.

The pilot should keep his hand on the jet throttles during the take-off run in order to handle immediately any jet emergency on take-off. Start applying elevator pressure at approximately 10 mph below nose-up speed. When an air speed of approximately 5 mph below nose-up speed has been attained, apply and maintain 50 to 75 pounds pull on the elevator control wheel. If control wheel pull is maintained until nose-up speed is attained, the airplane will begin to move to the take-off attitude.

As take-off air speed is approached, the 50- to 75-pound pull requirement of the control wheel will subside and, at the instant of take-off "get away," the force required will be reduced to approximately zero.

ENGINEERS

1. Propeller reverse safety check and set take-off power. Advance throttles to 35 inches M.P. on all engines, decrease master motor to 2000 rpm to insure that prop limit switches are against low blade stops, increase master motor to 2700 rpm, and recheck to insure that 35 inches are on all engines. If any propeller is in reverse, rpm on that engine will be approximately 300 higher than rpm of engines with propellers in normal pitch. Set TBS 7, advance throttle to 55 inches M.P., water injection on, set take-off power corrected for humidity. Report to aircraft commander, "Power set, propellers normal, ready for take-off."

2. Report, "Power stabilized," prior to nose-up speed.

PILOTS

ENGINEERS

TAKE-OFF (Cont'd)

As the airplane emerges from ground effect to climb, a normal tendency of the airplane to nose up will be experienced. This tendency must be countered by elevator "push force" and retrimming of the elevator trim tabs.

Initiate landing gear retraction as soon as the airplane is positively airborne.

Retraction and extension of the landing gear induces a mild change in longitudinal trim of the airplane. The sweep back of the wing causes flap movement to exercise a great effect on longitudinal trim. The resultant effect of flap movement can be reduced by operating the flaps in increments of 5 degrees.

AFTER TAKE-OFF.

PILOTS

1. Foot Brakes—Apply to stop wheel rotation. If the wheels are allowed to spin during gear retraction, unnecessary loads will be imposed on the retraction mechanism because of the gyro effect of the spinning wheels. The tires could also be damaged if the wheels were allowed to rotate in the wheel wells.

2. Nose Steering Switch—OFF.

3. Landing Gear Control Switch—RETRACT. The aircraft commander will give the order, "Gear up," over the interphone in addition to a visual order for gear up to the pilot. During retraction the scanners will report, "Left door coming open, right door coming open"; and after gear retraction, "Left door closed, right door closed." If the gear retraction sequence is not normal, or if the gear positioning jacks are not functioning properly, the scanners will report the discrepancy to the aircraft commander. It will take approximately 50 seconds to retract the gear.

ENGINEERS

1. Observe main hydraulic pressure normal.

PILOTS

ENGINEERS

AFTER TAKE-OFF (Cont'd)

Note

When the red landing gear indicator light remains on after gear retraction, a visual check should be made of the canoe door latches for proper engagement.

4. Landing Lights—Retracted and OFF.

5. Flap Switch—UP. At the verbal order from the aircraft commander on interphone, the pilot will begin to retract the flaps. Retraction should be accomplished in 5-degree increments to allow the pilot to trim the airplane as the flaps are raised.

Flap retraction should not begin until 130 mph IAS or 125 per cent of stalling speed, whichever is higher, has been obtained. (See "Flap Retraction Speeds," figure 6-6.) Since drag with the gear and flaps down is excessive, if it is practical, the landing gear should be retracted immediately and retraction of the flaps begun at 130 mph, even though the gear is not completely retracted. At least two alternators on the line is a requirement for simultaneous operation of the gear and flaps Do not fully retract the flaps until 140 mph IAS or 125 per cent of stalling speed, whichever is higher, has been reached.

The aft scanners should report the action of the flaps as they are raised to be sure that all flaps operate in unison. If either the inboard or outboard flaps fail to rise, the attitude of the airplane will be affected. If the inboard flaps fail, the aircraft will have a tendency to nose up; if the outboard flaps fail, the tendency will be to nose down. With any pair of flaps fully extended, the stalling speed is reduced approximately 6 mph. To operate one pair of flaps, open the circuit breakers for the other two pairs and operate the flap control switch. In the event the normal flap controls fail, use the alternate flap controls as described in "Wing Flaps," Section III.

CAUTION

Flaps must not be extended during flight except for take-off, landing, and emergencies. Propeller vibratory stresses encountered are increased with flaps extended.

2. Report, "Main hydraulic pressure relieved," after gear retraction is completed.

INITIAL CLIMB.

PILOTS

1. Power Condition No. 2—Jets 96 per cent rpm. After gear and flaps are up and a minimum of 500 feet above terrain has been reached. Unless some abnormality arises, this should serve as a notification to the pilot and engineer that you consider the aircraft safely aiborne and that power may be reduced as predicted for the flight. At the aircraft commander's discretion, each take-off is usually predicted to last from 3 to 5 minutes. At the end of the predicted period the pilot will reduce power on the jet engine to planned climb schedule.

2. Landing Gear and Brake Pump Switch—OFF when pressure is relieved. This is an added precaution against inadvertent operation of hydraulic motors and subsequent loss of system operation.

3. Hold Best Climb IAS—(Reference Take-Off and Landing Data Card). Climb performance has been tested and charted for all normal operation. Request the climb speed for your configuration from the engineer. Climb speed varies with power and altitude for long range climb. It also varies with gross weight for normal rated climb when maximum rate of climb is desired. The initial indicated air speed will drop off approximately 3 mph for each 5000 feet of altitude up to 35,000 feet and slightly more thereafter. Hold the correct air speed during climb—then performances should equal the engineer's and navigator's prediction. Charted climb air speed values result in stable operation under all weather conditions and the best compromise between power available from jet and reciprocating engines. This results in the best rate of climb consistent with efficient operation. If the jet engines are not to be used after level-off, they should be reduced to idle speed, preparatory to shutdown, the instant planned altitude is reached.

As the planned level-off altitude is attained, the aircraft may be climbed 200 to 500 feet above cruising altitude prior to reducing power unless instrument flight rules dictate leveling off at the exact altitude. This small amount of altitude will allow a cushion for the pilot to trim the aircraft while the engineer is stabilizing reciprocating power. Regardless of level-off technique, the engineer has sufficient power available from the reciprocating engines, at less cost in fuel consumption to complete this maneuver.

4. Bomb Bay Area—Checked. A designated crew member will inspect the bomb bay area for fuel fumes and fuel and hydraulic leaks. Upon completion of the check, the crew member will report to the aircraft commander.

ENGINEERS

1. Power Condition No. 2—Upon pilot's request.
2. Turbo Boost Selector—Reduce M.P.
3. Water Injection Switches—OFF. Use individual switches to cut off one water injection pump at a time. Note fuel flow increase, water pressure decrease to static value, and slight torque pressure drop-off.

Note

All ADI fluid may be expended during climb, if desired.

4. Reduce power to predicted climb schedule.

WARNING

During flight, do not move more than one mixture control lever at a time. This precludes the possibility of inadvertently moving all mixture levers to IDLE CUT-OFF and consequently, losing power on all reciprocating engines.

5. Torque, Fuel Flow, CHT, CAT., and M.P.—Within limits. Manually adjust controls to obtain specifications desired. Specified fuel flow for climb is indicated in the "Fuel Consumption" curves of the appendix.

Note

Engine fuel flow meters should be calibrated.

Torque varies with altitude due to engine cooling fans absorption of bhp. During any climb power setting, engine overheating can be combated by opening intercoolers and air plugs to lower CAT. and CHT; by enriching fuel flows; by reducing bmep; and by increasing air speed.

Note

Normally the alternator frequency will decrease during an extended climb and increase during descent because OAT. affects the resistance of the control circuit. So you must remember to adjust alternator frequency to compensate for these variations.

6. Anti-Icing Duct Temperatures—Increase as required.

STOPPING JET ENGINES (AIR).

After climb when the flight plan calls for shutting down the jet engines, the pilot will shut down jet engines as follows:

1. Throttles—Idle 3 minutes and then close. This procedure is followed in order to let temperatures throughout the jet engine stabilize. Because of the close tolerances involved and the fact that metals with different expansion and contraction factors were used in manufacturing the various parts of the engines and shroud ring, binding can result unless temperatures are stabilized. Remember that the tail pipe temperature indicator shows the temperature of the tail pipe only.

2. Booster Pumps—OFF.

2A. Air Plugs—Closed at or below 100°C tail pipe temperature and 30 per cent rpm. Check the fuel pressure and see that it reads zero before closing the air plugs. Watch tail pipe temperatures as the air plugs are closing; if temperatures rise sharply, open the air plugs on the affected jet immediately. Tail pipe temperature rise is an indication that the jet is still running. Attempt to shut off the affected jet by using the switch position of the throttle. If the jet still continues to run, close the engine fuel valve.

3. Engine Fuel Valves—Closed below 10 per cent rpm.

Note

> Immediately after shutdown, position the air plugs to allow the engine to windmill at 10 to 12 per cent rpm for a period of 10 minutes. After the 10-minute period, adjust the air plugs to maintain a windmilling rpm of 5 to 7 per cent.

4. Nose De-Ice—As required.

5. Pod Preheat—As required. Since pod preheat must be off when wing anti-icing is being used, in order to give adequate heat for wing anti-icing, preheating the jet pod must be handled with care when flying in icing conditions. Keep wing anti-icing heat on until the wings are free of ice, turn on pod preheat long enough to free the strut of ice, start the jets, and then turn pod preheat off and route the heat back to the wing.

6. Oil Heater Switch—As required. (Leave on at 15,000 feet and above or when OAT. is 5°C or (41°F) or below.

7. Oil Shutoff Valves—Always open during flight.

8. Throttle Circuit Breakers—Out, to prevent unnecessary operation of jet throttle amplifiers and inadvertent opening of the throttles.

9A. Air Plugs—Adjust to windmill 5 to 7 per cent rpm.

CRUISE NO. 1 (LOW ALTITUDE-HEAVY GROSS WEIGHT).

Cruising at any altitude calls for real cruise control. The responsibility for cruise control rests heavily on the engineer. By working closely with his aircraft commander and navigator, the engineer must base his operations on calculations derived from a series of performance charts and curves. In addition he must develop operational techniques such as *manual adjustment* and *manual leaning,* and *dual* and *single* turbo operation. While maintaining a reasonable balance of the many operational variables and techniques involved, he must develop, in coordination with his aircraft commander and the navigation team, definite procedures in conjunction with the *Long Range Cruise* problem to compromise with other problems such as navigation, bombing, etc.

Cruise No. 1 is the initial leg of the normal mission after take-off at maximum gross weight. At this time the long range air speed is, of necessity, relatively fast. The combination of gross weight, air speed, and altitude demands power settings which are above the manual leaning range. With perfect carburetion, operation would simply be in NORMAL mixture setting, but reasonable manufacturing tolerances do not allow such simplicity. To correct for this variable it is necessary to manually adjust the mixture controls until a specified fuel flow is obtained. These specified fuel flows are furnished the aircraft manufacturer by the engine manufacturer and in turn are plotted on engine fuel consumption curves, which are found in the appendix along with other operational data. For further information on manual adjustment, refer to "Mixture Control," Section VII.

Proper manual adjusting calls for accurate instrumentation; however, it must be noted by the operator that when operating below rated power, manually adjusted power settings are just slightly richer than best power. Investigate and observe the fuel flow at which best power is obtained. Common sense application of these observations will serve as a check of instrument calibration when compared with the average engine and will prevent marginal operation which might be detrimental to engine life.

After two or three cruises at this altitude, your gross weight and air-speed requirements will decrease to such a point that subsequent operation will phase into the manual leaning power range. Manual leaning procedures are given in Section VII, "Manual Leaning." Study these procedures carefully, for manual leaning is the "heart" of the overall operation of the B-36. It is one procedure that must be precise. Study the entire Section VII, "Reciprocating Engines" carefully, for it contains valuable information which will assist you in understanding various operational techniques and procedures.

BEFORE CLIMB OR HIGH POWER OPERATION.

Normally the first leg of the mission is accomplished with the jet engines off and the initial high reciprocating engine powers phased into lean operation. On some long initial cruises, it may become necessary to resort to single turbo operation if low rpm's in manual lean are attempted. You must anticipate the end of this leg, for several important steps must be taken before establishing a climb to a higher altitude. The engineer should know whether jet engines will be required for additional power, and will inform the aircraft commander of the required power configuration including the indicated air speeds to be maintained during the climb. In addition, the engineer and aircraft commander should allow themselves sufficient time to perform the items included in the following check lists when coordinating with the other crew members and establishing a time at which the climb should start.

STARTING JET ENGINES (AIR).

PILOTS

Note

Prior to starting jet engines, nose and cowl lips must be free of ice accumulation.

1. Notify engineer, "Set up jet start configuration."
2. All Circuit Breakers—In. To connect control and actuator circuits to their respective power sources.
3. Fire Detector Test Switches—TEST and release. This action checks the continuity of the detector system. Failure of any lamp to light within a reasonable length of time, or any light that flickers indicates a detector system malfunction and any later indications may not be reliable.
4. Throttle Selector Switches—LEVER.
5. Throttles—CLOSED.

Note

On airplanes equipped with a jet throttle position indicator, make a sweep of the engines with the selector switch to ascertain that the throttles are closed. If the indicator shows that a throttle is not in this position, close the throttle with the throttle override switch.

6. Pod Preheat Switch—As required. ON when icing is anticipated or 10 minutes prior to jet engine start when OAT. is —30°C or (—22°F) or colder. When jets are inoperative, pod preheat will not be effective unless the engineers' wing anti-icing switches are ON. Pod preheat should be turned off any time there is suspicion of fire so that fire may not enter the wing area.

ENGINEERS

1. Jet Start Configuration—Checked and, "Standing by for jet engine start." To insure positive fuel pressure to support reciprocating and jet engine operation, two tank valves and two booster pumps should be on in each wing.

BEFORE CLIMB (HIGH POWER OPERATION, AFTER A MANUAL LEAN SPARK ADVANCE CRUISE).

A tremendous amount of reciprocating engine damage can result if you fail to properly prepare the engine for high power operation. A good engineer should always remember the following items which must be checked, but even the best are prone to forget or overlook an item under certain conditions of stress or fatigue. By actually using the following check list, any oversight will be avoided and the transition from low to high power operational configurations will be successful.

1. Air Plugs and Intercoolers—OPEN. To prevent engine overheating during subsequent operation at higher bmep and increased fuel-air ratio.
2. Spark Advance Switches—RETARD.

Note

See Section VII, "Spark Selection" for the specific procedure for return from manual lean spark advance operation to retard spark.

STARTING JET ENGINES (AIR) (Cont'd)

7. Nose De-Ice Switch—As required. ON only to prevent ice forming on the jet air plugs.

8. Oil Heater Switch—As required. To maintain jet engine oil temperature when the ambient air temperature is below 5°C (41°F).

9. Oil Shutoff Valve Switches—OPEN. Always open during normal flight.

10. Air Plugs—OPEN (check doors visually). The aircraft commander and pilots will visually check their respective sides to see that air plugs are opening. The jet engines should start windmilling as the air plugs open. Approximately 185 mph IAS should result in a windmill speed of about 15 per cent rpm at any altitude. After air plugs have opened and the initial rpm build up has stabilized, the desired starting speed may be controlled by varying the indicated air speed.

11. Manifold Valve Switches (L & R)—OPEN.

12. Booster Pump Switches (L & R)—ON.

13. Throttle Position Indicator Selector Switch (Some Airplanes)—Select J-1 engine.

14. J-1 Engine Fuel Valve—OPEN.

15. J-1 Fuel and Oil Pressure Gages—Note reading. Notice where these pressure instruments zero so that you can tell when a pressure indication is obtained as rpm increases and the throttles are opened for a start.

16. Notify Aft Scanner—"Starting J-1." The scanners should be able to detect and report any unusual leaks or fire noted. With experience, they will let you know when combustion occurs by observing the heat waves.

17. J-1 Ignition Switch—Hold in ALT. This operation sets up the spark action which will ignite a combustible mixture as the proper fuel-air ratio is obtained when opening the throttle. Do not release the ignition switch until idle rpm for your specific altitude is stabilized.

18. J-1 Throttle—Open throttle to obtain 16 to 20 psi fuel pressure for normal altitude starts and 10 to 15 psi fuel pressure for starts at 40,000 feet or above. Ignition is primarily indicated by a sharp increase in tail pipe temperature. A successful start at any altitude is dependent on the correct fuel-air ratio; consequently, at high altitudes less fuel must be used because of the rarified air. As fuel pressure indication is received, the throttle should be retarded to obtain the desired fuel pressure mentioned above. In some instances this will necessitate retarding the throttle almost to the CLOSE position. Since low fuel pressure of this kind cannot easily be read, the tail pipe tempera-

3. Mixture Control—NORMAL (Lights On). To provide an adequate fuel flow for any condition until the desired power is set.

4. Engine Supercharger Switches—BOTH. Dual turbo and high power operation go hand in hand. Use of single turbo in conjunction with a dual turbo power setting will result in overheating, turbo overspeeding, and, if allowed to continue at high bmep, severe engine damage. Abnormally high CAT. is a prime indication of an engine stuck in single turbo in flight when setting up a dual turbo power setting. See "Supercharging," Section VII, for further information on use of single and dual turbo and shifting procedures. If a malfunction of the system forces single turbo operation on one or more engines, they may be safely operated at sufficiently reduced powers to prevent excessive CAT.

5. Desired Power—SET. Procedure for setting powers, after observing the above steps, is normal.

6. Anti-Icing Duct Temperatures—Increase as required. It is important that the anti-icing duct temperatures be increased prior to climb to higher altitudes. Doing this will prevent enclosure and blister icing during the climb, thereby eliminating the need to defrost after reaching the scheduled altitude. In some cases it may be feasible to increase the duct temperatures to the maximum limits. This will depend, of course, upon the conditions which are anticipated to be encountered at the higher altitudes.

PILOTS ENGINEERS

STARTING JET ENGINES (AIR) (Cont'd)

ture indicator and tachometer can be used as reliable references. The tail pipe temperature should be increased very gradually from 100°C as engine speed increases toward idle rpm. For altitudes of 30,000 to 40,000 feet, the tail pipe temperature should not exceed 350°C for start and idle. Throttle technique is very important and at high altitude the throttle must be advanced gradually and slowly allowing enough time for per cent rpm to increase to the corresponding throttle position. On airplanes equipped with a throttle position indicator, frequent reference to the indicator is recommended during this phase of the starting. It may at times become necessary to retard the throttle slightly if it is noted that the tail pipe temperature is rapidly increasing, if the tail pipe temperature is above the aforementioned value, or if a false start condition is evident. Use of the starter is not required for an air start.

CAUTION

Do not exceed maximum allowable tail pipe temperature when starting or during acceleration or operation.

Note

If combustion does not occur within 30 seconds after fuel pressure is available, discontinue this starting attempt and allow the excess fuel in the engine to drain. Close the throttle and place the ignition switch OFF. After allowing approximately 1 minute for draining, the starting attempt may be repeated.

19. J-1 Oil Pressure—Report indication on interphone. The oil pressure should increase with rpm. If a positive increase has not been observed by the time a start has been effected, the engine should be shut down to prevent damage from lack of lubrication.

20. J-1 Ignition Switch—Release at idle. When idle rpm for your specific altitude is stabilized, flame propagation should be complete and self-sustaining. Release the ignition switch, which is spring-loaded, to the OFF position.

21. J-1 Throttle—Adjust to maintain idle rpm. Allow the initial engines started to idle while starting subsequent engines. This aids in preventing a more asymmetrical power condition while starting the corresponding symmetrical jet engine.

PILOTS ENGINEERS

STARTING JET ENGINES (AIR) (Cont'd)

22. J-4, J-2, J-3—Repeat steps 13 through 21. As for a ground start, begin the start procedure with the engines which have accumulated the least time. However, subsequent starts will be from side to side in order to maintain the best balanced power condition. In order to even up the logged time when operating only two jets, you may operate any combination of jet engines provided one on each wing is used. One or two engines may be started at any time to offset loss of reciprocating engines if sufficient fuel remains or safety is a factor.

Simultaneous Starts.

The simultaneous air starting of two jet engines can be accomplished at altitudes of 30,000 feet and below. Jets should be started in symmetrical pairs. The normal starting procedure and check list will be used with the following:

1. The aircraft commander will simultaneously place the appropriate ignition start switches in the ALT position with his right hand.
2. He will simultaneously open both throttles normally with his left hand. Individual adjustments to control tail pipe temperatures during combustion will be made.
3. After combustion both throttles will be cautiously advanced to idle rpm and the ignition switches will be released. Both throttles will continue to be advanced together until the desired jet power setting is reached, before the remaining pair of jet engines is started.

The above procedure is useful during formation climbs and is also desirable from a standpoint of fuel economy.

CLIMB TO HIGH ALTITUDE.

Crew coordination is very important during climb to altitude, particularly coordination between the aircraft commander, the engineer, and the scanners. The scanners must keep check of reciprocating engine air plug settings, evidences of overheating, oil leaking, or any other sign of malfunction of the airplane. The engineer must be aware of all malfunctions as indicated by the engine instruments and reported by the scanners so as to effectively control the engines at peak efficiency during the climb. The aircraft commander must fly the correct air speed, maintaining the rate of climb steady for the given air speed, and retrim the airplane frequently to obtain best climb performance.

The engineer will maintain a close surveillance on the engine instruments and keep the air plugs adjusted to maximum allowable cylinder head temperatures, thereby obtaining minimum drag. The air plug is a direct control over cooling airflow and can be considered a throttle to the cooling passages. When the combination of air speed and fan results in an excess of air being pumped over that required to maintain satisfactory temperatures, considerable drag is eliminated by restricting the passage and, consequently, the weight of air being pumped.

The entire crew must be well trained, properly disciplined, and prepared to operate as a coordinated team if safety and efficiency are to be obtained at high altitudes. The B-36 has been operated consistently at extreme altitudes where the greatest strain is placed upon both the airplane and the individual. How well it will perform for you depends upon all the preparation, training, checking, and planning thus far—plus an alert ability to anticipate the requirements that will provide an ease of operation with a reasonable margin of safety. Any time operation is to be above 25,000 feet altitude, each crew member should have some specific task to perform that will aid the operation. All crew members should be notified and prepared for altitude operation before the climb begins until after the descent below critical altitude. The engineer's log should be up-to-date and the climb and initial cruise powers and air speeds should have already been entered in appropriate columns for ready reference and information to the aircraft commander and navigator when requested. Last minute preparations for pressurization, heating, and anti-icing should be considered. Any equipment needed must be accessible to your oxygen station.

The navigation team should be prepared to keep the pilot informed of correct headings to fly and to make frequent position reports.

You will normally use the jet engines for long range climb above 25,000 feet altitude. (See Appendix 1 for recommended climb power for various gross weights and altitudes.) The fuel consumed for a given climb increment for normal rated power is about equal to the fuel consumed using the recommended long range climb power, but a greater distance is covered since the time and average speed are greater.

CREW SAFETY AT ALTITUDE.

Crew safety at altitude is extremely important. The aircraft commander should be on guard at all times while flying at high altitude in seeing that his crew is doing the right thing at the right time. One of the most important aspects of altitude flying is oxygen discipline. Refer to "Oxygen System," Section IV.

HIGH ALTITUDE CRUISE.

Cruise at high altitude is normally defined in two categories: Cruise No. 2, which is cruising at high altitude with the jet engines operating, and Cruise No. 3, which is cruising at high altitude without the use of jet engines. Again the main factor is manual leaning, and the engineer must concern himself with the many problems that will confront him during these operations.

As cruise control extends the range of the airplane, so does it amplify the duties and responsibilities of the engineer. Complete proficiency in the use of the charts and curves will be attained only by understanding them and working with them. Conscientious study of the pages to follow and of Appendix 1 is essential.

Obviously, the term cruise control cannot be applied exclusively to any single operation. Actually, it consists of five interrelated operational steps as follows:

1. Preflight planning.
2. Inflight operations.
3. Inflight replanning.
4. Operations after failure of one or more engines.
5. Postflight analysis.

These steps are founded on a series of performance curves and charts. Since these charts and the use of them are basic to the other operations, they will be discussed first. However, before considering the charts and curves at length, let's have a brief explanation of "Drag Factors," and "Air Speed Versus Gross Weight and Altitudes," since doing so will make certain features of the charts and curves more readily understandable.

DRAG FACTORS.

Unnecessary drag is a very detrimental factor in planning proper cruise control. It can be caused by improper trimming of the airplane or by improper settings of air plugs or cooling doors.

To combat improper trim of the aircraft, it is recommended that a definite schedule of trimming be set up. For instance, if the engineer is on a 2-hour power schedule, the aircraft should be retrimmed every hour on the elevator axis. In all cases of power changes the aircraft should be retrimmed to conform with the new air speed, and it should also be retrimmed after all fuel transfers and changes in cg of the aircraft.

A second cause of drag to be reckoned with is the settings of the air plugs and cooling doors. From their fully open to fully closed positions the air plugs on all six engines can vary the air speed as much as 6 mph EAS and the intercoolers as much as 4 mph EAS. Open doors and hatches also cause drag. Keep them closed. When an air speed is given, it should be maintained as closely as possible to get maximum cooling of the engine with air plugs and cooling doors shut down as far as possible so as to maintain the engine temperatures within limits. The opening of these doors and plugs will reduce air speed considerably by increasing the drag.

AIR SPEED VERSUS GROSS WEIGHT AND ALTITUDE.

Air speed versus gross weight and altitude is the basis for the development of the nautical mile per pound charts which determine long-range cruising plans. In the nautical mile per pound charts a recommended EAS is obtained for a given weight and altitude. Through proper power setting and proper trimming of the airplane, the engineer and pilot maintain these recommended air speeds.

Since long-range flying is based on cruise control, it is necessary to see the effect of gross weight and altitude in air speed. Air speed is the starting point for the engineer in setting proper power, while the pilot must maintain level flight through correct trimming of the aircraft. The final goal, nautical miles per pounds, can then be attained.

Level-off for cruising altitude should be made from an altitude of 200 to 500 feet above cruising altitude. The engineer should set up cruise power commensurate with aircraft weight and altitude, less the extra 200 to 500 feet, to help establish cruising air speed and trim the aircraft cruising straight and level. Efficient cruising requires maintaining a recommended air speed which can be obtained from the "Specific Range Curves." Maintain the desired air speed by use of the elevators and vary power settings slightly to maintain altitude. Do not allow air speed to drop; if it is impossible to maintain altitude with a given air speed, check trim and then add power as necessary.

SYSTEMS OPERATION.

Operation of the various systems during flight is given in Section VII, "Systems Operation."

FLIGHT CHARACTERISTICS.

Refer to Section VI, "Flight Characteristics," for the characteristics of the aircraft during flight.

DESCENT FROM HIGH ALTITUDE.

After cruising at high altitudes, the next phase will be to descend to a medium altitude. For information concerning descents, refer to "Normal Descent" of this section.

CRUISE NO. 4 (MEDIUM ALTITUDE-LOW GROSS WEIGHT).

Cruising at a medium altitude at low gross weight on the last leg of the journey home is known as Cruise No. 4. Again the engineer concerns himself with manual leaning.

DESCENT.

NORMAL DESCENT.

Descent in every case should be governed by the air speed and propeller limitation specified in "Operating Limitations," Section V. Air speed is the more critical limit because undetected flutter could cause structural failure. Propeller vibration, however, usually means a sharp reduction in blade life rather than an immediate failure.

Descents should always be made at long-range air speed. Most long-range flights are made with the airplane on automatic pilot, and the rate of descent will be approximately 300 feet per minute. When necessary, power reduction will be made in accordance with the bmep power schedule of the appendix in order to maintain efficient and economical engine operation.

CAUTION

Do not collapse reciprocating engines except for emergency descent. This procedure is discussed in Section III.

Under no-wind conditions, approximately 2.2 nautical miles of range can be gained for every 1000 feet of altitude. For example, descent from 25,000 feet to sea level will add about 55 miles to the range. However, this is a small factor compared with the magnitude of winds at altitude. Consequently, wind conditions must be given primary consideration in making a descent. If there is a strong headwind at a high altitude and a tailwind is predicted for a lower altitude, obviously descent should be made to the lower altitude to take advantage of the tailwind. On the other hand, if the winds at all altitudes are the same but the nautical miles per gallon at the higher cruising altitude is greater than that which would be obtained at the lower altitude, the high altitude should be maintained since the airplane is already at altitude.

Another factor entering into the descent picture is crew fatigue. If there is only a slight difference in nautical miles per gallon obtainable at high and low altitude, the decision would probably be made to remain at the higher altitude so as to reduce the time required to complete the mission.

RAPID DESCENT.

When headwinds are encountered, it is best to descend rapidly through the regions of high adverse winds and cruise at altitudes where wind conditions are more favorable. Regardless of these factors, however, you should in no case descend below the altitude you will have to maintain for the remainder of the flight because of topographic conditions.

Rapid descent, like normal descent should also be governed by the air speed and propeller limits specified in Section V. In this case, however, power settings are reduced to minimum values required to prevent excessive wear and stress from reverse bearing loads. The absolute minimum setting is 1550 rpm and 15.5 inches M.P. Settings above this minimum should be computed on the basis of 1 inch M.P. for each 100 rpm increase.

CAUTION

Manifold pressures below these minimum values will be limited to 30 seconds or less. Gas pressure is needed inside the cylinder to prevent stress and wear caused by windmilling.

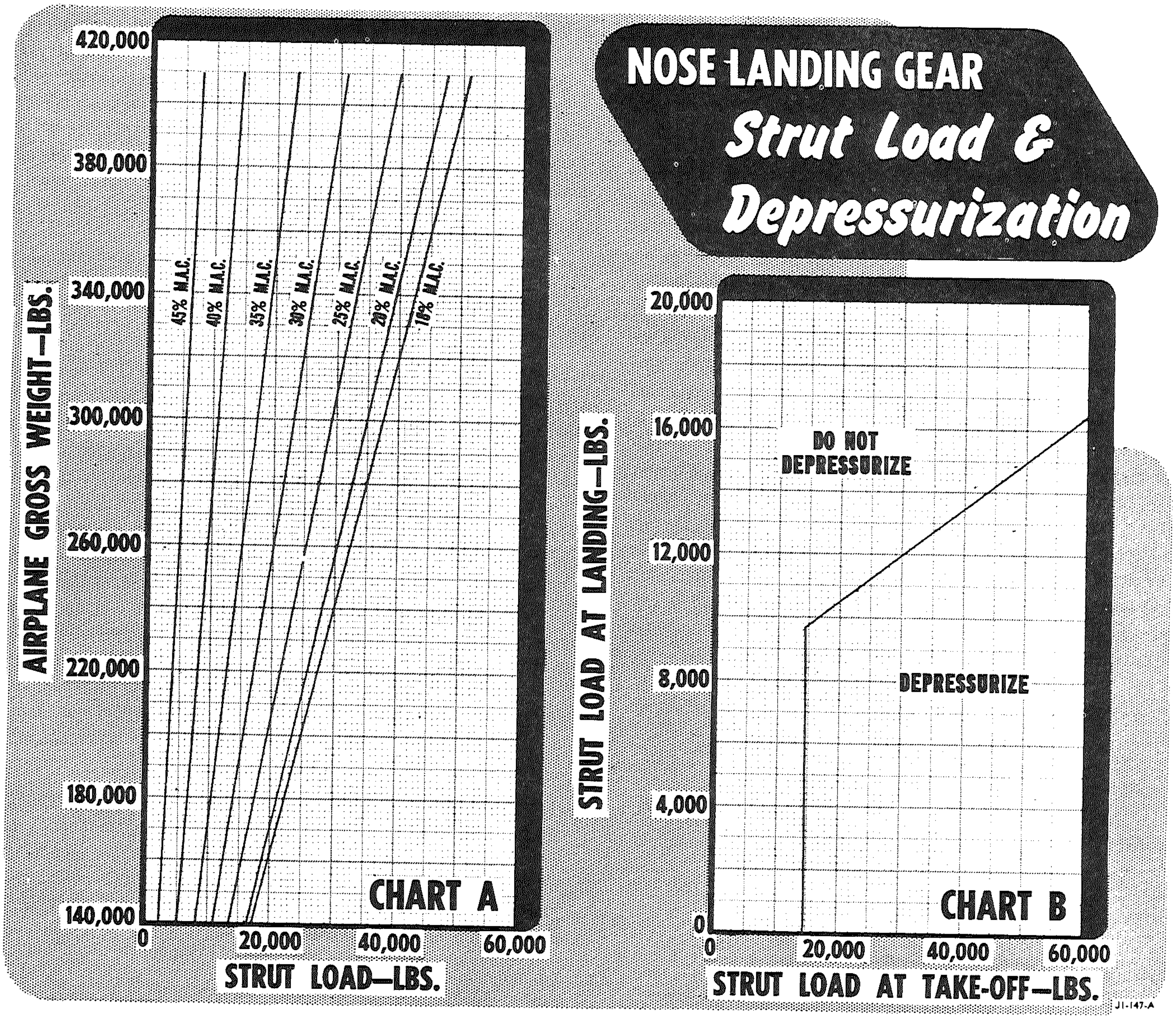


Figure 2-12.

J1-147-A

NORMAL LANDING.

This airplane is not difficult to land after you've made a few landings to adjust yourself to its landing attitude. This adjustment is necessary because your station is so far forward of the wing; and, with the nose-up condition of a normal landing, you are about 40 to 50 feet in the air. Since this airplane has such a large wing span, you must realize that somewhat less control response can be expected at the slower air speeds encountered during final approach. However, if you use good judgment and apply the knowledge gained from landing other airplanes, you can land this airplane without difficulty.

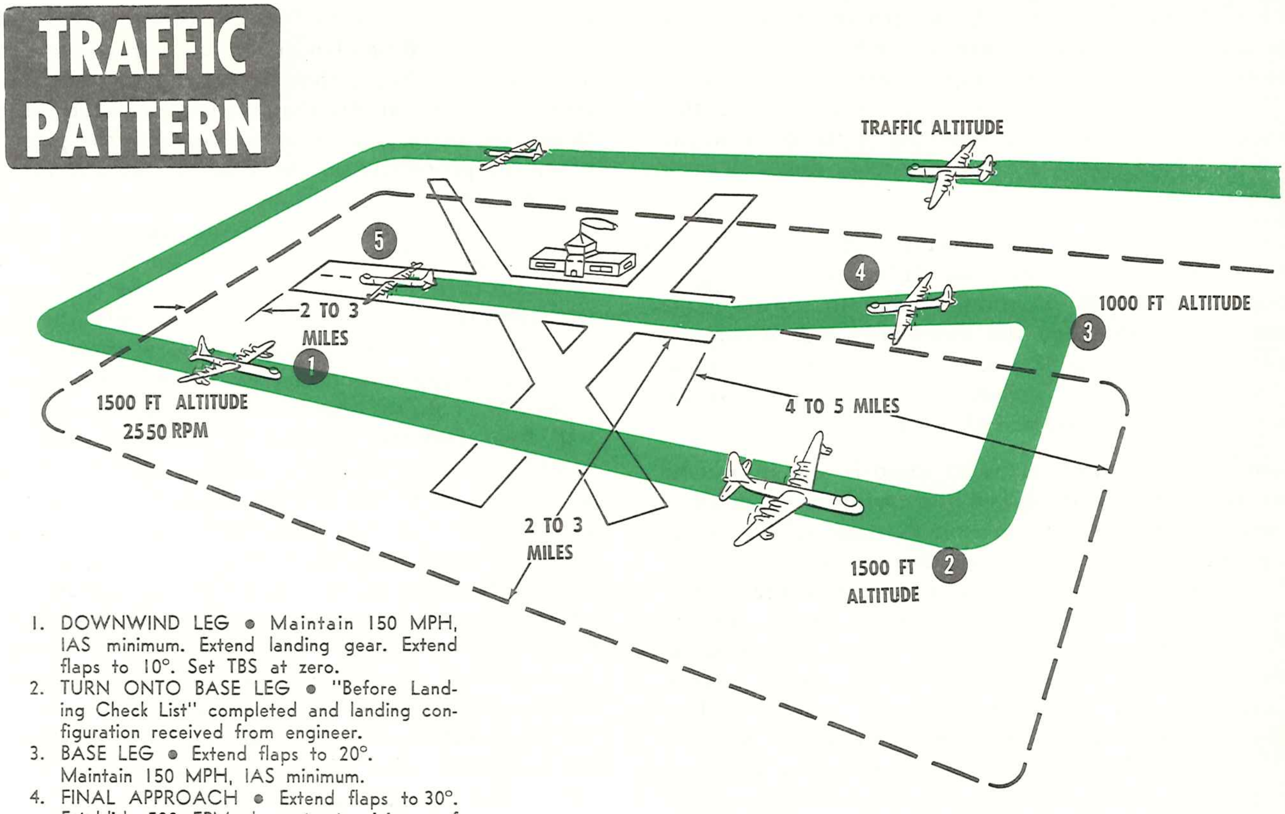
Note

Tests indicate that approximately 5 seconds less time is required to operate the elevator trim tab control wheel from one extreme position to the other when the operator's inboard arm rest is in the up position. This time saving could mean the difference between a successful maneuver and a crash during landing.

NOSE GEAR STRUT DEPRESSURIZATION.

The requirements for depressurization of the nose strut are based on the relationship of nose strut loads at take-off and landing. This relationship can be obtained from the charts in figure 2-12 to determine whether depressurization of the nose gear strut is necessary. The charts are used in the following manner:

1. Using Chart A, determine the strut load at take-off by finding the point of intersection of the lines representing take-off gross weight and cg location. From



1. DOWNWIND LEG • Maintain 150 MPH, IAS minimum. Extend landing gear. Extend flaps to 10°. Set TBS at zero.
2. TURN ONTO BASE LEG • "Before Landing Check List" completed and landing configuration received from engineer.
3. BASE LEG • Extend flaps to 20°. Maintain 150 MPH, IAS minimum.
4. FINAL APPROACH • Extend flaps to 30°. Establish 500 FPM descent at minimum of 135% stalling speed, not to exceed 145%.
5. LANDING • Use rudder above 60 MPH and nose steering below 60 MPH for directional control. Reverse propellers. Lock controls at 50 MPH.

73-103-A

Figure 2-13.

this point, follow the vertical line to the bottom of the chart and read the strut load.

2. To determine the strut load at landing, repeat step 1, using landing gross weight and cg location.

3. Using Chart B, follow the lines representing the strut loads at landing and at take-off until they intersect. The area in which the lines intersect will indicate whether or not depressurization is required.

TRAFFIC PATTERN.

Because of the high stability of the airplane, considerable longitudinal retrimming will be necessary when executing steep turns. This trimming must be accomplished during the entry and exit periods of the turns to maintain constant air speed and nominal elevator control forces.

The traffic pattern should be entered by flying upwind parallel to the landing runway at traffic altitudes. This will give you an opportunity to observe airdrome traffic and space your aircraft in the traffic pattern accordingly. The downwind leg is approximately two or three miles out from the landing runway at 1500 feet above the terrain. A 500-foot descent should be made on the base leg so that the turn on the final approach is accomplished at 1000 feet. Before turning on the base leg, the "Before Landing" check list should be complete and the landing configuration should be received from the engineer. This will permit a correct approach speed with a 500-foot per minute descent on the final leg.

A minimum air speed of 150 mph IAS should be maintained on the downwind leg during normal landings. The landing gear should not be extended until you are halfway through the downwind leg or when opposite the end of the landing runway. When the gear is extended and checked, the flaps should be lowered to 10 degrees. The minimum air speed for the downwind leg will be maintained for the base leg, and the flaps will be extended to 20 degrees. On the final approach, air speed should be maintained at a minimum of 135 per cent of stalling speed. Do not exceed 145 per cent of stalling speed. The flaps should also be lowered to 30 degrees.

When the flaps are lowered, the airplane tends to nose up and gain altitude. Therefore, when the flaps are lowered, anticipate this change in attitude and roll in enough nose-down elevator trim to counteract this tendency. Each successive lowering of the flaps on the base and final legs will require further down-elevator trim.

When the aircraft is at an average landing weight of about 200,000 to 230,000 pounds, a power setting of about 30 inches M. P. should maintain sufficient air speed and altitude on the downwind leg. When the gear is lowered and flaps set at 10 degrees, an increase in power to about 37 inches M.P. is necessary to maintain correct air speed and altitude.

Control effectiveness versus air speed is very important during the final approach while trying to maintain a constant IAS. Excessive aileron movement, cross trim, improper throttle settings, or overcontrolling tend to increase stall characteristics and decrease control effectiveness, with a resultant loss of air speed. On the final approach, keep the wings as level as possible. For directional control, minimize the use of aileron control. During cross-wind landings, employ rudder control rather than aileron control to correct for dift. Aileron control sluggishness is evident at low approach speeds and can cause wing wallow if inadvertent aileron overcontrol is used. Because of this condition and the low clearance of pods and outboard propellers from the runway (5-foot clearance between outboard propeller tips and the ground and 5-foot, 8-inch clearance between the pods and the ground), *it is imperative to maintain wings level during flare-out and landing.*

The aircraft should be landed in a slightly nose-high attitude at as high a touchdown speed as practical. In no case should full stall landings be attempted. Flare-out should be started from an altitude of 60 to 70 feet. Keep air speed well above stalling speed during the round out. When landing with an aft cg location, it must be remembered that during the flare-out the tail will drop more rapidly than with forward cg location. When the main gear is on the runway, the pilot will ready the propellers on the order of the aircraft commander. The nose should be eased down on the runway and directional control maintained with the rudder. Rudder control is effective down to speeds of 60 mph. Propellers will be reversed on the command of the aircraft commander who will apply the necessary power with the throttles to slow down the airplane. This application of power should not exceed 30 inches M.P. unless there is an emergency. The pilot will hold forward pressure to keep the nose wheel firmly on the runway. After the air speed has dropped to 50 mph IAS, the aircraft commander should lock the controls with his right hand and use nose wheel steering with his left hand. If nose steering is inoperative, differential power with the propellers in reverse pitch can be used to maintain directional control. Caution should be taken not to use the nose steering to make any large corrections until the airplane has slowed considerably. Severe oscillations or buffeting of the nose section will occur if you use overcontrol of the nose wheel steering on fast ground rolls.

WARNING

Flight crew will not be stationed in the lower nose section during landing because of the likelihood of personnel being trapped in event of a crash landing.

The aircraft commander will stand by on the interphone and the pilot will be on command radio with the mixer selector switch at INTER.

BEFORE LANDING.

PILOTS

1. Notify Crew, "Prepare to land." The safety belts and shoulder harnesses fastened and inertia reel lock controls UNLOCKED. The landing check should be started 8 to 10 minutes before landing.

2. Bomb Bay Area—Checked. A designated crew member will inspect the bomb bay area for fuel and hydraulic leaks.

ENGINEERS

1. Inflight Engine Checks—Completed, if desired. The following checks may be made prior to landing as conditions and time permit. In no way should these checks be allowed to interfere with normal landing procedures. Engine checks which are not accomplished at this time must be accomplished during the post-flight engine checks on the ground. If the following

PILOTS — ENGINEERS

BEFORE LANDING (Cont'd)

3. Autopilot—Off.

4. Jet Air Plug Switches—OPEN. Although the 5 to 7 per cent windmilling rpm experienced in flight with the jet air plugs closed will scavenge most of the jet oil, a certain amount will tend to collect in the engine. To scavenge all of the oil, it is necessary to open the air plugs to increase windmilling rpm when entering the landing pattern.

5. Jet Engines—As required. If landing at heavy gross weights, start the required number of jet engines at this time.

6. Engineer's Landing Configuration—Engineer reads, "Before landing check list complete, standing by for rpm, landing gear, and brake check. Gross weight ...."

7. Stalling Speeds and Take-Off and Landing Data—Checked and reviewed. A check of the placard on your

checks are completed during flight they need not be re-checked on the ground.

Note

The following analyzer checks can be accomplished in accordance with local procedure. Standard analyzer check procedure will be included when available.

a. Slow sweep 14 patterns for each magneto.

b. Magneto synchronization check.

c. Magneto dwell check.

2. Engine Supercharger Switches—BOTH.
3. Fuel Panel Checked—Booster pumps ON.
4. Oil Vent Heater Switch—As required.
5. Carburetor Preheat Switches—As required.
6. Cabin Pressure Shutoff Valve Switches—OFF.
7. Booster Fan Switch—As required.
8. Pitot Heater Switches—As required.
9. Wing, and Cabin Heat and Tail Anti-Icing Switches—OFF.
10. Engine Fan Speeds Switches—LOW RPM.
11. Electrical System—Checked.
12. Air Plugs and Intercoolers—As required.
13. Cabin Heater Power Switch—OFF.
14. Temperatures—Checked and within limits.
15. Mixture Control Selector Switches—LEVER.
16. Mixture Control Levers—NORMAL.
17. Turbo Boost Selector Lever—ZERO, calibration knobs indexed.
18. Spark Advance Switches—RETARD (guards down).
19. Propeller Selector Switches—AUTOMATIC OPERATION, Tel-Lamps Lighted.
20. Propeller Normal Pitch Indicator Lamps—Lighted.
21. Turbo Control Change-Over Switches (Group 1 Airplanes)—AUTO.
22. Turbo Control Vernier Switch (Group 2 Airplanes)—OFF.
23. Engineer's Landing Configuration—Engineer reads, "Before landing check list complete, standing by for rpm, landing gear, and brake check. Gross weight ...."
24. Master Tachometer—2550 rpm. At high gross weights, high field elevations, or in emergencies, 2700 rpm and 7 TBS setting may be used.
25. Report, "Hydraulic Pressure Relieved."

PILOTS

ENGINEERS

BEFORE LANDING (Cont'd)

instrument panel will give you the stalling speeds at various flap settings for the landing gross weight. Also, review the take-off and landing data with the pilot.

8. Master Tachometer—2550 rpm.

9. Landing Gear Control Switch—EXTEND. The gang bar arrangement will turn the brake pump switch ON. The pilot will report on the interphone, "Gear coming down," and will place the landing gear and brake pump switches in EXTEND and ON, respectively. The aft scanners will watch gear operation through the complete cycle and will report on interphone as follows: "Left door coming open, right door coming open. Left gear down and locked, right gear down and locked. Left door fully closed, right door fully closed." The pilot will observe the landing gear indicator lamps and note whether the warning horn is sounding; also he will receive the engineer's report that main hydraulic system pressure is relieved. The radio operator will check the nose gear through the inspection window and will report, "Nose gear down and locked." Complete extension of the gear normally takes approximately 45 seconds. After receiving the pilot's report that the gear is down and locked, the aircraft commander will check to see that the red landing gear indicator lamp is out and the green lamp is lighted. As an additional check to determine whether the landing gear is fully extended, he will retard at least one reciprocating engine throttle and check that landing gear warning horn does not sound.

The indicated air speed must not exceed 188 mph during landing gear extension. A visual check of the landing gear by the aft scanners and radio operator is very important. The green indicator lamp is operated by the main and nose gear limit switches and is not a positive check. The aft scanners check of the flags on the main gear side braces and the radio operator's check of the nose gear, together with the hydraulic pressure relief noted by the engineer, is a positive check. After receiving the radio operator's and scanners reports that the landing gear is down and locked, check that the nose wheel steering indictor is at zero.

10. Parking Brake Control—OFF. The parking brakes can be set accidently by personnel moving about on the flight deck.

11. Left and Right Brakes—Checked. After the gear is down and locked, check the brakes. The pilot will depress the foot pedals one at a time, and the engineer will report a drop in brake pressure as each pedal is operated. After both pedals are operated and the pressure has returned to normal, the engineer will report the fact on interphone.

26. Observe brake check and report, "Pressure normal."

PILOTS

ENGINEERS

BEFORE LANDING (Cont'd)

12. Nose Gear Strut—Bled, if required. See figure 2-12 to determine whether depressurization is necessary.

13. Nose Steering Switch—ON. No steering pressure will be indicated until the nose strut is compressed below 10 inches after landing.

14. Pilot rechecks gear down and locked, autopilot off, nose wheel steering switch ON, and reports to aircraft commander, "Gear down and locked, landing configuration complete."

15. Flaps—10 degrees.

BASE LEG.

1. Flaps—20 degrees.
2. Jet Air Plug Switches—CLOSE.
3. Landing Lights (if required)—Extended and checked.

FINAL APPROACH.

1. Flaps—30 degrees.

Maintain a minimum of 135 per cent of stalling speed or a minimum of 120 mph IAS, whichever is higher. Do not exceed 145 per cent of stalling speed. Lift with 30-degree flap setting is sufficient to allow a very steep landing approach with power off; however, normal approach is made with power on to prevent overcooling of the engines.

The aircraft commander will be advised by the pilot whenever the air speed falls below final approach speed or whenever a visual and altimeter cross-check indicates the aircraft to be dangerously low to the ground or other obstructions. The pilot will continuously monitor the air-speed, altimeter, and rate-of-climb indicators and will maintain a visual check of the ground or obstructions when possible. This will insure the immediate recognition of a dangerous condition for relay to the aircraft commander.

Note

The pilot will call out each 5 mph change in IAS and each 100-foot change in altitude, except during GCA and instrument letdowns.

WARNING

Extreme caution must be observed when in close proximity to the ground as only a small angle of bank can be executed before propellers or pods contact the runway.

LANDING.

PILOTS

1. Propeller Reverse Selector Switches—READY, on main gear contact. The pilot will place these switches in READY at the order of the aircraft commander.

CAUTION

Do not ready the propellers until ground contact has been made.

2. Propeller Reverse Pitch Switch—Depressed on aircraft commander's command. The pilot will actuate this switch at the order of the aircraft commander after the nose wheel has contacted the runway. When the pilot actuates the switch, the aircraft commander will increase the throttles to the desired power. With the propellers in reverse during normal landings, 30 inches M.P. is maximum; however, in emergencies full power application is acceptable. The pilot will stand by on the controls and will hold them in neutral while reversing with the exception of holding forward pressure on the elevators. The effect of reverse thrust from the propellers is greater at high speeds; thus, it is desirable to use reverse thrust as soon as possible after landing.

3. Control Surfaces—Locked at approximately 50 mph. On normal landing the flight controls should not be locked until forward speed reaches approximately 50 mph. This will permit the use of the rudder for directional control for as long as it is effective. Since gusty winds can cause serious rudder damage when the airplane's speed is less than 50 mph, the controls must be locked at approximately 50 mph on all landings. If more than 30 inches M.P. is needed after reverse pitch, controls must be locked at all speeds.

4. Propeller Reverse Selector Switches—SAFE. The aircraft commander will return the desired pairs of propellers to the normal position after the landing. The engines should be reduced to idle before returning the reverse selector switches to SAFE.

CAUTION

If the outboard propellers are not needed for emergency stopping, they must be placed in normal pitch before reaching 40 mph to prevent aileron flutter and possible damage.

5. Flaps—Retracted.

ENGINEERS

1. Brake and Nose Steering Pressure—Normal after nose wheel contacts ground.

2. Rpm and Manifold Pressure—Checked. After propellers are reversed, the engineer will normally stabilize power. Do not exceed 30 inches M.P. except in an emergency. This in no way means that the engineer will restrict additional power application required by the aircraft commander to maintain directional control.

PILOTS ENGINEERS

LANDING (Cont'd)

6. Jet Oil Shutoff Valve Switches—CLOSE, at zero per cent rpm. These valves should be closed at zero per cent rpm to trap all of the oil in the tanks. If this is not done and the oil tanks are filled before the next flight, the excess oil trapped in the engine will be forced out the vent lines on the next jet start. When closing the valves, be sure the associated circuit breakers are pushed in.

Note

One of the symmetrical pairs of reciprocating engines will be stopped on command of the aircraft commander after landing has been completed, after the airplane has been turned off the active runway, and after the engines have been checked for proper operation.

HEAVY GROSS WEIGHT LANDINGS.

With the forward cg location of the B-36 at high gross weights, very large up-elevator deflections are required when flying at low air speeds in the landing condition near the ground. This is caused by the great amount of static stability possessed by the aircraft when in a forward cg condition combined with the nullifying effect of the ground on the down wash air load over the tail. This requires additional up-elevator deflection to produce the total tail-down load needed to balance the pitching moments of the aircraft.

The following piloting techniques are recommended for landings with gross weights of approximately 283,000 pounds or more:

1. Start two jet engines on the downwind leg and have them operating at 90 per cent rpm.

2. Conduct the final approach portion of the landing as flat as practicable with power on, maintaining a minimum of 135 per cent stalling speed. Do not exceed 145 per cent stalling speed. Adjust reciprocating engine power to maintain these speeds.

3. Allow the power to remain on until the aircraft actually touches the runway. As soon as the main gear wheels are on the runway, cut power and apply additional up-elevator control force to counter the rapidly increasing nose-down moment of the aircraft which occurs when power is cut. This will minimize the impact of the nose wheel when the aircraft pitches forward.

4. When the nose wheel contacts the runway, reverse the propellers immediately. In the event of a minimum run landing, keep power on and reverse the propeller as soon as the main gear wheels touch the runway. No difficulty will be experienced in getting the nose wheel down. In fact, the nose will still go down rapidly unless additional up-elevator is employed.

MINIMUM-RUN LANDINGS.

Use the same procedure as that used in normal landing with the following exceptions: Reverse the propellers after the main landing gear touches the ground and before the nose wheel touches the ground. When reversing the propellers with the nose still in the air, the nose must not be at too high a deck angle and must be held steady since there is a slight tendency to nose up. When a maximum of 30 inches M.P. is used, reduce master motor speed to 2000 rpm. This will give a more effective reverse thrust.

CAUTION

Since the airplane has a very responsive brake system and is equipped with four-wheel main gears, extra care must be used to avoid skidding the rear wheels. Scanners should be alert for such observations and should notify the aircraft commander.

CROSS-WIND LANDINGS.

Cross-wind landings will be avoided if at all possible. If, at any point during final approach, lateral corrections of an appreciable magnitude are required, an immediate go-around will be executed in order to avoid having a wing drop while near the ground. Avoid dropping one wing to correct for a cross wind. The recommended procedure for making a cross-wind approach and landing is to head into the wind (crab) just enough to keep a straight ground patch and hold the wing level. Take out the crab with the rudder after flare-out and before touchdown, being careful not to inadvertently drop a wing. Put nose gear down as soon as possible after touchdown and apply forward pressure on the control column.

GO-AROUND.

The decision for go-around should be made before descending to 500 feet, if possible. The sooner the decision to go-around is made, the better the chances are for success. When weighing the possibilities for go-around in terms of altitude, air speed, gross weight, aircraft configuration, wind conditions, runway facilities, and visibility, the aircraft commander should always consider the advantages of a controlled crash landing over an unsuccessful go-around. This is especially true if aircraft performance is critical or altitude (500 feet or less) is marginal.

In the event a go-around becomes necessary, proceed as follows:

PILOTS

1. The aircraft commander will announce over interphone, "Go-around, flaps 20 degrees."

2. The pilot will raise the flaps from full down position to 20 degrees on aircraft commander's command.

CAUTION

Drag with full flaps is excessive. Raise the flaps to 20 degrees as quickly as possible when the decision to go around has been made. Do *not* raise flaps past 20 degrees until a safe IAS has been obtained. Flaps should not be completely retracted before reaching 140 mph IAS or 125 per cent of stalling speed (whichever is greater).

WARNING

A safe IAS must be maintained in a go-around; therefore, continue on the same approach angle until safe flying speed has been reached.

3. The aircraft commander will adjust power as required, coordinating reciprocating engine and jet engine power with the pilot.

ENGINEERS

1. Smoothly increase M.P. to 51.5 inches. If additional power is required, increase master motor cautiously to 2700 rpm and manifold pressure as required.

PILOTS | ENGINEERS

GO-AROUND (Cont'd)

4. Landing Gear Switch—RETRACT. The aircraft commander will give the order, "Gear up."

Note

A landing gear check will be made in accordance with the procedure in "Take-Off" of this section.

WARNING

The landing gear will not be retracted until it is certain that the touchdown will not be made. Remember that the aircraft will continue to settle for a short period after full power has been applied.

CAUTION

To avoid overspeeding propellers when increasing power in a go-around, advance the throttles to full open before advancing the turbo boost selector to 7 position.

TAXIING AFTER LANDING.

For taxiing instructions after landing, refer to "Taxiing" of this section. When taxiing after landing and after postflight engine checks, one symmetrical pair of engines may be shut down.

POSTFLIGHT ENGINE RUN-UP.

The postflight engine run-up will be performed by the pilots and engineer as follows:

PILOTS | ENGINEERS

CAUTION

Make sure wheels are chocked if engine run-up is performed in a congested area.

1. Parking Brake Control—ON.
2. Propeller Reverse Selector Switches—SAFE (lights out).
3. Nose Wheel Steering Switch—OFF.
4. Notify engineer, "Start postflight engine run-up."

Note

Those checks which were completed during the inflight engine checks need not be rechecked during the postflight engine run-up.

1. All Propeller Pitch Indicator Lamps—Lighted.
2. Master Tachometer—2700 rpm.
3. Parking Brakes—Set, pressure normal.
4. Nose Steering Pressure—ZERO.
5. Announce over interphone, "Ready for postflight."

PILOTS ENGINEERS

POSTFLIGHT ENGINE RUN-UP (Cont'd)

6. Engine Run-Up—Completed.
   a. Idle Speed and Mixture—Check.

Note

Refer to "Stopping Reciprocating Engines, Preflight Operational Equipment Check."

   b. Set throttles 1 and 6 to field barometric pressure.
   c. Note and record rpm, M.P., torque, and fuel flow.
   d. Perform single ignition check.
   e. Throttle Lever—Closed.
7. Repeat step 6 for remaining symmetrical engines.
8. Check that cylinder head temperatures are 180°C or below. Shut down engines 1 and 6 in accordance with "Stopping Reciprocating Engines" of this section.
9. Report to aircraft commander, "Postflight run complete, ready to taxi."
10. Repeat steps 1 through 4 and step 8 before shutting down remaining engines.

CAUTION

If an engine has been shut down in flight then unfeathered for emergency use, that engine should be carefully watched during engine shutdown on the ground. This is necessary because loss of ram air and an accumulation of oil or fuel around the engine and exhaust system creates a fire hazard. A check of that engine should be made before leaving the aircraft.

STOPPING RECIPROCATING ENGINES.

PILOTS ENGINEERS

The engineer will stop engines in accordance with the instructions given in "Preflight Operational Equipment Check, Stopping Reciprocating Engines." The aircraft commander will accomplish the following during engine shutdown.

1. Parking Brake Control—ON.
2. Propeller Reverse Selector Switches—SAFE (lights out).

PILOTS ENGINEERS

STOPPING RECIPROCATING ENGINES (Cont'd)

3. Nose Wheel Steering Switch—OFF.
4. Flight Instrument Switches—OFF.
5. Contact engineer, "Ready to stop engines."

CAUTION

Aircraft commander, engineer, and aft scanners will remain on interphone. The pilot will have radio tuned to tower frequency until the last propeller has stopped turning.

6. Radio Equipment—OFF.

BEFORE LEAVING AIRCRAFT.

PILOTS ENGINEERS

Check and accomplish the following before leaving the aircraft:

1. All Control Switches—Properly positioned. Check that the navigation, fuselage, cabin, compass, fluorescent, and all other miscellaneous lights are off. Pull the following circuit breakers on the pilot's circuit breaker panel; slaved gyro magnetic compass or N-1 compass, bomb salvo, bomb bay doors, aircraft commander's and pilot's turn and bank indicators. Check that all oxygen regulators are off.
2. Wheel Chocks—In place.
3. Parking Brake Control—OFF after wheels are chocked.
4. Postflight Visual Inspection—Completed.

a. The aircraft commander will state time for postflight crew inspection and will give crew permission to exit the aircraft.

b. Ground locks installed.

c. Unload the aircraft.

d. A rapid visual inspection of the exterior should be made by the aircraft commander.

1. Fuel Dip Stick Readings—As required (or the best available method of determining fuel remaining).
2. Forms and Reports—Completed. Coordinate with maintenance and operations.

PILOTS ENGINEERS

BEFORE LEAVING AIRCRAFT (Cont'd)

e. Crew will fall in at the left side of the nose in two ranks.

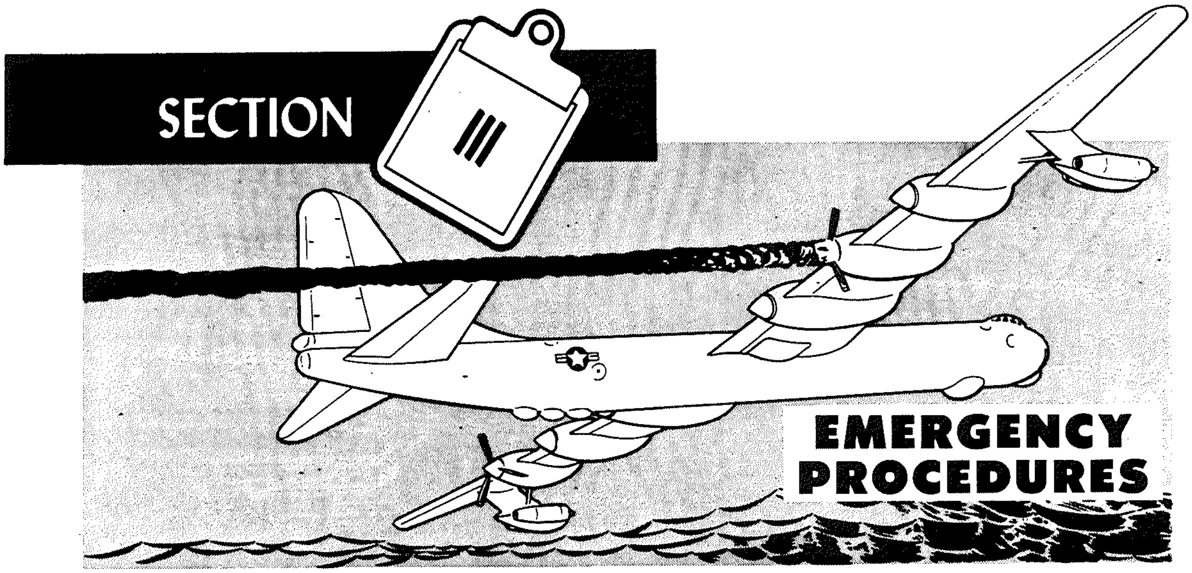
f. Roll call and aircraft discrepancies for entry in Form 781 (Form 1).

g. Collect all reports, logs, etc.

h. Dismiss crew.

Note

The postflight visual inspection will normally be conducted after each flight; however, weather, crew fatigue, and other intangible factors may sometimes necessitate a modification.



72-126-A

Survival in an emergency requires the fully coordinated effort of each crew member. A well trained crew will know what to do and, if properly disciplined, will react with efficiency. Since procedure drills are the nearest approach to reality, they should be conducted at every opportunity so that the crew will be familiar with each procedure and will learn to accomplish it in a minimum of time. If time and circumstances permit, planning for an impending bail-out or forced landing will increase the chances for survival. The chances of survival depend critically on communication equipment; water, food and medical supplies; and crew discipline.

Note

In case of any emergency, the aircraft commander will be notified over interphone on the CALL channel.

Emergency signals are given on the alarm bells and are as follows:

1. Prepare to bail out—Three short rings.
2. Bail-out—One long ring.
3. Prepare to ditch or crash land—Six short rings.
4. Ditching or crash landing—One long ring.

Note

If possible the crew should be warned and acknowledgement received by interphone.

ENGINE FAILURE.

In the event it becomes necessary to shut down two or more engines, the mission will be aborted and the aircraft will be landed at the nearest SAC base, returned to the home base, or landed at the nearest suitable air base, whichever is considered most practicable from a safety of flight standpoint in the opinion of the aircraft commander. At the discretion of the aircraft commander, if the aircraft is in the immediate vicinity of the target on a unit simulated combat mission, the bomb run may be completed prior to aborting the mission.

WARNING

If an engine fire is experienced, the mission will be aborted immediately.

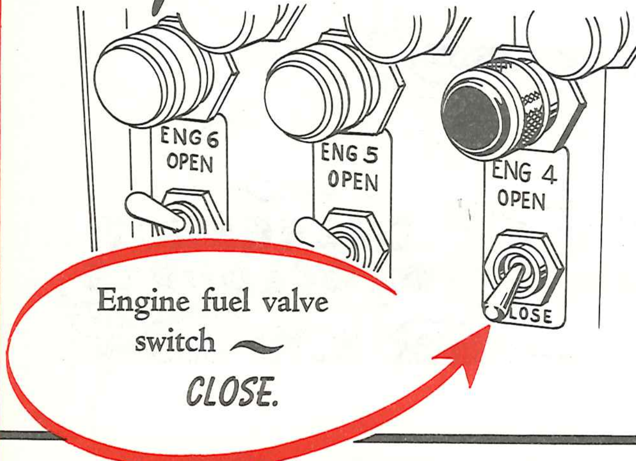
FLIGHT CHARACTERISTICS WITH PARTIAL POWER.

The airplane is not difficult to maneuver under conditions where some engines are inoperative. The ease of maneuverability results from the free-floating characteristic of the servo-operated control surfaces and the positive means of trimming the airplane. Remember too, that in case of critical power failure, the jet engines are there to supplement the remaining power.

It is important to be familiar with the appendix which gives rate of climb versus air speed for various flap and gear positions with engines inoperative. Do not be apprehensive about turns into dead engines. However, it should be remembered that with asymmetrical power, the drag of the inoperative engine and the thrust of the opposite engine combine to form a powerful turning effect. Any resulting turn increases the lift of the faster moving wing, causing a roll into the dead engine. Normal aileron correction tends to bring up the low wing but at the same time adds adverse yaw into the inoperative engine. With speed reduction the drag of the inoperative engine decreases, but the thrust of the opposite engine (at constant power setting) increases. As speed is decreased, both ailerons and rudder become less effective. Above the safety speeds listed in figure 3-2, full control of the airplane can be maintained with high asymmetrical power. When cruising on four or five engines, all engines should be kept operating at the same power setting. At low speeds, however, it is necessary to adjust to more symmetrical power conditions in order to maintain directional control. When it is necessary to apply power when in an asymmetrical power configuration, power must be applied on symmetrical engines first.

• *Reciprocating Engine* SHUTDOWN IN FLIGHT

Step 1



WARNING

Do not, without forethought, close other fuel valves or shut off fuel booster pumps, since other engines may be dependent on their position or operation.

CAUTION

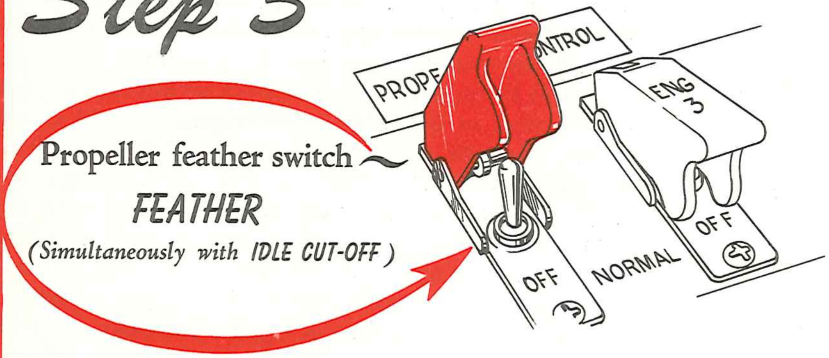
Do not close oil shutoff valves unless engine is being feathered because of fire.

Step 2

WARNING

On some airplanes the IDLE CUT-OFF position is away from the engineer. On other airplanes IDLE CUT-OFF is toward the engineer.

Step 3



CAUTION

Do not allow a propeller to windmill in reverse, because the engine may be damaged because of inadequate lubrication. If an engine is subjected to reverse windmilling for an appreciable length of time, it should be thoroughly checked after the flight.

NOTE

Because of an aerodynamic characteristic slight windmilling in reverse will occur on completion of the feathering cycle of propeller No. 1, 2, or 3. To remedy this condition, place the propeller selector switch of the affected propeller in FIXED PITCH, return the feather switch to NORMAL, and then jiggle the selector switch in the INC. RPM position until the windmilling has ceased. Leave the selector switch in FIXED PITCH position. If the propeller is inadvertently moved through the feather position and begins to windmill in the normal direction, actuate the feather switch and repeat the above procedure. When a propeller is feathered, the lower aft scanners will report to the engineer, "Propeller feathered and stopped." Report any rotation of the propeller after it is feathered.

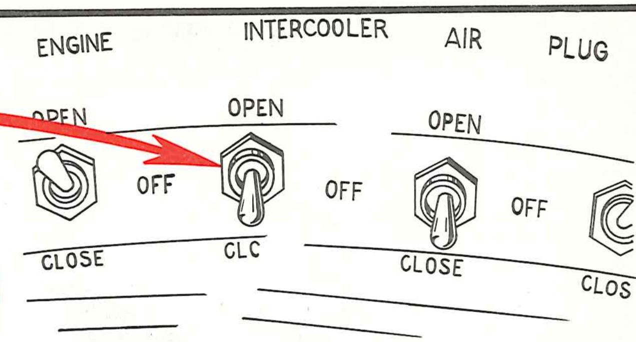
E1-853-B2

Figure 3-1. (Sheet 1 of 2)

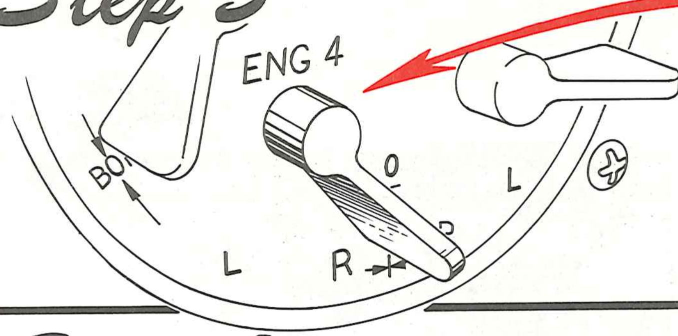
Step 4

Intercooler and airplug control switches ~

Hold in CLOSE *position until intercoolers and air plug are fully closed.*



Step 5



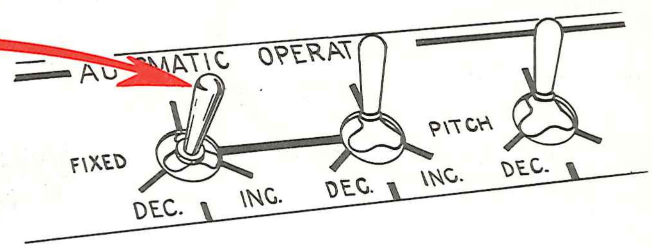
Ignition switch ~ OFF after emergency is over.

Note

The following steps may be accomplished at anytime after the emergency.

Step 6

Propeller selector switch ~ FIXED PITCH.



Step 7

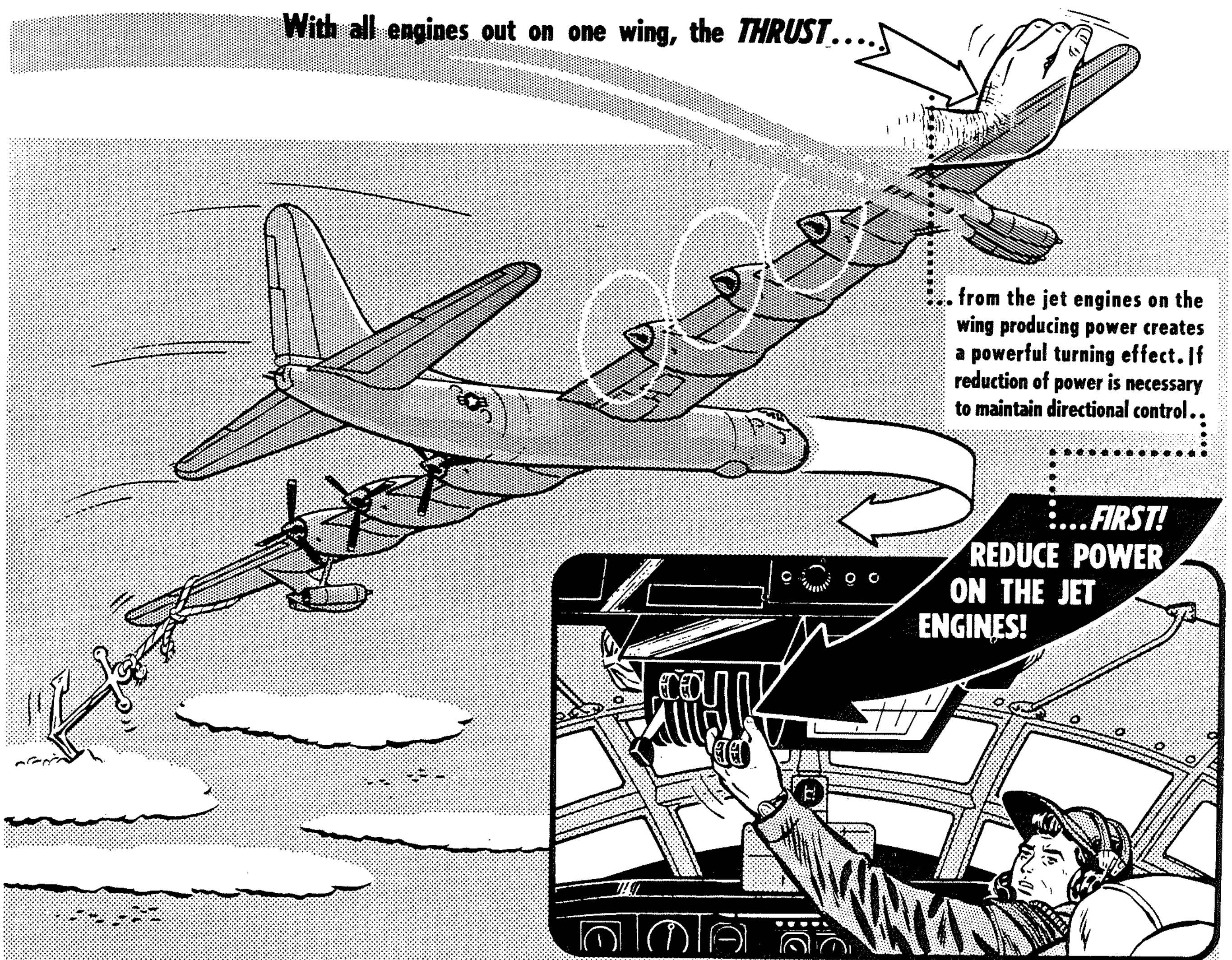
Frequency control knob ~ full DECREASE.

Note

Turn the voltage and frequency selector switch to the number of the feathered engine if it is alternator-equipped and check for zero readings on the frequency meter and the voltmeter.

73-125-A

Figure 3-1. (Sheet 2 of 2)



73-182-A

OIL DILUTION AFTER ENGINE SHUTDOWN.

After engine shutdown, if the engine is operable, the following procedures will be used:

1. Oil shutoff valve—Check OPEN.
2. Immediately after feathering, windmill the engine 50 to 100 rpm and allow the engine to cool to an oil temperature of 30° to 40°C.
3. Windmill engine to 800 rpm.
4. Engine fuel valve—Check OPEN.
5. Use normal oil dilution procedure. Refer to the oil dilution table, "Oil Dilution," Section IX.

FUEL PRESSURE DROP—ENGINE OPERATING NORMALLY.

If an engine's fuel pressure drops below the operating limits but the engine continues to operate normally, proceed as follows:

1. During ground operation:

   a. Stop the airplane.

   b. Shut down the engine immediately.

   c. Investigate the cause and correct the trouble before flight.

2. During flight—Attempt to determine the source of trouble, such as primer leakage, oil dilution solenoid valve leakage, engine driven fuel pump by-pass, valve leakage clogged pressure line, instrument failure, or fuel line leakage. After determining the source of trouble, proceed with one of the following courses of action:

   a. Shut down the affected engine immediately if it is not needed to sustain flight.

   b. If the fuel pressure drop was not caused by a fuel leak, continue normal operation of the engine.

   c. If the exact source of trouble cannot be established and the engine is required to sustain flight, keep the affected engine in operation at or above cruising speed. Maintain a close watch for indications of fire. Prior to reducing power for entrance into the landing pattern, shut down the affected engine.

MINIMUM IAS (MPH) FOR ZERO YAW

FULL RUDDER DEFLECTION

RED FIGURES ARE INDICATED AIR SPEEDS (MPH).
(ALL ENGINES AT TAKE-OFF POWER)

CONFIGURATION	77°F (OAT.)		104°F (OAT.)		NACA DAY							
	SEA LEVEL		SEA LEVEL		SEA LEVEL		3000'		6000'		9000'	
	300,000 LBS	370,000 LBS	300,000 LBS	370,000 LBS	300,000 LBS	370,000 LBS	300,000 LBS	370,000 LBS	300,000 LBS	400,000 LBS	300,000 LBS	400,000 LBS
6 RECIP ENG +3 JETS	105	99*	104	99*	106	100*	102	97*	98	93*	88*	88*
+2 JETS	146	148	143	146	146	149	141	144	135	139	130	131
5 RECIP ENG +4 JETS	118	118	106	110*	119	119	118	118	115	109*	104	108*
+3 JETS	147	150	145	148	149	151	147	150	144	146	143	146
+2 JETS	174	175	172	173	175	176	172	173	168	169	163	165
4 RECIP ENG +4 JETS	140	143	139	142	142	145	141	144	140	143	137	141
+3 JETS	163	164	161	163	166	168	165	166	162	164	161	163
+2 JETS	185	186	183	184	190	191	187	188	182	183	181	182
3 RECIP ENG +4 JETS	150	152	148	151	152	155	152	154	146	149	145	148

Speeds quoted are for the most asymmetric configuration, i.e., inoperative engines are those most outboard on one side.
*AIRPLANE IN GROUND ATTITUDE WHEN CG IS APPROXIMATELY 25% MAC AT 370,000 LBS OR 29% MAC AT 300,000 LBS
TAKE-OFF CONFIGURATION

72-113-A

Figure 3-2.

WARNING

Unless the added power is essential to effect a safe landing, do not reduce airspeed until the affected engine is shut down. Engine shutdown is necessary since a fuel leak may exist. Such a leak may not be evident during cruise due to the cooling and dispersing effect of the airflow over the engine. However, when power is reduced, the reduced cooling and dispersing effect may cause the fuel leak to ignite.

PROPELLER UNFEATHERNG DURING FLIGHT.

CAUTION

If a propeller has been feathered for 5 minutes or more in low temperatures requiring oil dilution as given in Section IX, "Oil Dilution," and the oil was not diluted at engine shutdown, do NOT unfeather. Also, due to the existence of a potential fire hazard, no attempt will be made to restart a reciprocating engine that has been feathered due to a malfunction, unless the aircraft commander deems it necessary to use that engine because of power loss of other engines.

1. Mixture control lever—IDLE CUT-OFF.
2. Throttle lever—Approximately 1/4 open.

Note

Above 30,000 feet a more open throttle will be required to initiate an engine start.

3. Engine oil shutoff valve switch—OPEN.
4. Engine fuel valve switch—OPEN.
5. Fuel pressure—10 to 14 psi.
6. Propeller selector switch—FIXED PITCH.
7. Propeller feather switch—NORMAL (guard down).
8. Propeller selector switch—INC. RPM until engine rpm is 10 to 50.

CAUTION

If rpm does not increase when the propeller selector switch is engaged, hydraulic lock is indicated; therefore, discontinue starting procedure and refeather.

9. Propeller selector switch—Hold in INC. RPM until engine turns over 600 to 800 rpm; then return to FIXED PITCH.

CAUTION

Check for an indication of oil pressure and alternator excitation. If there is no oil pressure indication within 30 seconds, refeather the engine.

10. Ignition switch—ON.
11. Mixture control—NORMAL.

Note

The torquemeter will indicate a successful engine start. When the mixture is brought to NORMAL, if the torque oil has congealed in the line to the autosyn transmitter, a power surge and a normal rise in CHT indicates a successful start. To accomplish a successful engine start at altitude, it may be necessary to increase rpm.

12. Propeller selector switch—INC. RPM, until 1400 rpm; then return to FIXED PITCH.
13. Throttle lever—Advance until M.P. is approximately 25 inches.
14. Propeller selector switch—As required to maintain 1400 rpm during throttle advance.

CAUTION

Warm up the engine at 1400 rpm and 25 inches M.P. until engine oil temperature reaches 40°C.

15. Propeller selector switch—INC. RPM, until rpm nearly matches rpm of the other engines.
16. Propeller selector switch—AUTOMATIC OPERATION.
17. Throttle lever—Advance as required for power setting.
18. Alternator—Parallel on bus. (Engines No. 2, 3, 4, or 5.)

ABORTING TAKE-OFF.

The aircraft commander is charged with the responsibility of making the decision on whether to abort a take-off. There will not be time to make a delayed decision. No one can tell you what to do in these situations; however, you can equip yourself with knowledge on which to base your decision by knowing your REFUSAL SPEED, your STOPPING DISTANCE WITH BRAKES ONLY, and your STOPPING DISTANCE WITH BRAKES AND REVERSE PROPS. Then if you have sufficient runway left when the decision is made to abort the take-off, you will know what to do.

If the aircraft commander should decide to abort a take-off after take-off power has been established, he should notify the crew by announcing over the interphone, "Aborting take-off." Immediately following this announcement, the crew members concerned will comply with the following procedure:

1. Engineer—Turn water injection switches OFF.
2. Pilot—Shut down jet engines and place propeller reverse selector switches in READY.
3. Aircraft Commander—Power as required.

Note

Propellers may be reversed at full take-off power; however, slight overspeeding of engines will occur.

4. Pilot—Depress reverse pitch switch upon command of aircraft commander.
5. Pilot—Check jet engine rpm and close all jet engine fuel valves if jets are still running.
6. Aircraft Commander—Use maximum brakes but avoid skidding.
7. Pilot—Hold forward pressure on control column, after nose gear is on the runway, to insure nose steering.
8. Aircraft Commander—Lock controls, if possible, below 50 mph.

Note

Prior to each take-off the aircraft commander will personally brief the pilot and engineers on the above "aborting take-off" procedure.

ENGINE FAILURE DURING TAKE-OFF.

In the event of engine failure on take-off, accomplish these steps:

1. Obtain directional control by using rudder with a minimum of aileron.
2. Pick up at least minimum control air speed before attempting to climb. (See figure 3-2.)
3. Raise the landing gear immediately, if practical, and start retracting the flaps at 125 per cent of stalling speed, even though the gear is not completely up. (See figure 6-6.)
4. If emergency power is being used, reduce this power as soon as possible.
5. Determine which engine or engines have failed and whether or not they are delivering enough power to carry themselves; if they are not, feather their propellers and make a normal landing approach.

CAUTION

Failure of an output tube of the electronic mixture control system may cause the mixture control to be driven to the IDLE CUT-OFF position. If there is evidence of such a failure as shown by complete loss of power with a sharp decrease in fuel flow and torque, with fuel pressure normal, retard throttle to prevent power surge and back firing and use the mixture control override switch to reset the mixture. If power is not restored, then feather the propeller.

Note

If sufficient power is not available to execute the landing pattern, prepare to crash land straight ahead. Refer to "Crash Landings" of this section.

WARNING

Never attempt to turn before directional control is obtained and a safe flying speed is reached.

TURBO BOOST CONTROL (GROUP I AIRPLANES).

When the normal turbo controls fail, proceed as follows:

1. Control manifold pressure within limits by use of the throttles.
2. Turbo vernier control switch—OFF.
3. Turbo control change-over switch—MAN.
4. Turbo override control switch—Move toward OPEN or CLOSE to attain the approximate manifold pressure desired.
5. Turbo vernier control switch—ON.
6. Turbo override control switch—Jiggle OPEN or CLOSE to trim to the desired manifold pressure.

Note

With the vernier switch ON, each actuation of the override switch will operate the waste gate for approximately 0.05 of a second. Therefore, when adjusting the manifold pressure, the override switch must be jiggled.

The turbo override system can be operated during emergency power operation to open the waste gates. (See "Obtaining Emergency Electrical Power" of this section.) However, there will be no indication from critical engine instruments such as manifold pressure, CHT, CAT., torque pressure, or fuel flow gages. Therefore, there can be no assurance of obtaining the proper power setting.

Note

If overboost occurs during take-off and the take-off manifold pressure is exceeded by more than 10 inches for a period of 15 seconds, the engine must be changed before the next flight. If the take-off manifold pressure is exceeded by not more than 10 inches for a period of 15 seconds, the engine must be inspected prior to the next flight.

OIL SPEWING.

Oil spewing at altitudes of approximately 37,000 feet and above is caused by insufficient crankcase scavenging. This condition can become a serious problem. A dangerous amount of oil may be lost, making it necessary to feather engines to prevent seizing. Also, oil spewing from the breather vent congeals on the wing trailing edge and is thrown into the propellers by the slipstream, damaging the propellers and the fuselage. If conditions allow, attempt to stop oil spewing by reducing rpm. If this does not alleviate the condition, reduce altitude. (For further information, refer to "Oil Spewing" of Section VII.)

PARTIAL POWER TAKE-OFF.

Note

After each flight when asymmetric power of two or more engines out on one side has been used, a post flight inspection of the vertical stabilizer closure skin must be accomplished.

This procedure should be used when some engines are inoperative and the airplane must be flown from a base where repair facilities are inadequate.

Note

If symmetrical engines are inoperative, use the normal take-off procedure. See Appendix 1 for take-off performance.

CAUTION

This procedure does not apply in the event of engine failure on take-off or reduced power take-off.

Study the applicable portion of the "Take-Off and Distance Curve" in the appendix. Prepare the airplane by closing the air plug doors of the inoperative jets and sealing the air intakes of the inoperative reciprocating engines, but do not seal any exhaust or air outlets. One point to consider in this type of take-off is the unbalanced thrust created by asymmetrical power. With full take-off power, full opposite rudder will not be sufficient to counteract the yaw at low speeds. Therefore, with all operative engines idling and the airplane restrained with the foot brakes, the take-off should be accomplished as follows:

1. Apply full take-off power to the symmetrical engines.
2. Release the foot brakes.

Note

If an outboard engine is inoperative, rudder trim should be set to approximately 8 degrees.

If a center is inoperative, set 5 degrees. If an inboard is inoperative set 3 degrees.

3. As the airplane accelerates and the rudder becomes more effective, slowly apply power to the remaining engines and compensate with rudder.

CAUTION

At no time should full power be applied to a strong side engine until all engines inboard from it are operating at full power.

4. When all operative engines are at full power, reduce rudder deflection to maintain zero yaw.

5. Use rudder trim and hold the nose wheel on the ground as long as possible to aid in maintaining directional control.

6. As soon as take-off air speed is reached, make a rapid pull-off followed by level flight to accelerate to a safe climbing speed; retract the landing gear as soon as the airplane is positively airborne.

WARNING

Remember that minimum safe climb speed is 120 per cent of stalling speed. See figure 3-2 for minimum yaw.

PARTIAL POWER LANDING.

It may sometimes be necessary to land with two or more engines inoperative; however, with careful planning there is seldom cause for alarm. When operating with asymmetric reciprocating engines inoperative, the resulting conditions of unbalanced thrust and lift greatly affect directional control at low air speeds with high powers on the remaining engines. For the critical air speeds below which effective control cannot be maintained with a given asymmetrical power configuration, refer to figure 3-2. There are many factors that must be considered in attempting a partial power landing. The aircraft commander must know the condition of critical systems needed for landing. He should weigh these factors and determine the subsequent action. After alerting the crew to prepare for a possible crash landing, proceed as follows:

1. Make sure that the cg location is within proper limits for landing.

2. Based on expected landing gross weight, determine whether jet engine thrust is required to replace the loss of the reciprocating engines.

3. If the jet engines are to be used, they should be operated at the required per cent rpm (figure 3-3), maintaining pattern speeds and final approach glide angle by retarding the reciprocating engine throttles.

4. The jets should be started as early as practical prior to entering the traffic pattern, based on estimated power requirements, fuel reserve, etc. (For starting procedure see "Starting Jet Engines in Flight," Section II.)

5. During the landing approach, maintain a safe air speed of 135 per cent of stalling speed. Do not exceed 145 per cent of stalling speed.

6. If altitude and power conditions are critical, leave the gear up as long as practical before entering the final approach, thereby eliminating the need for high engine power to overcome landing gear drag. Care must be used to insure that gear is fully down and locked prior to turning on final approach. Normal gear extension requires approximately 45 seconds.

7. Adjust power on operating engines to maintain the desired approach speed.

Jet Engine REQUIREMENTS

(PARTIAL POWER LANDING)

5 RECIPROCATING ENGINES

GROSS WEIGHT—POUNDS		JET POWER REQUIREMENTS	
FROM	TO	JETS	% RPM
———	236,000	None	———
236,000	288,000	2	90
288,000	303,000	2	96
303,000	313,000	2	100
313,000	331,000	4	90
331,000	362,000	4	96

4 RECIPROCATING ENGINES

GROSS WEIGHT—POUNDS		JET POWER REQUIREMENTS	
FROM	TO	JETS	% RPM
———	187,000	None	———
187,000	240,000	2	90
240,000	253,000	2	96
253,000	262,000	2	100
262,000	294,000	4	90
294,000	322,000	4	96
322,000	340,000	4	100

3 RECIPROCATING ENGINES

GROSS WEIGHT—POUNDS		JET POWER REQUIREMENTS	
FROM	TO	JETS	%RPM
———	192,000	2	90
192,000	208,000	2	100
208,000	236,000	4	90
236,000	264,000	4	96
264,000	275,000	4	100

NOTE

When landing gross weight is 283,000 pounds or over and all six reciprocating engines are operative, two jet engines will be run at 90% rpm to insure sufficient power in the event of reciprocating engine failure during landing.

69-168-A

Figure 3-3.

8. Adjust directional trim with the rudder trim tabs during final approach.

9. Position flaps at 20 degrees until there is no possibility of undershooting; then extend full flaps.

10. Just prior to touchdown, if conditions permit, fully retard throttles on live reciprocating engines and simultaneously neutralize the rudder trim controls. Do not reduce jet power until a safe landing is assured; however, slight reductions may be necessary to maintain correct final approach air speeds even after reciprocating engines have been fully retarded.

CAUTION

Jet engines do not provide as rapid acceleration of the aircraft as do reciprocating engines; therefore, required jet engine power changes must be anticipated earlier.

11. After the airplane contacts the runway, place the propeller reverse selector switches in the READY position in preparation for thrust reversal.

12. Shut down the jet engines and reverse the propellers simultaneously.

PROPELLER FAILURE.

RUNAWAY PROPELLER (OVERSPEEDING ENGINE).

Failure of the propeller synchronizing system may result in a runaway propeller. When such a failure occurs, the engine may exceed allowable limits. Attempt to reduce rpm as follows:

1. Engineer—Hold the propeller selector switch in the DEC. RPM position.

2. Engineer—Maintain M.P. within limits simultaneously with step 1.

3. If the above procedure does not reduce rpm, use momentary feather to control rpm.

CAUTION

When using momentary feather, remember that pitch change is 45 degrees per second.

4. Engineer—If this procedure does not reduce rpm, feather propeller on order from aircraft commander.

Note

If the propeller will not feather, engine overspeeding can be reduced by decreasing air speed and/or altitude.

CAUTION

All conditions of overspeeding should be noted on Form 781 (Form 1). If engine rpm was between 3100 and 3300 rpm, the engine must be inspected before the next flight. If the engine speed exceeded 3300 rpm, the engine must be changed.

EMERGENCY PITCH SETTING BEFORE LANDING.

When a landing is to be made in fixed pitch because of synchronizer failure, set the propeller blades and turbos to insure full power in the event of a go-around. This is done at traffic altitude before entering the final approach by using the following procedure:

1. Aircraft Commander—Maintain 135 per cent of stalling speed or 145 mph IAS whichever is greater, based on gear down and flaps 20 degrees while the engineer performs the following steps:

2. Engineer—Propeller Selector Switches — Increase all engines to approximately 2200 rpm then return to fixed pitch. This will provide the aircraft commander with sufficient power to maintain IAS and altitude.

3. Engineer—Turbo Calibration Trim Knobs—Full Decrease.

4. Engineer—TBS-7.

Note

Accomplish the remaining steps, one engine at a time symmetrically or on symmetrical engines. No. 1 and 6, 2 and 5, and 3 and 4, respectively. The aircraft commander can use remaining throttles to maintain the required airspeed. It is important that a constant airspeed and altitude be maintained while the engineer is setting this power to assure adequate and balanced power for go-around.

5. Engineer—**Throttle Lever—Full Open.**

6. Engineer—Turbo Calibration Knob—Increase to 55 inches M.P. maintaining 2550 rpm with propeller selector switch.

Note

The values desired are 2550 rpm and 55 inches M.P. which is adequate power for normal landing weights. At any rate, more power should be used only in an emergency since maximum dry engine power would be exceeded. When stabilized at 2550 rpm and 55 inches M.P., retard the throttle to the average power of the other engines and proceed with the next engine.

7. Aircraft Commander—Gear and flaps will be lowered at same time as in normal landing procedure.

CAUTION

In the event a go-around is necessary, advance throttle levers to full open *slowly* and *smoothly* to avoid overspeeding the propellers.

FIRE.

JET ENGINE FIRE ON THE GROUND.

In event of a jet engine ground fire, the pilot must call the tower and position his controls as follows:

1. All throttles—CLOSE.
2. Both manifold fuel switches—CLOSE.
3. All engine fuel valve switches—CLOSE.
4. All fuel booster pump switches—OFF.
5. All oil shutoff valve switches—CLOSE.
6. Pod preheat switch—OFF.

CAUTION

In the event fuel is burning on the ground, move the airplane upwind.

RECIPROCATING ENGINE FIRE ON THE GROUND.

If your aft scanners report a flaming exhaust stack, the fire is probably a torching turbo and may be put out by increasing the throttle momentarily. For other fires on the ground immediately warn the crew, signal to fire truck and the ground crew for portable equipment, and notify the control tower. Meanwhile the engineer should carry out this procedure:

CAUTION

If the jet engines are operating, shut them down.

1. All engine fuel and oil shutoff valve switches—CLOSE.
2. All alternator breaker hold-in switches—Hold in.

Note

This step is applicable only when the alternators are furnishing electrical power to the airplane.

3. All mixture control levers—IDLE CUT-OFF.

Note

There are instances where the fire will burn itself out after the fuel has been shut off; therefore, before proceeding to the next step check to see whether the fire is out.

4. Proper engine fire extinguisher selector switch—HOLD ON for at least five seconds as soon as the engine stops.
5. Fire extinguisher discharge selector switch—Place in the reserve position—Discharge if fire is still burning.
6. All ignition switches—OFF.
7. External power and battery switches—OFF.

WARNING

Repeated or prolonged exposure to high concentrations of bromochloromethane (CB) or decomposition products should be avoided. CB is a narcotic agent of moderate intensity but of prolonged duration. It is considered to be less toxic than carbon tetrachloride, methyl bromide, or the usual products of combustion. It is safer to use than previous fire extinguishing agents; however, normal precautions should be taken including the use of oxygen when available.

INFLIGHT FIRE FIGHTING PROCEDURES.

Reciprocating Engines.

When a crew member spots a fire he will place his interphone selector switch in the CALL position and report "Flame" or "Smoke," whichever is applicable, "From No.......... engine." The crew member will further identify the location of the flame or the type and location of the smoke. The engineer will use this information in conjunction with his fire warning lamp indicators to determine the exact location of the fire and he will immediately inform the aircraft commander of the extent of the emergency condition.

Note

It is possible to isolate engine or wing fires through the use of fuel shutoff valves. To accomplish this the engineer must take into consideration his fuel configuration—then determine the valves that can be shut off without jeopardizing the operation of other engines.

1. Affected engine's fuel shutoff switch—CLOSE.
2. Mixture control lever—IDLE CUT-OFF.
3. Propeller feather switch—Feather, simultaneously with idle cut-off.
4. Affected engine's oil shutoff switch—CLOSE.

Note

There are cases when the fire will burn itself out after the engine is feathered and the fuel is cut off. Therefore, before continuing with the fire fighting procedure, check to see whether the fire is extinguished.

5. Proper fire extinguisher engine selector switch—Hold ON for at least five seconds as soon as engine stops.
6. Air plug and intercooler switches—OPEN.
7. Proper cabin pressure wing shutoff valve switch—OFF. Use pressure from unaffected wing.
8. Proper cabin heat and tail anti-ice control switch—OFF, if fire is in engine No. 3 or No. 4.
9. Proper wing anti-ice control switch—OFF, if fire is in engine No. 1, 2, 5, or 6.
10. Fire extinguisher discharge selector switch—Place in reserve position and repeat step 5 if necessary.
11. After the emergency is over, the proper ignition switch may be turned OFF.
12. Do not restart engine.

Analysis of Fire Warning Lamp Indication. When a reciprocating engine fire warning lamp lights, the engineer will take action to determine the cause of the indication. This action is necessary to prevent inadvertent shutdown of a good engine due to a false indication.

If a fire warning lamp lights during flight, the engineer will hold his interphone selector switch in CALL and request the applicable lower aft scanner to check for flame, smoke, or any other abnormality. If flame or smoke is reported, follow the instructions described under "Inflight Fire Fighting Procedures" of this section. If the scanner reports, "No smoke or flame," position the controls of the affected engine as follows to determine the cause of the warning indication.

1. Position the air plug fully OPEN to dissipate nacelle heat and check the resultant drop in CHT.

Note

> If the warning lamp goes out, normal operation of the engine can be continued. If the lamp remains lighted, proceed with step 2.

2. Temporarily reduce power on the affected engine to check for an exhaust system failure.
3. If the lamp remains lighted after power is reduced, shut down the engine.

Note

> If the lamp remains lighted after the engine is shut down, the fire detector system is probably faulty. In this case, unfeather the engine and resume normal operation.

4. If the lamp goes out after power is reduced, shut down the engine unless it is needed to maintain safety of flight in which case it may be operated at reduced power.

Jet Engines.

In the event of a jet engine fire in flight, the pilot will position the jet engine controls as follows:

1. Throttle—CLOSE.
2. Proper engine fuel valve switch—CLOSE.
3. Proper oil shutoff valve switch—CLOSE (OPEN, after fire is extinguished).
4. Pod preheat switch—OFF.
5. Nose de-ice switch—OFF.

Note

> If fire is not extinguished, repeat steps 1 through 3 on remaining jet engine in affected pod and proceed with steps 6 and 7.

6. Proper manifold fuel valve switch—CLOSE.
7. Proper fuel booster pump switch—OFF.

WING FIRE.

A wing fire involving fuel and oil tanks may be difficult to identify, because the smoke and flames will probably emerge from the engine nacelle. A wing fire will, therefore, probably be reported as an engine fire by the aft cabin scanners and should be fought as such until all the extinguishing agent is exhausted. The engineer will turn off the anti-icing system and stop the flow of cabin pressurizing air from the wing on fire. Check that the other wing is furnishing pressurization. After the fire is out, a reasonable length of time must be allowed for the fumes to dissipate before investigating the damage via the wing crawlway.

FUSELAGE FIRE.

Reduce the draft by shutting off pressurized or ventilating air. Isolate the fire by use of valves and doors. Know the locations and limitations of the hand fire extinguishers.

1. Crew—Don oxygen masks and goggles and set diluter lever of oxygen regulator to 100% OXYGEN. On A-14 regulator, set dial according to altitude. On D-1 regulator, push emergency toggle lever to left or right.
2. Crew—Locate cause of fire.
3. Crew—If it is an electrical fire, isolate the circuit.
4. Crew—If the fire is caused by fluid leak, stop the fluid flow.
5. Engineer—Affected cabin pressure control—OFF if necessary.
6. Engineer—Cabin pressure wing shutoff valve switches—OFF, if necessary.
7. Crew—Aft cabin manual pressure shutoff valve —CLOSED, if necessary.
8. Crew—Use hand fire extinguishers.

WARNING

> Do not increase ventilation until the flames are extinguished. Use oxygen masks for protection against fumes.

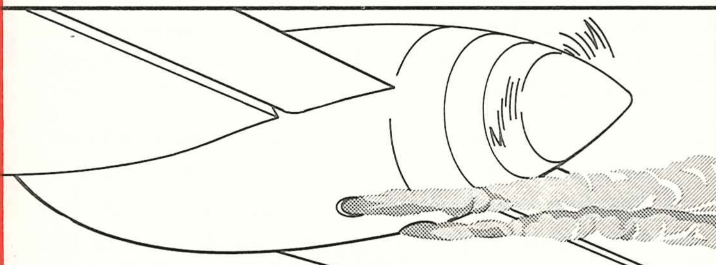
9. Crew—Open dump valves, doors, or hatches as required *after* the fire is out.

DIAGNOSING *Smoke & Fire* . . . .

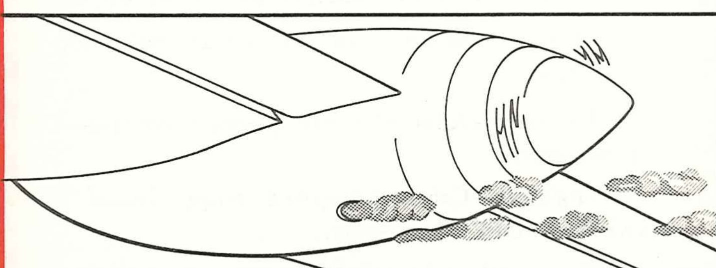
• • RECIPROCATING ENGINE FIRE IN FLIGHT

Engine abnormalities are often difficult to diagnose either rapidly or accurately while in flight; however, from indications of the engine instruments coupled with information from the scanners in the aft cabin, fairly effective action can be taken in a minimum time. Engine malfunctions are often indicated by smoke or fire. Torching exhaust stacks are observed sometimes when the engine is operating on excessively rich mixtures. In some instances flame may extend through the air plug opening and the propeller. Effective leaning of the mixture will stop this condition almost immediately.

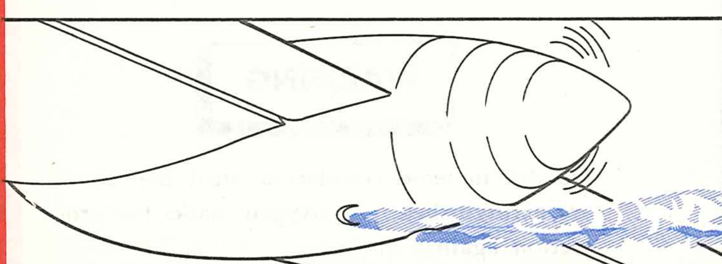
THIN BLACK SMOKE FROM EXHAUST



PUFFS OF BLACK SMOKE FROM EXHAUST



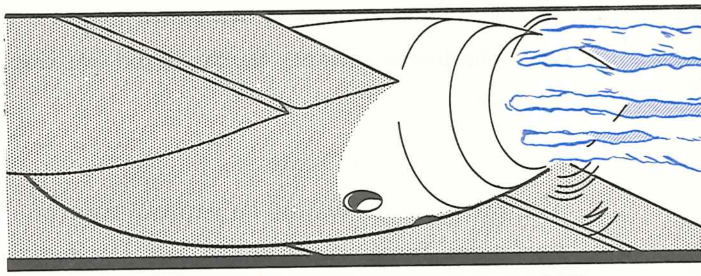
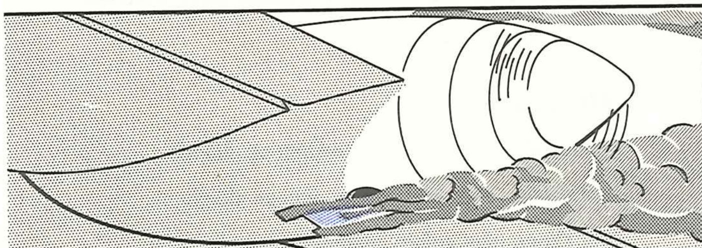
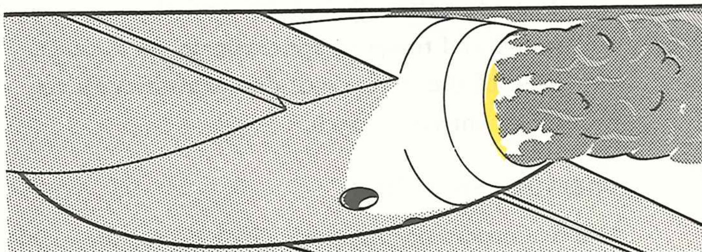
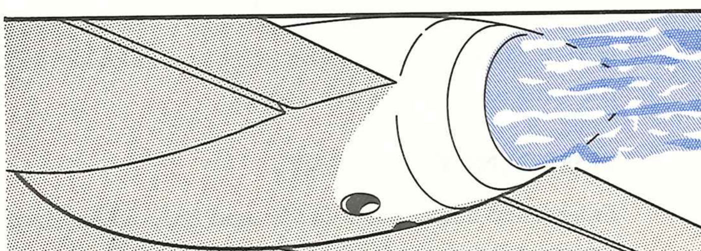
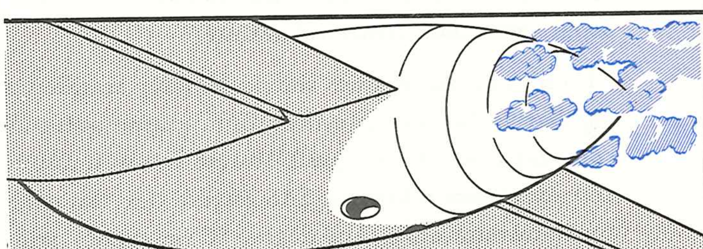
THIN BLUISH WHITE SMOKE FROM EXHAUST



	PROBABLE CAUSE	CORRECTIVE ACTION
THIN BLACK SMOKE FROM EXHAUST	RICH MIXTURE AT HIGH POWER	NONE
	RICH MIXTURES AT HIGH RPM AND LOW MANIFOLD PRESSURE	ADJUST POWER SETTING
	LEAKY PRIMER	NONE
PUFFS OF BLACK SMOKE FROM EXHAUST	DETONATION	CHECK FUEL PRESSURE. CHECK MIXTURE CONTROL SETTING RICHEN MIXTURE. REDUCE MANIFOLD PRESSURE. REDUCE CYLINDER HEAD TEMPERATURE.
	CYLINDER MALFUNCTION	REDUCE POWER. WATCH FOR FIRE.
	FOULED SPARK PLUGS	INCREASE CYLINDER HEAD TEMPERATURE TO LIMIT.
THIN BLUISH WHITE SMOKE FROM EXHAUST	INTERNAL FAILURE—RINGS	CHECK OIL PRESSURE. CHECK OIL QUANTITY.
	IMPELLER SEAL OR TURBO SEAL OIL LEAKAGE	

69-169-A

Figure 3-4. (Sheet 1 of 2)

	PROBABLE CAUSE	CORRECTIVE ACTION
WHITE SMOKE FROM AIR PLUG OPENING 	EXHAUST SYSTEM FAILURE	CUT OFF FUEL. FEATHER PROPELLER. WATCH FOR FIRE.
BLACK SMOKE FROM LOUVERS, BLUISH WHITE SMOKE FROM LOUVERS OR OIL COOLER DOOR. 	FUEL LINE AFIRE	CUT OFF FUEL. FEATHER PROPELLER. USE FIRE PROCEDURE.
	OIL LEAK	CHECK OIL PRESSURE. CHECK OIL QUANTITY. WATCH FOR FIRE.
DENSE BLACK SMOKE AND FLAME FROM AIR PLUG OPENING. FIRE MAY IMMEDIATELY BURN THROUGH UPPER COWLING OF NACELLE. 	BROKEN FUEL LINE OR ACCESSORY SECTION FIRE	CUT OFF FUEL. FEATHER PROPELLER. USE FIRE PROCEDURE.
THIN BLUISH WHITE SMOKE FROM AIR PLUG OPENING 	OIL LEAK	CHECK OIL PRESSURE. CHECK OIL QUANTITY. WATCH FOR FIRE.
PUFFS OF BLUISH WHITE SMOKE FROM AIR PLUG OPENING 	OIL LEAK	CHECK OIL PRESSURE. CHECK OIL QUANTITY. WATCH FOR INTERNAL ENGINE FAILURE. WATCH FOR FIRE.

69-170-A

Figure 3-4. (Sheet 2 of 2)

ELECTRICAL FIRE.

Fuses and circuit breakers protect most of the electrical circuits and tend to isolate an electrical fire. However, there are cases where fuses of high capacity will permit a short sufficient to cause a fire. In such instances use A-20 fire extinguisher and attempt to isolate the circuit containing the short.

WARNING

Repeated or prolonged exposure to high concentrations of bromochloromethane (CB) or decomposition products should be avoided. CB is a narcotic agent of moderate intensity but of prolonged duration. It is considered to be less toxic than carbon tetrachloride, methyl bromide, or the usual products of combustion. It is safer to use than previous fire extinguishing agents; however, normal precautions should be taken including the use of oxygen when available.

SMOKE ELIMINATION.

To eliminate smoke and toxic fumes from the cabins, use the procedures in the following paragraphs:

UNPRESSURIZED FLIGHT.

Forward Cabin.

1. Open the nose turret disposal door.
2. Open the left forward escape hatch.
3. Partially open the aircraft commander's and pilot's clear vision panels.
4. Partially remove the right upper forward escape hatch.

Note

The smoke and fumes should be completely eliminated in approximately 1 minute and 15 seconds after the fire is extinguished. Most of the smoke will dissipate through the clear vision panel openings.

CAUTION

If the clear vision panels are opened while a fire is still burning in the observer's compartment, flames may be drawn up to the flight deck.

Camera Compartment.

1. Open the left escape hatch.
2. Open the hatch leading to the bomb bay.
3. Open the lower entrance hatch on the left side of the airplane.

Note

The compartment should be entirely clear of smoke and fumes in approximately 1 minute and 36 seconds after the fire is extinguished. Most of the smoke will dissipate through the left escape hatch.

Aft Cabin.

1. Open the catwalk entrance hatch.
2. Open the tail cone access door.
3. Open the cabin entrance hatch.

Note

The aft cabin should be entirely clear of smoke and fumes in approximately 3 minutes. Most of the smoke will dissipate through the cabin entrance hatch.

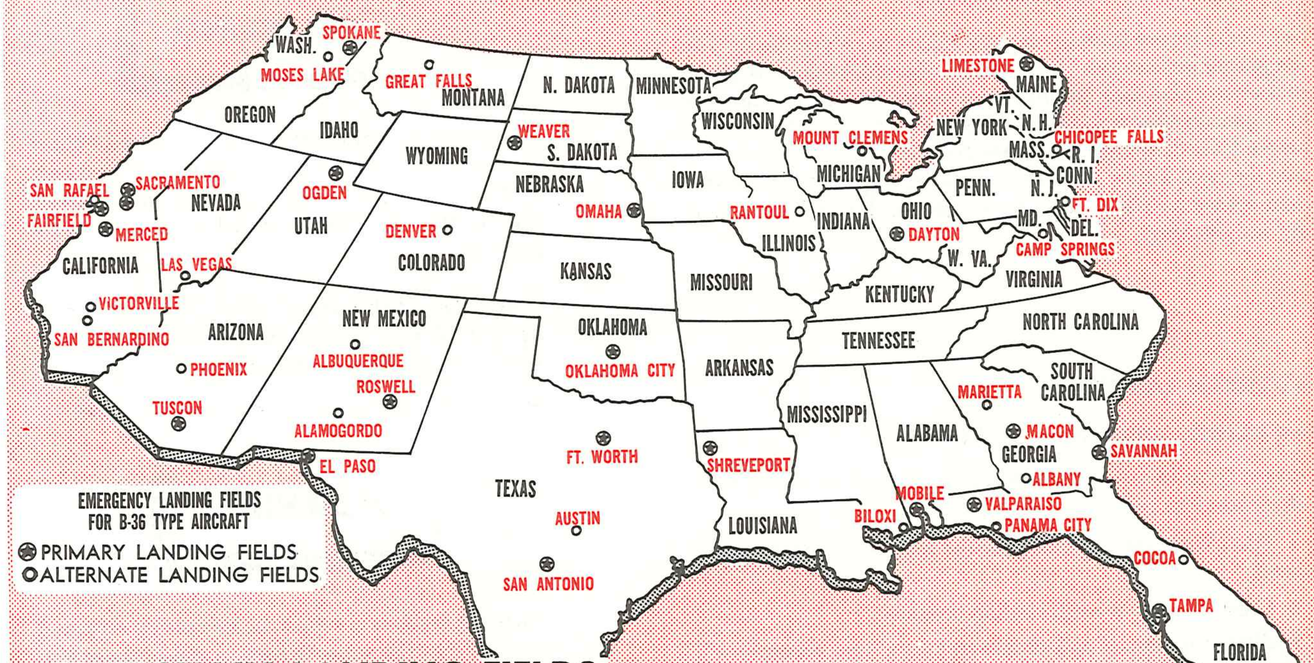
PRESSURIZED FLIGHT.

If a fire occurs during pressurized flight, the airplane must first be depressurized; then the cabins can be cleared of smoke as indicated in the preceding paragraph. During depressurization approximately 50 per cent of the smoke and fumes will be eliminated before the exits and hatches are opened.

EMERGENCY DESCENT.

Emergency descent should be used only when circumstances call for maximum rate of letdown. Engine wear and propeller vibration must be tolerated under these conditions, but air-speed limits should be observed to avoid immediate structural failure.

Throttles on six engines should be fully retarded, the auxiliary cabin heater switch OFF, engine speed 2300 rpm above 40,000 feet and 2550 rpm below 40,000 feet, and maximum allowable IAS (figure 5-3) maintained for maximum drag. The degree of emergency will be the governing factor, but engines No. 3 and 4 can be maintained at sufficient power to provide pressure and heat.



• EMERGENCY LANDING FIELDS.

In the event of an emergency where a landing at other than the home base is necessary, the aircraft commander will make every attempt, consistent with safety, to land at a *Primary Field*. If it is not possible, he should try to land on an *Alternate Field*. All *Primary Fields* have fuel, adequate maintenance, and the proper type of runway for B-36 operation. All *Alternate Fields* are adequate for limited B-36 operation only. They cannot refuel or perform major maintenance on B-36 type aircraft, and the runways are not stressed for continuous B-36 operation.

WARNING

Runway lengths are approximate. Consult the latest revision of "Radio Facility Charts" for correct runway lengths of fields listed below.

PRIMARY FIELDS

Location	*Base*	*Longest Runway*
Alabama, Mobile	Brookley AFB	8800
Arizona, Tucson	Davis Monthan AFB	7900
California, Fairfield	Travis AFB	8100
California, Merced	Castle AFB	7000
California, Sacramento	Mather AFB	7500
California, Sacramento	McClellan AFB	7000
Florida, Tampa	MacDill AFB	10,000
Florida, Valparaiso	Eglin AFB	8000
Georgia, Macon	Robins AFB	7000
Georgia, Savannah	Hunter AFB	10,500
Louisiana, Shreveport	Barksdale AFB	10,000
Maine, Limestone	Loring AFB	10,000
Nebraska, Omaha	Offutt AFB	6100
New Mexico, Roswell	Walker AFB	8500
Ohio, Dayton	Wright-Patterson AFB/Patterson	8000
Oklahoma, Oklahoma City	Tinker AFB	7800
South Dakota, Weaver	Ellsworth AFB	10,500
Texas, Fort Worth	Carswell AFB	8200
Texas, El Paso	Biggs AFB	9500
Texas, San Antonio	Kelly AFB	6700
Utah, Ogden	Hill AFB	7500
Washington, Spokane	Fairchild AFB	10,500

ALTERNATE FIELDS

Location	*Base*	*Longest Runway*
Arizona, Chandler	Williams AFB	6100
California, San Bernardino	Norton AFB	7600
California, San Rafael	Hamilton AFB	6200
California, Victorville	George AFB	9500
Colorado, Denver	Lowry AFB	8300
Florida, Cocoa	Patrick AFB	10,000
Florida, Miami	Miami International	9400
Florida, Panama City	Tyndall AFB	8000
Georgia, Albany	Turner AFB	9200
Georgia, Marietta	Dobbins AFB	7500
Illinois, Rantoul	Chanute AFB	6300
Maryland, Camp Springs	Andrews AFB	5500
Massachusetts, Chicopee Falls	Westover AFB	7300
Michigan, Mt. Clemens	Selfridge AFB	8200
Mississippi, Biloxi	Keesler AFB	6500
Montana, Great Falls	Great Falls AFB	9500
Nevada, Las Vegas	Nellis AFB	6800
New Jersey, Fort Dix	McGuire AFB	8200
New Mexico. Alamogordo	Holloman AFB	8400
New Mexico, Albuquerque	Kirtland AFB	10,200
Texas, Austin	Bergstrom AFB	8000
Washington, Moses Lake	Larson AFB	10,000

73-128-A

Figure 3-5.

●FORCED LANDINGS

Successful forced landings depend on the crews' familiarity with the proper procedures. One crew member will be designated for the command of each compartment during emergencies and will be responsible for reporting the compartment clear of personnel before leaving. Frequent dry-run drills should be conducted so that the crew will be prepared for this emergency. The instructions contained in the following paragraphs deal with crash landing and ditching.

● ●CRASH LANDINGS.

● ● ●Crash Landing On Take-Off.

In case of an impending crash landing immediately after take-off, proceed as follows:

1. Pilot–Warn crew to brace for the impact and land straight ahead.
2. Crew–Remain in crash landing positions.
3. After the impact and deceleration, the aft scanners will proceed as follows:

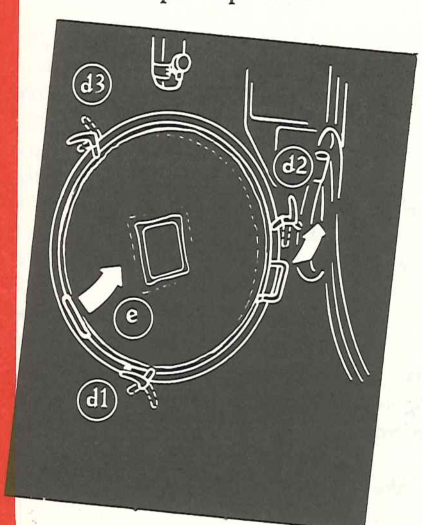
WARNING

It is the aircraft commander's responsibility to see that the following escape procedures are regularly rehearsed. The importance of regular escape drills cannot be over-emphasized.

a. Undo safety belt.

b. Stand up.

c. Swing outboard arm rest into an upward position.



d. Release hatch latches.

WARNING

The upper latch *must* be the last latch released. Failure to observe this caution may result in a delayed exit, for there is danger that the latch may fall back into place or that the hatch may fall out and strike the crewmen.

e. Grasp the hatch and pull hatch inboard and upward. (Pivot hatch about the aft edge to clear the scanner's oxygen panel.)

f. Stow hatch, release escape rope, and make exit.

WARNING

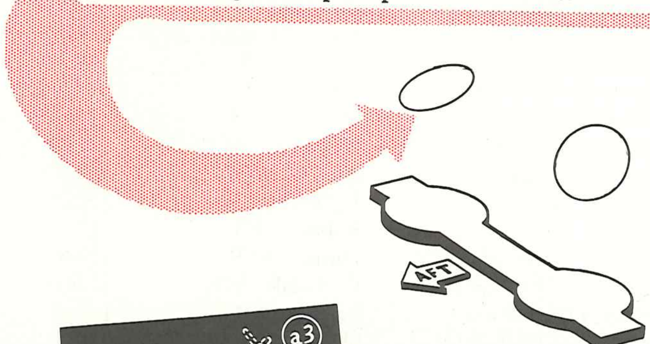
When the hatch is removed, be sure that it is stowed clear of the exit so as not to hamper exit of those who must follow you.

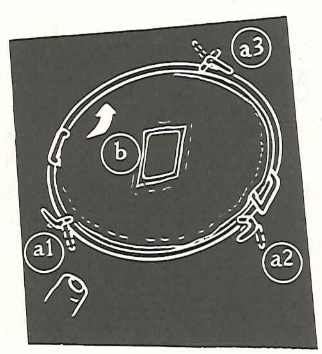
4. The tail gunner and crew members on the right bunk exit through the right escape hatch; those on the left bunk exit through the left escape hatch.

NOTE

If escape through the two lower aft escape hatches is impossible, follow procedure in step 5 and exit through the upper aft escape hatches.

5. The upper aft escape hatches are alternate escape exits. To escape through these ports proceed as follows:





a. Release hatch latches.

69-171

Figure 3-6. (Sheet 1 of 2)

WARNING

The upper latch *must* be the last latch released. Failure to observe this caution may result in a delayed exit for there is danger that the latch may fall back into place or that the hatch may fall out and strike the crewman.

b. Grasp the hatch and remove it.

WARNING

When the hatch is removed be sure that it is stowed clear of the exit and that it is not dropped on crewmen behind you.

c. Stow the hatch, release escape rope if provided, and make exit.

6. The pilots and engineers exit through their hatches in the canopy.

7. All personnel in the radio operator's compartment must use the left escape hatch if possible; however, if jamming prevents removal of this hatch, use the upper right and left forward escape hatches.

67-175-A

Figure 3-6. (Sheet 2 of 2)

Controlled Crash Landing.

When it is possible, the decision to crash land should be made early enough to allow the crew time for adequate preparation. These general instructions must be remembered in case of a crash landing.

1. If control of the landing gear position is retained by the aircraft commander and an airfield is not available for landing, land the aircraft with the gear retracted on the smoothest possible terrain. If an airfield is available, normal wheels-down landing should be accomplished. If the gear cannot be extended, make the landing on terrain as smooth and hard as possible, preferably an airfield runway if available.

2. If it is possible, crash land near a road, a telephone line, or a small settlement to assure quick communication and immediate medical aid.

3. The crew will take the positions used for ditching (figure 3-9).

4. The crew must brace for the impact and remain braced until the airplane has come to rest. The forces generated during deceleration are enough to cause serious injury to any unprepared crew member.

Before Approach. When the decision to crash land is made, warn the crew by interphone and by six short rings of the alarm bells. The crew must immediately make the following preparations:

1. Pilot—Salvo all bombs and bomb bay tanks over an unpopulated area if possible.

2. Pilot—Bomb bay door switches—CLOSE.

3. Radio Operator—Transmit course, altitude, ground speed, and position; and turn IFF to EMERGENCY.

4. Photo-Navigator—Remove left forward escape hatch and stow in nose of airplane.

5. First Photographer — Remove emergency escape hatch in camera compartment and stow under floor in forward section of compartment.

6. Second Radio Operator—Open the forward turret bay doors.

Note

Opening the forward turret bay doors will interfere with the source of airspeed indication.

WARNING

If the turret doors fail to open, notify the aircraft commander.

7. Aircraft Commander—If turret doors fail to open, direct crew members to assume crash landing positions in the radio and camera compartments. The second engineer will remain on the flight deck.

Note

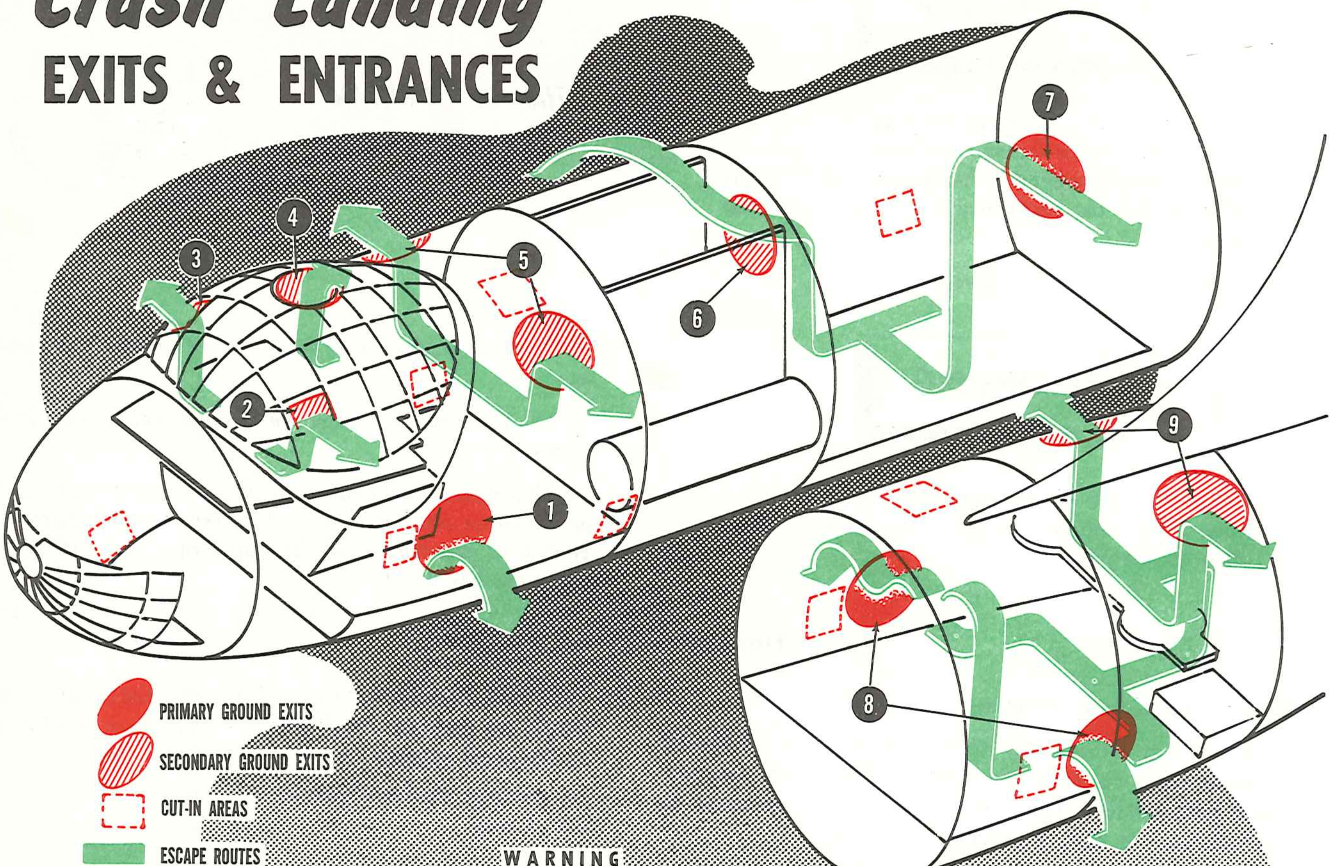
Place as many men as possible in the radio compartment.

8. Crew—Jettison all loose equipment and items which might fly loose on impact.

WARNING

Do not jettison the hand axes, because they may be needed to cut through the fuselage.

Crash Landing
EXITS & ENTRANCES



WARNING

WHEN A CRASH LANDING IS MADE WITH THE GEAR DOWN EXTREME CAUTION MUST BE OBSERVED WHEN USING THE UPPER ESCAPE EXITS SINCE THEY ARE SO HIGH ABOVE THE GROUND.

1. LEFT FORWARD ESCAPE HATCH
2. AIRCRAFT COMMANDER'S ESCAPE HATCH
3. PILOT'S ESCAPE HATCH
4. ENGINEER'S ESCAPE HATCH
5. UPPER FORWARD ESCAPE HATCHES
6. TURRET ACCESS DOOR
7. CAMERA COMPARTMENT ESCAPE HATCH
8. LOWER AFT ESCAPE HATCH
9. UPPER AFT ESCAPE HATCH

68-109-A

Figure 3-7.

9. To prevent jamming, leave all emergency hatches open, but leave bomb bay doors closed.

10. Crew—Release the three locking clamps on respective hatches and pull hatches inside the fuselage. Hatches in the forward cabin must be placed in the nose of the airplane; those in the aft cabin should be secured under the bunks and against the forward bulkhead of the compartment.

11. Crew—Assume crash landing positions.

12. All crew members will remove parachute and flak suits and use for padding. Don flak helmets and loosen neckties.

13. Compartment Commander—Report to aircraft commander when his compartment is ready for crash landing. Crew members in the turret bay will report to the aircraft commander when they are ready for crash landing.

14. Aircraft Commander—Give crew members not essential to crash landing permission to bail out.

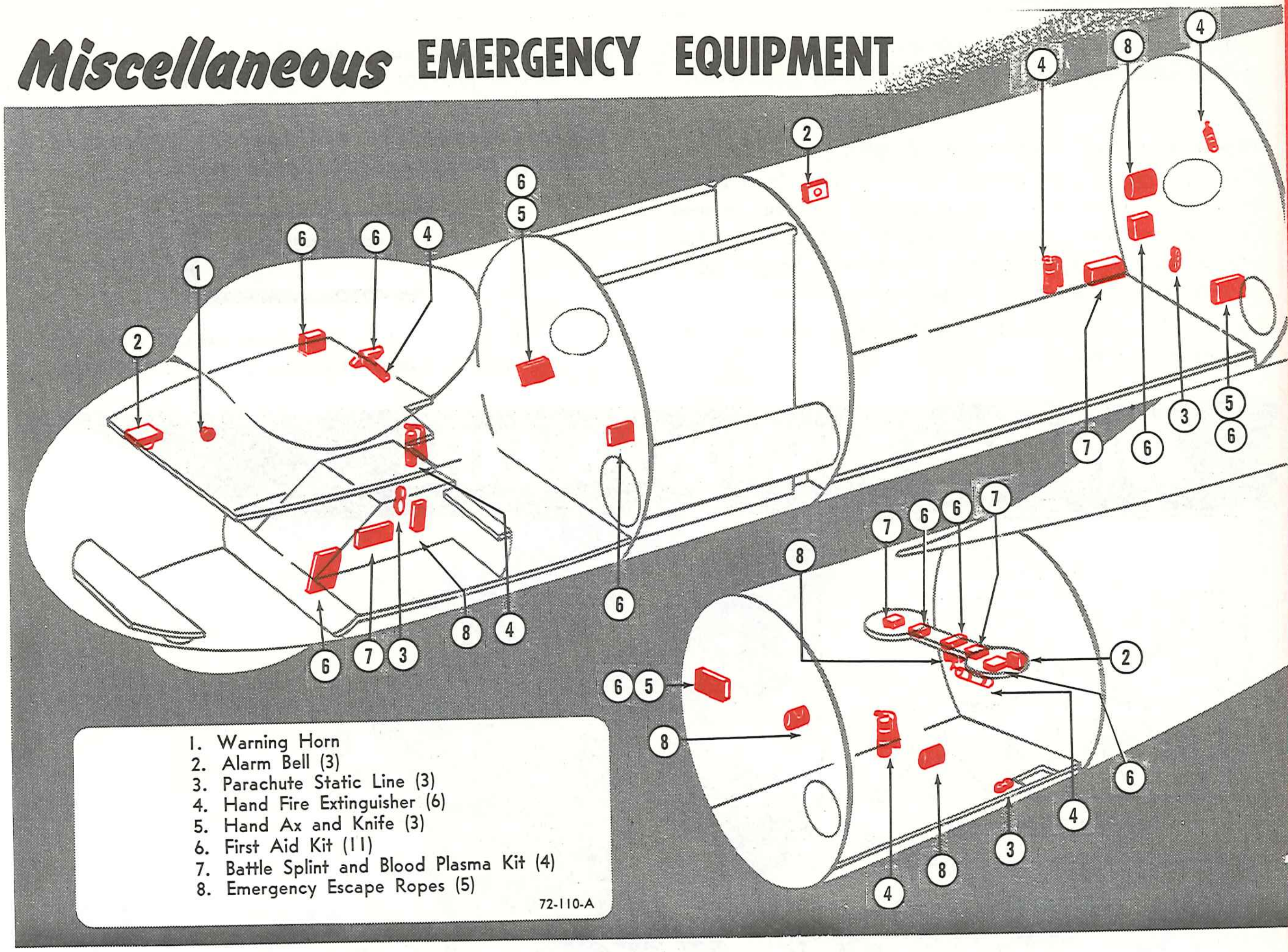
15. Aircraft Commander—If practical, circle the landing area until the remaining fuel supply is 500 gallons in each wing.

16. Aircraft Commander—If the landing is to be made on a known airfield, notify the tower to clear traffic and have crash equipment standing by.

Approach and Contact. Begin the approach far enough from the landing area to allow the remaining crew members time to make last minute preparations. The pilot and the engineer must accomplish the following:

1. Engineer—Obtain a fuel configuration in each wing of one tank feeding three engines and close the fuel cross-feed valve and the necessary manifold valves.

Miscellaneous EMERGENCY EQUIPMENT



72-110-A

Figure 3-8.

2. Aircraft Commander—Fully extend the flaps and maintain a very flat approach.
3. Aircraft Commander—By one long ring of the alarm bell and by interphone warn the crew to prepare for the impact.
4. Pilots—Tighten safety belts and shoulder harnesses and lock inertia reel lock controls.

CAUTION

The pilots are prevented from bending forward when the inertia reel is locked; therefore, all switches not readily accessible must be "cut" before moving the control to the LOCKED position.

5. Engineer—All alternator breaker hold-in switches—Hold in; mixture control lever—IDLE CUT-OFF on aircraft commander's request.
6. Engineer—All fuel valve switches—CLOSE.
7. Engineer—Engine ignition and battery switches—OFF on impact.

Emergency Entrance.

If it becomes necessary to enter the airplane to rescue trapped crew members, use the emergency entrance as shown in figure 3-7. The escape hatches in the forward cabin and camera compartment can be released from the outside if not jammed. Otherwise, it is necessary to chop through the fuselage at one end of the marked cut-in areas.

DITCHING.

At the present time RB-36 type aircraft do not carry permanently installed ditching equipment; however, ditching is considered preferable to over water bail-out when water temperatures and availability of surface vessels would indicate that mass survival of the crew members would be improbable. Final decision to bail out or ditch the aircraft is the responsibility of the aircraft commander.

Note

The following ditching procedure is for a 19-man crew and is meant to be used as a guide only until adequate provisions are made for ditching the aircraft.

Ditching drills should be performed until each crew member is thoroughly familiar with the procedure and the specific duties for which he is responsible. Make an equipment check before each overwater flight. Kits should be complete and crew life vests, survival suits, and life rafts should be in good condition.

Preparation For Overwater Flight.

Spare emergency equipment for crew members using the turret bay positions for ditching shall be stowed in the bay to eliminate any hindrance in assuming positions. A long interphone cord should also be provided for communication with these crew members.

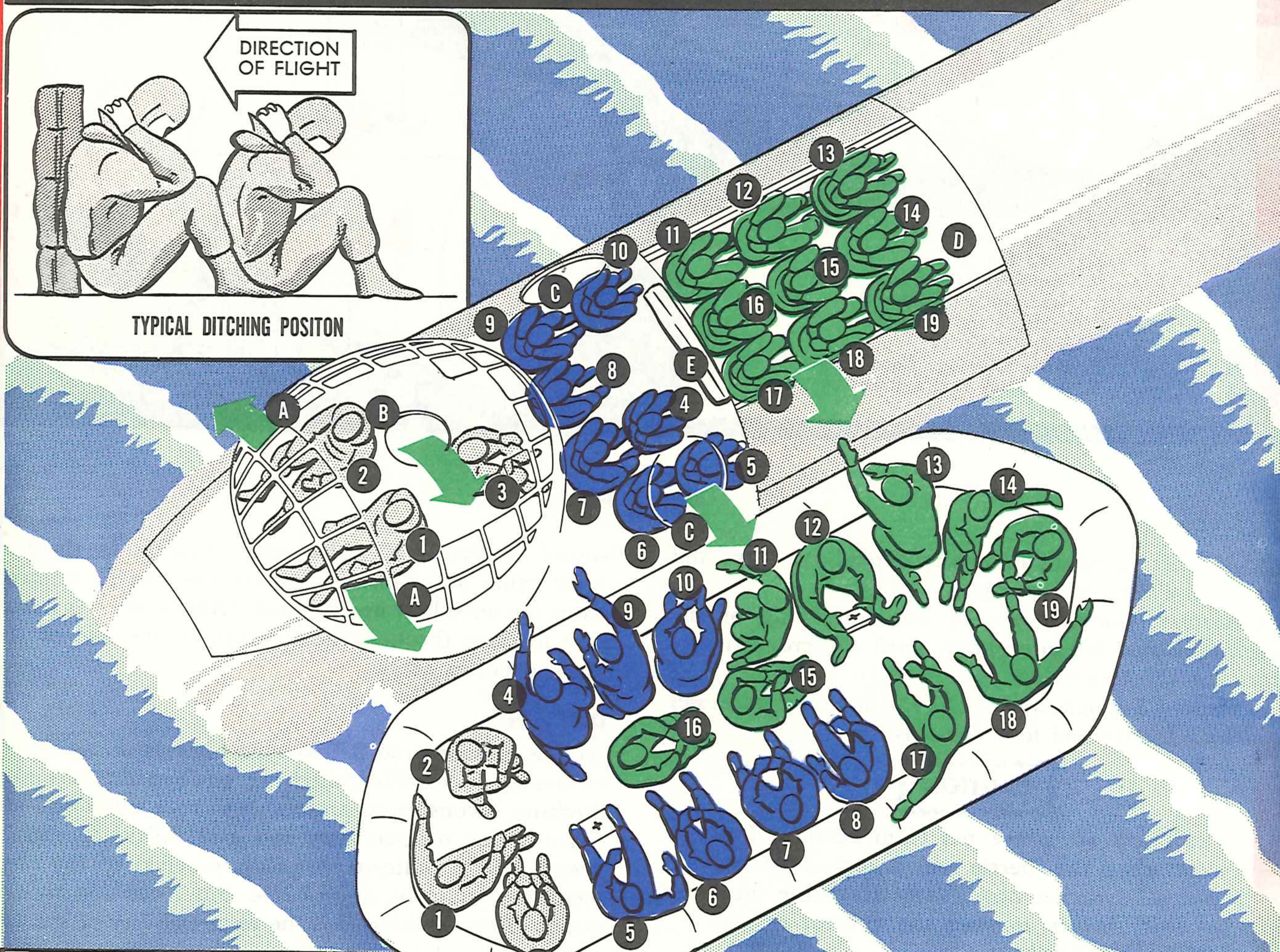
One type F-2A 20-man life raft should be stowed in the forward turret bay.

A static line 30 feet in length should be provided for the raft to prevent its drifting free from the airplane after ditching. The static line must be attached to the raft in a manner that will cause the discharge of the inflating bottle when the line is pulled.

WARNING

The 30-foot static line must be cut after the life raft is loaded and the crew members are

Ditching POSITIONS & EXITS



*1. AIRCRAFT COMMANDER	8. RADAR OBSERVER	13. TAIL GUNNER	A. PILOTS' ESCAPE HATCH
2. PILOT	9. FIRST RADIO OPERATOR	14. LOWER RIGHT SCANNER	B. ENGINEERS' ESCAPE HATCH
3. FIRST ENGINEER	10. SECOND RADIO OPERATOR	15. ECM OBSERVER (M.F.)	C. FORWARD ESCAPE HATCHES
4. SECOND ENGINEER	11. WEATHER OBSERVER	16. ECM OBSERVER (L.F.)	D. TURRET BAY
5. COPILOT	12. LOWER LEFT SCANNER	17. FIRST PHOTOGRAPHER	E. RAFT STOWAGE
6. PRIMARY NAVIGATOR		18. ECM OBSERVER (I.F.)	
7. PHOTO-NAVIGATOR		19. ECM OBSERVER (H.F.)	*RAFT COMMANDER

72-111-A

Figure 3-9.

aboard to prevent the sinking airplane from pulling the raft under.

CAUTION

Be careful to prevent entanglement of the static line which might result in inflation of the life raft before its ejection.

A Gibson Girl radio should be stowed on the floor of the radio operator's compartment. Two static lines and a G-8 aerial delivery-type parachute shall be provided for the radio. The static lines serve the same purpose as the one provided for the life raft.

Before Approach.

When ditching becomes imperative, give the crew warning over the interphone and also by six short rings of the alarm bells. Crew members not actively engaged in controlling the airplane should jettison loose equipment and any objects which might fly loose on impact. When jettisoning is completed, crew members must assume the positions shown in figure 3-9 for ditching.

All crew members should remove their flak suits and parachutes. The one-man rafts should be removed from the parachutes and stowed for later use. The crew must don R-1 anti-exposure suits, flak helmets, emergency kits, life vests, and gloves. Neckties should be loosened.

The weather observer, aft scanners, tail gunner, first photographer, and ECM observers will use the forward turret bay positions for ditching. Entrance to the turret bay is made through the turret access door in the camera compartment. The life raft in the turret bay must be placed vertically against the forward wall of the turret bay so that it will cushion the shock of the impact for the crew members.

Note

One man in the upper forward turret bay is required to have his headset plugged into the interphone control panel located at the first photographer's station.

All crew members except the aircraft commander and the pilot shall sit facing aft with their hands clasped behind their heads to prevent snapping their necks on impact. They should use their parachutes and all available padding for their backs. The crew members in the turret bay should sit in three-man tandems, with the back men braced against the life raft. All upper escape hatches, pilots' windows, and the engineer's escape hatch must be removed and the hatches stowed prior to impact. After the impact each man must take his one-man life raft when he leaves the airplane.

Crew Responsibilities.

When a decision is made to ditch the airplane, each crew member must follow the procedures as outlined in the following paragraphs.

Aircraft Commander.

1. Duties before impact:

a. Warn pilot, "Prepare for ditching in——— minutes."

b. Give 6 short rings on the alarm bells.

c. Order pilot, "Open emergency exits and jettison loose equipment." Open canopy window and jettison if possible.

WARNING

If notified turret doors fail to open: place as many men as possible in radio compartment and balance in camera compartment; place 20-man raft against bulkhead 3 in radio compartment. Second engineer will remain on flight deck.

d. Fasten safety belt and shoulder harness.

e. Radio other craft of your distress, giving position and time of ditching. Have the radio operator broadcast a position report and turn the IFF switch to EMERGENCY.

f. Order Pilot—"Stations for ditching. Impact in ———minutes." Have pilot obtain weight from engineer and figure stalling speed.

g. About five seconds before impact, give order: "Brace for impact." Have the pilot give one long ring on the alarm bell.

h. Instruct engineer to complete ditching configuration.

i. Just before impact have pilot pull emergency ignition switch.

2. Ditching Position:

a. Lower seat and push rearward. Brace feet on rudder pedals with knees flexed and hands on control wheel after locking inertia reel.

CAUTION

The pilots are prevented from bending forward when the inertia reel is locked; therefore, all switches not readily accessible must be "cut" before moving the control to the LOCKED position.

3. Duties after impact:

a. Check to see that the crew is clear, throw out one-man life raft, and exit through the left canopy window.

b. Take command of the 20-man raft. Supervise removal of injured crew members and the securing of emergency equipment aboard the raft. Guide the raft a safe distance from the airplane.

Pilot.

1. Duties before impact:

a. Relay the aircraft commander's instructions to the crew. Receive acknowledgements and notify the aircraft commander, "Crew notified."

b. Open the window; jettison, if possible.

c. Fasten shoulder harness and safety belt.

d. Stand by on interphone to relay aircraft commander's orders to crew. Check progress of crew in jettisoning equipment. A minimum of one minute before impact, order radio operator to clamp down key and assume ditching position. Relay command, "Brace for impact." Send one long ring on the alarm bells.

e. On aircraft commander's order, have engineer close tank valves and turn ignition switches OFF.

2. Ditching position:

a. Lower seat and push rearward. Brace feet on rudder pedal stand with knees flexed, left hand on left knee, and right hand braced against the right window frame after locking inertia reel.

CAUTION

The pilots are prevented from bending forward when the inertia reel is locked; therefore, all switches not readily accessible must be "cut" before moving the control to the LOCKED position.

3. Duties after impact:

a. Throw out one-man life raft, exit through the right window, and proceed to 20-man raft.

b. Assist aircraft commander in supervising removal of injured crew members and emergency equipment.

Copilot.

1. Duties before impact:

a. Acknowledge ditching order if on interphone. If not on interphone, relay acknowledgement through someone else.

b. Remove upper left escape hatch and pass to the nose section.

c. Remove and jettison the low frequency ECM operator's chair. Take the first aid kit from left side of radio compartment and secure to arm.

2. Ditching position:

a. Seated on floor on left side of radio compartment facing aft with back to primary navigator's knees. Clasp hands behind head to prevent snapping neck.

b. The parachute will be used for padding. The one-man raft may be used as padding or may be held on lap.

3. Duties after impact:

a. Take one-man raft and exit through the upper left escape hatch to the 20-man raft.

b. Assist injured crew members and aid in stowing equipment in raft.

First Engineer.

1. Duties before impact:

a. Acknowledge ditching order.

b. If ditching is necessary because of insufficient fuel, estimate the remaining time aloft and inform aircraft commander and naivgator.

c. Fasten safety belt.

d. Obtain a fuel configuration of the most outboard tank in each wing feeding the three engines in that wing, then close the cross-feed valve and the necessary manifold valves.

e. On aircraft commander's command, "Complete ditching configuration": CLOSE the tank valves; all hold-in switches—IN; mixture control levers—IDLE CUT-OFF; ignition switches—OFF; battery switch—OFF.

2. Ditching position:

a. In the first engineer's seat facing aft with hands clasped behind head to prevent snapping the neck on impact.

3. Duties after impact:

a. Take all necessary equipment and exit through the engineer's escape hatch to 20-man raft.

b. Assist injured crew members and aid in stowing equipment aboard raft.

Second Engineer.

1. Duties before impact:

a. Acknowledge ditching order.

b. Assist first engineer.

c. Assist in jettisoning loose equipment.

d. On command, remove the engineer's escape hatch and pass it to the nose compartment.

2. Ditching position:

a. Seated on left side of radio compartment, facing aft, with back to photo-navigator. Clasp hands behind head to prevent snapping neck. Use all available padding.

3. Duties after impact:

a. Obtain necessary emergency equipment.

b. Exit through engineer's escape hatch to the 20-man raft.

Primary Navigator.

1. Duties before impact:

a. Acknowledge ditching order.

b. Through coordination with the aircraft commander and the engineer, calculate the course, altitude, ground speed, and probable position of ditching. Give this information and an accurate Loran line to the radio operator so that he may broadcast a position report.

c. Inform aircraft commander of surface wind speed and direction.

d. Destroy classified documents and material and aid in jettisoning all loose equipment. Gather essential maps and navigation equipment, including the octant if possible, into water-tight bags or tuck into clothing.

e. Take first aid kit from table and secure to arm.

2. Ditching position:

a. Seated on left side of radio compartment floor, facing aft. Use all available padding. Clasp hands behind head to prevent snapping neck.

3. Duties after impact:

a. Assist in ejecting emergency equipment through upper left escape hatch.

b. Take necessary equipment and exit from hatch into the 20-man raft.

c. Assist injured crew members and aid in stowing equipment aboard the raft.

Photo-Navigator.

1. Duties before impact:

a. Acknowledge ditching order.

b. If time permits, salvo remaining bombs. Do not open bomb bay doors except to salvo bombs. Do not drop bomb bay fuel tanks if empty. Make certain bomb bay doors close. Take left forward hatch from copilot and stow in the nose. Pass bombsight back for jettisoning.

c. Destroy all classified equipment and documents.

d. Take first aid kit from left side of radio compartment and secure to arm. Stow knife in clothing.

2. Ditching position:

a. Seated on floor of radio compartment between the primary navigator and the radar observer. Face aft with hands clasped behind head to prevent snapping neck. Use parachute and other available padding for back. Use one-man life raft as padding or hold on lap.

3. Duties after impact:

a. Exit through upper left escape hatch to 20-man raft. Assist injured crew members and aid in stowing equipment aboard raft.

b. Assist navigator in removal of navigation equipment.

Radar Observer.

1. Duties before impact:

a. Acknowledge ditching order.

b. Destroy classified documents and materials.

c. Assist in removing upper right escape hatch and pass to nose section. Remove and jettison all loose equipment.

d. Take first aid kit from the position on the ECM racks and secure to arm.

2. Ditching position:

a. Seated on floor of radio compartment on right side of fuselage between first radio operator and photo-navigator. Face aft and clasp hands behind head to prevent snapping neck. Use parachute and all available padding for back. Use one-man raft for padding or hold on lap.

3. Duties after impact:

a. Obtain necessary emergency equipment and a water jug. Throw out one-man raft and exit through left or right escape hatch to the 20-man raft.

b. Assist injured crew members and aid in stowing equipment aboard raft.

Weather Observer.

1. Duties before impact:

a. Acknowledge ditching order.

b. Proceed directly to the forward turret bay. Connect interphone extension cord to first photographer's interphone panel for contact with other compartments.

2. Ditching position:

a. Seated against forward bulkhead on right side of forward turret bay, using 20-man raft for padding.

3. Duties after impact:

a. Assist in lowering the life raft into the water.

b. Proceed across the turret bay to the raft.

First Radio Operator.

1. Duties before impact:

a. Acknowledge ditching order.

b. Set IFF switch on EMERGENCY, if installed.

c. Transmit position, course, altitude, and ground speed as received from navigator. Relay fix or bearings and estimated time and position of ditching.

d. Destroy all classified material and documents.

e. Remain on interphone.

f. On command of pilot, screw down transmitter key.

2. Ditching position:

a. Seated on floor on right side of radio compartment next to radar observer. Face aft with hands clasped behind head to prevent snapping neck.

3. Duties after impact:

a. Throw out one-man raft, take Gibson Girl radio, and exit through upper left or right escape hatch to 20-man raft.

b. Assist injured crew members and aid in stowing equipment aboard raft.

Second Radio Operator.

1. Duties before impact:

a. Acknowledge ditching order.

b. Open the forward turret doors.

WARNING

If turret doors fail to open notify the aircraft commander.

c. Remove upper right escape hatch and stow in nose section.

d. Jettison first radio operator's seat.

e. Take first aid kit from forward right side of the radio compartment and secure to arm.

2. Ditching position:

a. Seated on the floor at the right side of the radio compartment facing aft, with back to first radio operator's knees. Clasp hands behind head to prevent snapping neck.

3. Duties after impact:

a. Take CRC-7VHF transmitter-receiver, water jug and one-man raft, and exit through the left or right upper forward escape hatch to the 20-man raft.

ECM Observer (L.F.).

1. Duties before impact:

a. Acknowledge ditching order, relay if necessary.

b. Aid in jettisoning loose equipment.

2. Ditching position:

a. Seated against forward bulkhead in forward turret bay, between weather observer and first photographer. Use 20-man raft for padding.

3. Duties after impact:

a. Assist injured crew members.

b. Throw out one-man life raft and assist in lowering the 20-man raft into the water.

c. Proceed to the 20-man raft and aid in stowing emergency equipment aboard raft.

First Photographer.

1. Duties before impact:

a. Acknowledge ditching order.

b. Remove upper forward turret bay access door and jettison. Remove and stow camera compartment escape hatch.

c. Jettison all loose equipment, camera magazines, side oblique camera, etc. from entrance hatch. *Make sure this hatch is closed securely when finished.*

d. Take first aid kit, secure to arm, and proceed into forward turret bay.

2. Ditching position:

a. Seated against forward bulkhead in forward turret bay, left side, using 20-man raft for padding.

3. Duties after impact:

a. Assist in lowering life raft from turret bay into the water.

b. Make sure that the drift line for the raft is fastened to the aircraft and that the raft cover has been partially opened.

c. Board 20-man raft, assist injured crew members, and aid in stowing equipment aboard raft.

ECM Observer (M.F.).

1. Duties before impact:

a. Acknowledge ditching order.

b. Assist in jettisoning all loose equipment in rear compartment. Destroy all classified material.

c. Proceed to forward turret bay through camera compartment, and assume ditching position.

2. Ditching Position:

a. Seated in the forward turret bay, with back to L.F. ECM observer's knees. Clasp hands behind head to prevent snapping neck.

3. Duties after impact:

a. Assist in launching 20-man raft, load emergency equipment, and board raft.

b. Assist injured crew members into raft.

ECM Observer (I.F.).

1. Duties before impact:

a. Acknowledge ditching order.

b. Assist in jettisoning all loose equipment in rear compartment. Destroy all classified material.

c. Assist tail gunner in stowing all food and liquid containers in A-3 bag.

d. Proceed to forward turret bay through the camera compartment and assume ditching position.

2. Ditching Position:

a. Seated in the forward turret bay, left side, with back to first photographer's knees. Clasp hands behind head to prevent snapping neck.

3. Duties after impact:

a. Assist in launching 20-man raft and board raft.

b. Assist in lowering injured crew members into raft and load emergency equipment.

ECM Observer (H.F.).

1. Duties before impact:

a. Acknowledge ditching order.

b. Assist in jettisoning all loose equipment in rear compartment. Destroy all classified material.

c. Remove first aid kit from under sighting platform and secure to arm.

d. Proceed to forward turret bay through the camera compartment and assume ditching position.

2. Ditching position:

a. Seated in forward turret bay, left side, with back to I.F. ECM observer's knees. Clasp hands behind head to prevent snapping neck.

3. Duties after impact:

a. Take emergency equipment and board 20-man raft.

b. Assist in lowering injured crew members into raft.

Lower Left Scanner.

1. Duties before impact:

a. Acknowledge ditching order.

b. Remove first aid kit from under sighting platform and secure to arm.

c. Take water jug and proceed to forward turret bay through the camera compartment. Assume ditching position.

2. Ditching position:

a. Seated in forward turret bay, right side, with back to weather observer's knees. Clasp hands behind head to prevent snapping neck.

3. Duties after impact:

a. Take water jug and board 20-man raft.

b. Assist injured crew members.

Tail Gunner.

1. Duties before impact:

a. Acknowledge ditching order.

b. Destroy all classified equipment and jettison loose equipment.

c. Remove first aid kit from under sighting station and secure to arm.

d. Remove all food and liquid containers and put in A-3 bag.

e. Take A-3 bag and proceed to forward turret bay through the camera compartment and assume ditching position.

2. Ditching position:

a. Seated in the forward turret bay, right side, with back to lower left scanner's knees. Clasp hands behind head to prevent snapping neck.

3. Duties after impact:

a. Take A-3 bag containing food and proceed to the 20-man raft.

Lower Right Scanner.

1. Duties before impact:

a. Acknowledge ditching order.

b. Remove first aid kit from above bomb bay entrance hatch and secure to arm.

c. Take water jug and proceed to forward turret bay through the camera compartment. Assume ditching position.

2. Ditching position:

a. Seated in forward turret bay, with back to M.F. ECM observer's knees. Clasp hands behind head to prevent snapping neck.

3. Duties after impact:

a. Take water jug and board 20-man raft.

b. Assist injured crew members.

Approach and Contact.

It is believed that ditching the airplane with 30-degree flaps while maintaining a 9-degree nose-high attitude at a low air speed will result in the most satisfactory procedure. This must be accomplished while power is still available in order to maintain the lowest possible rate of descent. The landing gear should be up and the bomb bay doors closed. Head the airplane parallel to uniform waves or swells. If the sea is irregular and confused, make the ditching into the wind. Aim for contact along the swell crest or just after the crest has passed.

BAIL-OUT.

If over uninhabited territory, all bail-outs should be made so that the crew will land in the same vicinity. If over water and surface vessels are below, the airplane should be headed so that the crew members will drift into the course of the vessel. A slow turn may be executed or two bail-out runs made, if necessary, to place the men close together. See figure 3-10 for emergency exits. Procedure varies according to conditions. If circumstances permit, descend to at least 10,000 feet and minimize forward speed. Over-water or polar bail-outs should be made with as much of the survival equipment as possible. When alerting the crew, it is advisable to remind them of their survival equipment. How to attach all survival equipment to the parachute should be stressed at practice drills. Successful bail-outs result chiefly from the intuitive action taken by the crew members under circumstances frequently unfavorable for clear thinking and logic. It is strongly recommended that frequent and thorough drills be performed at the aircraft to instill conditioned habits and to insure smoothness of performance of each man's duties.

When bailing out, it is essential to remember a few elementary points concerning the parachute.

1. If the bail-out is made at night, it is advisable to place your right hand very close to the rip cord since you must rely on feel alone.

2. If the bail-out is during daylight hours, place your right hand near the rip cord. When you are ready to open your chute, look to see where the handle is rather than depending upon feel.

3. Keep your legs together and your body straight with the elbows close in and the left hand holding the oxygen mask tight to the face.

4. If feasible, the best body position for you to attain at the time of opening is feet toward the ground with the back and chest style parachutes.

5. During an emergency jump, do not waste too much time attaining a particular body position. Delay long enough to be certain you have cleared the aircraft, then pull the ripcord.

Steps given below apply to standard unpressurized bail-out procedure:

1. Aircraft Commander—Perform the following:

a. Direct pilot to give "prepare to bail out" emergency signal: three short rings on the alarm bells, amplified by interphone warning.

b. Ascertain that crew members have completed special and general duties as outlined below.

c. Check parachute, bail-out bottle, goggles, gloves, and helmet with mask. Secure E-1 kit or dinghy to the parachute harness after leaving the seat. If over water, wear a Mae West under the chute.

2. Aircraft Commander—Order photo-navigator to

open bomb bay doors, salvo the bombs and bomb bay fuel tank if not over a populated area, and leave doors open.

3. Radio Operator—Transmit course, altitude, ground speed, and estimated position of bail-out as received from the navigator; turn IFF switch to EMERGENCY.

4. Observer—Remove left escape hatch and place it in the nose compartment.

5. First Photographer—Remove camera compartment escape hatch and stow.

6. Primary Navigator—Compute position report for radio operator.

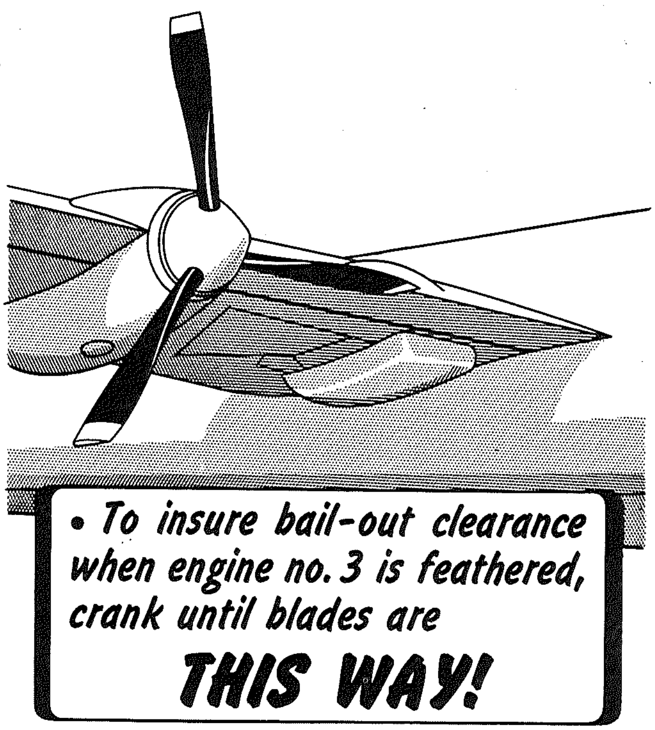
7. Crew—If time permits, destroy classified equipment.

8. Aft Cabin Scanners—Remove lower aft escape hatches. (See figure 3-6.)

9. Pilot—Give bail-out emergency signal on aircraft commander's direction: one long sustained ring on the alarm bells, amplified by interphone warning.

CAUTION

The No. 3 engine should not be feathered to position the propeller for bail-out unless sufficient altitude and power of other engines remain to enable successful abandonment of the aircraft.



All compartment commanders will report to the aircraft commander, "Compartment Clear." After determining that all crew members have bailed out, the aircraft commander will be free to abandon the aircraft after putting it on autopilot with a heading that will avoid populated areas.

To bail out of the recommended exit in the forward or aft cabin, the crew members sit at the escape hatch in a tight ball and roll out of the exit. This procedure will eliminate the possibility of being caught on the edge of the hatch.

Note

If time and condition permit, as many crew members as possible should bail out of the aft compartment since it is considered the safest.

When using the forward bomb bay for bail out, crew members should sit at the forward right side of the bay and roll out head first. Interphone contact between the bomb bay and the aircraft commander must be established before the bomb bay is used for bail out. Personnel using the wheel well for bail out should climb down the entrance ladder and jump from there.

HIGH ALTITUDE BAIL-OUT.

During high altitude bail-out the jumper is faced with three major problems:

1. Lack of oxygen.
2. Low temperatures.
3. High shock during opening of parachute.

If it becomes necessary to bail out at high altitude, every attempt should be made to ride the airplane down to at least 30,000 feet before bail out is attempted. During descent, the following steps should be taken:

Note

If bail out is necessary at extreme altitudes, refer to "Emergency Depressurization," Section IV.

1. If possible while the airplane is being depressurized, each crew member should remain at his station and breathe 100 per cent oxygen at the required setting for the corresponding altitude.
2. Helmet chin straps should be cinched, mask straps tightened, flying clothes and gloves secured, goggles put in place, and oxygen mask disconnect secured to parachute harness.
3. Bail-out bottles should be fastened to parachutes just above the accessory ring and connected to oxygen masks with oxygen hose under parachute harnesses.
4. Portable oxygen bottles should be used by crew members opening the emergency exits.

WARNING

Each crew member using a portable oxygen bottle will be closely watched by another crew member. At the first sign of anoxia, he will be returned to the ship's system and replaced by another man.

When the alarm bell rings and the interphone command is received for bail-out, each crew member should proceed as follows:

1. Take several deep breaths from the airplane's oxygen system.
2. Pull out the safety pin, actuate the bail-out bottles, and disconnect from the aircraft's oxygen system.
3. Go quickly to the designated escape hatch.
4. Place right hand near ripcord but not on it.
5. With the left hand holding mask to the face and with chin on chest, bail out.

Free Fall. (See figure 3-11.)

Remember, the average useful consciousness is about 15 seconds at 40,000 feet without oxygen. After clearing the airplane, straighten the body and keep the knees flexed and the elbows at the sides. The right hand should remain near the rip cord and the left hand on the mask as during bail-out. If the ground is visible, pull the rip cord to open the chute between 10,000 and 5000 feet (approximately two minutes after bail-out from 40,000 feet). At night or in weather conditions where the terrain is not visible, attempt to free fall for one minute before pulling the rip cord if bail-out is made from above 35,000 feet. When the parachute has opened, readjust and tighten the oxygen mask.

Note

> Some parachute assemblies are equipped with an automatic rip cord release. The release is preset by the parachute rigger for a time delay of 5 seconds and an altitude of 5000 feet above the highest terrain on the projected flight path. If you have a parachute with an automatic release, pull the arming knob (red ball on the left side of the harness just above the leg strap fastener) at the instant of bail-out. The automatic release will then release the parachute at the preset altitude. The automatic release does not interfere with the manual operation of the rip-cord.

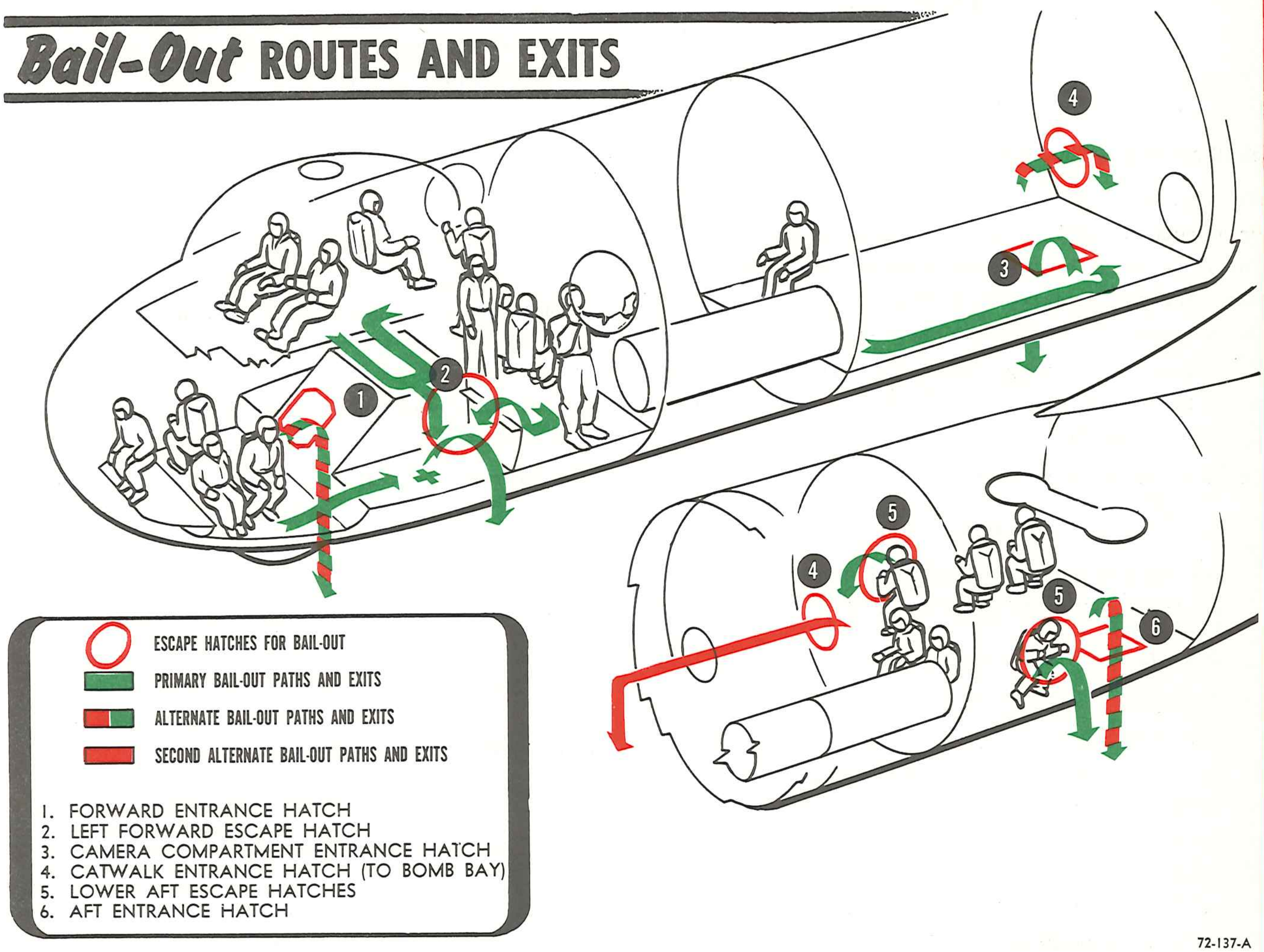
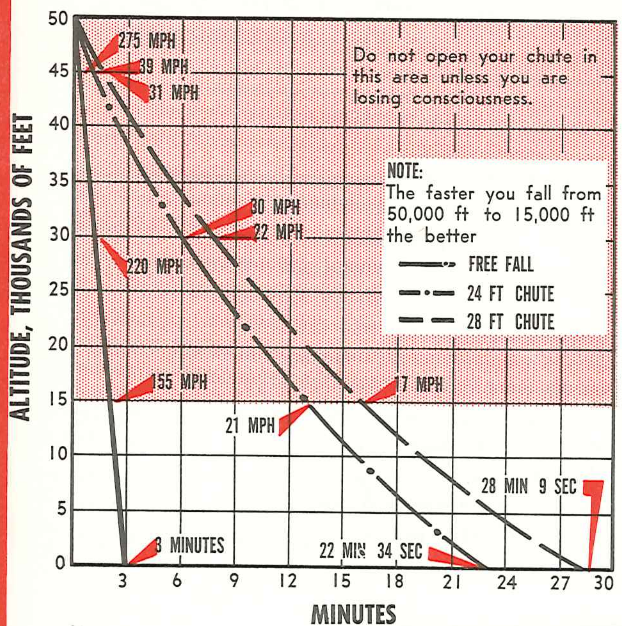


Figure 3-10.

VELOCITY OF DESCENT FROM 50,000 FT
FREE FALL AND WITH PARACHUTE



69-172-A

Figure 3-11.

OVERWATER BAIL-OUT.

The signals for bail-out over water are the same as for normal bail-out. Overwater bail-out from high altitude is made only in an extreme emergency and when time for preparation is limited. If time permits the crew should prepare as follows:

1. Necessary clothing and equipment will be donned in the order listed.

   a. Heavy clothing, if climatic conditions warrant.

   b. R-1 anti-exposure suit.

   Note

   Do not put on suit unless water temperature is approximately 52°F or below.

   c. B-5 life vest.

   d. Parachute.

   e. One-man life raft.

2. The second radio operator will bring the Gibson Girl radio from the forward cabin to the camera compartment. The first photographer, assisted by the co-pilot and second radio operator, will remove the F-2A 20-man life raft from the forward turret bay. They will carry it through the camera compartment access door to the photo compartment main entrance hatch. G-8 aerial delivery-type parachutes will be attached to the radio and the raft; static lines will be attached to the rip cord handles. The drift line for the raft will also be attached to the airplane at this position so the radio and raft can be jettisoned rapidly.

3. The drift lines will be attached to the raft lanyard to insure inflation of the raft when jettisoned. This enables the crew members to retrieve the raft when they are afloat.

Note

The life raft cover should be partially unfastened prior to jettisoning to insure easier inflation.

4. On bail-out order, the raft and the radio will be jettisoned from the camera compartment and half of the crew will bail out. Then, the remainder of the crew will bail out.

5. Upon contact with the water the crew member will:

   a. Release canopy if equipped with a quick release.

   b. Get clear of harness.

   c. Inflate life vest.

   d. Inflate one-man raft.

   e. Enter one-man raft from low end.

POLAR BAIL-OUT.

Since most of the polar flights are over desolate, frozen country, the E-1 kit has been designed to fasten to your parachute harness in the same manner as the dinghy. For bail-out over remote areas, and when time permits, the following items should be put on over your regular flying clothes in the order listed:

1. Emergency survival vest buttoned tight. (Either C-1 vest or E-1 kit, not both.)

2. Rubberized anti-exposure suit fitted snugly around the face, if there is the slightest chance of landing in water.

3. Parachute. Fasten the E-1 kit to your parachute harness. Because of the weight and bulk of the kit, it can be attached most easily by sitting on it and then snapping to the harness.

FUEL AND OIL SYSTEMS.

ENGINE-DRIVEN FUEL PUMP FAILURE.

The loss of an engine-driven fuel pump will result in a sharp decrease in fuel pressure and a loss in torque pressure. If this occurs, determine whether or not the engine is delivering enough power to carry itself; if not, feather the propeller. Additional power may be obtained by use of the engine primer in an emergency.

MANUAL OPERATION OF FUEL AND OIL VALVES.

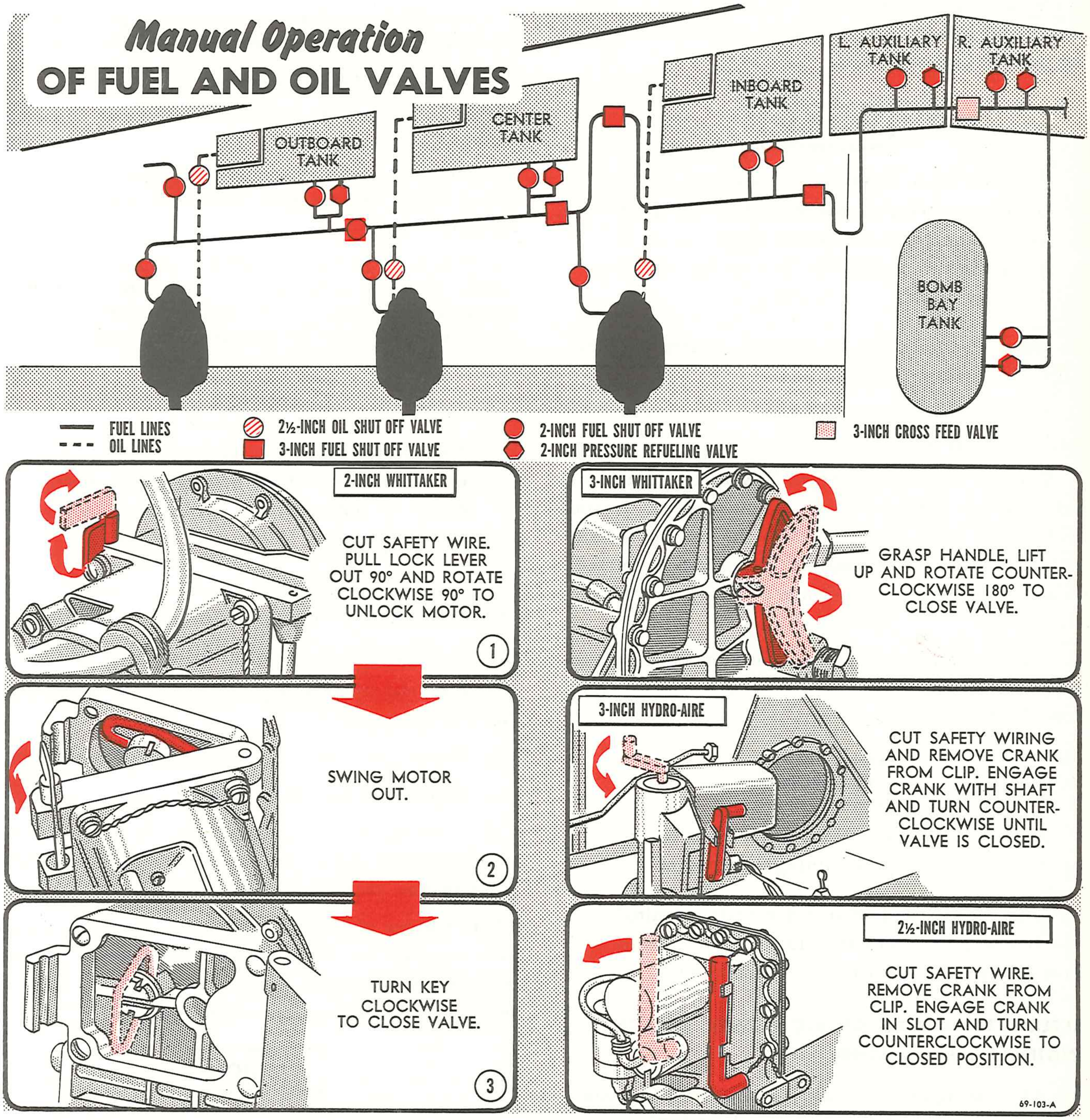
If electrical failure or unit malfunction should prevent normal operation of the fuel and oil shutoff valves, they can be operated manually. (See figure 3-12.) The jet engine fuel and oil shutoff valves and the oil shutoff valve for reciprocating engine No. 6 are inaccessible during flight. The cross-feed valve and the bomb bay tank valves are accessible from the catwalk. The other valves are accessible from the wing crawlway.

ELECTRICAL SYSTEM.

EXCESSIVE ELECTRICAL LOADS.

At the first indication of an unusual or excessive electrical load for which no correction is immediately evident, perform the following steps as rapidly as possible:

1. All four bus tie-breaker switches—OPEN.



69-103-A

Figure 3-12.

Note

To allow more rapid diagnosis, completely isolate the four buses. Bus isolation will insure that power is still available on normal buses. A faulted bus will be indicated by a high kilowatt reading. Any load division malfunction will be eliminated by bus isolation. See Section VII, "Chart For Electrical System Trouble Shooting" for probable causes and remedies.

2. Immediately de-excite any alternator that is carrying too much load, (kwatt or kvar), or that is fluctuating over 10 cycles or volts.

CAUTION

If it becomes necessary to de-excite No. 5 alternator (which feeds bus 501), the engineer's fuse panel a-c power switch must be placed in the ALTERNATE position. (Check indicator light.)

3. Check the frequency and voltage control and stability of remaining isolated buses.

4. Reduce all electrical loads to a practical minimum until diagnosis is complete.

5. Connect adjacent operative bus to the dead bus and note for excessive loads or fluctuations. If the dead bus is clear of fault, allow the bus to remain energized. If excessive loads or fluctuations are noted, isolate immediately and do not restore power to the affected bus.

6. Place the selector switch between the two buses to be connected. When the synchronizing lamps are dark, close the bus tie-breakers.

CAUTION

Restore only essential electrical loads to prevent overloading remaining alternators.

7. If check as stated in step 5 reveals a faulted bus, that bus and its alternator must be left isolated and must not be used until the fault is cleared.

ALTERNATE SOURCE OF A-C POWER FOR THE ENGINEER'S FUSE PANEL.

Should it be determined that a-c power for the engineer's fuse panel has been disrupted, as indicated by the lack of power for such critical items as mixture controls, spark advance, turbosuperchargers, anti-icing, cabin pressure, etc., check the indicator lamp on the engineer's fuse panel to see whether power is being supplied to that panel. If the lamp is not burning, place the fuse panel a-c power switch in the ALTERNATE position. If there is still no indication of power, check the feeder fuses in the left and right cabin power panels.

EMERGENCY ELECTRICAL POWER OPERATION.

Restoring Normal Electrical Power.

If a complete loss of normal alternator power occurs, the following operating procedure will be followed:

1. All bus tie-breakers OPEN.

2. De-excite only the alternators indicating abnormal readings.

3. Recheck to insure that the alternator breaker indicating lamps of previously paralleled alternators are lighted.

4. Reduce a-c and d-c electrical loads to a minimum. Notify all crew members that the battery switch is going to be turned OFF, rendering the interphone inoperative; then turn the battery switch OFF.

CAUTION

If the battery switch is left ON, the d-c load requirements will drain battery power which should be conserved for operation of essential equipment.

5. Turn the voltage and frequency selector switch to any alternator which is excited or will excite.

6. Re-excite this alternator as follows:

a. Place the emergency power control in the EMERGENCY position.

b. Momentarily hold the exciter control switch ON.

c. Adjust voltage and frequency to normal.

d. If voltage and frequency cannot be adjusted, momentarily hold the exciter control switch in the OFF position and proceed to another alternator.

7. If voltage and frequency can be adjusted to normal, connect the alternator to its respective bus by holding the alternator breaker switch in the CLOSE position until the indicator lamp goes out.

CAUTION

The kilowatt-kilovar meter should be observed closely while connecting the alternator to the respective bus to assure that an overload condition does not exist. If the kilowatt-kilovar meter indicates that the overload condition exists, the bus is faulted and cannot be used until the fault is cleared. In this case, the alternator should be removed from the line immediately and care exercised to keep the faulted bus disconnected from the rest of the electrical system.

8. Return the emergency power control to NORMAL.

CAUTION

Do not leave alternator selector switch in any bus position with an alternator on the line while switches are in EMERGENCY.

9. After the above procedure is accomplished for each alternator, parallel all working alternators using the bus tie-breakers. Use normal paralleling procedures except connect the voltage and frequency selector switch between the two buses to be paralleled. When the alternator synchronizing lamps are dark, close the bus tie-breaker switch connecting these two buses.

10. Battery switch ON.

Obtaining Emergency Electrical Power (Group 1 Airplanes).

When a-c power to the engineer's fuse panel is disrupted, the battery will automatically be disconnected from the d-c bus. Reconnect the battery to the bus by placing the battery switch in EMER ON.

CAUTION

Reduce d-c load requirements to a minimum before connecting the battery. This will conserve battery power for the operation of essential equipment.

If all a-c power is lost, place the emergency circuit selector switch in EMERGENCY to obtain power for operation of the pilots' directional and attitude gyros.

Note

Power for the gyros is available from the inverter regardless of the position of the battery switch. Direct current for the pilots' turn and bank indicator, the right hand pitot heater, and the normal interphone amplifier is also provided by this circuit.

Obtaining Emergency Electrical Power.

Note

On group 1 airplanes, an additional emergency power circuit is provided. This additional circuit can be utilized (refer to "Obtaining Emergency Electrical Power, Group 1 Airplanes" of this section) while emergency power is being obtained by the procedure described in this paragraph.

If attempts to get an alternator back on the line fail and there is an alternator capable of being excited, enough a-c and d-c power can be obtained to operate all d-c units, the pilot's attitude and directional gyros and, if installed, the turbo override controls. Proceed as follows:

1. Position the voltage and frequency selector switch to any alternator which will excite or which appears to be in underdrive.

Note

An underdrive condition may be verified by increasing or decreasing engine speed and noting that the frequency is proportional to engine rpm.

2. Place the emergency power control in the EMERGENCY position.
3. Momentarily hold the exciter control relay switch ON.
4. Place the pilot's flight instrument switch in the EMERGENCY position.
5. Restore only essential d-c loads.

WARNING

Do not permit the d-c load to exceed 1.0 (50 amperes) as indicated on the loadmeter of the transformer-rectifier test unit, when selected to the RADIO OPERATOR position. An overload can damage the t-r unit with a resulting loss of emergency power. In this event, the radio operator's t-r unit can be replaced with another t-r unit even during pressurized flight.

RELEASING THE CONSTANT-SPEED DRIVE FROM UNDERDRIVE.

If the constant-speed drive goes into underdrive, proceed as follows:

CAUTION

If the alternator overspeeds and does not go into underdrive, feather the engine immediately to avoid alternator disintegration.

1. Open the alternator breaker.

CAUTION

Prolonged motoring of the alternator may damage the override clutch in the drive.

2. Shut down the engine.

Note

When the engine is feathered, the overspeed control will automatically reset itself.

3. Turn the frequency control knob fully counterclockwise to avoid overspeeding of the drive when the engine is restarted.

4. Start the engine and advance the throttle to obtain 1150 to 1200 rpm. This will hold alternator speed within safe limits in the event the cause of overspeeding still exists.

5. If frequency control is normal and the cause of overspeed no longer exists or if the overspeed control puts the alternator in underdrive again, resume normal operation of the engine.

Note

If the alternator stays in underdrive, full rated alternator power may be obtained by increasing engine rpm to approximately 2800 to obtain a minimum of 360 cycles.

ALTERNATOR MOTORING.

The free-wheeling element in the constant-speed drive permits motoring of the alternator, for short periods of time, as indicated by low or negative kilowatt indications; however, if the alternator has motored continuously for approximately 5 minutes and attempts at adjusting the alternator have failed, OPEN the affected alternator breaker.

CAUTION

Do not feather the affected engine. This action is not necessary since opening the alternator breaker protects the electrical system and the shear section of the constant-speed drive protects the engine in the event that the motoring was caused by internal drive failure.

ALTERNATOR FIELD FLASHING.

Extreme fluctuations of voltage during alternator excitation may be the result of improper voltage regulation caused by reversed alternator exciter field polarity. If this condition exists, flash the alternator field in the following manner:

1. Isolate the affected alternator by placing the alternator breaker switch in the OPEN position. Check to see that the alternator breaker indicator lamp is lighted.

2. Check that the alternator field flashing circuit breaker is engaged.

3. De-excite the alternator and flash the field by momentarily holding the exciter control relay switch in the OFF position.

4. The alternator field is now flashed, and the alternator is ready for excitation.

5. If the extreme fluctuations continue when the alternator is excited, flash the field again.

6. If the malfunction persists, repeated use of the flashing circuit is not recommended.

EMERGENCY FLIGHT PROCEDURE IN THE EVENT OF A COMPLETE FAILURE OF A-C POWER.

A complete failure of all four alternators to the extent that not even one can be excited constitutes an extreme emergency. The battery switch must be placed in the OFF position immediately and only be turned to the ON position when an engine rpm change is desired. All electrical switches throughout the aircraft must be placed to the OFF or neutral position in order to conserve the battery.

This type of electrical failure would most probably occur during a cruise condition; but regardless of when it occurs, every precaution must be taken by the aircraft commander and the engineer to control the engines so as not to cause engine failures before a successful landing is accomplished.

If cruise is required before reaching a landing field, and the electrical failure occurred when cruise power was set, leave the engine controls as they were when the electrical failure occurred. The engineer would have no indication of the engine power since all autosyn instruments (torque pressure, manifold pressure, CHT, CAT., and fuel flow) would be inoperative.

Note

For airplanes in Group 1, refer to "Engine Instrument Trouble Shooting," Section VII.

Air speed would be the best indication of the power settings of the engines. If the air speed is excessive, retard the throttles. If the air speed is too low, increase the engine rpm gradually by intermittent use of the battery and propeller selector switches. Because the waste gates should remain where they were at the time of the electrical failure, engine power may be varied by gradual changes in engine rpm and throttle settings.

If a descent of several thousand feet is to be made and a relatively low engine rpm was set at the time of electrical failure, the rpm must be increased occasionally by intermittent use of the battery and the propeller selector switches in the descent. This is due to the more dense air at lower altitudes which would tend to automatically decrease the engine rpm (approximately 50 rpm decrease for each 1000-foot descent). Continue to hold the desired rpm throughout the descent by intermittent use of the battery and propeller selector switches at 5000-foot increments and control air speed by use of the throttles. As the aircraft approaches the landing pattern altitude, *gradually increase* the rpm to 2550 and continue to adjust the throttles to maintain the desired air speed. This procedure will prevent exceeding the engine limitations to destructive values even if the waste gates are closed more than they normally would be. Extreme care must be exercised when increasing the engine rpm since the manifold pressure is dependent upon the waste gate position. As the rpm is increased, RETARD the throttle at the same time and cross reference cylinder head temperature. A safe landing can be accomplished even if the engines were in advanced spark and manual lean at the time of the complete electrical failure. By constant surveillance of air speed and adjustment of the throttles, the engines would be operating at a reasonably low bmep which would "cushion" the manual lean and spark advance settings.

The aircraft commander will order the landing gear extended by use of the emergency hand pump and selector valve in the radio compartment.

CAUTION

The emergency reservoir must be reserviced after the landing gear is extended. If this method of extension is unsuccessful the aircraft commander will order a mechanical drop of the landing gear. The aircraft commander will accomplish the landing without the aid of the wing flaps and a "go-around" should not be attempted due to the high engine power requirements with these adverse conditions.

Reverse propellers may be used after touch-down by use of the battery and reverse pitch switches. A crew member will be standing by at the emergency hand pump in the radio compartment with the selector to the CHARGE BRAKE ACCUMULATOR position. The aircraft commander must use steady pressure on the brake pedals to conserve brake accumulator pressure. After the aircraft has stopped the engineer will shut down all engines by CLOSING all engine fuel valves and then turning the battery switch OFF. The aircraft commander will then set the parking brakes.

Note

The parking brakes can be set after the battery switch is turned off.

A-C POWER DISTRIBUTION TO CRITICAL EQUIPMENT.

The following table shows the power distribution from each main a-c bus to various equipment whose operation is considered essential for safety of flight.

BUS 201 (AC)

PANELS FED BY BUS 201

Engine No. 2 Power Panel
Engine No. 1 Power Panel
Left Pod Power Panel
Left Fwd Turret Power Panel
Left Fwd Cabin Power Panel
DECM Power Panel
Weather Observer's Control Panel (Some Airplanes)
28V A-C Power Panel
Radar Operator's Circuit Breaker Panel
Copilot's Circuit Breaker Panel
Photo Navigator's Circuit Breaker Panel
Photo Navigator's Switch Panel
LF ECM Operator's Circuit Breaker Panel
*Engineer's Fuse Panel
*Engineer's Control Panel & Table
*Jet Engine Control Panel

EQUIPMENT FED BY ABOVE PANELS

†Air Plug, Jet
†Aileron Trim Tab, L Wing
†Air Plug, Recip Eng Nos. 1 & 2
*Anti-icing, Cabin Heating and Tail
†Anti-icing, Jet Nos. 1 & 2
*Anti-icing, Wing
†Carb Preheat, Recip Eng Nos. 1 & 2
†Compass N-1
†Fan Speed, Recip Eng Nos. 1 & 2
†Fuel Booster Pump, Jet L Wing
†Fuel Booster Pump, L Aux Tank
†Fuel Booster Pump, L Outbd Wing Tank
†Flaps, L Outbd & L Center
†Gyro Horizon Indicator, Pilot's
†Hydraulic Pump No. 1, Main
†Ignition, Jet Nos. 1 & 2
Instruments, Jet Nos. 1 & 2
*Instruments, Recip Eng No. 1, 2, 3, 4, 5 & 6 (Some Airplanes)
Instruments, Recip Eng Nos. 1 & 2 (Some Airplanes)
†Intercooler, Recip Eng Nos. 1 & 2
*Mixture Control
†Oil Cooler Control, Recip Eng Nos. 1 & 2
*†Oil Cooler Override, Recip Eng Nos. 1, 2, 3, 4, 5 & 6
*Oil Valves, Jet No. 1, 2, 3 & 4 (Some Airplanes)
*Oil Valves, Recip Eng Nos. 1, 2, 3, 4, 5 & 6
†Omninavigational Receiver AN/ARN-14
*Pitot Heaters (Some Airplanes)
*Pod Preheat, Jet Engs.
*Spark Advance
*Throttle, Jet Engs.
Transformer Rectifier "A", Camera Compartment
Transformer Rectifier "B", Camera Compartment
Transformer Rectifier, Radar Observers
*†Turbo Override Control
*Turbo Select, Recip Eng Nos. 1, 2, 3, 4, 5 & 6
Vertical Gyro, Pilot's
†Water Injection, Recip Eng Nos. 1 & 2
28V A-C Power System, Fwd Cabin
Flight Cabin Interior Lights
Flight Deck Flood Lights
†Landing Lights

*Alternate power source through Engineer's Alternate Power Switch
†Equipment requiring AC and DC power for operation

BUS 301 (AC)

PANELS FED BY BUS 301

Engine No. 3 Power Panel
Left Aft Turret Power Panel
Left Aft Cabin Power Panel

EQUIPMENT FED BY ABOVE PANELS

†Air Plug, Recip Eng No. 3
†Carb Preheat, Recip Eng No. 3
†Fan Speed, Recip Eng No. 3
†Flap, L Inbd
†Fuel Booster Pump, L Center Wing Tank
†Fuel Booster Pump, L Inbd Wing Tank
Instruments, Recip Eng No. 3
†Intercooler Control, Recip Eng No. 3
†Oil Cooler Control, Recip Eng No. 3
Transformer Rectifier, Aft Cabin
Transformer Rectifier No. 1, Bomb Bay
†Water Injection, Recip Eng No. 3

BUS 401 (AC)

PANELS FED BY BUS 401

Engine No. 4 Power Panel
Bomb Bay Lighting Control Panel
Right Aft Turret Power Panel
Right Aft Cabin Power Panel

EQUIPMENT FED BY ABOVE PANELS

†Air Plug, Recip Eng No. 4
†Carb Preheat, Recip Eng No. 4
†Fan Speed, Recip Eng No. 4
†Flap, R Inboard
†Fuel Booster Pump, R Center Wing Tank
†Fuel Booster Pump, R Inbd Wing Tank
Hydraulic Pressure Indicator
Instruments, Recip Eng No. 4 (Some Airplanes)
†Intercooler Control, Recip Eng No. 4
†Oil Cooler Control, Recip Eng No. 4
†Water Injection, Recip Eng No. 4
26V A-C Power System, Aft Cabin

BUS 501 (AC)

PANELS FED BY BUS 501

Engine No. 5 Power Panel
Engine No. 6 Power Panel
Right Pod Power Panel
Right Fwd Turret Power Panel
Right Fwd Cabin Power Panel
Engineer's Fuse Panel
Engineer's Control Panel & Table
Jet Control Panel

EQUIPMENT FED BY ABOVE PANELS

†Aileron Trim Tab, R Wing
†Air Plug, Recip Eng Nos. 5 & 6
†Air Plug, Jet Nos. 3 & 4
Anti-icing, Cabin Heating & Tail
†Anti-icing, Jet Nos. 3 & 4
Anti-icing, Wing
†Carb Preheat, Recip Eng Nos. 5 & 6
Directional Gyro, Copilot's
Fan Speed, Recip Eng Nos. 1, 2, 3, 4, 5 & 6 (Some Airplanes)
†Fan Speed, Recip Eng Nos. 5 & 6
†Flaps, R Outbd & R Center
†Fuel Booster Pump, Jet R Wing
†Fuel Booster Pump, R Wing Aux Tank
†Fuel Booster Pump, R Outbd Wing Tank
†Hydraulic Brake Pump
†Hydraulic Pump No. 2, Main
†Ignition, Jet Nos. 3 & 4
Instruments, Jet Nos. 3 & 4
Instruments, Recip Eng Nos. 1, 2, 3, 4, 5 & 6 (Some Airplanes)
Instruments, Recip Eng Nos. 5 & 6 (Some Airplanes)
†Intercoolers, Recip Eng Nos. 5 & 6
Lighting, Engineer's Instrument Panel
Lighting, Pilots & Copilot's Instrument Panel
Mixture Control
†Oil Cooler Control, Recip Eng Nos. 5 & 6
†Oil Cooler Override, Recip Eng Nos. 1, 2, 3, 4, 5 & 6
Oil Valves, Jet (Some Airplanes)
Oil Valves, Recip Eng Nos. 1, 2, 3, 4, 5 & 6
Pitot Heaters (Some Airplanes)
Pod Preheat, Jet Engs.
Spark Advance
Throttle, Jet Nos. 1, 2, 3 & 4
Transformer Rectifier No. 2, Bomb Bay
Transformer Rectifier, Copilot's
Transformer Rectifier "C", Camera Compartment
Transformer Rectifier, Radio Operator's
†Turbo Override Control
Turbo Regulator Control
Vertical Gyro, Copilot's
†Water Injection, Recip Eng Nos. 5 & 6

*Alternate Power source through Engineer's Alternate Power Switch
†Equipment Requiring AC and DC power for operation

WING FLAPS.

At any time a pair of flaps fails to extend or retract normally it will be necessary for someone to operate the emergency switches on the alternate flap control panel near the right wing crawlway entrance. The following steps should be accomplished to raise or lower the flaps in an emergency:

1. Plug in a headset at the alternate flap control panel to establish interphone contact with the pilots and scanners.

Note

In some airplanes it will be necessary to turn the wing crawlway lights and interphone switches to the ON position to utilize this jackbox.

2. Hold the proper alternate flap control selector switch in the UP or DOWN position, depending on the flap movement desired.
3. With the aft cabin scanners checking flap position, hold the proper master flap control selector switch in the spring-loaded ALTERNATE position.
4. If the synchronizing system is completely inoperative, proper flap positioning will depend on the judgment of the scanners.
5. For landing, set flaps at 20 degrees and land in this configuration.

WARNING

Do not lower flaps to 30 degrees since flaps cannot be raised quickly in the event of go-around.

If the synchronizing system is operative and you move the lagging flap approximately two and one-half degrees past the position of the symmetrical good flap, the scanners will notice that the good flap will follow with a jumping motion. To keep the flap settings at the required deflection, the scanner must inform you to release the switch at the first movement of the good flap. At this point, both flaps will be equal in deflection.

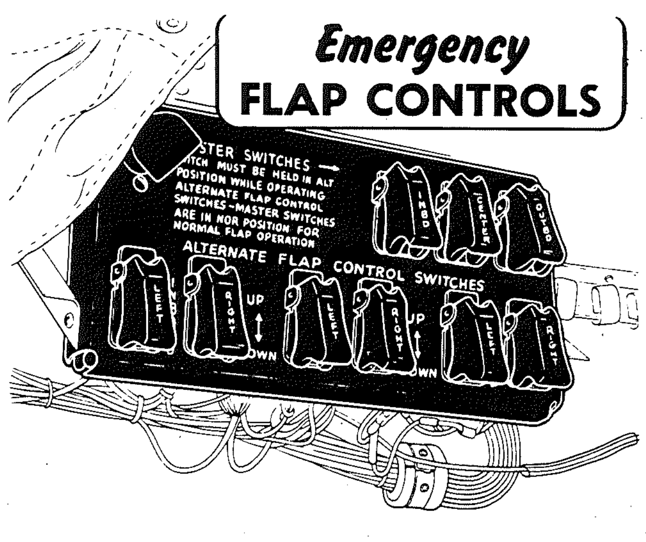


Figure 3-13.

Note

If the emergency flap control system is inoperative, check alternate flap panel circuit breaker switch at bulkhead 8.0 d-c power panel then check the fuses at the respective engine power panel of each flap. If the fuses are blown, replace them and attempt the emergency switches again before trying the normal system. If the emergency system works, do not use the normal system until maintenance can be accomplished. For further information, refer to "Emergency Operation of Electrical Equipment," Section VII.

EMERGENCY LANDING GEAR OPERATION.

If the landing gear fails to respond to the positioning of the landing gear control switch, three emergency methods are provided to effect landing gear operation. Emergency gear extension procedures should be attempted in the order listed, except when the main hydraulic reservoir is empty; in this case the first procedure should be omitted. These methods are as follows:

1. Manual Operation of Main Selector Valve.
2. Emergency Hydraulic Landing Gear Extension.
3. Manual Extension of Main and Nose Landing Gear.

Note

Gear retraction can be accomplished by the first method only. Extension can be accomplished by any of the three methods.

To determine the probable cause of normal control failure, proceed as follows:

1. Place the landing gear control switch in EXTEND or RETRACT as required.

Note

If no hydraulic pressure is indicated, the landing gear extend or retract relays may be inoperative.

2. Hold the hydraulic pump override switch ON.

Note

a. If there is no hydraulic pressure, check the main hydraulic reservoir fluid level and the main hydro pump fuses in the main a-c power panel.

b. If pressure is indicated, but the gear does not operate, a faulty electrical circuit to the selector valve may be the source of trouble.

3. Turn the landing gear control switch OFF and release the hydraulic pump override switch to OFF.

CAUTION

Do not operate the main hydraulic pumps more than two out of every ten minutes at maximum pressure since sustained operation will damage the pump motors.

Note

For further information, refer to "Emergency Operation of Electrical Equipment," Section VII.

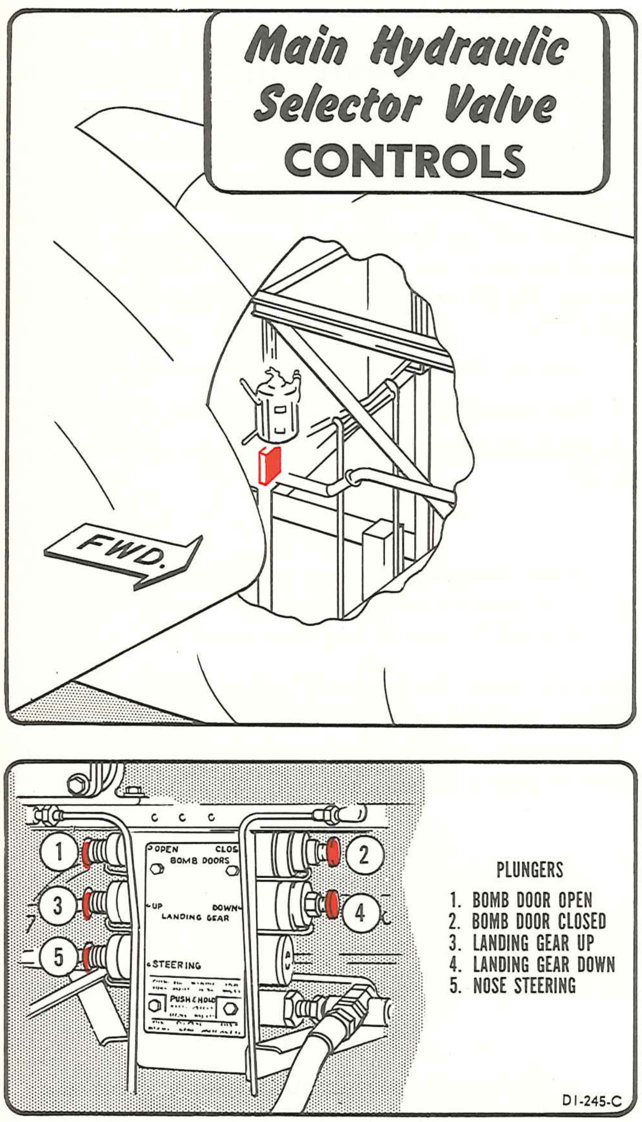


Figure 3-14.

MANUAL OPERATION OF MAIN SELECTOR VALVE.

1. Landing gear control switch—OFF.
2. Landing gear control circuit breaker—Pull out.

CAUTION

The preceding steps should be accomplished to prevent inadvertent operation of the gear.

3. Main selector valve—Push in and hold the UP or DOWN landing gear plunger, as desired.

CAUTION

The crew member operating the selector valve must be in interphone contact with the aircraft commander, engineer, and scanners, and must notify the engineer when he has positioned the valve plunger.

4. Hydraulic pump override switch—Hold ON until lower aft cabin scanners report, "Door open, gear coming down, door closed"; then turn OFF.

CAUTION

To prevent pump motor damage, limit the operation of the main hydraulic pumps to two minutes out of every ten minutes at maximum pressure.

Note

At any time normal gear sequence stops, the scanners will immediately report this condition over interphone.

5. Main selector valve—Release plunger when notified that gear action has been completed.

WARNING

To be sure the gear is down and locked, the aft scanners should visually check the position of the pink flourescent flag (figure 3-15) on each main gear side brace. The flags will not be visible when the gear is down and locked. Scanners will also notice a snapping motion of the latch link rod as it goes into the locked position.

6. Landing gear control circuit breaker—IN and check gear position indicator lights.

7. Nose gear—Checked visually down and locked by the radio operator.

EMERGENCY HYDRAULIC EXTENSION.

If the main hydraulic pumps fail to operate in response to the landing gear control switch or the pump override switch, use the following procedure to extend the landing gear:

1. Landing gear control switch—OFF.

2. Landing gear control circuit breaker—Pull out.

CAUTION

The preceding steps will prevent inadvertent operation of the gear. The crew member pumping the gear down must establish interphone contact with the aircraft commander and the scanners.

3. Emergency selector valve—Position at EXTEND LANDING GEAR.

WARNING

Make sure that the emergency selector valve is held in the detent position during landing gear extension to prevent rupture of the hydraulic lines.

4. Hand pump—Operate until the gear is down and locked. Pump vigorously for the first 10 cycles to position the shuttle valve. The nose gear usually extends first, the main gear doors open, and then the main gear extends.

Note

The main gear doors will remain down since they cannot be retracted by hand pump operation.

WARNING

If the green landing gear indicator light does not come on when the landing gear control

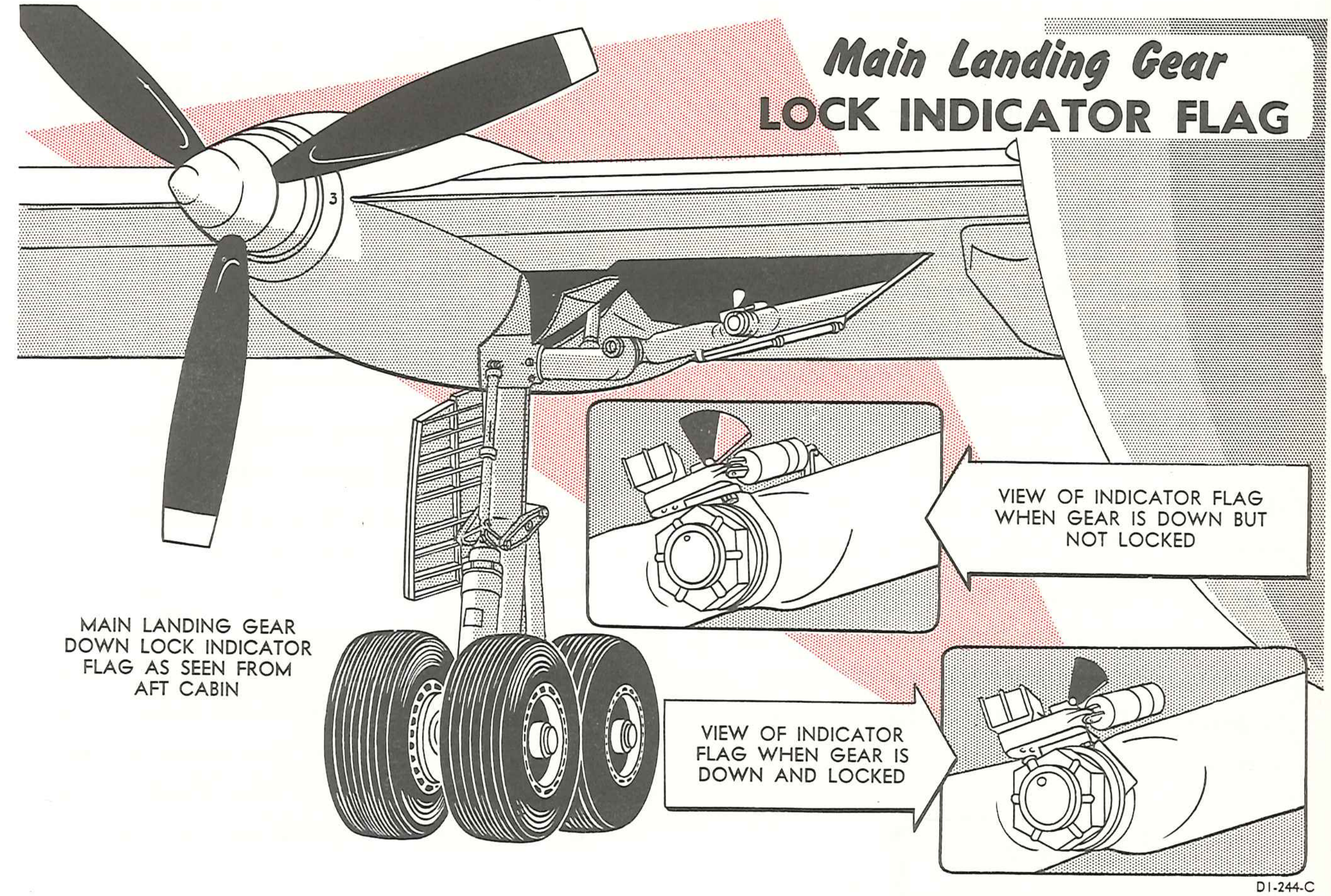


Figure 3-15.

Landing Gear & Brake EMERGENCY HYDRAULIC CONTROLS

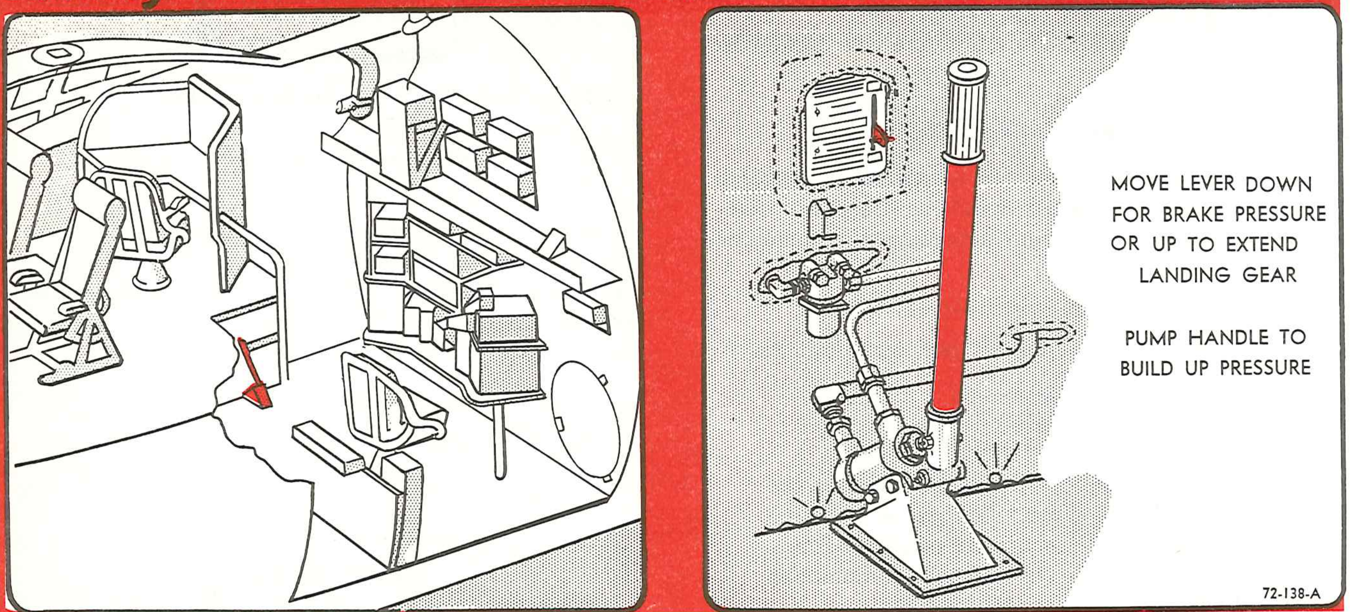


Figure 3-16.

circuit breaker is pushed in, make a visual check at the wing crawlway entrances to be sure the gear is down and locked.

5. Emergency selector valve lever—Return to the CHARGE BRAKE ACCUMULATOR position.

CAUTION

The emergency selector valve must be placed in the CHARGE BRAKE ACCUMULATOR position before operating the normal brake hydraulic system. Otherwise, fluid will be transferred into the emergency reservoir if the emergency brake check valve between the emergency selector valve and the hydraulic gage line is leaking. If fluid begins to overflow in the emergency reservoir during gear extension, the emergency selector valve must be placed in EXTEND LANDING GEAR to prevent further loss of fluid.

WARNING

If the normal gear system is operated after an emergency extension of the gear, the landing gear control switch must first be moved to EXTEND to position shuttle valves properly and close canoe doors. Because the landing gear doors remain down after a hand-pump extension of the gear, the gear and the doors might retract simultaneously if the landing gear control switch was moved to RETRACT first.

CAUTION

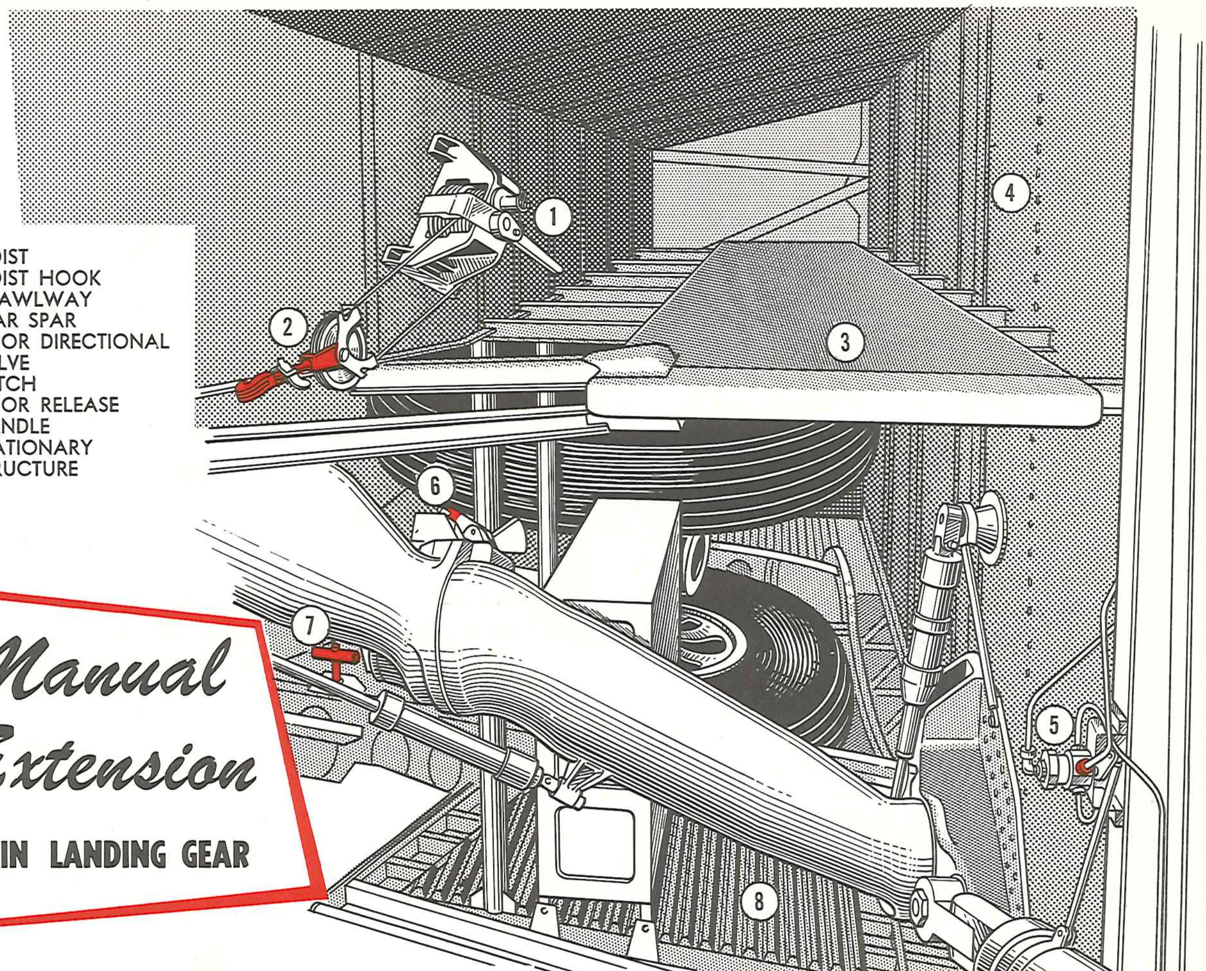
If during hand pump extension of the gear, the landing gear control switch is inadvertently moved to RETRACT, a hydraulic lock will be created between the nose gear emergency extension line and the emergency hand pump. To overcome this condition, momentarily place the landing gear control switch in EXTEND. This action will reposition a shuttle valve in the nose gear emergency line and remove the hydraulic lock. There will be no loss of hydraulic fluid and the resulting pressure will be normal.

6. Reservice emergency hydraulic reservoir prior to landing, if necessary.

Manual Extension

MAIN LANDING GEAR

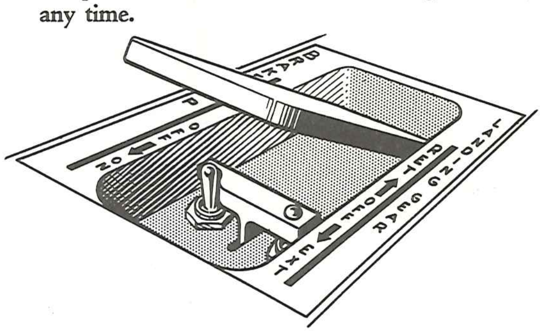
1. HOIST
2. HOIST HOOK
3. CRAWLWAY
4. REAR SPAR
5. DOOR DIRECTIONAL VALVE
6. LATCH
7. DOOR RELEASE HANDLE
8. STATIONARY STRUCTURE



Before attempting a manual extension of the main gear, the landing gear control switch must be OFF and its circuit breaker pulled. Two crew members will proceed to the wing crawlway entrance hatch. One will plug into the interphone system at the hatch. The other will gain access to the manual extension controls shown above via the wing crawlway and extend the gear as follows:

WARNING

No parachute will be worn in the wing crawlway at any time.



Step 1 Assume a position on the wing crawlway from where it will be possible to reach the red latch link pin. Remove this pin and allow the latch link rod to drop free of the latch. This prevents the possibility of pressure in the hydraulic system interfering with manual unlatching and also eliminates the hazard of someone operating the gear while you are working in the wheel well.

Note

A complete inspection of manual extension equipment will be made before extending the gear.

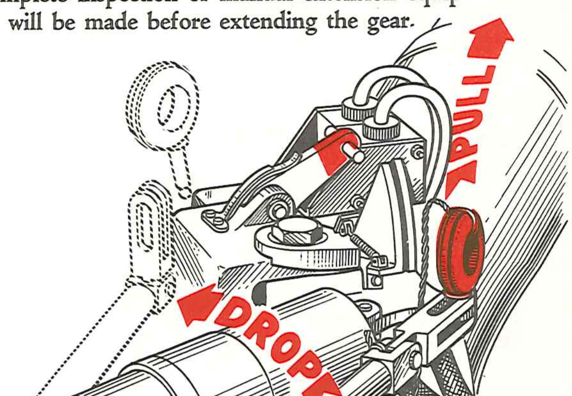
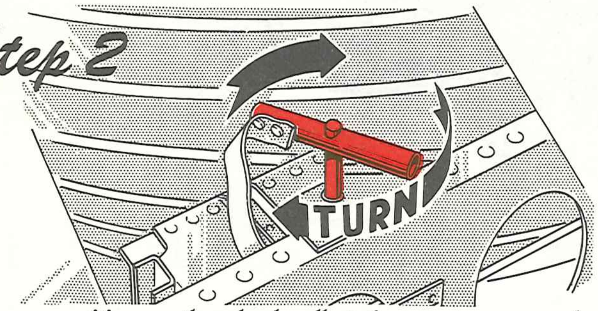
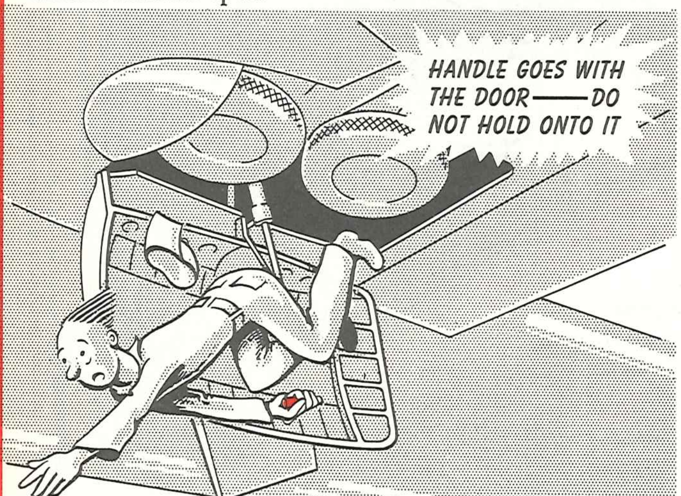


Figure 3-17. (Sheet 1 of 3)

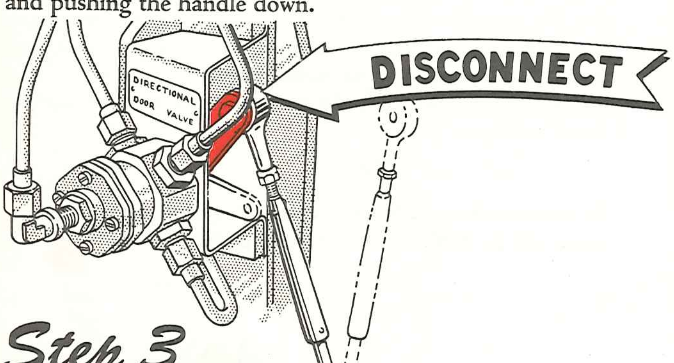
Step 2



Assume a position on the wheel well stationary structure and remove the safety wire or strap from the main wheel well door release handle. Turn the handle clockwise until the door is unlatched and falls open.

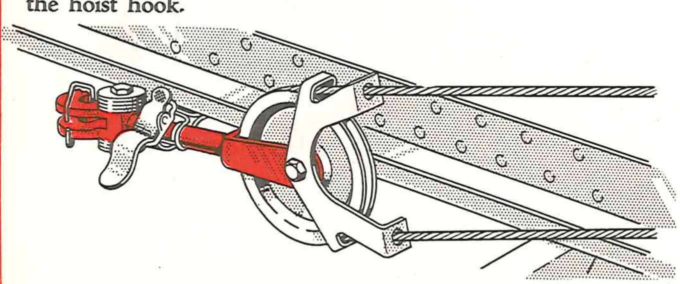


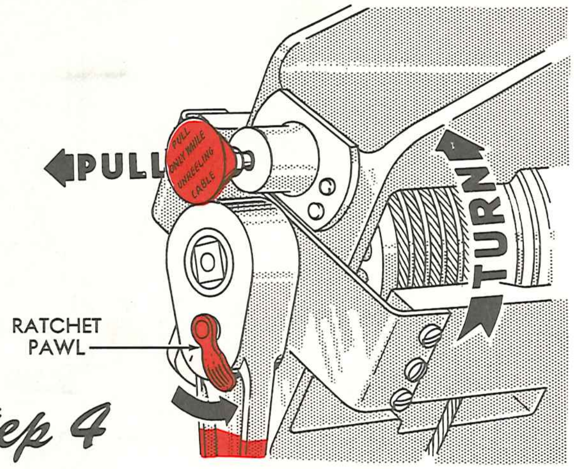
If the door does not extend completely, a hydraulic lock is indicated between the main selector valve and the door jack. Relieve this lock by disconnecting the rod from the valve handle and pushing the handle down.



Step 3

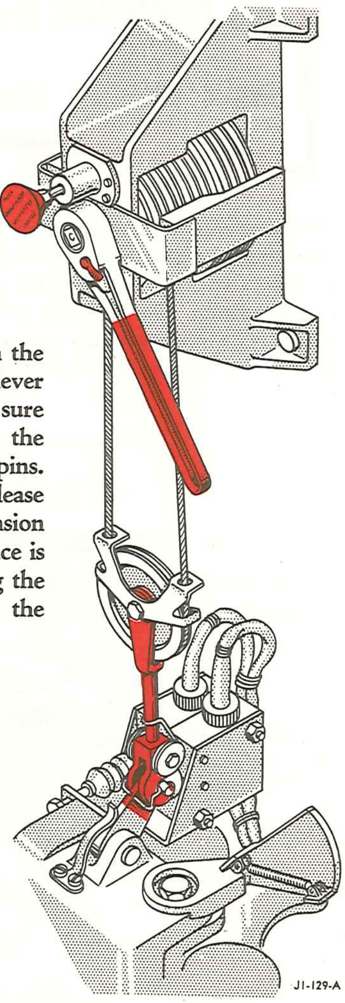
From a position on the wheel well stationary structure, unstow the hoist hook.





Step 4

If the hoist hook does not reach the latch release lever, the hoist lock pin located above the ratchet handle on the cable drum must be disengaged from the drum to extend the cable. The hoist lock pin is disengaged by pulling out and holding its spring loaded button. The ratchet handle pawl must then be set to allow unreeling of the cable (counterclockwise turning of the drum). The cable extends by unwinding from the large drum and winding onto the small drum. Releasing the button will re-engage the hoist lock pin with the cable drum.

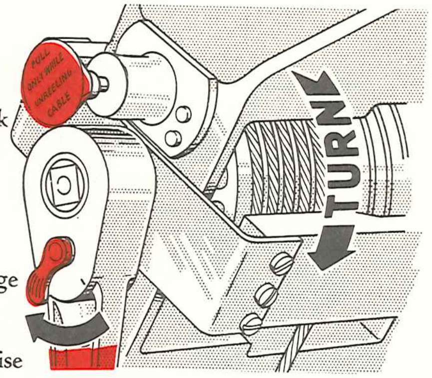


Step 5

Engage the hoist hook with the pins on the latch release lever and hold it there making sure that the spring release on the hoist hook is behind the pins. This will insure positive release of the hook when cable tension is relieved after the side brace is raised. Also, when engaging the hoist hook, make sure that the cables are not crossed.

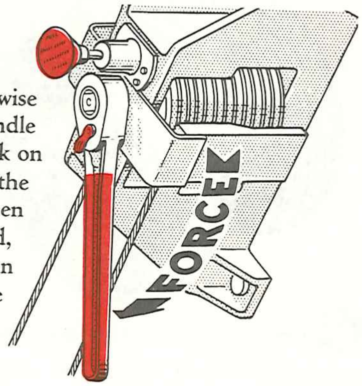
Figure 3-17. (Sheet 2 of 3)

Step 6



Engage the hoist lock pin by releasing the button. Reverse the ratchet handle pawl so that operation of the ratchet will wind the cable onto thc large drum (force being applied to the ratchet handle in the clockwise direction).

Step 7

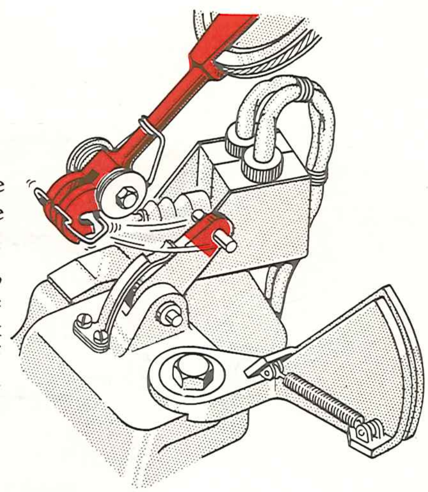


Tighten the cable by a clockwise movement of the ratchet handle while holding the hoist hook on the latch release lever until the cable slack is taken up. When the hoist lock pin is engaged, the only movement that can be made is in the clockwise direction (cable unwinding onto the large drum).

Step 8

For the right main gear, lying on the catwalk facing aft, *push* the ratchet handle for clockwise movement of the drum. For the left main gear, lying on the catwalk facing aft, *pull* the ratchet handle for clockwise movement of the drum. Continue applying force to the ratchet handle in the clockwise direction to apply tension to the cable, and turning the handle in the counterclockwise direction to obtain a new "bite" on the drum. This racheting is necessary because of the limited space and leverage when in a prone position.

Step 9

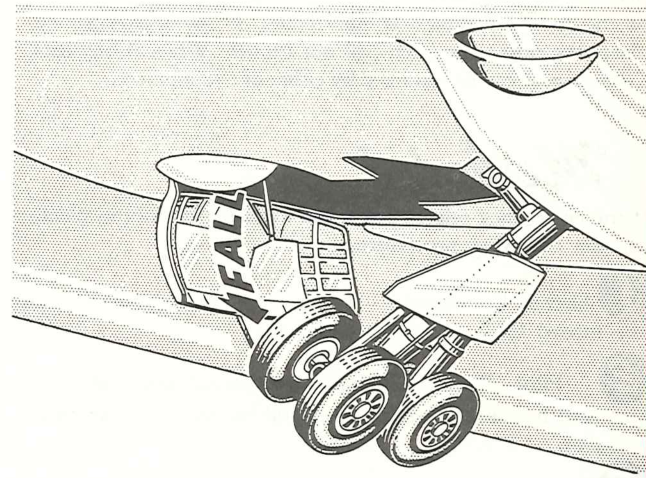


When the latch release lever unlatches the side brace, and the side brace begins to rise, cable tension will be relieved and the hook should spring free. If the hook remains engaged, disengage it by hand.

Step 10

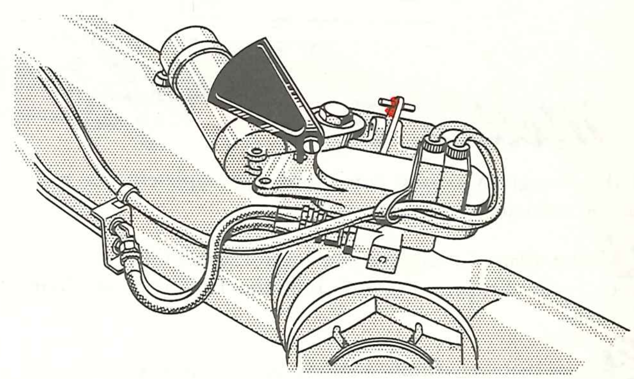
The gear will fall away under its own weight and should lock after extension. If it does not lock in the down position a slight kicking of the latch link bracket should engage the lock.

Note: If the latch cannot be engaged install the ground safety lock.



Step 11

Check the position of the pink flag on the landing gear side brace. If the gear is down and locked, the flag will not be visible.



Step 12

Push in pilot's landing gear circuit breaker and check landing gear indicator lamps.

Step 13

Leave the landing gear switch OFF and place the brake pump switch ON.

J1-130-A

Figure 3-17. (Sheet 3 of 3)

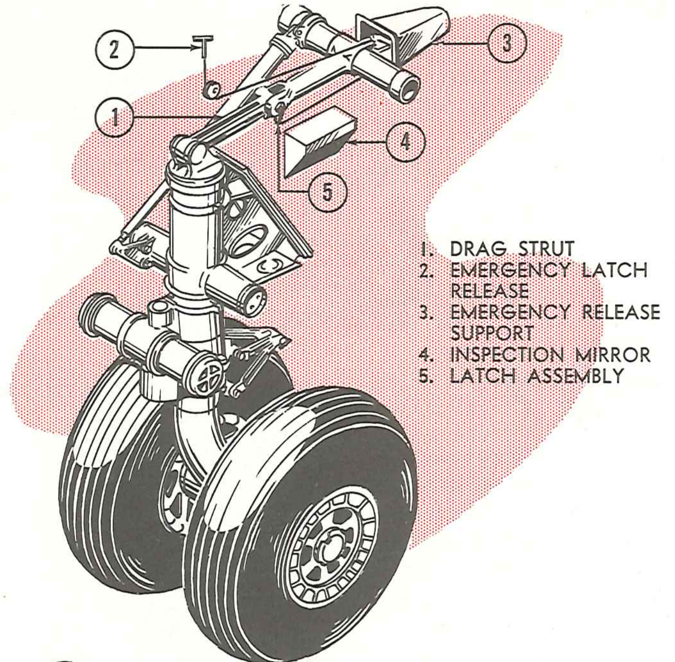
• EMERGENCY RETRACTION OF NOSE LANDING GEAR

In the event the nose gear fails to retract with the main landing gear, determine whether the emergency release pin is in place by looking through the inspection window in the floor of the radio operator's compartment. If the pin is not in place, the nose gear latch will not unlock. When this occurs, the nose gear can be retracted by either of two methods.

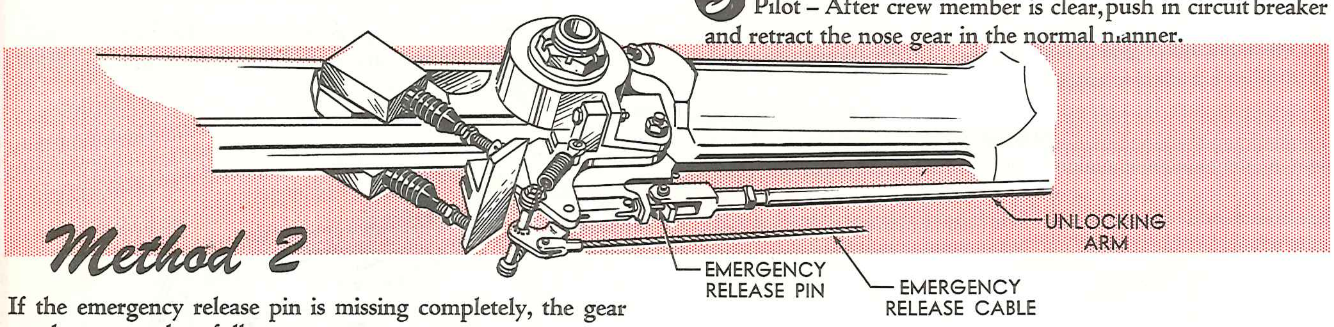
Method 1

If tne emergency release pin is still available but not in place, use the following procedure:

1. Aircraft Commander – Instruct that all radar equipment be turned OFF.
2. Pilot – Place the landing gear control switch off, check for zero hydraulic pressure, and pull the landing gear circuit breaker.
3. Crew member–Enter the radar equipment bay beneath the forward turrets and, using the access hole in the forward bulkhead, insert the release pin through the latch assembly beneath the forward end of the latch release rod.



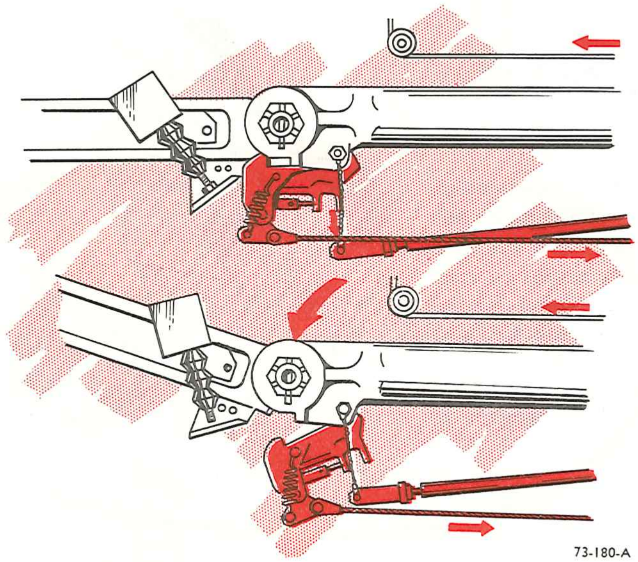
4. Crew member-To connect the unlocking arm it may be necessary to rotate the unlocking arm collar slightly. *Do not attempt to adjust the rod length.*
5. Pilot – After crew member is clear, push in circuit breaker and retract the nose gear in the normal manner.



Method 2

If the emergency release pin is missing completely, the gear can be retracted as follows:

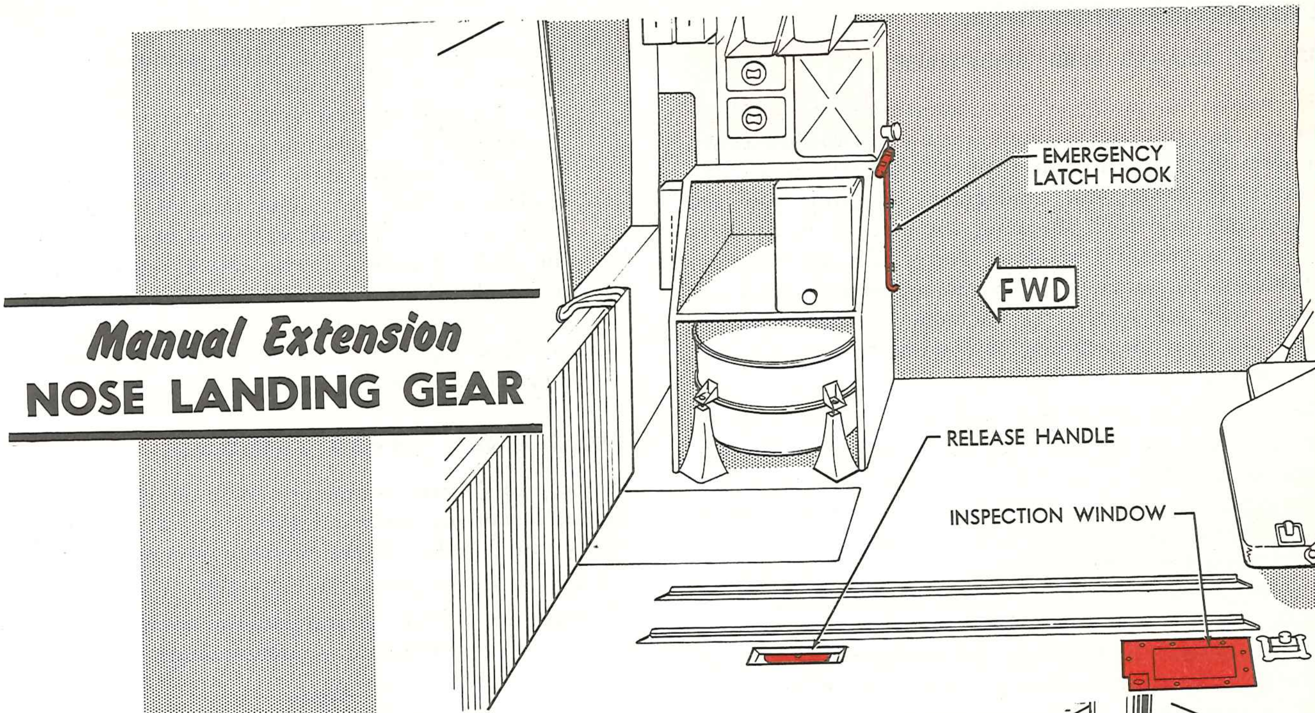
1. Pilot–Place the landing gear control switch OFF, check for zero hydraulic pressure, and pull the landing gear circuit breaker.
2. Crew member–Apply a steady pull of approximately 150 pounds on the nose gear release handle. The latch will open and the cable will pull through the floor another two or three inches. Check the position of the latch by looking through the inspection window.
3. Crew member–While holding the cable tight, inform pilot to push in circuit breaker and place the landing gear control switch in RETRACT. When the gear begins to retract, release the handle; the gear should then lock in the retracted position.
4. Crew member–Make sure that the release cable is properly seated over the pulleys; this is essential because the nose gear must be extended manually when the above method is used for retraction.



73-180-A

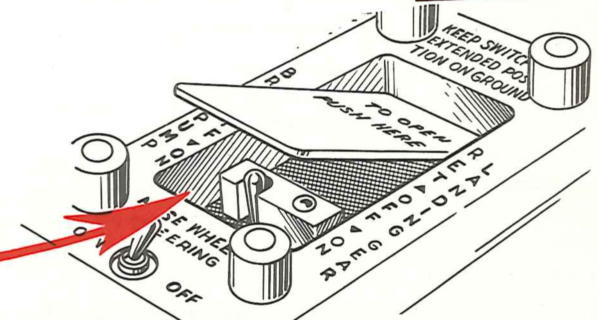
Figure 3-18.

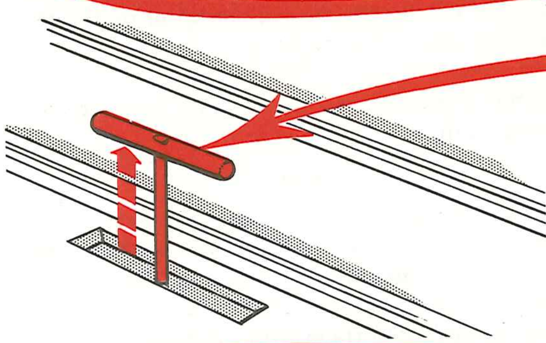
Manual Extension NOSE LANDING GEAR



Step 1

Pilot–Place the landing gear control switch OFF, check for zero hydraulic pressure, and pull the landing gear circuit breaker.





Step 2

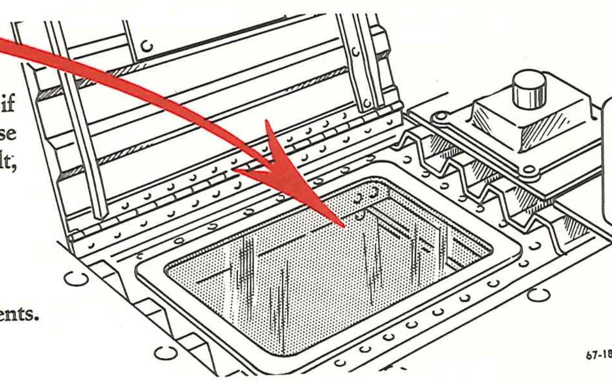
Crew member–Apply a steady pull of approximately 50 pounds on the nose gear release handle until the cable comes through the floor approximately ten inches. Release the handle immediately when all the cable slack is taken up because the gear will extend and rapidly retract the handle. Failure to release the handle will result in injury to the hands.

Step 3

Crew member–Look through the inspection window to see if the gear is locked. If it is not, break the window with the nose gear latching hook, insert the hook into the hollow pivot bolt, and pull up until the latch is locked.

CAUTION

Wear goggles to prevent eye injury caused by glass fragments.



67-183-A

Figure 3-19.

EMERGENCY STOPPING.

USE OF BRAKES AND PROPELLERS.

For normal stopping of the aircraft, reverse pitch of the six reciprocating engines is sufficient to slow down or stop the aircraft with little or no brake action required. However, for emergency stopping you are concerned only with stopping the aircraft in as short a space as possible without going off the runway. Therefore all normal restrictions on use of brakes and props will not apply. To increase the effects of reverse thrust, reduce rpm to 2000 with the master motor as power is applied.

You will not be concerned with burning out a set of brakes, blowing out tires, or exceeding prop restrictions in reverse. Your main concern is to save the crew and the aircraft. The brakes have an independent hydraulic system which keeps pressure available in one accumulator. The accumulator is kept automatically charged by an a-c motor-driven pump; however, if the automatic operation fails the engineer has an override switch to maintain the necessary pressure in the accumulators. If neither of these systems are operative, an emergency hand pump method is available.

CAUTION

With the brake system off, a fully charged accumulator will furnish enough pressure for three brake applications. In order to obtain the most effective braking action with a minimum of three applications available, keep the brake pedals depressed as long as the action is required.

The normal operating limits of 30 inches M.P. for use in reverse pitch may be exceeded if necessary for emergency stopping. When this limitation is exceeded, the controls must be LOCKED to prevent damage to the control surfaces.

CAUTION

If the brakes are not available during landing, landing roll, or while taxiing, the aircraft will be stopped on the runway or taxi strip by using reverse pitch for braking action. Hold the aircraft stationary by using either reverse or forward action of the propellers. If the cause is from a broken hydraulic line, the brake pump circuit breaker will be pulled to prevent fluid from being pumped overboard. *Do not* shut down engines until chocks or other objects have been placed under the main gear to prevent the aircraft from rolling after the engines have been stopped. Stop engines at low rpm regardless of propeller pitch position. The aircraft will be towed to the parking apron. If the active runway has to be cleared, the aircraft may be taxied off the runway with extreme caution and stopped not less than 100 feet from the active runway and then towed to the parking apron.

EMERGENCY BRAKE PRESSURE.

If the pilots' brake pump switch is on, the brake low pressure warning lamp is lighted, and a pressure gage check indicates low brake pressure, proceed as follows:

1. Pilot—Brake pump switch—ON.
2. Engineer—Brake pump pressure override switch—ON; hold until pressure is within range.

Note

Should step 2 fail to produce pressure, perform the following steps:

3. Crew—Emergency selector valve—CHARGE BRAKE ACCUMULATOR.

CAUTION

Be sure that the emergency selector valve is held in the detent during charging or the hydraulic lines may rupture.

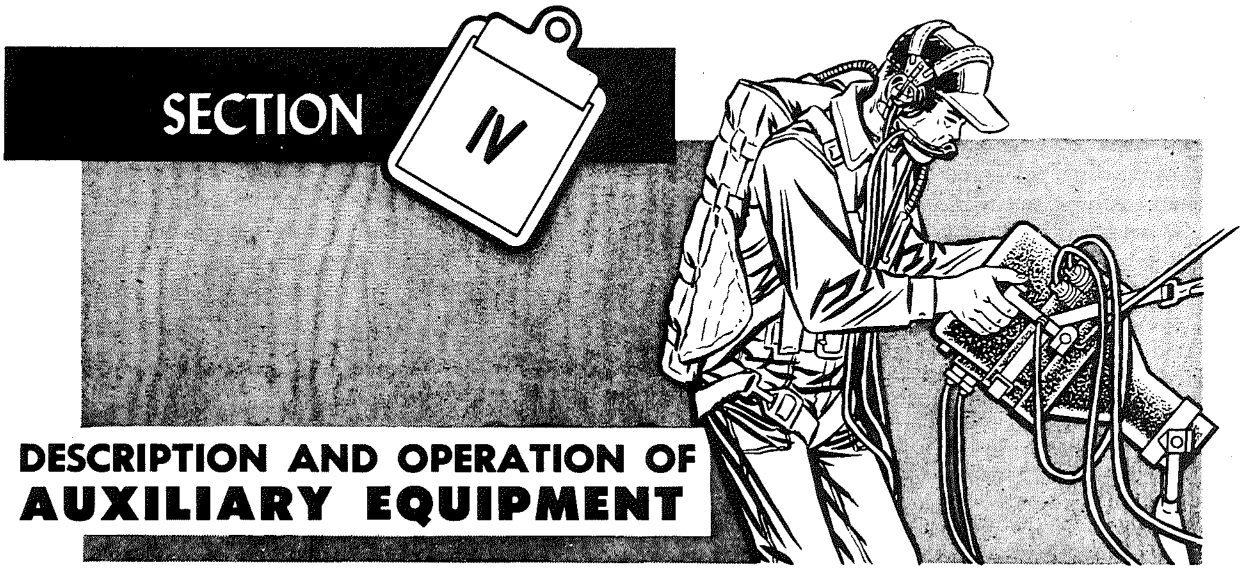
4. Crew—Operate hand pump until pressure is within normal range.

Note

A fully charged accumulator will supply brake pressure for three full brake applications. To obtain maximum efficiency from fully charged accumulator, apply the brakes moderately and hold them using differential braking as required.

CAUTION

Do not fully release the brake pedals. If you do, the efficiency of the brake system will be decreased.



SECTION IV

DESCRIPTION AND OPERATION OF AUXILIARY EQUIPMENT

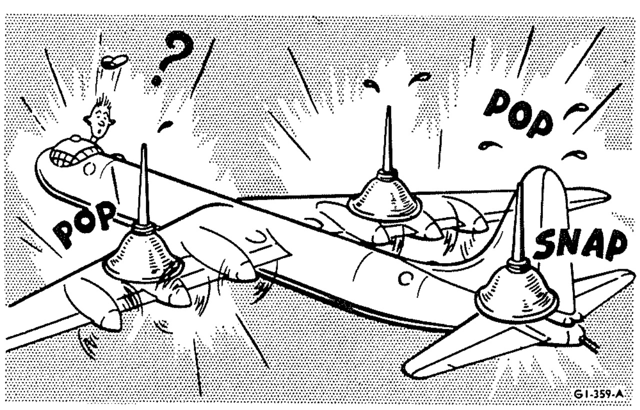
68-129-A

HEATING AND ANTI-ICING SYSTEM.

Heated air for wing and tail anti-icing and for heating pressurized air is obtained by ducting ram air from the nacelle cooling air tunnel through the two primary exhaust gas heat exchangers in each nacelle. The heated air from engines 1, 2, 5, and 6 is used for wing anti-icing. Engines 3 and 4 provide the air which is used as required in the secondary heat exchanger to heat the pressurized air for cabin heating. The air from engines 3 and 4 is also used to provide tail anti-icing. A duct system routes the air from the nacelles to the leading edges of the wing and tail. Flow is controlled by electrically operated valves located in the duct system. These valves are controlled from the engineer's station and operate on 115-volt a-c power. See figure 4-9 for system arrangement.

Note

> During operation of the anti-icing system, the leading edge of the wing and tail surfaces may "oilcan." The "oilcanning" is a normal occurrence and will not have any damaging effects.



G1-359-A

There are adjustable outlets in the forward and aft cabins to permit manual control of the heated air in these cabins. The camera compartment heat is thermostatically controlled and the outlets are not adjustable. An auxiliary cabin heater is connected to the camera compartment heating system to provide heat automatically when the normal system is unable to maintain desired compartment temperature.

HEATING AND ANTI-ICING CONTROLS.

Cabin Heat and Tail Anti-Icing Switches (Cabin Air Supply from Turbos).

For operating the modulating dump valves in the inboard nacelles there are two three-position switches (26, figure 1-20) on the engineers' control panel. These switches are spring-loaded to enable you to regulate the amount of heated air going to the tail for anti-icing or to supply the secondary heat exchanger for cabin heat. When the switches are held ON, the valves are positioned for full cabin heat and tail anti-icing; when they are held OFF, the valves are positioned for full dump.

Cabin Temperature Switch.

This three-position spring-loaded switch (21, figure 1-20) controls a modulating valve which regulates the amount of heated air passing through the secondary heat exchanger on its way to the tail for anti-icing. When the switch is held in the INCREASE position, the tail anti-icing air is routed through the secondary heat exchangers to heat the cabin air. In the DECREASE position, the tail anti-icing air bypasses the secondary heat exchanger and no heat is supplied to the cabins other than that provided by the heat of compression of the pressurized air from the turbos. An indicator lamp (20, figure 1-20) glows when the valve has reached either of its extreme travel limits.

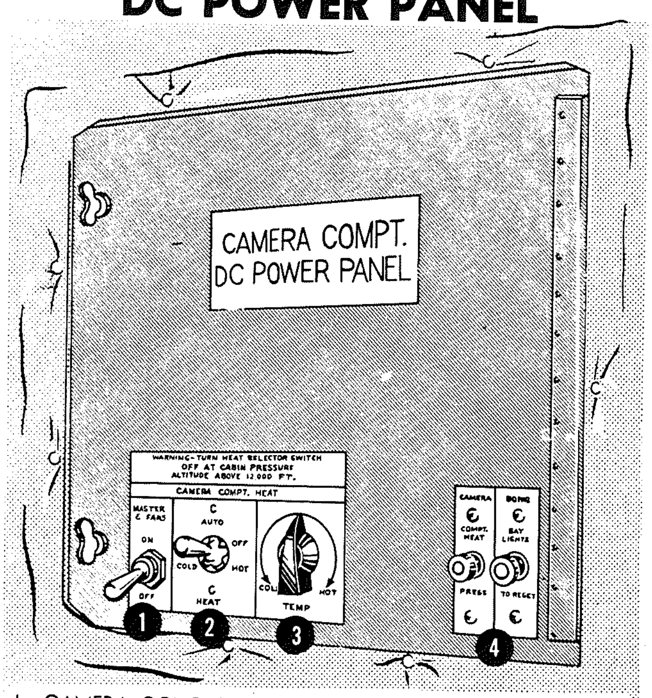
Wing Anti-Icing Switches.

Four three-position switches (28, figure 1-20) are located on the engineer's control panel to control the dump valves for engines 1, 2, 5, and 6. These switches have operating positions marked ON and OFF and a neutral center position which is not marked. Placing the switches in the ON position actuates the valves in a direction which permits heated air to enter the anti-icing ducts. With the switches in the OFF position, the valves are actuated in the opposite direction to route the heated air overboard. The valves may be stopped at any intermediate position by returning the switches to the neutral center position. In this manner the anti-icing air temperature is controlled by regulating the volume of heated air which enters the system.

Camera Compartment Master Temperature Switch.

This two-position switch (1, figure 4-1), located on the d-c power panel in the camera compartment, supplies electrical power to the camera compartment temperature selector switch and the camera window defrosting fan switch. When this switch is turned ON, the defrosting fans for the camera windows will operate if the defroster switch is in the NORMAL position. (Refer to "Defroster Switch" of this section.)

Camera Compartment
DC POWER PANEL



1. CAMERA COMPARTMENT TEMPERATURE MASTER SWITCH
2. CAMERA COMPARTMENT TEMPERATURE SELECTOR SWITCH
3. CAMERA COMPARTMENT TEMPERATURE RHEOSTAT
4. CIRCUIT BREAKERS

FI-186-B

Figure 4-1.

Camera Compartment Temperature Selector Switch.

This switch (2, figure 4-1), located on the d-c power panel in the camera compartment, has positions marked COLD, AUTO, HOT, and OFF. The COLD and HOT positions are spring-loaded and actuate the mixing valve for manually obtaining the desired temperature. When the switch is in the AUTO position, the temperature is thermostatically controlled, and is regulated by the camera compartment temperature rheostat. The HOT and COLD positions are used to position the mixing valve for manual temperature control. When the mixing valve is in the extreme hot position, the auxiliary cabin heater will operate automatically to provide additional heat. (Refer to "Auxiliary Heaters" of this section.)

CAUTION

When the cabin pressure altitude exceeds 12,000 feet and the auxiliary cabin heater is operating the selector switch must be turned OFF to stop heater operation. This is necessary because the cooling air supplied by the heater fan at this altitude is insufficient to cool the fan motor, thus causing rotor seizure.

When the selector switch is moved to the OFF position to stop heater operation the mixing valve will remain in the hot position. Thus heated air will continue to be supplied to the camera compartment but it will not be supplemented by heat from the auxiliary cabin heater.

Camera Compartment Temperature Rheostat.

This control (3, figure 4-1), located on the camera compartment d-c power panel, is used to regulate the temperature when the camera compartment temperature selector switch is in the AUTO position.

INDICATORS.

Duct Air Temperature Gage.

The temperature of air entering the forward cabin through the pressure duct is read from a gage (7, figure 1-18) at the engineers' station. Temperature indications are supplied by a temperature bulb located in the pressure duct.

Cabin Heat and Anti-Icing Air Maximum Temperature Warning Lamps.

Cabin heat and anti-icing temperature warning lamps (27, figure 1-20) are located at the engineers' station. The thermal switches which relay temperature indications to the warning lamps are located as follows: one thermal switch in the anti-icing duct downstream from each nacelle dump valve, and two fire detector thermal switches in the heating ducts between the dump valve and the primary heat exchanger.

When the thermal switch downstream from the dump valve is subjected to temperatures in the range of 210° to 221°C for the tail air and 171° to 182°C for the wing air, the corresponding warning lamp will light. The lamp will also light when the corresponding fire detector thermal switches are subjected to temperatures in excess of 425°C.

CAUTION

For two or three minutes after turning the system on, you may get erroneous indications from the maximum temperature warning lamps of the wing and tail anti-icing system. This false reading is caused by the time lapse required for the internal temperature of the thermal switches to stabilize.

Master Temperature Indicator (Some Airplanes). Temperature sensing devices located downstream of the dump valves in each nacelle heat anti-icing duct are connected to the master temperature indicator. For a description of the master tempearture indicator see "Master Temperature Indicator," Section I.

CAUTION

An anti-icing temperature of 70°C or over when the anti-icing is not being used indicates that a dump valve is leaking excessively and should be replaced.

Wing and Tail Anti-Icing Air Temperature Gages (Some Airplanes). Five anti-icing air temperature gages are located on the engineers' auxiliary instrument panel. Four of the gages indicate the anti-icing air temperature in the wing ducts and one indicates the air temperature in the tail anti-icing duct.

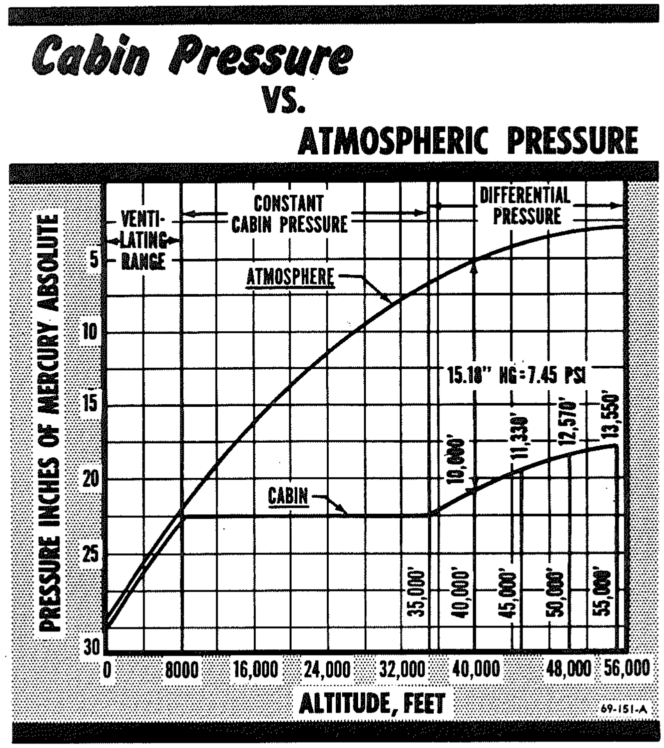
Note

The tail anti-icing temperature indication for later airplanes is taken as the air enters the tail; therefore, it is lower than that for other airplanes, where the indication is taken as the air enters the fuselage.

Cabin Temperature Control Valve Indicator Lamp. This lamp (20, figure 1-20) glows when the valve has reached either of its extreme travel limits.

PRESSURIZATION SYSTEM.

The forward and aft cabins, the camera compartment, and the interconnecting communication tubes are pressurized by a controllable system which utilizes air from the right turbosupercharger in each nacelle. Pressure regulators are located in each cabin and the camera compartment to maintain cabin pressure automatically. The pressure regulator in the camera compartment is slaved to the forward cabin regulator to maintain approximately equal pressure between the two compartments. The pressure regulators are set to allow an unpressurized condition from sea level to 8000 feet, to permit a constant pressure altitude of 8000 feet from 8000 to 35,000 feet, and to hold a constant differential pressure of 7.45 psi above 35,000 feet. (See figure 4-2.) In pressurized flight either cabin can be depressurized while maintaining pressure in the other cabin. A booster fan is provided to draw ambient air into the duct system when an auxiliary source of ventilating and pressurizing air is required. See figure 4-9 for system arrangement.



69-151-A

Figure 4-2.

CAUTION

Cabin pressurization is not available when carburetor preheat is used. Some pressurization and cabin heat can be made available at low altitudes by turning on the cabin booster fan. However, as altitude is increased the efficiency of the booster fan will be reduced at an increased rate. Above 12,000 feet the booster fan operates at such low efficiency that cabin pressure can decrease to the extent that some airplane equipment becomes inoperative. However, normal cabin pressurization will be available above 12,000 feet in

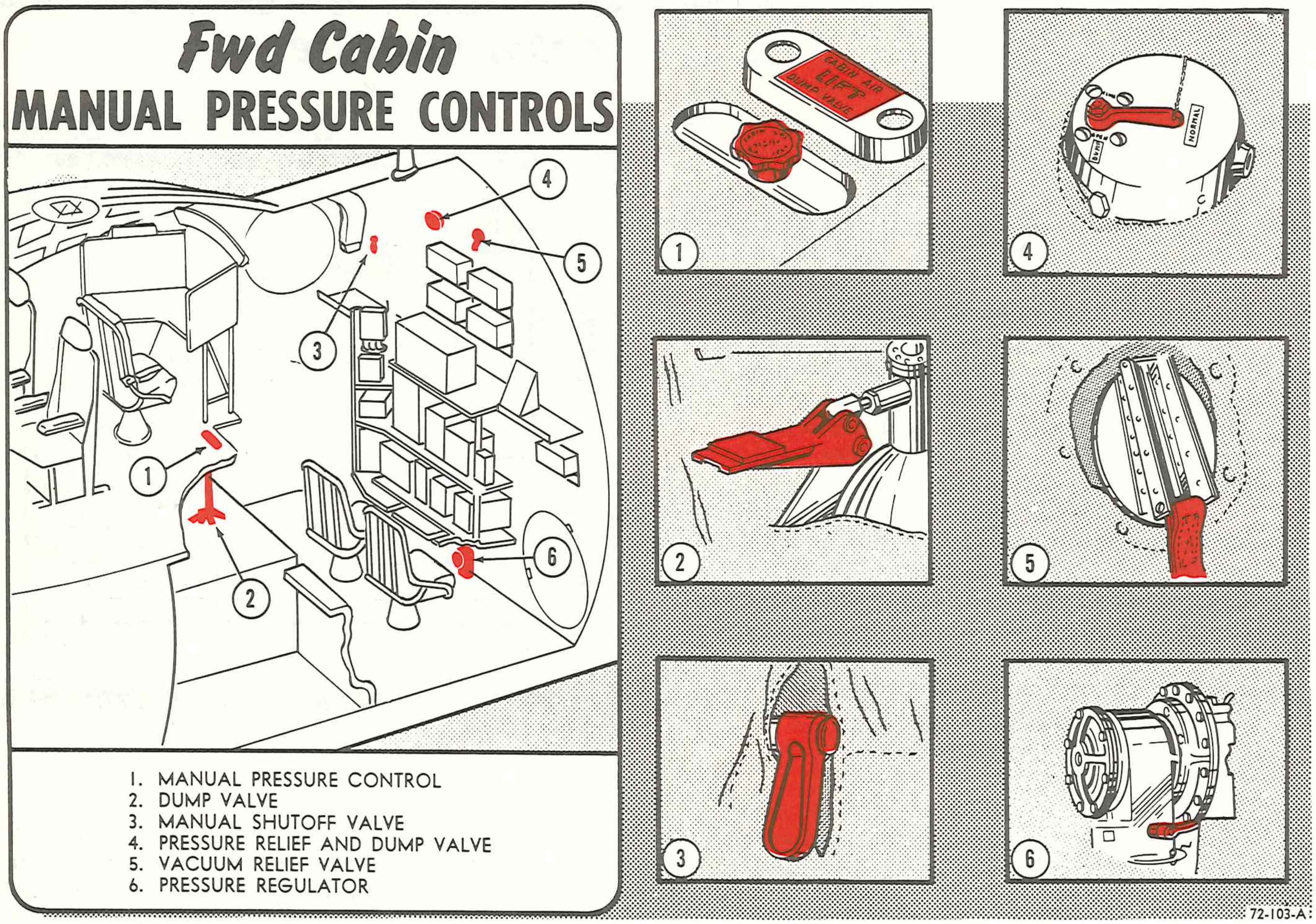


Figure 4-3.

most cases, since carburetor preheat is seldom required above this altitude because of the heat provided by turbo boost. Above 12,000 feet altitude carburetor preheat should be used only as an emergency measure.

NORMAL CONTROLS.

Cabin Pressure Shutoff Valve Switches (Cabin Supply From Turbos).

The flow of pressurized air from the nacelles to the fuselage is controlled by two three-position switches (22, figure 1-20) located on the engineer's control panel. These switches operate two modulating shutoff valves which control the flow of pressurized air from each wing system by connecting 115-volt a-c power to the valve actuators. The switches have a neutral off position and positions marked ON and OFF.

Note

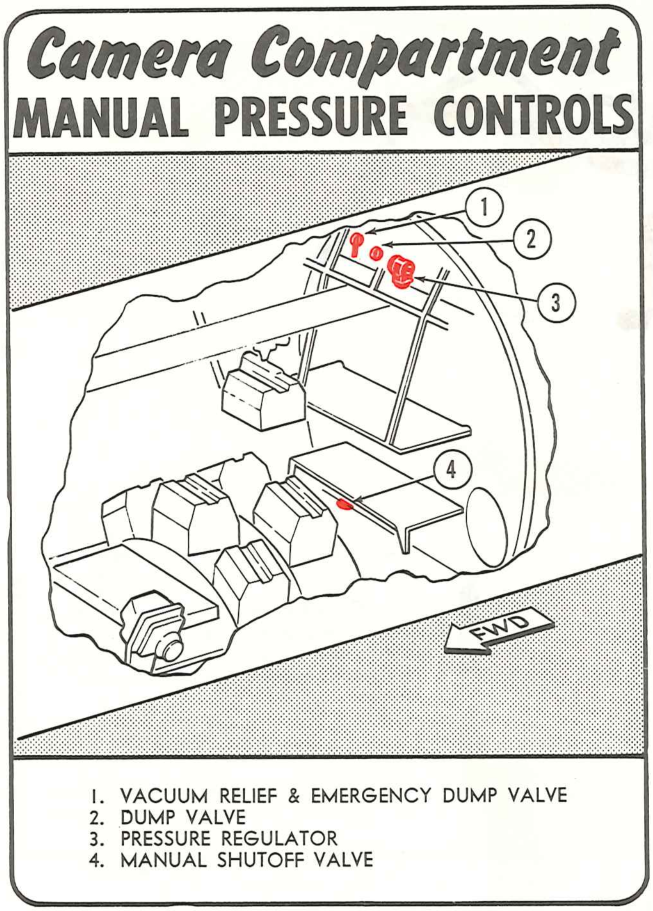
The cabin pressure shutoff valves are automatically turned off when the carburetor preheat system is turned on. In this condition the cabin booster fan should be turned on.

Cabin Pressure Switches.

The flow of pressurized air to the crew compartments is controlled by three two-position switches—one each for the forward cabin (41, figure 1-20), the camera compartment (24, figure 1-20), and the aft cabin (25, figure 1-20). Each switch completes a 115-volt a-c circuit to a shutoff valve in the pressure duct leading to its respective compartment.

CABIN AIR BOOSTER FAN.

A two-speed booster fan is located in the ventilating air duct and supplies air independent of the turbos to the cabins. The fan is operated on LOW when it is used to ventilate the cabins during ground operation and flight altitudes up to 8000 feet. For pressurized flight above 8000 feet it is operated in the HIGH position to furnish additional boost to the cabins for more positive pressurization and heating. The fan can also be used in conjunction with the secondary heat exchanger to supply heated air to the cabins independent of the cabin pressure system in unpressurized flight.



68-105-A

Figure 4-4.

Cabin Air Booster Fan Control Switch.

A three-position switch (23, figure 1-20) located on the engineers' auxiliary control and instrument panel, controls the action of the booster fan. This switch has positions marked HIGH ABOVE 8000 FEET, BELOW 8000 FEET LOW, and OFF. The low speed position is used for ventilating the cabins during ground operation and at altitudes up to 8000 feet. This position can also be used in conjunction with the secondary heat exchanger for cabin heat during unpressurized flight. The high speed position can be used at altitudes above 8000 feet to create additional boost for more positive heating and pressurization. Each switch position completes a 28-volt d-c circuit to the respective fan speed control relay which connects 208-volt three-phase alternating current to the fan motor.

CAUTION

Never run the fan at high speed at altitudes below 8000 feet except for a few seconds to check its operation. The greater air resistance to the fan blades at altitudes below 8000 feet will cause the motor to burn out.

INDICATORS.

Cabin Altimeters.

Three altimeters, one for each cabin, located on the engineers' auxiliary instrument panel (7, 9, and 11, figure 1-19), indicate the pressure altitude of each cabin.

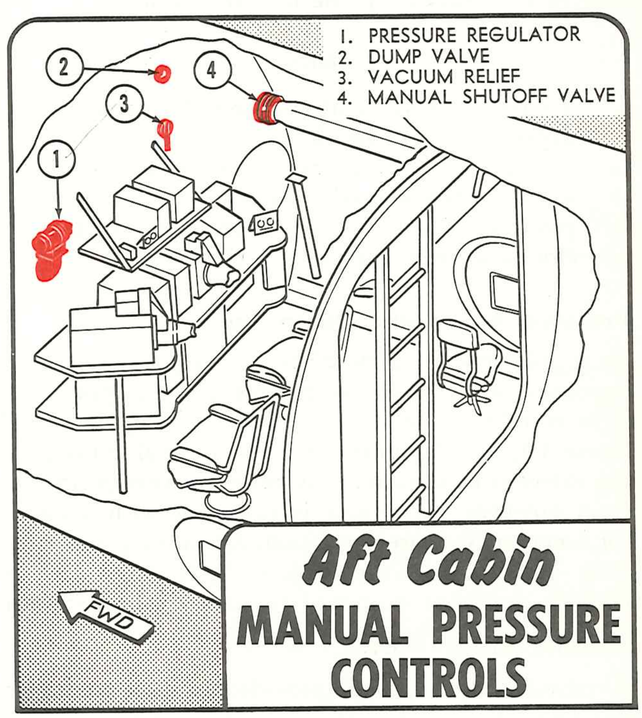
EMERGENCY CONTROLS.

Manual Shutoff Valves.

In the event of failure of the electrical pressurization shutoff valves, which are controlled by the cabin pressure shutoff valve switches, manual shutoff valves are provided in each cabin. The extreme positions of the valve handles are OPEN and CLOSED. The forward shutoff valve (3, figure 4-3) is located in the pressure duct inlet just forward of the aft bulkhead in the forward cabin. The camera compartment shutoff valv (4, figure 4-4) is located just forward of the aft bull head in the floor of the compartment. The valve (4 figure 4-5) in the aft cabin is located in the pressure duct inlet near the forward bulkhead.

Forward Cabin Dump Valve.

The forward cabin dump valve (2, figure 4-3) located under the flight deck step, has a foot-operated dump pedal provided on the valve body. This valve can be used to decrease the pressure in all cabins simultaneously, provided the communication tube doors are open. Release of the pressurized air is obtained by depressing the quick-release pedal on the valve body. The manual pressure control knob located on the floor



68-154-A

Figure 4-5.

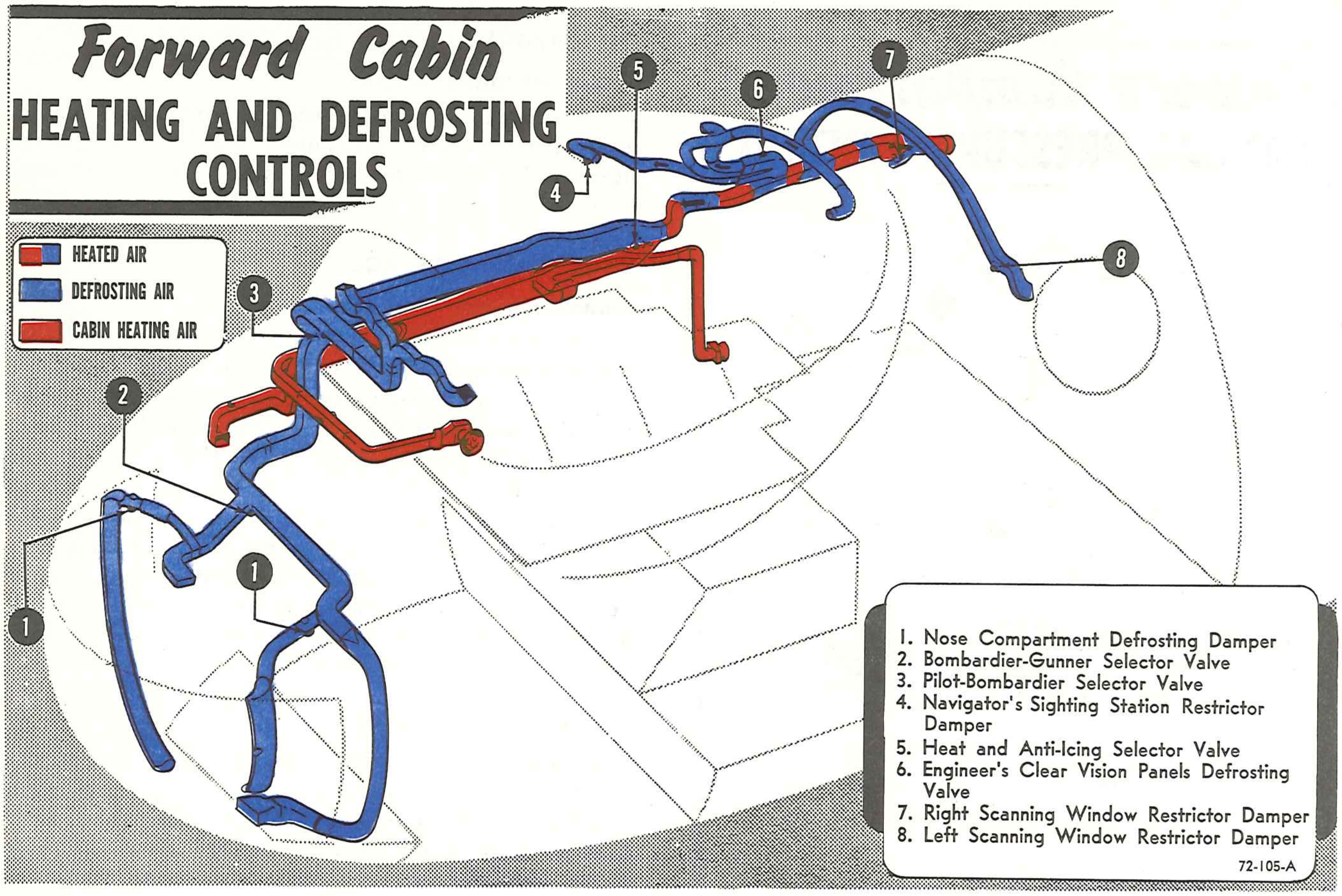


Figure 4-6.

near the engineer's station can be used to manually control the pressure in the forward cabin.

Note

> To reset the valve after using the pedal for depressurizing, the knob must be rotated counterclockwise several times and pulled up until the release pedal locks in its untripped position. Then the knob must be turned clockwise until the valve is closed.

Pressure Relief and Dump Valves.

To supplement the forward cabin dump valve in cabin depressurization, each compartment is equipped with a pressure relief and dump valve (4, figure 4-3; 2, figure 4-4; and 2, figure 4-5). The normal function of the valves is to automatically relieve excess cabin pressure; however, each valve is equipped with a handle for emergency depressurization. By cutting the safety wire and moving the handle from NORMAL to DUMP, the valve is opened to release cabin pressure.

Vacuum Relief Valves.

A vacuum relief valve is provided in each crew compartment. These valves (1, figure 4-4 and 3, figure 4-5) can be used for emergency depressurization by pulling the strap attached to each valve.

Pressure Regulator Control.

In the event of a pressure regulator failure which would allow the escape of pressurized air, a manual shutoff valve on the side of the regulator (figure 4-3, 4-4, and 4-5) can be used to close off its air exit provisions; the forward cabin manual pressure control knob can be used to modulate air pressure.

CABIN HEATING, DEFROSTING, AND ENCLOSURE ANTI-ICING.

After heated air is ducted into the cabins, it can be regulated by manual controls. These controls consist of selector valves, restrictor dampers, and various types of outlets. (See figures 4-6 and 4-8.) The defroster outlets, which are nonadjustable, provide heating as well as defrosting. Adjustable heating outlets provide heated air when defrosting is not required.

CONTROLS.

Heat and Anti-Ice Selector Valve.

This valve (1, figure 4-6) is located in the heating duct in the right forward side of the radio operator's compartment. Double ducting is installed from the valve forward into the flight compartment. One section carries air to the enclosure defrosting and anti-icing outlets; the other carries it to the heating outlets. The valve control knob can be moved to the HEAT position when cabin heating alone is required or the ANTI-ICE position if both heating and defrosting are required.

CAUTION

Place the selector valve in its center position to prevent excessive pressure in the forward cabin ducts at high altitude in an unpressurized high air-flow condition.

Pilot-Bombardier Selector Valve.

This valve (figure 4-6) is located forward and to the right of the pilot's rudder pedals. This knob has positions marked PILOT and BOMB'R. The PILOT position is used to route the flow of heated air for the pilot's enclosure defrosting outlet. The BOMB'R position directs the heated air to the bombardier-gunner selector valve.

Bombardier-Gunner Selector Valve.

This valve (figure 4-6) is located over the radar observer's station. The control knob has positions marked BOMB, BOTH, and GUN. The BOMB position is used to route the heated air to the optical flat and to the defrosting duct on the left side of the nose enclosure. The GUN position is used to route the air to the defrosting duct on the right side of the nose enclosure. The BOTH position allows heated air to flow to both locations simultaneously.

Restrictor Dampers.

Restrictor dampers (figure 4-6) are installed in the heating ducts which lead to the following locations in the forward cabin: the heating outlets in the radio operator's compartment, the pilots' heating outlets, and the radar observer's heating outlet. A restrictor damper is also installed in the duct leading to the right forward heating outlet in the aft cabin. These dampers are used to regulate the flow of heating air to the various outlets noted.

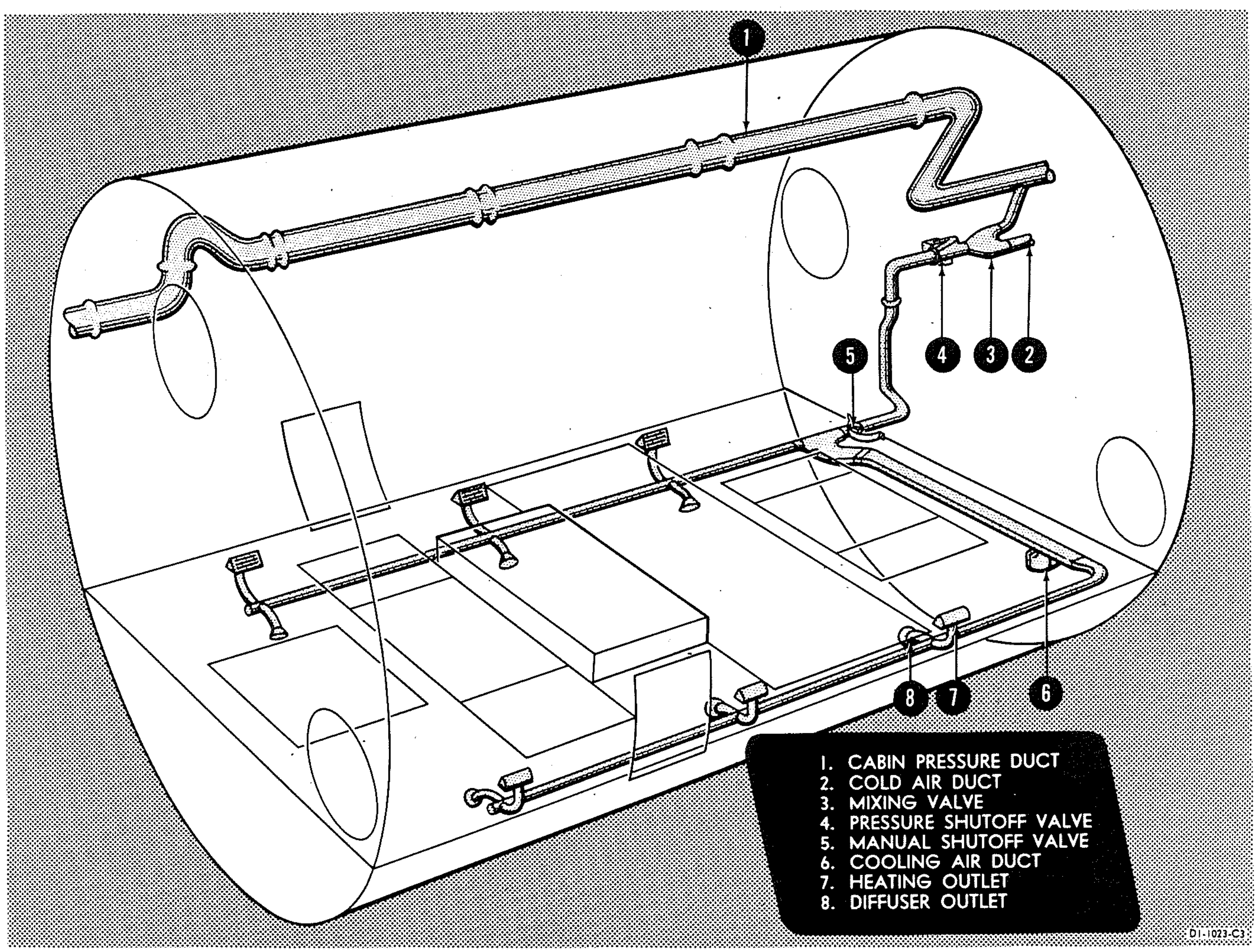
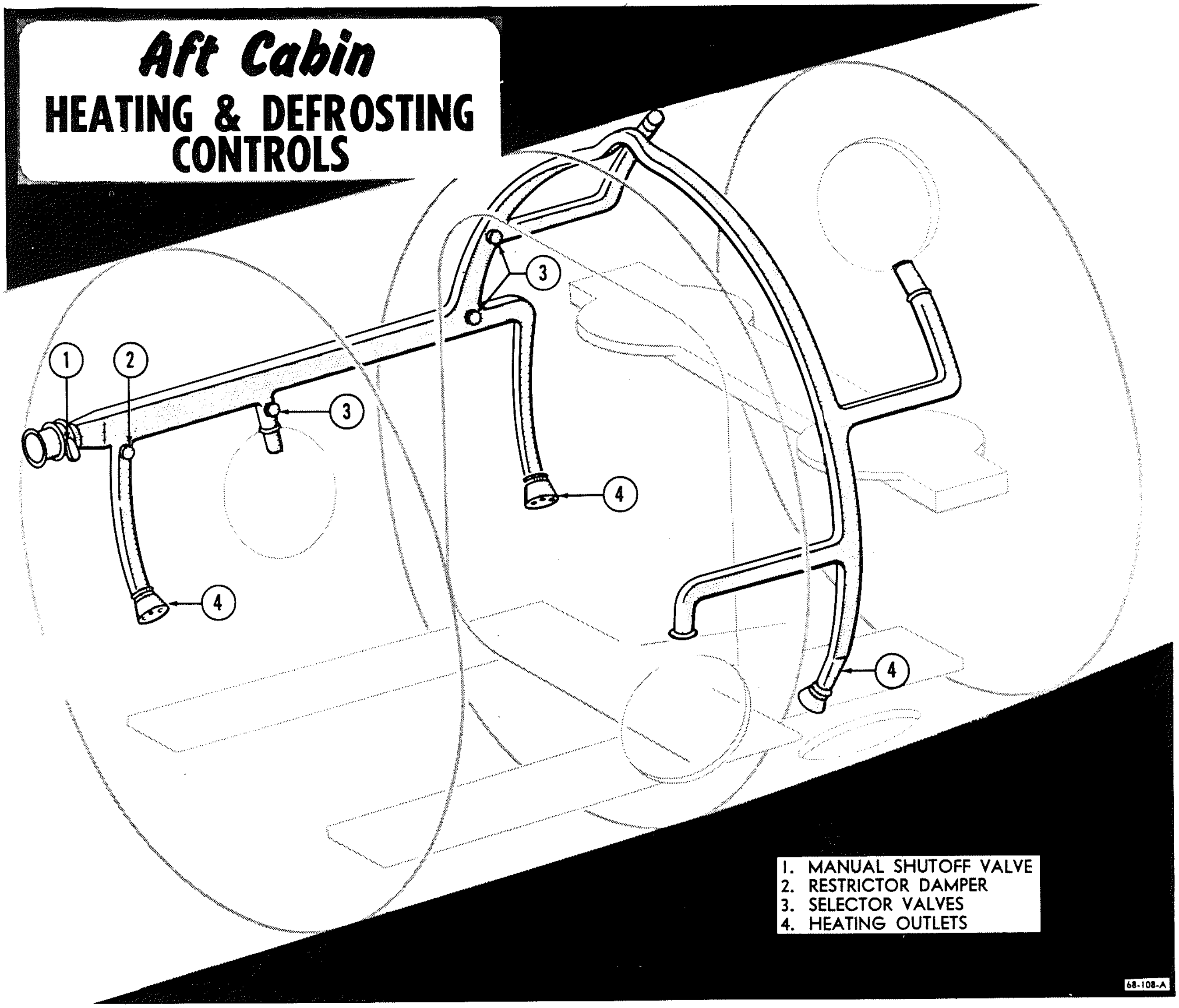


Figure 4-7. Camera Compartment Heating Controls



68-108-A

Figure 4-8.

Heating Outlets.

Seven outlets are installed in the heating ducts—four (figure 4-6) in the forward cabin and three (figure 4-8) in the aft cabin. In the forward cabin an outlet is located at the aircraft commander's station, the pilot's station, the right side of the radio operators' compartment, and the weather observer's station. In the aft cabin, heating outlets are located just aft of each lower scanning blister and in the right forward side of the cabin near the catwalk entrance. Each outlet has five manually controlled positions which provide five different flow patterns.

Defrosting Nozzles.

Defrosting nozzles (figure 4-6 and figure 4-8) are located at the engineers' clear vision window, on each side of the nose enclosure, and in the nose enclosure.

OPERATION OF CABIN HEATING, ANTI-ICING, AND PRESSURIZATION SYSTEMS.

CREW RESPONSIBILITY.

Obtaining optimum cabin heating and defrosting requires the cooperative effort of every crew member. When heating and defrosting are required, the crew members are responsible for the duties listed in the following paragraphs.

Aircraft Commander and Pilot.

Before flight the aircraft commander will assure himself that a periodic check of the cabin pressure duct system has been made with the cabin pressure test machine. From the results of the test he will determine what the capabilities of his system will be.

HEATING, ANTI-ICING AND PRESSURIZATION SYSTEMS

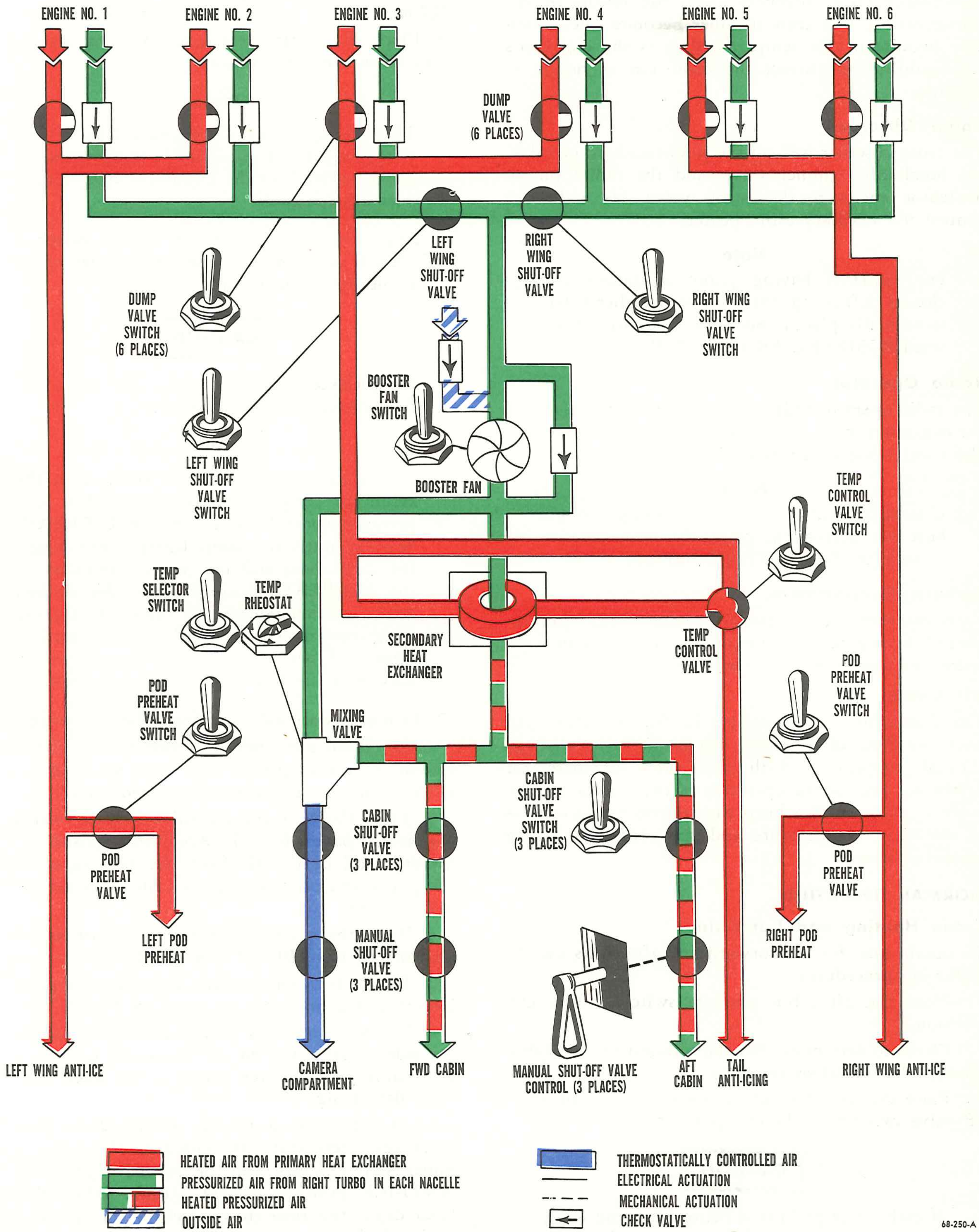


Figure 4-9.

Engineer.

The engineer is responsible for the control of his valves and will maintain optimum duct temperatures and air flow. To achieve this he will receive reports from other crew members as to the results of his configuration. If a crew member becomes uncomfortable because of the temperature, it is the engineer's responsibility to correct the condition as nearly as possible.

Radar Observer.

The radar observer will set the pilot-bombardier valve, the bombardier-gunner valve, and the radial photo-navigator enclosure defrosting valve. He will also control the auxiliary cabin heater.

Note

For airplanes having photo-navigator's enclosure defrosting, the pilot-bombardier valve is normally placed about the 3/4 position toward BOMBARDIER CONTROL.

Radio Operator.

The radio operator will set the heat anti-ice valve and the engineers' clear vision double pane valve. He will also control the auxiliary cabin heater.

Note

If trouble is encountered in obtaining enough heat for defrosting, place the heat anti-ice valve in the full ANTI-ICE position.

Camera Compartment.

Crew members in the camera compartment shall report to the engineer for any change in air flow in regulating the heat in that compartment.

Aft Cabin.

The compartment commander in the aft cabin will have the duty of obtaining optimum valve settings, through cooperation with other crew members, for defrosting and for the operation of the auxiliary cabin heaters. He will also keep the engineer informed as to the cabin temperature and the condition of the scanning blisters.

NORMAL OPERATION.

Cabin Heating and Defrosting.

To obtain heat for the forward and aft cabins use the following procedures:

1. Place the aft cabin pressure switch in the ON position.
2. Check to determine that the forward and aft cabin manual shutoff valves are open.
3. Place the left and right cabin pressure wing shutoff valve switches in the ON position.

CAUTION

If carburetor preheat is being used, the wing shutoff valves cannot be opened. In this condition the cabin booster fan should be turned on to supply some heat. However, heat will be reduced as altitude is increased.

4. Hold the cabin temperature control switch in the DECREASE position until the lamp lights.
5. Place the cabin heat and tail anti-ice control switches in the ON position.

Note

These dump valves may be modulated if necessary to prevent exceeding a temperature of 215°C as read on the engineers' master temperature indicator.

6. Jiggle the cabin temperature control switch in the INCREASE position until the temperature of the air is suitable for cabin heating.

CAUTION

Do not exceed 105°C as read on the engineers' duct air temperature indicator.

Note

As an alternate method for controlling the cabin air temperature, hold the cabin temperature control switch in the INCREASE position until the lamp lights. Then jiggle the cabin heat and tail anti-ice switches in the DECREASE position until the desired cabin air temperature is obtained. During icing conditions the procedure as outlined in steps 4, 5, and 6 should be used to insure maximum air flow for anti-icing the tail.

7. In the forward cabin perform the following:

a. For those airplanes equipped with a defrosting system for the engineers' two clear vision panes, restrict the flow to the amount required for vision.

b. Place the heat anti-ice valve located behind the engineers' panel in full ANTI-ICE position, thus diverting all of the air from the heating outlets to the pilots' and photo-navigator's enclosure for defrosting purposes.

c. Place the pilot-bombardier enclosure defrosting control 3/4 from PILOT toward BOMB.

d. In the photo-navigator's compartment place the bombardier-gunner selector valve on BOTH.

e. In those airplanes having defrosting nozzles for the side radial panes on the photo-navigator's enclosure, adjust the selector valves in the ducts for optimum defrosting.

f. As a refinement to the above system, provided acceptable defrosting is obtained, the valve listed under step b above may be moved slightly off the ANTI-ICE position toward HEAT. After this has been done, the restrictor valves in the ducts to the radio operator's compartment, the photo-navigator's compartment, and the aircraft commander's station should be adjusted, as well as the heating outlets to these stations and to the pilots' station.

8. Turn the auxiliary cabin heater switches to LOW or HIGH as required.

CAUTION

Do not turn the heaters on if the pressure altitude of the cabin exceeds 12,000 feet, because the cooling air supplied by the heater fan would be insufficient to cool the fan motor, causing rotor seizure.

9. Turn on cabin booster fan.

Enclosure Anti-Icing.

For optimum enclosure anti-icing under severe icing conditions, it will be necessary to obtain maximum flow of heated air to the pilots' and the photo-navigator's enclosures. Maximum flow is accomplished as follows:

1. Place the heat anti-ice selector control knob in the ANTI-ICE position.
2. Place both cabin pressure wing shutoff valve switches in the ON position.
3. Restrict flow to the camera compartment and the aft cabin to that required for pressurization.
4. Obtain high manifold pressure by placing the engine supercharger switches on BOTH. (See "Shifting Turbos," Section VII.) Also advance the turbo boost selector lever as near to position 10 as conditions permit.
5. Hold the cabin heat and tail anti-icing control switches in the OFF position.

CAUTION

If tail anti-icing temperatures are too high, jiggle the cabin heat and tail anti-ice control switches to obtain proper temperatures.

6. Hold the cabin temperature control switch in the INCREASE position until the indicator lamp lights.

CAUTION

To forestall damage to the enclosure panes, the duct temperature must not be allowed to exceed 105°C.

7. Turn on the cabin booster fan.
8. Adjust the flow between the photo-navigator's and pilots' enclosures as required.

When frosting or icing of a certain enclosure becomes critical, such as the pilots' enclosure during landing, it may be necessary to direct the entire flow of heated air to that area by adjusting the selector provided in the heating ducts for these stations. When the entire supply of heating air is being used for defrosting purposes, the auxiliary cabin heaters can be used for cabin heating if required.

Under certain atmospheric conditions, moisture will form between the inner and outer panes of the enclosures. This condition can be alleviated by obtaining a maximum flow of heating air to the enclosure as described in the preceding paragraphs. The pilots' ventilating fans, located on each outboard frame of the rudder pedal, can be used to obtain a more uniform and lower temperature on the flight deck, since they tend to replace the hot air with cooler air from the lower portion of the cabin.

Cabin Pressurization.

The pressurization system is put in operation by placing the cabin pressure shutoff valve switches ON. The camera compartment and aft cabin pressure switches must be ON for pressurization in their respective compartments.

EMERGENCY OPERATION.

Anti-Icing Overheating.

When any of the warning lamps indicate an excessive temperature, check this temperature immediately and govern any subsequent action on the basis of the master temperature indicator rather than the warning lamps. If an excessive temperature is indicated, proceed as follows:

1. Engineer—Proper wing or cabin heat and tail anti-ice switch—Momentarily OFF, routing some of the heated air overboard, until the temperature is within limits.
2. Engineer—Reduce power of the engine in the nacelle indicated. Opening the air plugs will also aid in diminishing heat.
3. Pilot—If climbing, increase the air speed without increasing power.

WARNING

If none of the above efforts reduces the excessive temperature satisfactorily, position the proper wing or cabin heat and tail anti-ice switch to OFF for full dump. Observe the warning lamp; if it still burns, a temperature in excess of 425°C between one of the heat exchangers and the dump valve in the affected nacelle is indicated. The only known cause of this condition is a ruptured heat exchanger which permits exhaust gases to enter the anti-icing duct. If this condition exists, alert the scanners, because a fire may be imminent and engine shutdown necessary.

Cabin Pressure Control.

If a pressure regulator fails, shut off the unit and let the pressure of that cabin be controlled through the pressure regulator of another cabin. This can be accomplished by opening the communication tube doors between the compartment with a failed regulator and the compartment with an operative regulator. It may be possible to control the pressure in all three compartments by a single regulator in either the forward or aft cabin by opening all communication tube doors. If a single regulator proves insufficient, the engineer must assist the single regulator by operation of the manual pressure control. In case of camera compartment or aft cabin shutoff valve failure, shut off the pressure by closing the manual shutoff valve in the compartment.

EMERGENCY DEPRESSURIZATION.

If it becomes necessary to depressurize the cabins so that escape hatches can be opened in an emergency, all crew members must go on 100 per cent oxygen and the airplane must be depressurized as soon as possible. The engineer must cut off cabin air flow, and the crew member in charge of each cabin must see that all dump valves are opened. In the camera compartment and the aft cabin the strap on the vacuum relief valve should be pulled and held open to speed depressurization. If the dump valves do not do the job, use the hand axes and cut through the fuselage along the stringers. The stringers will act as barriers to any objects being sucked out of the airplane.

WARNING

Do not attempt to break the scanning windows to depressurize the cabins.

VENTILATION EQUIPMENT.

The cabin air can be circulated for ventilation by means of electrically operated fans. The main source of ventilation is provided by the cabin air booster fan, which can be used to pull outside air through the pressurizing ducts into the crew compartments. (Refer to "Cabin Air Booster Fan" of this section.) Two circulating fans are located at the pilots' station to aid in ventilating the flight compartment. The fans of the four auxiliary cabin heaters can be used independently of the heating elements to provide additional air circulation in the cabins. (Refer to "Auxiliary Cabin Heaters" of this section.)

PILOTS' AIR CIRCULATING FANS.

The pilots' two air circulating fans are installed on the outboard frames of the rudder pedals. The fans are adjustable and are operated by an ON-OFF switch located on each mounting bracket.

OBTAINING CABIN VENTILATION ON GROUND.

For ventilation during ground operations, accomplish the following:

1. Open the communication tube doors.
2. Turn the cabin heat and tail anti-icing control switches OFF.
3. Place the cabin air booster fan switch in the low speed position and control the air flow with the selector valves and restrictor dampers.
4. Utilize the pilots' air circulating fans and the auxiliary cabin heater fans for ventilating local areas.

OBTAINING CABIN VENTILATION IN FLIGHT.

For ventilation during flight, perform the following steps:

1. Turn the cabin pressure shutoff valve switches OFF.
2. Turn the cabin heat and tail anti-icing switches OFF.
3. Turn the aft cabin pressure switch ON.
4. Place the cabin air booster fan switch in the low speed position and control the air flow with the selector valves and restrictor dampers.
5. Utilize the pilots' air circulating fans and the auxiliary cabin heater fans for ventilating local areas.
6. Open the communication tube doors.
7. If a small quantity of heat is desired, perform the preceding steps, with one exception: Place the cabin pressure shutoff valve switches ON. In this manner the heat of compression can be utilized, eliminating use of the tail anti-icing system to obtain cabin heat.

AUXILIARY CABIN HEATERS.

In addition to the regular cabin heating system, four portable cabin heaters are stowed in the airplane. One is located under the flight deck step in the forward cabin, and one is on the radio operators' floor just below the catwalk entrance hatch. In the aft cabin a heater is stowed at the forward bulkhead and the other is at the aft bulkhead. Each heater is comprised of a heating element and a motor-driven fan which operate on 208-volt, 3-phase alternating current. Each heater is equipped with an electric cord of sufficient length to allow the heater to be moved about the cabin.

Note

An electric heater is also provided in the camera compartment. However, this heater is connected to the camera compartment heating system and is automatically controlled.

CONTROLS.

Heater Control Switch.

Each heater is controlled by a three-position switch marked HIGH, LOW, and OFF. The HIGH and LOW positions are provided to control the output of the heating element. The heater power circuit is provided with power from the fan control circuit; therefore, the fan switch must be ON before the heater will operate.

Fan Control Switch.

When cabin heating is not required, the fan of each heater may be operated independently to provide additional air circulation. Independent operation is made possible by a fan control switch located on each unit. This on-off switch controls the fan motor and applies power to the heater control switch.

Cabin Heater Power Switch.

This two-position switch (2, figure 1-19), located on the engineers' auxiliary control panel, is used to shut off the four auxiliary cabin heaters. During engine starting or when a partial loss of alternator power occurs, this switch should be placed in OFF position. With either of these conditions existent there is a possibility of overloading the a-c system because of the high power requirements of the heaters.

Note

When external power is on the airplane, the heater power circuit is automatically deenergized, regardless of the positions of heater power switch.

CAUTION

Crew members must be sure that the heaters are free of obstruction at all times in order to avoid inadvertent operation of the heater.

JET POD HEATING AND ANTI-ICING SYSTEM.

The jet pod heating and anti-icing system employs three independent sources of heat and is designed to perform the following functions: to prevent icing of the nacelle and the strut leading edges, to prevent the formation of ice on the nose cones and air plugs, and to provide heat for the jet oil system prior to starting the engines during flight.

CAUTION

There are no provisions for the internal anti-icing of the jet engine. Internal icing is indicated by an increase in tail pipe temperature which can be alleviated by reducing the rpm.

JET NACELLE AND STRUT ANTI-ICING.

For nacelle and strut anti-icing when the jet engines are operating, hot air is bled through a port at the 12th stage of each compressor and is controlled by a valve, which operates in conjunction with the nose cone and air plug anti-icing facilities. A portion of the heated air is ducted to the nacelle leading edge where it flows aft between the inner and outer skins

Auxiliary CABIN HEATER

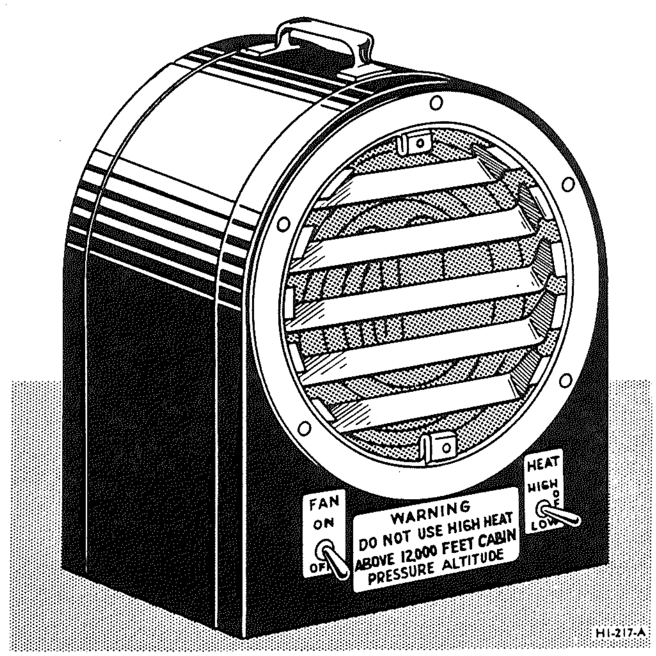


Figure 4-10.

and exits from the nacelle through louvers in the cowling forward of the fire wall. The remainder of the air is used for anti-icing of the strut leading edge and is ducted through the double skin passages of the leading edge to the top of the strut. The air then flows aft to the strut trailing edge where it exits through louvers.

NOSE CONE AND AIR PLUG ANTI-ICING.

The air plug and nose cone of each engine are provided with electrical heating elements to prevent the formation of ice on these sections. The system should be turned on in icing conditions when the engines are operating.

PREHEATING.

Wing anti-icing air is used to provide heat for the jet engine oil system prior to starting the engines during flight. The flow of this air is controlled by a valve located in the duct which conveys the air from the wing leading edge to each jet pod. A portion of this air is used for heating the oil cooler and oil lines in each nacelle. The remainder of the air is ducted into the strut to heat the lines which lead from the oil tank to the engines.

Note

The wing anti-icing system must be in operation before jet pod preheating can be accomplished.

CONTROLS.

Nose De-Ice Switch.

This on-off switch-type circuit breaker (20, figure 1-23), located on the jet control panel, controls the nose cone and air plug heating elements and the internal anti-icing valve for nacelle and strut anti-icing. When this switch is place ON, 28-volt direct current energizes a relay which connects 208-volt a-c power to the electrical heating elements of the nose cones and the air plug doors. Also, 28-volt direct current opens a valve which permits heated air from the engine compressor to be routed into the pod nacelle and strut for anti-icing.

Pod Preheat Switch.

This on-off switch (21, figure 1-23) operates a valve in the duct leading from each wing leading edge to the jet nacelles and their struts. When the switch is placed ON, 115-volt alternating current is routed to the pod preheat valve actuators which opens the valves. Wing anti-icing air is then routed to the nacelles and struts for pod preheating, provided the wing anti-icing system is in operation.

WARNING

In the event of a jet engine fire, this switch must be placed in the OFF position to prevent fire from passing through the duct to the interior of strut and wing.

Note

When the wing anti-icing system is being used during severe icing conditions, the pod preheat control switch must be in the OFF position to obtain maximum heat for wing anti-icing.

PITOT TUBE HEATERS.

Pitot tube heat is controlled by two on-off switches (29, figure 1-20) located on the engineers' control panel. When the switches are in the ON position 28-volt d-c power is routed to the heaters.

OIL HEATERS.

OIL TANK VENT LINE HEATERS.

Each reciprocating engine oil tank vent line is equipped with a heating element to prevent vapors from congealing, freezing, and consequently plugging the vent lines. The heaters are controlled by a single switch (40, figure 1-20) located on the engineers' control panel. The switch positions are ON and OFF. When the switch is in the ON position, 28-volt direct current is routed to a relay which in turn energizes the heater element circuit with 115-volt alternating current. This switch should be placed in the ON position for ground and flight operations when the ambient air temperature is at 0°C (32°F) and below.

OIL TANK HOPPER HEATERS.

Electrical heating elements for each oil hopper and outlet line are provided for preheating the reciprocating engine oil prior to starting. The heating elements require a power output of 5250 watts and operate on 115-volts—either alternating or direct current. Because the portable power cart of the airplane does not have sufficient output, the power must be supplied by ground facilities. An oil tank heater receptacle (13, figure 1-47) for plugging in the external power source is located beneath each oil tank. Access to the receptacles is gained through panels on the lower surface of the wing. For further information see "Cold Weather Procedures" of Section IX.

JET ENGINE OIL HEATERS.

The jet engine oil tanks are equipped with 28-volt d-c controlled, 115-volt a-c actuated heating elements for maintaining the oil temperature above an operating minimum. A thermal switch located in each tank closes when the oil temperature drops to approximately 4°C (40°F) (±5°) and reopens at approximately 2 degrees above its closing temperature. If the jet engine oil heater switch is turned ON, the oil is heated automatically when the thermal switch closes. For additional information regarding the heating of jet engine oil, refer to "Jet Pod Heating and Anti-Icing System," of this section.

Jet Engine Oil Heater Switch.

A two-position switch-type circuit breaker (19, figure 1-15) located on the pilots' jet control panel controls the action of both oil heaters. When it is in the ON position, 115-volt a-c power is supplied to each heating element.

COMMUNICATION AND ASSOCIATED ELECTRONIC EQUIPMENT.

The communication and associated electronic equipment consists of radio and interphone equipment to provide airplane-to-airplane communication, airplane-to-ground communication, and intraplane communication between crew members; navigation sets for guidance and instrument landing; and radar sets for identification, long range navigation, radar defense, and tail turret control. Equipment is provided on each wing and on the rudder and elevators to discharge static electricity. For antenna arrangement see figure 4-12. A functional breakdown of the installed equipment of the airplane is listed in figure 4-11.

COMMUNICATION & ASSOCIATED *Electronic Equipment*

	TYPE	DESIGNATION	USE	PRIMARY OPERATOR	RANGE	LOCATION
COMMUNICATION EQUIPMENT	INTERPHONE	USAF COMBAT	CREW COMMUNICATIONS	CREW		ALL CREW STATIONS
	COMMAND RADIO (VHF)	AN/ARC-3	PLANE-TO-PLANE OR PLANE-TO-GROUND COMMUNICATION	AIRCRAFT COMMANDER AND PILOT	30 MILES AT 1000 FEET	PILOTS' STATION
	COMMAND RADIO (UHF)	AN/ARC-27 (GROUP 1 AIRPLANES)	PLANE-TO-PLANE OR PLANE-TO-GROUND COMMUNICATION	AIRCRAFT COMMANDER AND PILOT	30 MILES AT 1000 FEET	PILOTS' STATION
	LIAISON RADIO	AN/ARC-8	CODE OR VOICE TRANSMISSION AND RECEPTION	RADIO OPERATOR	5000 MILES	RADIO OPERATOR'S STATION
	RADIO RANGE RECEIVER	BC-453-( ) (AIRPLANES NOT IN GROUP 1)	RECEPTION OF CODE AND RANGE SIGNALS	AIRCRAFT COMMANDER AND PILOT		PILOTS' STATION
	RADIO SET (WALKIE-TALKIE)	AN/CRC-7	EMERGENCY	CREW	15 MILES AT 2000 FEET	
	WIRE RECORDER	AN/ANQ-1A	TO RECORD VOICE AND AUDIO SIGNALS	RADIO OPERATOR & ECM OBSERVERS		RADIO OPERATOR & ECM OBSERVERS' STATION
NAVIGATION EQUIPMENT	INSTRUMENT APPROACH (GLIDE PATH)	AN/ARN-5-( )	VISUAL INDICATION FOR VERTICAL GUIDANCE DURING INSTRUMENT APPROACH	AIRCRAFT COMMANDER AND PILOT	LOCAL	PILOTS' STATION
	INSTRUMENT APPROACH (LOCALIZER)	RC-103-A (AIRPLANES NOT IN GROUP 1)	VISUAL INDICATION FOR LATERAL GUIDANCE DURING INSTRUMENT APPROACH	AIRCRAFT COMMANDER AND PILOT	LOCAL	PILOTS' STATION
	RADIO COMPASS	AN/ARN-7	RECEPTION OF CODE OR VOICE SIGNALS, DIRECTIONAL BEARING AND HOMING	AIRCRAFT COMMANDER, PILOT, AND NAVIGATOR	200 MILES	PILOTS' & NAVIGATOR'S STATION
	MARKER BEACON	AN/ARN-12 OR RC-193-A	TO OBTAIN FIX ON NAVIGATION BEAM	AIRCRAFT COMMANDER AND PILOT	LOCAL	PILOTS' STATION
	OMNI-DIRECTIONAL NAVIGATION RECEIVER	AN/ARN-14 (GROUP 1 AIRPLANES)	POSITION FINDING, HOMING, AND INDICATON OF LATERAL ALIGNMENT FOR INSTRUMENT APPROACH	AIRCRAFT COMMANDER AND PILOT	200 MILES AT 40,000 FEET	PILOTS' STATION
RADAR EQUIPMENT	IDENTIFICATION SET	AN/APX-6	IDENTIFICATION	RADIO OPERATOR		RADIO OPERATOR'S STATION
	LORAN SET	AN/APN-9( )	LONG RANGE NAVIGATION	NAVIGATOR	750 MILES	NAVIGATOR'S STATION
	RADAR SET	AN/APQ-24	HIGH ALTITUDE BOMBING AND NAVIGATION AID	RADAR OBSERVER	200 MILES	RADAR OBSERVER'S STATION
	AUTOMATIC GUN LAYING	AN/APG-32	TO CONTROL THE TAIL TURRET	TAIL GUNNER		TAIL GUNNER'S STATION
MISC	RADIO ALTIMETER	SCR-718-D	TO INDICATE ABSOLUTE ALTITUDE	WEATHER OBSERVER		WEATHER OBSERVER'S STATION
	RADIO RECEIVER	BC-454-( )	TO RECEIVE RADIOSONDE SIGNALS	RADIOSONDE OPERATOR		RADIOSONDE OPERATOR'S STATION

72-106-A

Figure 4-11.

ANTENNA LOCATIONS

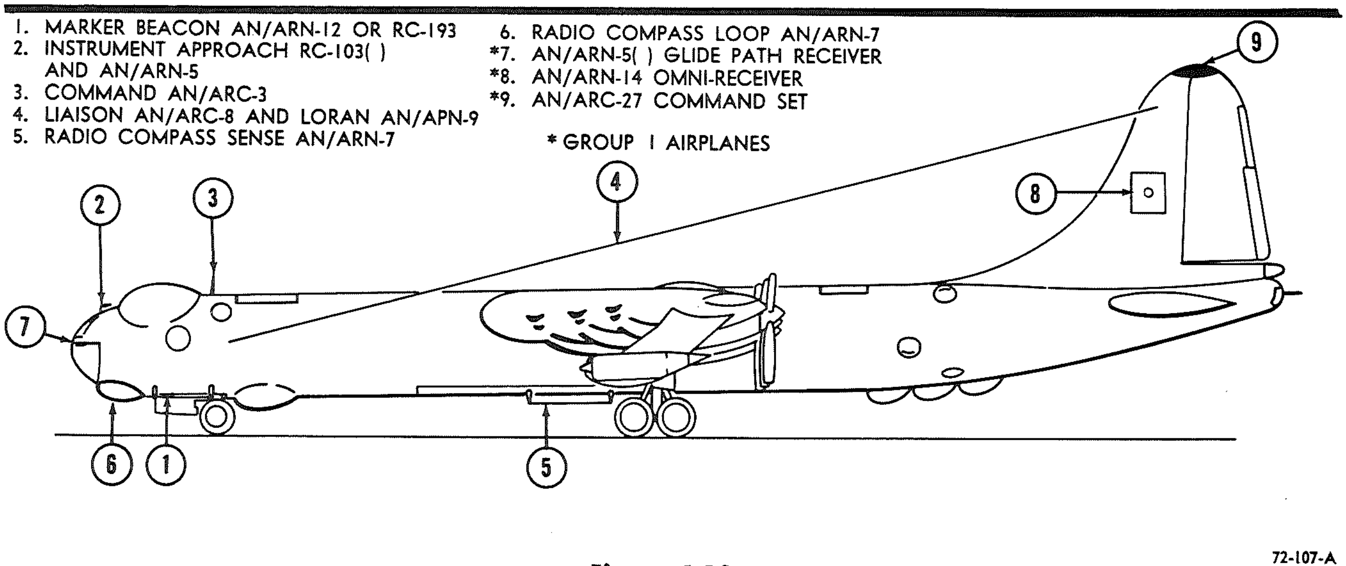


Figure 4-12.

COMBAT INTERPHONE SYSTEM.

The interphone system provides interphone communication between all crew stations. In addition, remote interphone jackboxes are located in the wing crawlways between the nacelles, in the tail section, in the bomb bays, and outside under the fuselage.

The basic interphone system is conventional. The system, however, has been modified to include a private interphone channel; a call circuit; and provisions for either the aircraft commander or pilot, or both, to mix command radio, radio compass, interphone, marker beacon, and localizer audio signals into one output.

To start the interphone amplifier, turn on the airplane's main power supply. Make sure the ON-OFF switch on the amplifier is in the ON position.

Note

Normally this switch is safety-wired in the ON position.

Private Interphone Channel.

The private interphone channel employs a private interphone amplifier and can be used in the event of normal interphone channel failure. Two variations of the private interphone channel are used. Airplanes not in group 1 have a special interphone switch (1, figure 4-17) on the pilots' pedestal which provides primary control of the private interphone channel. When this switch is in the normal CRUISE COMBAT position and the private interphone channel is in use, communication between all crew stations is available. Placing the switch in the PRIVATE position removes all crew stations from the channel except those for the aircraft commander, pilot, photo-navigator, photographer, radar observer, and the left oblique camera station. Thus a private communication channel is available for close coordination between these stations, and the remainder of the crew can still use the normal interphone system.

On airplanes in group 1, interphone contact with the wing, bomb bay, and external audio outlets must be made by using the private interphone channel. On airplanes not in group 1, these outlets are on the normal interphone channel.

On airplanes not in group 1, when it is desired to restrict the private interphone channel to any of the six designated stations, the following steps must be performed by the aircraft commander or pilot:

1. Place the special interphone switch in the PRIVATE position.
2. Hold the selector switch on the interphone control panel in the spring-loaded CALL position.
3. Direct the crew members with whom communication is desired to place their selector switches in the PVT. INTER position.
4. Release the selector switch, place it in the PVT. INTER position, and continue the conversation on the private interphone channel.

On airplanes in group 1 the special interphone switch for the private interphone channel has not been incorporated, thereby eliminating the restrictions on the private interphone channel use except those imposed by crew discipline. Use of the special interphone switch in the PRIVATE position prevented communication between aft cabin crew members and the flight deck if the normal interphone channel became inoperative.

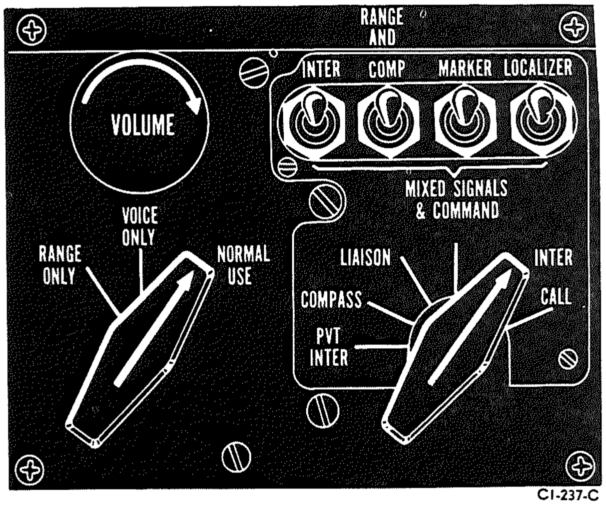


Figure 4-13. Pilots' Interphone Panel

When use of the private interphone channel is desired, the following steps must be performed:

1. Hold the selector switch on the interphone control panel in the spring-loaded CALL position and speak into the microphone, directing the crew members with whom communication is desired to place their selector switches in the PVT. INTER position.

Note

This also places all panels in direct communication with all audio outlet stations.

Note

The call position will be inoperative if the private interphone circuit breaker is pulled.

2. Release the selector switch, place it in the PVT. INTER position, and continue the conversation on the private interphone channel.

Emergency Interphone Operation.

When the normal interphone system has become inoperative, the crew member first noticing the deficiency will alert the other crew members to switch to PVT. INTER., since the call circuit operates through the normal interphone amplifier only and will be inoperative. On airplanes which have a special interphone switch on the pilots' pedestal, the switch must be in the CRUISE COMBAT position at all times, except in instances where close coordination is required between the six crew members on the private circuit.

Note

In case of mixer amplifier failure, any of the three amplifiers can be interchanged.

Wing Interphone Control Switch (Some Airplanes).

An on-off wing interphone control switch is provided at each wing crawlway entrance hatch. This switch is used to isolate the wing interphone channel from the basic interphone channel so that, in the event a nacelle fire short circuits the wing interphone channel, the basic interphone channel will remain operative. Each switch is mechanically ganged to a wing crawlway light switch.

CAUTION

When the wing interphone channel is not in use, the wing interphone control switch must always be in the OFF position to prevent failure of the private interphone channel in the event of a short circuit in the wing interphone wiring.

An indicator lamp (15, figure 1-20), located on the engineers' panel, lights when one or both of the wing interphone control switches are on.

Call Circuit.

A call circuit is provided to enable a crew member at any crew station to interrupt the reception of the other stations provided the normal interphone channel is operative. When the call circuit is selected by holding a selector switch in the spring-loaded CALL position, all other interphone controls are switched from any facility being used to the output of the normal interphone amplifier.

Mixed Signals and Command.

This feature of the interphone system is provided for the aircraft commander and pilot only. (See figure 4-13.) It allows either or both of them to mix any combination of radio compass, interphone, marker beacon, and localizer audio signals with command radio signals, affording close coordination for take-

Figure 4-14. Radio Operator's Interphone Panel

off or landing operation. To use the mixed signals and command feature, proceed as follows:

1. Place the selector switch on the interphone control panel in the MIXED SIGNALS & COMMAND position. The command radio signals will be received in the headset, provided the set is in operation and its volume is properly adjusted.

2. Adjust the volume control on the interphone control panel for the desired output level.

3. To transmit on the command radio set, close the microphone switch and speak into the microphone. The VOICE-CW-MCW switch on the transmitter must be in the VOICE position.

Note

The remainder of the crew, excluding the radio operator, can hear the command set by placing their selector switches in the COMMAND or RADIO position. The RADIO position is effective in this case only if the radar observer's interphone radio switch is in the COMMAND position.

4. To receive signals from the other sets in conjunction with command radio signals, place any combination of the toggle switches marked INTER-COMP-MARKER-LOCALIZER in the ON position. The INTER switch is for the interphone channel, and the COMP switch is for the radio compass channel. The MARKER switch is for the marker beacon channel, and the LOCALIZER switch is for the localizer channel.

Note

These four channels are operative only when their switches are on and the interphone selector switch is set at MIXED SIGNALS & COMMAND.

Mixed Signals and Liaison.

This facility is provided for the radio operator only and is utilized as follows:

1. Place the selector switch on the interphone control panel in the MIXED SIGNALS & LIAISON position. The liaison radio signals will be received in the headset, provided the set is in operation and its volume is properly adjusted.

2. Adjust the volume control on the interphone panel to the desired output volume.

3. To transmit on the liaison radio set, close the microphone switch and speak into the microphone. The VOICE-CW-MCW switch on the liaison transmitter must be in the VOICE position.

Note

Other crew members can hear the liaison set by placing their selector switches in the LIAISON or RADIO position. The RADIO position is effective in this case only if the radar observer's interphone radio switch is in the LIAISON position.

Radio Operator's ARC-27 CONTROL UNIT

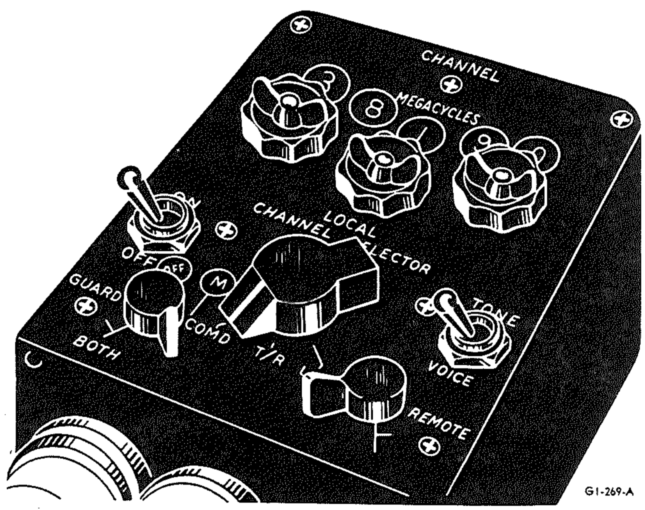


Figure 4-15.

4. To receive audio signals from ECM sets in conjunction with liaison radio signals, place any combination of the four switches in the on position. The audio signals of the selected sets and the liaison set will be received simultaneously.

RADIO CIRCUIT.

This facility can be selected at the interphone control panels for all crew members except the pilots, the radio operator, the radar observer, and the photo-navigator. When an interphone selector switch is placed in the RADIO position, the crew member receives audio signals from the command, liaison, or compass radios. The radio to be received is determined by the position of the radar observer's interphone radio switch.

COMMAND RADIO SETS.

All airplanes are equipped with the AN/ARC-3 command radio set for plane-to-plane or plane-to-ground communication. The set operates in the VHF range. On airplanes in group 1 the UHF AN/ARC-27 set is also installed. On airplanes equipped with both sets, both receivers may be operated at the same time to permit reception on all channels. Transmission on a desired set is controlled by the pilots' command radio selector switch. If both sets are operating when a signal is received which does not disclose its type of command set or frequency range, the pilots must determine which set is receiving the signal before they can transmit on the correct command set. To determine which operating set is receiving an undisclosed signal, proceed as follows:

1. Vary the volume on one set. If the audio level remains unchanged, the set with the original volume setting is receiving the signal and must be used for transmission.

2. If the receiving set cannot be determined by varying the volume, transmit on first one set and then the other until contact is made.

Pilots' Command Radio Selector Switch.

This switch (7, figure 4-17), marked ARC-3 and ARC-27, permits the pilots to transmit on either the AN/ARC-3 or AN/ARC-27 command radios. The pilots may receive radio signals on either set, regardless of the selector switch position, providing their interphone selector switches are placed in the MIXED SIGNALS & COMMAND position and the sets are turned on.

Note

Other crew members, with the exception of the radio operator and the radar observer, will hear the command set indicated by the command radio selector switch position when their interphone selector switches are placed in the RADIO position and the radar observer's interphone selector switch is placed in the COMMAND position. The radio operator's interphone panel, like that of the pilots' and the radar observer, has a COMMAND position which gives him command radio reception independent of the radar observer.

Command Radio AN/ARC-3.

Operation of this equipment is accomplished from the control panel (2, figure 4-17) on the pilots' pedestal. Operate as follows:

1. Place the selector switch on the interphone control panel to MIXED SIGNALS & COMMAND.

2. Place the command radio selector switch in the ARC-3 position on group 1 airplanes.

3. Place the ON-OFF switch on the command set control unit to the ON position and turn the channel selector switch to any one of the positions designated A through H on the control unit. This action applies power to the unit, which then automatically tunes itself to the channel selected.

4. To stop the equipment, place the ON-OFF switch in the OFF position.

Command Radio Set AN/ARC-27 (Group 1 Airplanes).

Operation of this equipment can be accomplished from either the pilots' or the radio operator's position (5, figure 4-17), depending on the setting of the control panel at the radio operator's station. For operation from the control on the pilots' pedestal, the radio operator's control panel is adjusted as follows:

1. Place the LOCAL-REMOTE switch on REMOTE position.

2. Place the TONE-VOICE switch in VOICE position.

With these adjustments made, operate from the control panel on the pilots' pedestal as follows:

1. Place the selector switch on either the aircraft commander or the pilot's interphone control panel in MIXED SIGNALS & COMMAND position.

2. Place the command radio selector switch in the ARC-27 position.

3. Turn on the command radio set by operating the OFF—T/R—T/R + G REC—ADF switch to the T/R position.

Note

Allow at least one minute warmup time before attempting transmission.

4. With the switch in T/R position, the equipment is ready for transmission and reception on any of eighteen preset frequencies and the guard frequency depending on the setting of the channel selector switch. Operate the channel selector to the desired preset channel.

5. Turn the OFF—T/R—T/R + G REC—ADF switch to the T/R + G REC position, making reception possible on both the main and guard channel frequencies. For transmission on the guard channel frequency, the OFF—T/R—T/R + G REC—ADF switch must be in the T/R position and the channel selector switch in G position.

6. Tone or modulated continuous wave operation for an emergency signal or to aid direction-finding equipment is accomplished from the radio operator's control panel. Proceed as follows:

a. Place the TONE-VOICE switch in the TONE position.

b. Place the power switch in the ON position.

c. Place the LOCAL-REMOTE switch in the LOCAL position.

d. Place the radio operator's GUARD, BOTH, COMD T/R switch in the BOTH or COMD T/R position.

e. Adjust the local channel selector switch as needed.

f. To turn the equipment off from the radio operator's control panel, place the LOCAL-REMOTE switch in LOCAL and the power switch in the OFF position.

7. To turn the equipment off, place the OFF—T/R—T/R + G REC—ADF switch in the OFF position.

LIAISON RADIO SET AN/ARC-8.

Control of transmitting equipment is accomplished from the radio operator's table. The equipment is started by placing the LOCAL-REMOTE switch to the LOCAL position and setting the emission switch to VOICE. A remote control panel (4, figure 4-17) is located on the pilots' pedestal for use by the pilot or copilot. Control of this panel is attained when the radio operator places the LOCAL-REMOTE switch to REMOTE. A green light on the pilots' remote control panel will indicate that the transmitter is ready for remote control. To stop the transmitter, place the emission switch in the OFF position.

RADIO RANGE RECEIVER BC-453-B (AIRPLANES NOT IN GROUP 1).

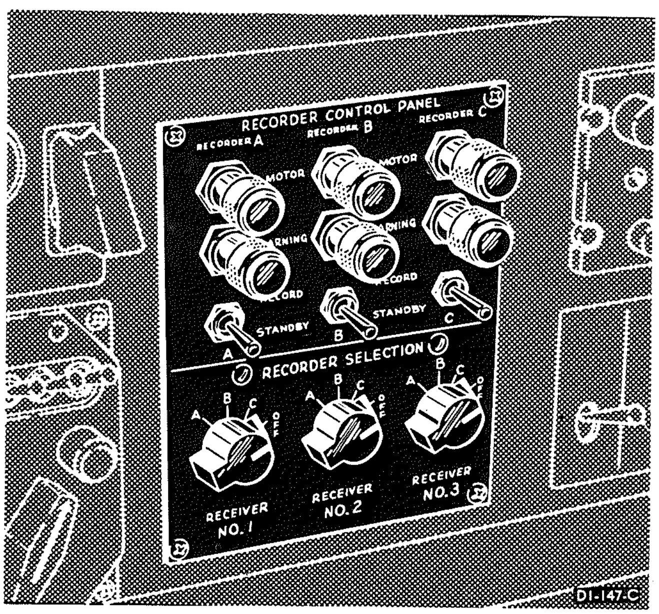
Operation of this equipment is accomplished from a remote control panel on the pilots' pedestal. The receiver is started by placing the CW-OFF-MCW switch on the control panel in either the CW or MCW position. To turn the equipment off, place the CW-OFF-MCW switch in the OFF position.

WIRE RECORDERS.

One AN/ANQ-1A wire recorder is provided for each ECM station in the aft cabin on some airplanes, and two recorders are provided for the LF-ECM operator. Each recorder has provisions for a replaceable wire magazine and is operated from an adjacent control panel. The LF-ECM operator can record his voice, receiver signals, or a combination of both. Play-back of the recordings must be made only on ground equipment.

Wire Magazines.

Each magazine for the wire recorders contain sufficient wire to record continuously for a total elapsed recording time of one hour. An elapsed time indicator shows the amount of time already used for recording. A handle is provided on the recorder for locking and releasing the magazine. This handle has positions marked LOCK, LATCH, and RELEASE. The end of the handle must be pushed in before it can be moved to or from the LOCK position. To install the magazine, move the handle to the LATCH position and place the magazine in the recess provided for it in the recorder. Push in with enough force to override the spring-loaded latching hooks on either side of the recorder. When it is determined that these hooks have latched the magazine, move the handle to the LOCK position.



DI-147-C

Figure 4-16. Radio Operator's Recorder Control Panel

Note

The recorder motor will not run unless the handle is in the LOCK position.

To release the magazine, move the handle to the RELEASE position. This raises the latching hooks and allows the magazine to be removed.

Note

Be sure the recorder motor has fully stopped before releasing the magazine.

A broken recording wire may be repaired by tying the loose ends into a square knot, annealing the knot, and trimming the loose ends as close to the knot as possible.

Control of the recording operation is maintained through the interphone selector switches, the recorder control panels, and the microphone control switches.

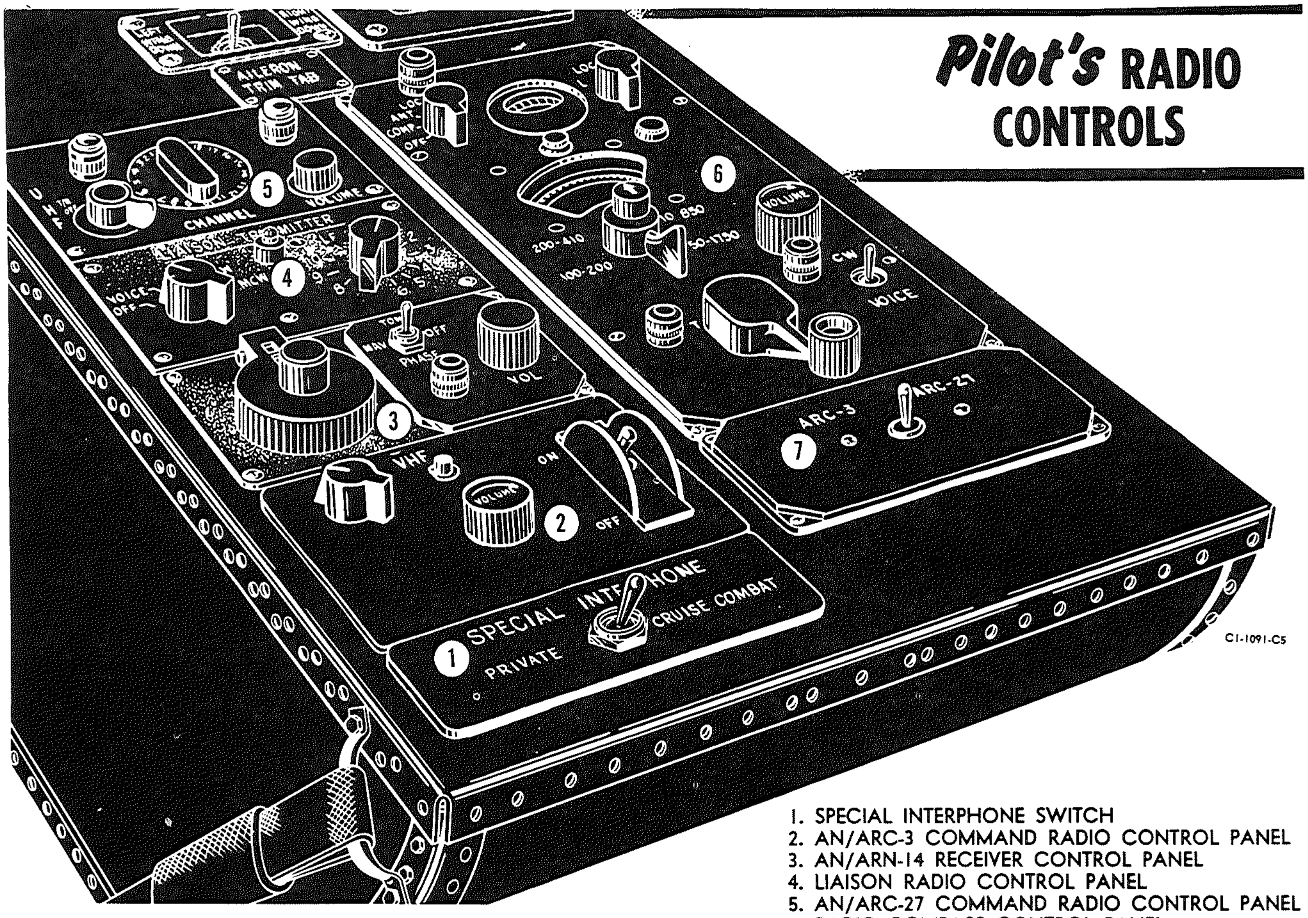
Radio Operator's Recording Controls.

There is a circuit breaker on the radio operator's circuit breaker panel for each recorder. They are marked RECORDER A and RECORDER B. Any time that either of these circuit breakers is closed, current is supplied to warmup the corresponding recorder amplifier and the recorder motor will run if the RECORD-STANDBY switch is in the RECORD position.

Radio Operator's Recorder Control Panel. A control panel (figure 4-16) is provided for the radio operator's recorders. For each recorder, this panel contains a green lamp which indicates when the recorder motor is running, and a red lamp which indicates when five minutes of recording time remain. This panel also contains RECORDER SELECTION switches to control the recording of receiver audio signals and RECORD-STANDBY switches, one for each recorder. The volume control on the interphone control box is used to control voice level for recording, whereas the individual receiver volume controls are used when recording audio receiver signals.

Note

Monitoring of audio receiver signals may be accomplished by placing the interphone selector switch in the MIXED SIGNALS &



1. SPECIAL INTERPHONE SWITCH
2. AN/ARC-3 COMMAND RADIO CONTROL PANEL
3. AN/ARN-14 RECEIVER CONTROL PANEL
4. LIAISON RADIO CONTROL PANEL
5. AN/ARC-27 COMMAND RADIO CONTROL PANEL
6. RADIO COMPASS CONTROL PANEL
7. COMMAND RADIO SELECTOR SWITCH

CI-1091-C5

Figure 4-17.

LIAISON position and feeding the receiver signals into the mixer amplifier. An on-off switch for each receiver is provided on the interphone control box. This action, however, is not essentially a factor of recorder operation. On some airplanes a headset audio selector switch is installed at the LF-ECM operator's station. This switch provides the operator with direct monitoring of either recorder A or B sidetone and also has a position for normal audio reception to monitor recorder sidetone, set the selector switch to RECORDER A MONITOR or RECORDER B MONITOR, as desired.

Record-Standby Switches. A RECORD-STANDBY switch is provided for each recorder and is essentially an on-off switch for the recorder motor.

Note

The RECORD-STANDBY switch and indicator lamps beneath the caption RECORDER C are inoperative.

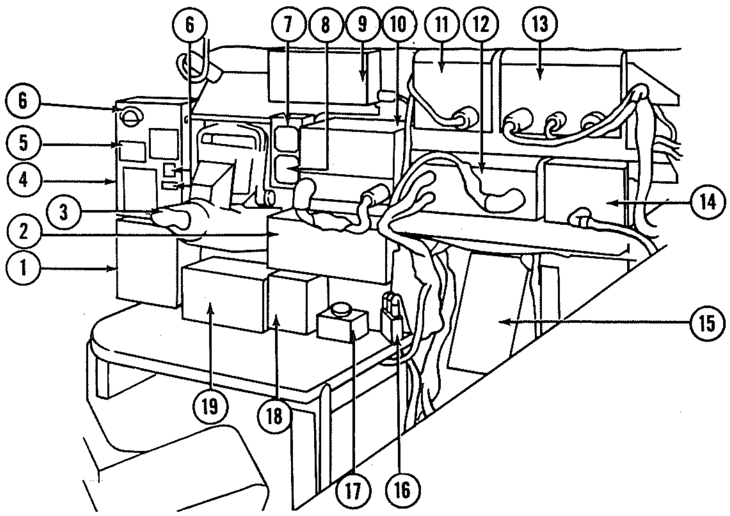
Placing this switch in the RECORD position allows the respective recorder motor to run continuously. With the switch in the STANDBY position, the motor will run only when the microphone switch is depressed. The RECORD-STANDBY switch should be in the STANDBY position except when continuous recording is desired.

Recorder Selection Switches. For each receiver from which audio signals may be recorded a RECORDER SELECTION switch is provided for selecting a recorder to operate with that receiver. Each switch has positions marked A, B, C, and OFF; however, the C position is inoperative because only two recording units, A and B, are provided.

Note

RECORDER SELECTION switch, RECEIVER No. 1, places the audio output of APR4-TN16 receiver to the input of either recorder A or recorder B as desired. RECORDER SELECTION switch, RECEIVER No. 2, places the audio output of APR4-TN17 receiver to

RADAR OBSERVER'S *Station*



1. RADAR CONTROL UNIT C-413/APS-23
2. BALLISTICS COMPUTER CP-21/APA-44
3. INDICATOR ID-218/APS-23
4. OXYGEN CONTROLS
5. INTERPHONE CONTROL PANELS
6. RADAR PRESSURE CONTROLS
7. MONITOR VOLTMETER ID-166/APA-44
8. STEERING METER ID-165/APA-44
9. TRUE AIRSPEED UNIT ID-168/APA-44
10. SYNCHRONIZER SN-47/APS-23
11. POWER SUPPLY UNIT PP-185/APA-44
12. AMPLIFIER AM-116/APA-44
13. SERVO UNIT AM-118/APA-44
14. RECTIFIER POWER UNIT PP-259/APS-23
15. RIGHT FORWARD CABIN POWER PANEL
16. P-3B CONTROL BOX
17. TYPE E-2 TURN CONTROLLER
18. TRACKING CONTROL UNIT C-293/APA-44
19. MILEAGE COMPUTER CP-22/APA-44

76-132-A

76-132-A

Figure 4-18. (Sheet 1 of 2)

the input of either recorder. RECORDER SELECTION switch, RECEIVER No. 3, places the audio output of ARR-7 receiver to the input of either recorder.

Interphone Selector Switch. The interphone selector switch has several positions, two of which are marked RECORDER A and RECORDER B respectively. These positions are used when the radio operator desires to record his voice, as no other audible signal is fed through the interphone control box.

Radio Operator's Recording Operation. The radio operator's voice and audio signals from his receivers may be recorded independently or concurrently. For recording audio signals on recorder A, proceed as follows:

1. Place interphone selector switch to RECORDER A position.
2. Close the RECORDER A circuit breaker (allow 30 to 60 seconds for tubes to warm before proceeding).
3. Place the desired RECORDER SELECTION switch or switches, in the A position.
4. Place the RECORD-STANDBY switch for recorder A in the RECORD position.
5. Adjust the volume control on each receiver to the desired headset level which is also the correct recording level.

Note

While recording, occasionally check to see if both wire spools are turning.

Note

If the unit does not operate, check the magazine release handle to see if it is in the LOCK position.

6. To record voice while recording audio signals from a receiver, close microphone switch and speak into the microphone.

Note

Be sure the interphone selector switch is in the RECORDER A position.

7. When recording is finished, move the RECORD-STANDBY switch for recorder A to STANDBY unless it is desired to leave the recorder motor running, and return the RECORDER SELECTION switch or switches to OFF.
8. If you do not intend to use your recorder for a prolonged period, open the RECORDER A circuit breaker and return the interphone selector switch to INTER.

Note

For the identical operation of recorder B, proceed in a like manner and substitute B for A where applicable.

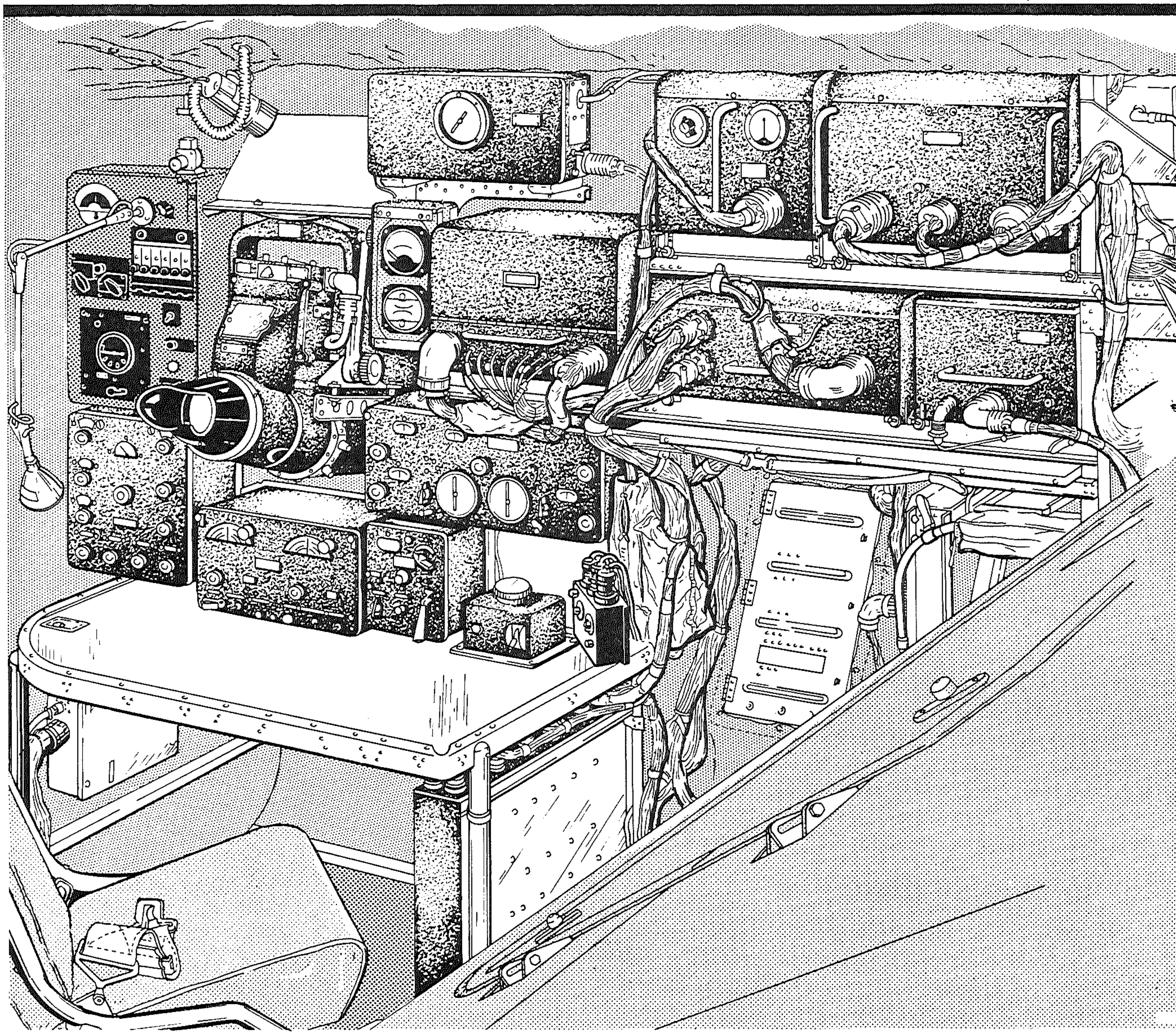

76-132-A

Figure 4-18. (Sheet 2 of 2)

For recording voice only on recorder A, proceed as follows:

1. Place the interphone selector switch in the RECORDER A position.

2. Close the RECORDER A circuit breaker (allow 30 to 60 seconds for tubes to warm before proceeding).

3. Place RECORDER SELECTION switches to OFF.

4. Place the RECORD-STANDBY switch for recorder A in the STANDBY position for intermittent recording or in the RECORD position for continuous recording.

5. Depress the microphone switch and speak into the microphone.

6. Adjust the volume control on the interphone control box to the desired level.

Note

While recording, occasionally check to see if both wire spools are turning.

Note

If the unit does not operate, check the magazine release handle to see if it is in the LOCK position.

7. When recording is finished, release the microphone switch and return the RECORD-STANDBY switch for recorder A to STANDBY, unless it is desired to leave the recorder motor running.

8. If you do not intend to use your recorder for a prolonged period, open the RECORDER A circuit breaker and return the interphone selector switch to INTER.

Note

For identical operation of recorder B, proceed in a like manner and substitute B for A where applicable.

RADIO SET AN/CRC-7 (WALKIE-TALKIE).

This set is stowed on the left side of the radio operators' compartment adjacent to the food locker and is provided for emergency use. To start the unit, remove the lock pin from the three switch keys marked TONE, TRAN, and REC and press the desired key. To stop the set, release the keys.

INSTRUMENT APPROACH EQUIPMENT.

The instrument approach equipment of airplanes not in group 1 consists of AN/ARN-5( ) and RC-103-( ) receivers, a control panel on the pilots' pedestal, and an indicator (1, figure 1-13) on the pilots' instrument panel. About 20 minutes before approaching the runway, turn the selector switch to the appropriate channel and allow the receivers to warm up. Visual indication of the signals received by both receivers is transposed onto the pilot's indicator.

Airplanes in group 1 obtain glide path signals from the AN/ARN-5( ) receiver and obtain localizer signals from the AN/ARN-14 receiver. These signals provide visual reference on the course indicator located on the pilots' instrument panel. For instrument approach operation, set the switch on the AN/ARN-14 control panel (3, figure 4-17) to the TONE position. To stop the equipment, place the switch on NAV OFF.

RADIO COMPASS AN/ARN-7( ).

This equipment is used by the pilot and photo-navigator; each has a control panel and an indicator. The pilot's control panel (6, figure 4-17) is located on the pilots' pedestal, and the photo-navigator's control panel (figure 4-49) is located adjacent to the photo-navigator's instrument panel. On airplanes not in group 1, one radio compass indicator is located on the photo-navigator's instrument panel (15, figure 4-49), and one is located on the pilot's instrument panel (26, figure 1-13). On group 1 airplanes the radio compass indication is read on the front pointers of the radio magnetic indicators for the AN/ARN-14 receivers. One radio magnetic indicator is located on the pilots' instrument panel and one is located on the photo-navigator's instrument panel.

To start the radio compass equipment, momentarily hold the function switch on the control panel in the spring-loaded CONT position and move the function switch to the COMP or ANT position. To stop the equipment, turn the function switch to OFF.

Note

On group 1 airplanes the radio compass will not give visual indications unless the N-1 high latitude compass or the AN/ARN-14 receiver is operating.

MARKER BEACON SET AN/ARN-12 OR RC-193A.

Some airplanes are equipped with the RC-193A set, while other airplanes have the AN/ARN-12 set. The operation of this equipment is automatic when the ship's d-c power is on and its circuit breaker is closed.

Marker beacon signals are indicated by a lamp at the corner of the instrument approach indicator on the pilots' instrument panel. To receive signals aurally the interphone control panel marker switch must be on MARKER and the selector switch must be on MIXED SIGNALS & COMMAND.

RADIO RECEIVER AN/ARN-14 (GROUP 1 AIRPLANES).

This radio navigational aid consists of a receiver, a course indicator, two radio magnetic indicators, and a bearing converter indicator.

Note

The bearing converter indicator is located in the aft cabin and is for test and adjustment purposes only.

The course indicator and one magnetic indicator (1 and 26, figure 1-13) are located on the pilots' instrument panel. The other magnetic indicator is located on the photo-navigator's instrument panel. The course indicator provides the facilities for an instrument approach indicator, a magnetic heading indicator, a course selector, and a marker beacon indicator. The radio magnetic indicators consist of a rotating compass card that indicates the magnetic heading as detected by the N-1 high latitude compass, a front pointer actuated by the radio compass, and a rear pointer actuated by the AN/ARN-14 receiver. To turn the AN/ARN-14 receiver on, place the switch on the control panel (3, figure 4-15) to the TONE position. To stop the operation, place the switch in the NAV OFF position.

LORAN SET AN/APN-9.

The receiver-indicator (1, figure 4-38) of this set is installed on the photo-navigator's table. A control panel incorporated on the front of the receiver-indicator in conjunction with a detachable visor provides all of the manual controls. To start the set, proceed as follows:

1. Set the AMPLITUDE BALANCE control at its center position.
2. Turn the FINE DELAY control to its center position of rotation.
3. Set the DRIFT control at its center position of rotation.
4. Turn the RECEIVER GAIN control clockwise until the STATION rate identification (pilot light) illuminates. Wait at least five minutes to allow the equip-

AN/APN-9 LORAN CALIBRATION *Chart*

FUNCT	STN	PRR	SCOPE PATTERN	REMARKS	ADJ	CRSE	FINE
5	0	L OR H		ADJUST FOR DISTINCT PICTURE	FOCUS		
5	0	L OR H		ADJUST TO OPERATOR'S DESIRE	BRILL		
1	0	L OR H		ADJUST ALTERNATELY FOR LENGTH & POSITION	SL. SWP. H. CENT. & AMPL.		
2	0	L OR H		ADJUST ALTERNATELY FOR LENGTH & POSITION	FA. SWP. H. CENT. & AMPL.		
2	0	L OR H		ADJUST TO CENTER VERTICALLY	VERTICAL CENTER		
5	0	L OR H	100 MS MARKER 1000 MS MARKER	ADJUST 1000 MS MKRS 1/8"-1/4" ABOVE 100 MS MKRS	MARKER AMPL.		
5	0	L OR H	CROSS-HAIR	ADJUST UNTIL CROSS HAIR BARELY TOUCHES 10 MS MARKERS ON UPPER TRACE	CROSS HAIR		
4	0	H	1 2 3 4 5 1 2 3 4 5	5 (1000 SPACES) BETWEEN (5000 MKRS)	C		
4	0	H	1 2 3	3 (5000 MS MARKERS)	D		
4	0	L	1 2 3 4	4 (5000 MS MARKERS)	E		
5	0	H	BOTTOM TRACE 1 2 3 4 5 / 50 40 30 20 10	4 (10 MS MKRS) BETWEEN (50 MS MKRS)	A		
5	0	H	TOP TRACE 1000 MC	9 (100 MS MKRS) BETWEEN (1000 MS MKRS)	B		
5	0	H	CROSS HAIR 1 2 3 4 5 6 7 8	COUNT 8 SPACES FROM CROSS HAIR ON LEFT TO FIRST STN RATE ON RIGHT (BTM TRACE)	B		
5	1	H	CROSS HAIR 1 2 3 4 5 6 7	COUNT 7 SPACES FROM CROSS HAIR TO STN RATE MARKER	B		
5	2	H	1 2 3 4 5 6	COUNT 6	2		
5	3	H	CROSS HAIR 1 2 3 4 5	COUNT 5	2		
5	4	H	1 2 3 4	COUNT 4	4		
5	5	H	1 2 3	COUNT 3	4		
5	6	H	CROSS HAIR 1 2	COUNT 2	F 6		
5	7	H	CROSS HAIR 1	COUNT 1	F 6		
5	4	H	MOVE L-R SWITCH TO RIGHT, STN RATE MARKER SHOULD JUMP TWO SPACES LEFT.		B R-L		
4	0	H		MARKER READS BETWEEN 11,000 & 11,500	5 HOLE RIGHT SIDE	C.C.W.	C.W.
4	0	H		MARKER JUST OFF SCREEN. RECHECK PREVIOUS STEP	2 HOLE RIGHT SIDE	C.W.	C.W.
4	0	L		MARKER READS BETWEEN 13,500 & 14,000	4 HOLE RIGHT SIDE	C.C.W.	C.W.
4	0	L		MARKER JUST OFF SCREEN. RECHECK PREVIOUS STEP	3 HOLE RIGHT SIDE	C.W.	C.C.W.
5	0	H	ROTATE FINE DELAY C.W. TO C.C.W. & COUNT HUNDREDS; READ NO LESS THAN 700 NOR MORE THAN 1500		1 HOLE RIGHT SIDE	SET ON 5000	C.W. & C.C.W.

69-153-A

Figure 4-19.

ment to warm up. The set is now ready for operation. (See figure 4-19 for calibration information.)

To stop the equipment, turn the RECEIVER GAIN control to POWER OFF and check to see that the pilot light is not illuminated. Also check to see that the pattern on the indicator screen has disappeared.

IDENTIFICATION SET AN/APX-6.

Provisions have been made for the installation of an AN/APX-6 identification set at the radio operator's station.

Operation.

To operate the identification set AN/APX-6, proceed as follows:

CAUTION

Before take-off, insert three destructors in the face of AN/APX-6 IFF transpondor located beneath the step under the left escape hatch. Remove all three destructors immediately after landing, and insert dummy plugs.

1. Master control in OFF position.
2. Set receiver frequency counter to correct frequency channel.
3. Turn low frequency counter to same channel.
4. Set transmitter frequency counter to transmitting channel.
5. Rotate master control to NORM position (full sensitivity and maximum performance) or to STDY or LOW as required.
6. Set the mode 2 switch to I/P or required position.
7. Set the mode 3 switch to OUT or required position.
8. For emergency operation, press the dial stop, and rotate master control to EMERGENCY position.
9. An impact switch to fire the detonators and destroy the IFF system is incorporated in the system as a security measure. However, the detonators may be fired manually by a destructor switch on the IFF control panel. To manually fire destructors, lift destructor guard by breaking safety wire and place toggle switch in the ON position.

CAUTION

The destructor switch should be operated only when AN/APX-6 equipment is in danger of falling into enemy hands.

10. To turn off equipment, rotate master switch to the OFF position.

RADAR SET AN/APQ-24.

Operation of the AN/APQ-24 radar set is accomplished from the radar observer's station (figure 4-18). The equipment is started as follows:

CAUTION

When the set is started it is essential that the following controls on control unit C-413/APS-23 be set as specified: range control at less than 50 miles; sweep delay control depressed; tuning switch at RAD MAN. or RAD AFC.

1. Set the controls on indicator ID-218/APS-23 (7, figure 4-18) as follows:
   a. Bias Control—Fully counterclockwise.
   b. Marker Intensity Control—Fully counterclockwise.
   c. Video Gain Control—Fully counterclockwise.
   d. Sector Amplitude Control—Fully clockwise.
2. Set the controls on control unit C-413/APS-23 (1, figure 4-18) as follows:
   a. Power Switch—OFF.
   b. Meter Switch—DC (+ 26.5 volts).
   c. Range Control—5.
   d. Tilt Control—0.
   e. Illumination Control—As desired.
   f. Receiver Gain Control—Fully counterclockwise.
   g. Tuning Switch—RAD AFC.
   h. Antijamming Switch—OFF.
   i. Contrast Control—Fully counterclockwise.
   j. Sweep Delay Control—Fully counterclockwise and depressed.
3. Turn the receiver gain control on the C-416/APS-23 control unit fully counterclockwise.
4. Turn the function switch on the C-293/APA-44 tracking control unit (3, figure 4-18) to OFF and the illumination control counterclockwise.
5. Set the controls on mileage computer CP-22/APA-44 (2, figure 4-18) as follows:
   a. North-South Mileage Slew Control—0.
   b. North-South Target Fix Slew Control—0.
   c. East-West Mileage Slew Control—0.
   d. East-West Target Fix Slew Control—0.
   e. Arming Mechanism Switch—OFF.
   f. Pilot's Steering Meter Disconnect Switch—OFF.
   g. Offset Switch—OFF.
   h. Selector Switch—RANGE MARKS.
6. Set the controls on ballistics computer CP-21/APA-44 (6, figure 4-18) as follows:
   a. Altitude Control—0.
   b. Bomb Trail Control—0.
   c. Time-of-Fall Control—0.
   d. Offset Control (N-S)—0.
   e. Offset Control (E-W)—0.

7. Place the air-speed test switch on air-speed indicator ID-168/APA-44 (15, figure 4-18) at NORMAL for flight operation. For ground operation, place the switch in the HOLD position.

8. After the engines have been started, turn the power switch of the C-413/APS-23 control unit to the SCAN OFF position.

9. Turn the meter switch of the C-413/APS-23 control unit to AC and check that the a-c voltage is within limits of 115 (± 5) volts.

10. Turn the function switch of the C-293/APA-44 tracking control unit to SEARCH.

Note

A 5-minute delay is automatically introduced in the power switch circuit. After the WIND DETERM pilot lamp on the tracking control unit lights, wait approximately 30 seconds before proceeding.

11. Press the air-speed indicator reference voltage button on the CP-22/APA-44 mileage computer to be sure that the voltage is present on the ID-166/APA-44 true air-speed meter.

12. Set the meter switch on the C-413/APS-23 control unit to 26.5. The voltage indication on the meter scale should be 26.5 (± 2) volts.

13. Turn the meter switch to each of its positions and check for proper readings.

14. Allow 15 minutes for circuits to stabilize before attempting operation.

15. To check the set before operation, turn the power switch on the C-413/APS-23 control unit to SCAN SLOW.

16. Turn the marker intensity control on the ID-218/APS-23 indicator clockwise until trace is visible and then counterclockwise until trace disappears.

17. Turn the video gain control on the ID-218/APS-23 indicator clockwise one-half turn.

18. Turn the receiver gain control on the C-413/APS-23 control unit clockwise until echoes are seen and then counterclockwise until echoes disappear.

19. Turn the video gain control on the ID-218/APS-23 indicator fully counterclockwise.

20. Return both the power switch on the C-413/APS-23 control unit and the function switch on the C-293/APA-44 tracking control unit to STDBY.

21. If search operation is planned, leave the function switch at SEARCH and turn the power switch to SCAN SLOW or SCAN FAST as desired.

To stop the operation, proceed as follows:

1. Turn the function switch on the tracking control unit to OFF.

2. Turn the power switch on the radar control unit to OFF.

RADAR PRESSURIZATION.

A 115-volt, a-c, motor-driven pressure pump located in the right side of the radio operator's compartment provides pressurized air for the radio frequency unit, the radio frequency line (wave guide), and the modulating unit of the AN/APQ-24 radar set. The pressure pump draws cabin air through a dehydrator to remove all moisture and then pressurizes it before it is routed to the units. The system incorporates a pressure pump switch, a pressure gage, an indicator lamp, and a pressure drain valve located at the radar observer's station. The system is controlled by the pressure pump switch which has three positions—AUTOMATIC ON, OFF, and MANUAL ON. When the switch is in the AUTOMATIC ON position, operation of the pump is controlled automatically by the action of a pressure switch. The indicator lamp lights when the pump is in operation.

CAUTION

If the pressure begins to exceed its specified limits, as indicated on the pressure gage, and the indicator lamp indicates that the pump is still operating, the pump should be stopped by placing the switch in the OFF position.

If the pressure begins to drop to a critically low point and the indicator lamp indicates that the pump is not in operation, hold the switch in the spring-loaded MANUAL ON position until the pressure is back to normal.

CAUTION

Do not operate the radar set until radar t-r unit air pressure is above minimum limits.

RADIO RECEIVER BC-454( ).

A BC-454( ) receiver is located at the right lower aft scanner's station (3, figure 4-29). This unit, which operates on 28-volt direct current, is controlled by an ON-OFF switch (5, figure 4-30) on the radiosonde control panel. Placing the switch in the ON position automatically connects the lower aft scanner's interphone to receive from the BC-454( ) receiver when his interphone selector switch is set on RADIO.

RADIO ALTIMETER.

A radio altimeter (2, figure 4-28) is located at the weather observer's station for use during weather reconnaissance missions. The radio altimeter gives absolute altitude readings which are used in conjunction with aerograph readings to evaluate radiosonde data. The altimeter operates on 115-volt a-c power and is controlled by an ON-OFF switch located on the instrument housing.

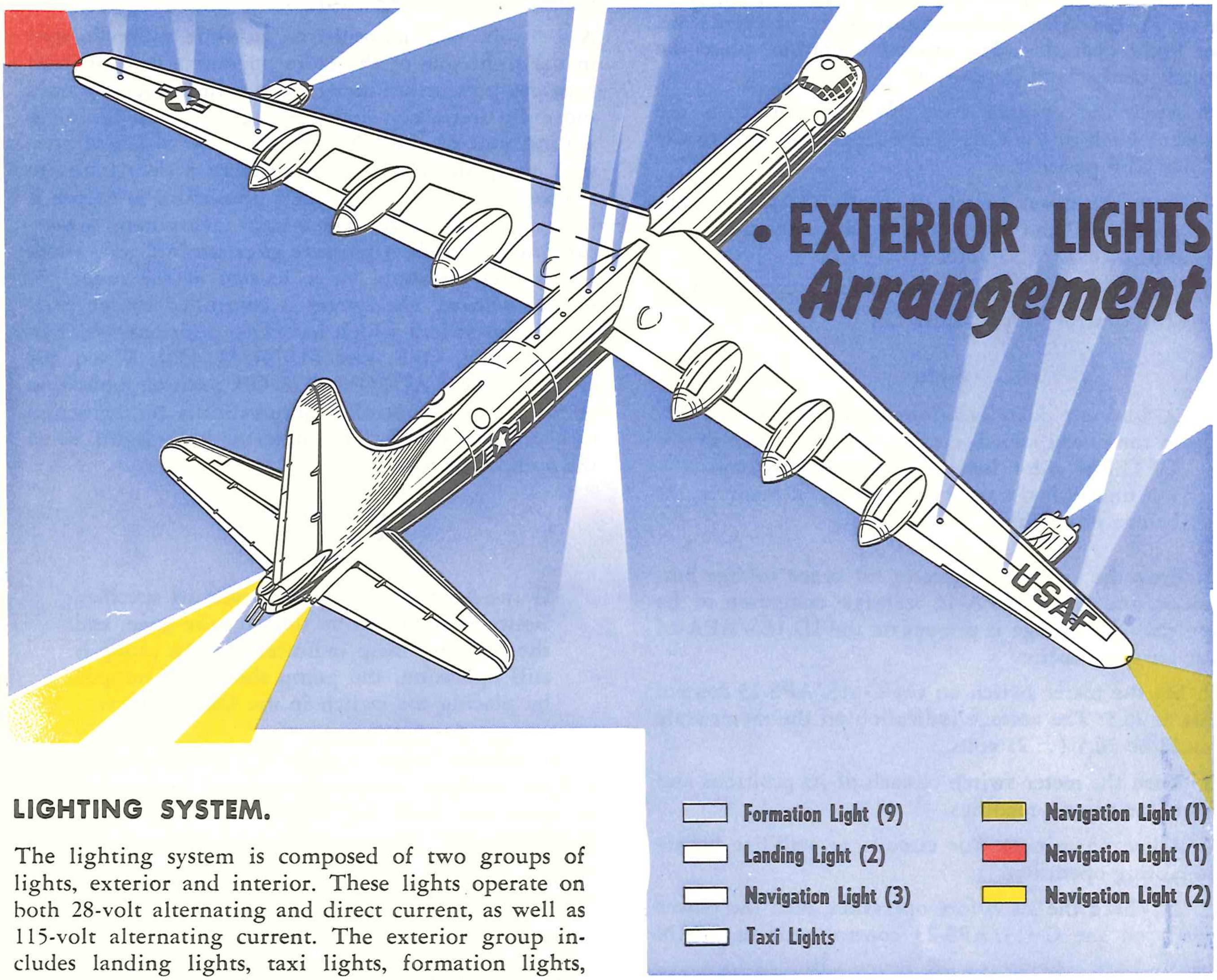


Figure 4-20.

LIGHTING SYSTEM.

The lighting system is composed of two groups of lights, exterior and interior. These lights operate on both 28-volt alternating and direct current, as well as 115-volt alternating current. The exterior group includes landing lights, taxi lights, formation lights, navigation lights, and code-signalling lights. Interior lighting is accomplished by means of dome, cockpit, and other miscellaneous lights. Receptacles for operating Aldis signal lights are located at the navigator's station, on the copilot's fairing, and at each sighting station.

EXTERIOR LIGHTS.

Landing Lights.

Two retractable landing lights are mounted flush with the fuselage, one on each side of the nose section just above the lower flight deck floor. In airplanes not in group 1 each landing light has a three-position switch (6, figure 1-14) marked RETRACT, EXTEND, and OFF. The EXTEND position controls both extension and illumination. In group 1 airplanes each light has a three-position switch marked RETRACT, EXTEND, and OFF which controls only extension and retraction. An additional switch marked ON and OFF energizes the filaments of both lamps.

CAUTION

When operating in extremely cold temperatures or during icing conditions, the filament control switch should be placed ON for a short time before extending the light. This action will preheat the light assemblies and remove any ice that might interfere with proper extension of the lights.

Taxi Lights (Some Airplanes).

Some airplanes are equipped with two taxi lights located on the jet pods. The lights, located between the engine housing of each pod, are controlled by a single switch at the pilot's station.

Taxi Light Switch. The taxi lights are controlled by an ON-OFF switch (31, figure 1-13) located on the lower right corner of the pilots' instrument panel.

Navigation Lights.

The navigation light system consists of a red light assembly on the left wing tip, a green light assembly on the right wing tip, two yellow and two white lights on the stabilizer close to the fuselage, and two white lights, one on the upper fuselage approximately in line with the wing trailing edge and one on the lower fuselage forward of the wing leading edge. The system is used to indicate the position and direction of motion of the airplane. The wing tip lights and white tail lights operate on a-c power. The yellow tail lights and flasher mechanism operate on d-c power. The wing tip lights and the white and yellow tail lights will burn steadily or can be made to flash alternately through the use of the flasher mechanism. When flashing, one circuit closes for approximately one-half second, then both circuits are open, the other circuit closes for approximately one-half second, then both open, etc. While burning steadily or flashing, these lights can be made bright or dim.

Navigation Lights Selector Switch. A three-position switch (1, figure 1-14) located on the pilots' pedestal controls the wing and tail navigation lights. This switch has positions marked STEADY, OFF, and FLASH. When it is in the STEADY position, the wing tip lights and both the white and yellow lights on the tail will burn continuously. The FLASH position causes the wing tip lights and the white tail lights to flash alternately with the yellow tail lights.

Wing and Tail Navigation Lights Dimming Switch. A two-position switch (8, figure 1-14) on the pilots' pedestal controls the intensity of the wing tip lights and both the white and yellow tail lights. The switch has positions marked BRIGHT and DIM and controls the light intensity accordingly.

Fuselage Navigation Lights Switch. A three-position switch (8, figure 1-14) on the pilots' pedestal controls the action of the two small white lights which are located on the top and bottom of the fuselage. This switch has positions marked BRIGHT, OFF and DIM, and controls the light intensity accordingly.

Formation Lights.

Nine blue formation light assemblies are installed on the airplane. Three are mounted on the left wing, three on the right wing, and three on the aft part of the upper fuselage. The lights are controlled by a switch (9, figure 1-14) on the pilots' pedestal. The three positions of the switch are OFF, DIM, and BRIGHT.

INTERIOR LIGHTS.

Dome, instrument, control panel, cockpit, table, coaming and crew station lights are located throughout the forward cabin to provide the crew with adequate illumination. The lights are controlled by built-in dimmer and switch units, panel switches, and rheostats. Two switches, one each near the catwalk entrance hatches of the camera compartment and the aft cabin, control dome lights in the bomb bays, the radar equipment bay, and the aft turret bay. The forward turret bay dome lights switch is located at the entrance hatch in the camera compartment. The camera compartment dome lights are controlled by two switches, one each near the communication tube entrances of the camera compartment. The camera well lights switch is located near the aft entrance of the forward section of the communication tube in the camera compartment.

Lighting in the forward section of the communication tube is controlled by a switch-type circuit breaker on the radio operator's panel. Lights in the aft portion of the tube burn continuously when the push-pull type circuit breakers for the camera compartment dome light control panel and the aft cabin dome light switch are closed.

The aft cabin dome lights are controlled by two switches, one on the left side of the cabin near the communication tube and the other at the entrance hatch. The sighting station cockpit lights are controlled by built-in dimmer and switch units. The switch for the tail cone and tail turret dome lights is a switch-type circuit breaker located above the tail cone entrance hatch. A switch at each wing crawlway entrance controls the wing crawlway lights. Mounted on the engineers' control panel is a switch-type circuit breaker (31, figure 1-20) for control of the nose and main landing gear wheel well lights. A subflight deck light is controlled by a switch-type circuit breaker on the radio operator's circuit breaker panel.

ALDIS LAMP RECEPTACLES.

Receptacles for operating the Aldis lamps are located at the navigator's station, the pilots' station, and at each sighting station.

FLIGHT DECK FLOOD LIGHTS (GROUP 4 AIRPLANES).

The flight deck is provided with three flood lights in the pilots' enclosure. The lights are arranged to shine on the pilot's, copilot's, and engineers' station. At each of the lights is a three-position switch with RED, WHITE, and neutral off positions. With the white lights on, the blinding effect of lightning is minimized. The red lights are used when night vision must be preserved.

LIGHTING SYSTEM EMERGENCY OPERATION.

In the event of failure of all alternators, the only electric power available will be from the airplane battery. To conserve the strength of the battery, it is necessary that all nonessential lights be turned off.

OXYGEN SYSTEM.

The airplane is equipped with a low pressure oxygen system consisting of 32 type G-1 oxygen cylinders, 5 portable diluter oxygen units, 9 recharger hoses, and oxygen controls at each crew station. The airplane is equipped with D-1 or D-2 automatic pressure-breathing diluter-demand regulators. The oxygen cylinders are on the left side of the bomb bay area and the forward turret bay; the system is serviced through a single filler valve on the lower left side of the fuselage near the radome. (See figure 1-50.)

Note

> The system must be fully charged to 400 psi prior to all flights.

For combat safety each crew oxygen station is supplied from two distribution lines through automatic check valves. The approximate duration of the oxygen system is given in figure 4-18. Only a pressure-breathing demand oxygen mask will be used above 34,000 feet pressure altitude.

Note

> As an airplane ascends to high altitudes where the temperature is normally quite low, the oxygen cylinders become chilled. As the cylinders become colder, the oxygen gage pressure is reduced, sometimes rather rapidly. With a 38°C (100°F) decrease in temperature in the cylinders the gage pressure can be expected to drop 20 per cent. This rapid fall in pressure is occasionally a cause for unnecessary alarm. All the oxygen is still there, and as the airplane descends to warmer altitudes, the pressure will tend to rise again, so that the rate of oxygen usage may appear to be slower than normal. A rapid fall in oxygen pressure while the airplane is in level flight, or while it is descending, is not ordinarily due to falling temperature. When this happens, leakage or loss of oxygen must be suspected.

D-1 AND D-2 REGULATOR CONTROLS AND INDICATORS.

A type D-1 or D-2 automatic pressure-breathing diluter-demand oxygen regulator (figure 4-21) is installed at each crew station. Three additional regulators are installed at training stations in the forward cabin, and one is in the camera compartment for personnel using the bunks. An oxygen flow indicator and a pressure gage are incorporated in the regulator. The function of the regulator is to simulate sea level oxygen pressure conditions in high altitude flight. The regulator accomplishes this by means of an aneroid assembly which progressively delivers a richer oxygen-air mixture to the oxygen mask at correspondingly greater pressures until at high altitude (generally beginning in the vicinity of 34,000 feet) 100 per cent oxygen is being delivered at a pressure varying from 2 to 17 inches of water.

Typical OXYGEN PANEL

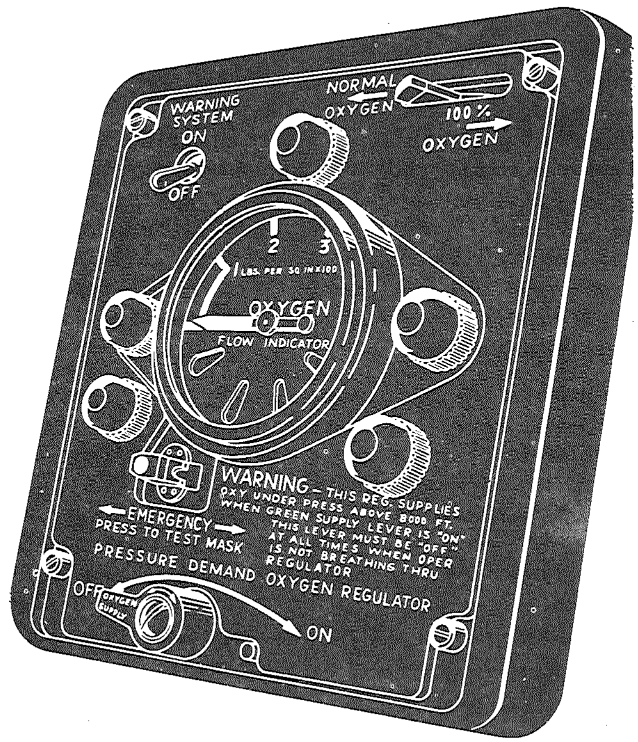


Figure 4-21.

J1-209-A

Regulator Diluter Control.

A diluter lever is provided on each oxygen regulator. At NORMAL OXYGEN the lever opens the air inlet valve so that the regulator automatically supplies a proper mixture of air and oxygen to the mask at all altitudes provided the regulator supply lever is on. The lever at 100% OXYGEN closes the air inlet valve so that 100 per cent oxygen is supplied to the mask for emergency use.

Regulator Supply Valve Lever.

An oxygen supply valve lever is located at the bottom of each regulator panel. The lever, when turned to the ON position, opens the oxygen supply to the regulator. The lever, when turned to the OFF position cuts off the oxygen supply. A force of approximately 20 inch-pounds should be used in turning the valve.

WARNING

If the supply valve is left ON at an unused station, the oxygen supply will be depleted.

Regulator Emergency Toggle Lever.

The emergency toggle lever provides a means of manually supplying positive pressure to the mask for emergency purposes. Pushing the lever in gives a positive pressure to the mask. The pressure is automatically stopped when the lever is released. This feature of the lever is to be used when testing the fit of the oxygen mask. The lever can also be pushed to either side (right or left). This action locks the lever to give a continuous positive pressure to the mask.

WARNING

Except for testing oxygen mask fit, the emergency toggle lever is not to be used except in an emergency, because the duration of the oxygen supply will be seriously affected.

Regulator Warning System Switch.

This switch is inoperative because the oxygen system warning signals are not incorporated in this airplane.

Pressure Gage and Flow Indicator.

A combination pressure gage and flow indicator is mounted on the face of each regulator. The pressure gage shows oxygen cylinder pressure and is calibrated from 0 to 500 psi. The range from 400 to 450 psi is marked FULL. The flow indicator consists of a blinker plate which indicates the flow of oxygen by exposing four fluorescent painted segments with each inhalation.

PORTABLE OXYGEN EQUIPMENT.

The portable oxygen units are provided to furnish the crew with a means of entering the unpressurized areas in the airplane while at high altitude, as well as an emergency system in case of failure of an oxygen panel. Each of the five portable diluter-demand oxygen units consists of an A-6 walk-around oxygen cylinder and an A-15 auto-mix regulator. Two portable units are located in the forward cabin, two are in the camera compartment, and one is in the aft cabin. The four recharger hoses in the forward cabin are located at the stations of the photo-navigator, the pilot, the copilot, and the radio operator. One recharger is located on the right side of the camera compartment, two are on the right side of the airplane in the bomb bay area, and two are in the aft cabin. Any of the nine recharger hoses may be used to fill the portable cylinders.

Note

The A-15 regulator is not a pressure demand regulator and therefore cannot be used above 34,000 feet in an unpressurized cabin. Type A-21 regulators must be used above 34,000 feet up to 45,000 feet.

OPERATIONAL USE OF OXYGEN EQUIPMENT.

Both the D-1 and the D-2 pressure demand regulators provide adequate protection below approximately 43,000 feet. Protection becomes marginal between 43,000 and 45,000 feet because of the likelihood of mask leakage and the fatigue of breathing against higher pressure settings. Both regulators serve only as emergency devices above 45,000 feet, useful for preserving consciousness long enough to descend to a safe altitude after rapid decompression. As an example, at 50,000 feet no longer than two minutes of consciousness can be anticipated with the D-1 or D-2 regulator.

These limitations of the oxygen equipment impose the following restrictions on crew and aircraft operation.

1. The number of crew members and passengers will not be greater than the number of installed oxygen outlets and walk-around bottles on any flight above 14,000 feet if the aircraft is not pressurized; 20,000 feet if pressurized; or 34,000 feet if walk-around bottles do not have pressure demand regulators. If walk-around bottles are used for a primary source of oxygen, they will be connected to a recharger hose above 35,000 feet.

Note

If passengers who are not qualified air crew members are being carried and walk-around bottles are used as the primary source of oxygen, the altitude will be limited to 30,000 feet.

Preflight Check of Oxygen Equipment.

Each crew member will preflight his oxygen equipment as follows:

1. Regulator and Hose Connections.

a. Alligator clip (clothing clamp) in proper working condition.

b. Clamps secure at each end of regulator.

c. Regulator elbow nut tight.

d. Connect the attachment strap on the mask male connector to the parachute chest strap by routing the connector strap under the chest strap as close to the center as possible, up behind the chest strap, down in front of the chest strap, around again; then snap it to the connector.

e. Connect the mask-to-regulator tubing female disconnect to the mask male connector; listen for the click and look to see that the sealing gasket is only half exposed.

CREW MEMBERS OXYGEN DURATION-HRS

CABIN ALT, FT	GAGE PRESSURE, PSI 400	350	300	250	200	150	100	BELOW 100
40,000	9.9 9.9	8.5 8.5	7.1 7.1	5.7 5.7	4.3 4.3	2.8 2.8	1.4 1.4	EMERGENCY DESCEND TO ALTITUDE NOT REQUIRING OXYGEN
35,000	9.9 9.9	8.5 8.5	7.1 7.1	5.7 5.7	4.3 4.3	2.8 2.8	1.4 1.4	
30,000	7.4 7.4	6.3 6.3	5.3 5.3	4.2 4.2	3.2 3.2	2.1 2.1	1.1 1.1	
25,000	5.9 7.0	5.1 6.0	4.2 5.0	3.4 4.0	2.5 3.0	1.7 2.0	0.8 1.0	
20,000	4.8 7.9	4.2 6.7	3.4 5.6	2.8 4.5	2.1 3.4	1.4 2.2	0.7 1.1	
15,000	3.7 9.5	3.2 8.2	2.7 6.8	2.1 5.4	1.6 4.1	1.1 2.7	0.5 1.4	
10,000	3.2 12.7	2.7 11.9	2.3 9.0	1.8 7.3	1.3 5.4	0.9 3.6	0.5 1.8	

RED FIGURES INDICATE DILUTER LEVER IN 100% POSITION
BLACK FIGURES INDICATE DILUTER LEVER IN NORMAL POSITION
CYLINDERS-30EA. G-1
CREW-18

D1-169-C

Figure 4-22.

f. Attach the alligator clip to the end of the mask male connector strap.

2. D-1 or D-2 Regulator Check.

a. With the regulator supply valve lever OFF, set the diluter lever at NORMAL OXYGEN. Cabin air only should be delivered by the regulator. Place the diluter lever in the 100% OXYGEN position. Neither cabin air nor oxygen should be delivered by the regulator.

b. With the oxygen supply lever ON, accomplish the following:

(1) Check gage for proper pressure (400 to 450 psi or FULL).

(2) Return diluter lever to NORMAL OXYGEN.

(3) Move emergency toggle lever to either right or left and check for continuous positive pressure.

(4) Depress emergency toggle lever and check for greater positive pressure.

Note

With the emergency toggle lever depressed, check the mask for proper fit.

c. With the regulator supply valve ON, the oxygen mask connected to the regulator, and the diluter lever in 100% OXYGEN position, conduct the following check while breathing normally:

(1) Observe the blinker for proper operation.

(2) Deflect the emergency toggle lever to the right or left. A positive pressure should be applied to the mask. Return the emergency toggle lever to center position.

(3) Depress the emergency toggle straight in. A positive pressure should be applied to the mask. Hold your breath to determine whether there is leakage around the mask. Release the emergency toggle lever; positive pressure should cease.

(4) Return the diluter lever to NORMAL OXYGEN position.

d. Return the oxygen supply lever to OFF, using approximately 20 inch-pounds of torque to insure that the supply valve is completely closed. Then push the emergency toggle lever in momentarily to reset the gage to a zero reading.

Note

If pressure builds up after several minutes, the oxygen supply valve is not fully closed. This condition will cause oxygen to flow from the regulator any time the cabin altitude reaches the altitude at which the regulator begins to meter oxygen.

e. Check the regulator for outward leakage by using the following blow-back test: Remove mask and blow gently into the end of the oxygen regulator hose as during normal exhalation. (Blowing hard may tend to seal a leaky diluter air valve.) Resistance to blowing indicates that the demand diaphragm, the diluter air valve, and the mask-to-regulator tubing are satisfactory; little or no resistance to blowing indicates that they are faulty.

Note

Conduct the blow-back test on all demand regulators twice, once with the diluter valve at the NORMAL OXYGEN position and again at the 100% OXYGEN position.

3. Portable Walk-Around Bottle—Type A-6.

a. Attach recharger hose and fill bottle to at least 400 psi.

b. Detach and listen for leaks in the regulator inlet fitting.

c. Check pressure gage. Should be at least 400 psi.

d. Plug mask into regulator and check pull to disconnect. It should be from 10 to 20 pounds.

e. Blow gently into regulator to detect leaks in diaphragm or check valve.

CAUTION

Excessive blowing may rupture diaphragm.

4. Emergency Bail-Out Bottle—Type H-2.

Note

A fully charged H-2 cylinder will last aproximately 10 minutes, depending on altitude and temperature.

a. Check pressure gage. Pressure should be 1800 psi.

Note

With a full charge of 1800 psi the oxygen supply will last approximately 10 minutes. Temperature and altitude will vary the duration time.

b. Check adequate fit of all connections.

c. Secure bottle to parachute harness below the D-ring.

Normal Oxygen Procedures.

The following rules will be followed on every altitude flight.

1. Mask will be worn at all times when *cabin* altitude is 10,000 feet and above.

2. *Pressure altitude 10,000 to 28,000 feet and cabin altitude below 10,000 feet.*

Mask and helmet need not be worn. Mask will be plugged into an oxygen regulator or a walk-around bottle and kept accessible near person.

WARNING

When the aircraft is pressurized and the pressure altitude is above 25,000 feet, crew members stationed near blowable structures, such as blisters or large plexiglas panels will keep their seat belts or safety straps fastened, if provided.

3. *Pressure altitude 28,000 to 35,000 feet and cabin altitude below 10,000 feet.*

At least one crew member in each compartment will remain on oxygen.

The mask will be attached to helmet and plugged into regulator. The helmet will be worn but the mask need not be applied to the face.

Pressure altitude above 35,000 feet and cabin altitude below 10,000 feet.

All crew members will have the mask loosely fitted to face; however, the aircraft commander may, at his discretion, authorize certain crew members to remove their masks. Permission will apply to specific instances *only.*

4. *Pressure altitude above 35,000 feet and cabin altitude above 10,000 feet.*

All crew members will have the mask snugly fitted to face with the oxygen supply lever ON.

5. Oxygen mask and helmet will not be stowed in or near blisters or plexiglas panels.

6. The H-2 bail-out bottle will be attached to the parachute harness just above the accessory ring and connected to the oxygen hose adapter at 28,000 feet. The bottle may be attached either to the left or right side of the harness, depending on crew position.

7. *Regulator Settings.*

D-1 or D-2 REGULATOR

Cabin Altitude	*Regulator Setting*
0-10,000 feet	Oxygen Supply Lever OFF
10,000 feet and above	Oxygen Supply Lever ON

Note

The diluter lever will be in the NORMAL OXYGEN position at all times. However, in case of an emergency under 30,000 feet, the 100% OXYGEN position will be used.

Crew Interphone Oxygen Checks. The pilot will initiate a full crew interphone check at frequent intervals as stated below. The check will be made from tail to nose as outlined under the interphone and alarm bell check in "Taxiing," Section II. The check is as follows:

1. Oxygen gage pressure reading in pounds.
2. Position of controls.
3. The compartment commanders will check crew members for unusual behavior symptomatic of hypoxia.
4. Frequency of checks will conform to periods of useful consciousness at various altitudes.

a. Hourly check by compartments when cabin altitude is under 15,000 feet.

b. At cabin altitudes of 15,000 to 25,000 feet, check will be made every 15 minutes.

c. At cabin altitudes above 25,000 feet, compartment checks will be made every five minutes and individual checks will be made every fifteen minutes.

Oxygen System Emergency Operation.

With symptoms of the onset of hypoxia, or if smoke or fuel fumes should enter the cabin, set the diluter lever of the oxygen regulator to the 100% OXYGEN position. In the event of accidental loss of cabin pressure, set the diluter lever of the regulator to 100% OXYGEN and push the emergency toggle lever to the right or left.

CAUTION

When use of 100% OXYGEN or EMERGENCY becomes necessary, the aircraft commander will be informed of this action. Use of 100% OXYGEN or EMERGENCY will reduce oxygen duration of the airplane. After the emergency is over, set the diluter lever to NORMAL OXYGEN and push the emergency toggle lever to the center position.

If the regulator should become inoperative, disconnect the mask from the airplane oxygen system and connect it to a portable oxygen unit. If an adequately filled portable unit is not available, pull the cord of the H-2 emergency oxygen cylinder.

WARNING

When use of the H-2 emergency oxygen cylinder becomes necessary, the aircraft commander will be informed of this action so that he can immediately descend to an altitude at which oxygen is not required.

OXYGEN DISCIPLINE.

Oxygen discipline is extremely important at high altitude because of the very short period of useful consciousness in the event of an oxygen system malfunction, improperly used oxygen equipment, or an explosive decompression. Training in the altitude chamber should be taken very seriously and practiced religiously during all high altitude flights. In fact, the aircraft commander must enforce good oxygen discipline. This discipline should not begin in the air, but on the ground during personal equipment inspection. He should see that every crew member has properly fitted equipment, knows how to use his oxygen equipment, and knows how to handle any emergency situation. Lack of oxygen discipline in a crew could destroy it as surely as an anti-aircraft shell.

Rapid Decompression.

Explosive decompression or sudden loss of cabin pressurization results in an equalization of cabin altitude and airplane altitude within a few seconds time. In aircraft hulls with large cabin volumes, this explosive type of decompression occurs only with the sudden and complete blowout of a large blister or panel. Since time is all-important in preventing hypoxia after explosive decompression, crew members will immediately report hull defects which could possibly cause loss of pressure. If decompression occurs without warning, the following will be accomplished:

1. Notice of the emergency will be immediately transmitted over interphone to provide all crew members time to carry out necessary oxygen procedures.
2. Immediately following this notice, the engineer will announce over interphone pressure altitude and final cabin altitude in each compartment.

The crew members in the damaged compartment will recognize explosive decompression by the following events: dull booming sound with forceful out-rush of air and usually a formation of fog; forceful expiration of breath with mask chattering back and forth on face; passage of gas and belching; rapid popping of ears or plugging of ears; rasping or screeching in interphone.

Crew members in remote areas of hull may not hear or feel anything except a rapid popping and plugging of ears, which of itself alone should be sufficient warning to crewmen that cabin pressure has been lost.

Mechanical effects of the explosive decompression result in considerable suction being exerted toward the blown hull area. Therefore, crew members at duty stations near structures which might blow out must keep their seat belt or safety straps fastened when the cabin is pressurized. The communication tube should not be used except in cases of emergency at altitudes above 30,000 feet when cabin pressurization is being used.

The extent and severity of physical effects on personnel following explosive decompression depend on the following factors:

1. Rapidity of decompression.
2. Final cabin altitude resulting from decompression.
3. Range of altitude differential or pressure gradient through which cabin decompression has occurred.

4. Duration of time spent without oxygen at resultant altitude.

5. Individual physical condition.

The important physical effects of explosive decompression on personnel are hypoxia and decompression sickness such as bends or chokes (altitude dysbarism). Hypoxia is the most immediate, potentially dangerous, and disabling threat to the air crew. The average useful conscious time is indicated in the following table:

AVERAGE USEFUL CONSCIOUS *Time*

ALTITUDE	
20,000 Feet	. . 15 Minutes
25,000 Feet	. 3-4 Minutes
30,000 Feet	. . 1 Minute
35,000 Feet	. . 45 Seconds
40,000 Feet	. 15-20 Seconds
45,000 Feet	. . 10 Seconds
50,000 Feet	. . 10 Seconds

HI-400-A4

HI-400-A4

When explosive decompression occurs, perform the following steps as rapidly as possible:

1. If mask is not on face, turn the supply switch on and then apply mask to face.

2. If mask is being worn, turn the lever on before tightening the face straps. The D-1 or D-2 regulators operates automatically when the oxygen supply valve lever is turned ON.

3. Check oxygen hose connections and blinker activity at regulator.

4. All crew members will be accounted for over the interphone as soon as possible, particular attention being given those not at their stations at the time of decompression.

5. If the aircraft is above 40,000 feet and all occupants are not provided with automatic or manual pressure demand oxygen equipment, the aircraft commander will rapidly descend to 40,000 feet and, as soon as the operational situation permits, descend to 34,000 feet or below for additional safety.

6. If the aircraft is above 45,000 feet, the aircraft commander will rapidly descend to 45,000 feet and, as soon as the operational situation permits, descend to 43,000 feet or below for additional safety.

7. All crew members will observe other occupants for symptoms of hypoxia, and if any occupant appears to be in difficulty or has lost consciousness, notify the aircraft commander.

Treatment of Hypoxia Victims.

A crewman evidencing hypoxia symptoms will be assisted by the nearest crew member, if the latter can go to the aid of the victim without detaching himself from his own regulator hose. If this is impossible, he will report intended rescue action over the interphone to the aircraft commander who will approve the action or designate another rescuer if it is essential that the reporting crew member remain at this station. The designated rescuer will act as follows:

1. Connect his mask to a walk-around bottle if one is available, or pull his bail-out valve cable if a walk-around bottle is not available.

2. Turn the hypoxia individual's emergency toggle valve to either side and hold his mask in place forcibly until he regains consciousness and appears rational and able to take care of himself. If the victim's oxygen equipment appears not to be functioning properly and other regulator outlets or walk-around bottles are not available, fasten his mask tightly to his face and pull his bail-out bottle valve cable. Since hypoxia victims may struggle violently and aggressively when regaining consciousness, they must be restrained to prevent dislodging their own or rescuer's masks. If using a walk-around bottle, the rescuer will not allow the pressure to drop below 100 psi without refilling; if using a bail-out bottle, he will not remain disconnected from an oxygen regulator for more than five minutes. An individual should not be disconnected from his walk-around bottle more than one-half the average useful consciousness time.

3. Whether the victim is immediately revived or not, the rescuer will return to his own station at once, reconnect his oxygen regulator, and report to the aircraft commander the status of the emergency.

4. If the victim has not recovered, the rescuer will return to him and continue revival efforts. If there is doubt that he is breathing, artificial respiration will be employed.

5. If informed that the victim has not recovered, the aircraft commander will determine whether the operational situation will permit immediate descent to an ambient pressure altitude of 15,000 feet or below, at which 100 per cent oxygen and artificial respiration will be adequate to revive the victim.

6. Administration of oxygen and, if necessary, artificial respiration will be continued until the victim has recovered or it is positively determined that he is dead.

Use of Pressure Oxygen Breathing Following Cabin Decompression.

The pressure oxygen system is designed primarily for emergency use and will provide adequate oxygen to the crew during descent of the airplane from an altitude of 50,000 feet down to 35,000 feet or below, where normal diluter-demand oxygen can be used from the regulator. Pressure breathing requires a forceful expiration against an oxygen pressure resistance. At the higher pressures the individual not conditioned to and practiced in pressure breathing will become fatigued, but there is no discomfort or injury inflicted on him as the result of pressure breathing during the time of descent after cabin decompression. Likewise, no damage to the lungs will occur as a result of having the mask on the face and breathing normal or 100 per cent oxygen at the time of descent after cabin decompression or at the time explosive decompression occurs.

Bends, chokes, and creeps; decompression sickness, and altitude bysbarism are synonymous terms and indicate a condition of the body in which nitrogen bubbles are released into the tissue spaces and blood stream as a result of the sudden loss of pressure surrounding the body. This physical effect seldom occurs except after prolonged exposure at cabin altitudes in excess of 35,000 to 40,000 feet, or after explosive decompression through large pressure differentials to resultant cabin altitudes above 40,000 feet.

The condition is relieved upon descent of the airplane to 30,000 feet or below, or upon repressurization of the cabin. When decompression sickness occurs after decompression, it is seldom disabling and has no permanent after-effects on the body. The incidence and severity of decompression sickness at any given altitude can be markedly reduced by preliminary denitrogenization or by wearing a pressure suit.

Denitrogenization Procedure For Prevention of Decompression Sickness.

Tactical considerations may require that the aircraft complete a specific portion of the mission at an altitude of 40,000 feet without descending to a lower altitude, even though complete pressurization is lost. This requires that the crew receive maximum possible protection against potential decompression sickness. To accomplish this protection the following procedure is outlined:

1. One hour prior to reaching the critical point in the flight the aircraft commander will order all crew members to put on oxygen masks, if not already being worn, and to turn regulator to 100% OXYGEN.

2. Cabin pressure will be maintained at or below 10,000 feet for 30 minutes, during which time the crew will be breathing 100 per cent oxygen.

3. Cabin pressure will then be gradually decreased during the next 30 minutes until a cabin altitude of 30,000 feet is reached. At this point cabin altitude is leveled off and maintained there with crew on 100 per cent oxygen through the critical period of the flight.

4. If cabin pressure is completely lost during the critical period, maximum protection against disabling hypoxia symptoms will be afforded crew members by setting the regulator at 100% OXYGEN.

Use of Walk-Around Bottles.

Walk-around bottles will be used under the following conditions:

1. In an unpressurized aircraft when crew members will be absent from their stations:

   a. Over *ten* minutes between 14,000 and 16,000 feet.

   b. Over *five* minutes between 16,000 and 18,000 feet.

   c. Over *two* minutes between 18,000 and 20,000 feet.

2. In communication tubes in pressurized aircraft at 25,000 feet or above.

3. In a pressurized cabin above 30,000 feet, with mask plugged into bottle if crew member is not close to regular station. Mask will be worn and plugged in above 35,000 feet unless permission to the contrary has been granted, in which case the crew member not on oxygen will be under the constant observation of one who is.

Precautions in Using Walk-Around Bottles.

1. Keep charged to at least 400 psi when not in use.

2. If recharger hose leaks, keep it attached to walk-around bottle to conserve oxygen.

3. When using a walk-around bottle, check the pressure gage regularly and recharge when gage reads 100 psi.

AUTOPILOT.

The airplane is equipped with a type E-6 autopilot. This electro-mechanical device automatically positions the control surfaces for level flight, coordinated turns, or flight paths based on information provided by other equipment.

Primary control of the system is accomplished from the autopilot control panel (3, figure 1-14) located on the pilots' pedestal. "Second station" turn control operation can be transferred to the radar observer at the discretion of the aircraft commander.

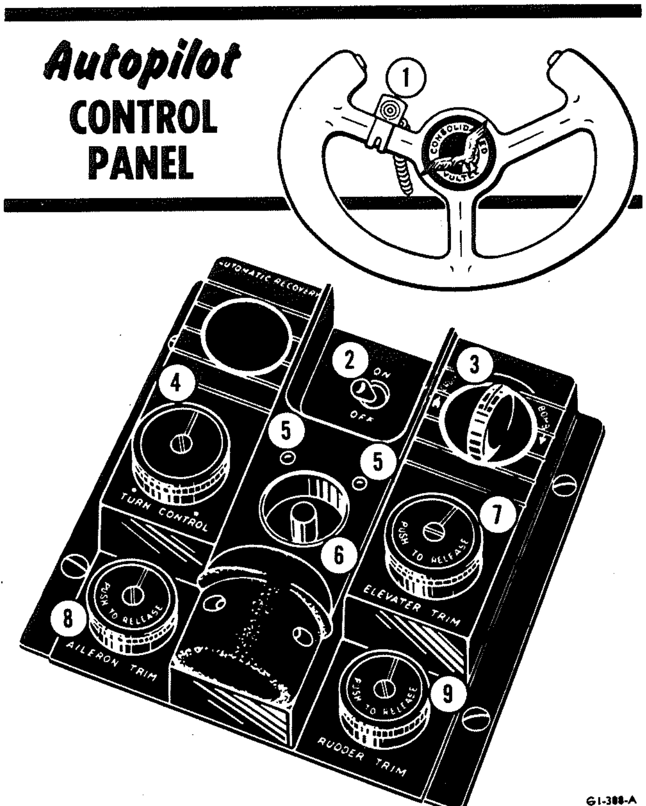
Calibration controls are also provided for the adjustment of autopilot response through the wide variations in gross weight, cg, air speed, and altitude. These calibration controls are located in the observer's compartment.

PRIMARY CONTROLS.

The primary controls of the autopilot are located on the autopilot control panel (figure 4-23). Individual controls on the autopilot control panel are discussed in the following paragraphs.

Autopilot On-Off Switch.

This switch (6, figure 4-23) controls 115-volt alternating current from the right forward power panel.



1. AUTOPILOT RELEASE SWITCH
2. AUTOPILOT ON-OFF SWITCH
3. CRUISE-BOMB KNOB
4. TURN CONTROL KNOB
5. INDICATOR LIGHTS
6. ENGAGE SWITCH
7. ELEVATOR TRIM KNOB
8. AILERON TRIM KNOB
9. RUDDER TRIM KNOB

GI-388-A

Figure 4-23.

The autopilot is normally ready for operation three minutes after this switch is placed in the ON position.

Elevator, Rudder, and Aileron Trim Knobs.

These knobs (8, 9, and 2, figure 4-23) are used to apply electrical trim to the autopilot while it is engaged. If the autopilot is ON but not engaged, these knobs will normally oscillate in order to maintain a neutral position with respect to the movement of the control surfaces. Each knob has a push-button type switch located in its center. These push-button switches can be used to disengage the three axes individually. If an axis is disengaged by one of these switches, the autopilot engage switch must be pressed to re-engage the axis.

Autopilot Engage Switch.

A push-button type switch (4, figure 4-23) is provided to engage the autopilot after the green lights on the autopilot control panel begin to flicker. After the autopilot is engaged, the green lamps will burn steadily. In case of a momentary loss of a-c or d-c power, the autopilot will automatically disengage.

Turn Control Knob.

The turn control knob (3, figure 4-23) is used to establish a coordinated automatic turn in the direction of knob rotation. Maximum bank obtainable is 32 degrees.

Cruise-Bomb Knob.

This knob (7, figure 4-23) controls the "directional stiffness" of the system or the amount of corrective bank angle applied for each degree of heading error. Turning the knob toward BOMB increases directional stiffness; turning the knob toward CRUISE reduces directional stiffness.

Automatic Recovery Switch.

The automatic recovery switch should not be used because airplane response is too violent. This control is covered by a plate.

Autopilot Release Switches.

Both control wheels are equipped with an autopilot release switch (1, figure 4-23). Either switch will release all three control axes simultaneously.

TRANSFER CONTROLS.

The following controls are used during remote or "second station" turn control operation by the radar observer.

N-2 Transfer Switch.

This switch (30, figure 1-13), located on the pilots' instrument panel, is provided to enable the radar observer to utilize the turn control feature of the autopilot. The switch has two positions, RADAR BOMB and PILOT. Normally it is left in the PILOT position and the turn control is operated from the autopilot control panel on the pilots' pedestal. When the switch is placed in the RADAR BOMB position, the autopilot turn control is made available to the radar observer as well as the pilots.

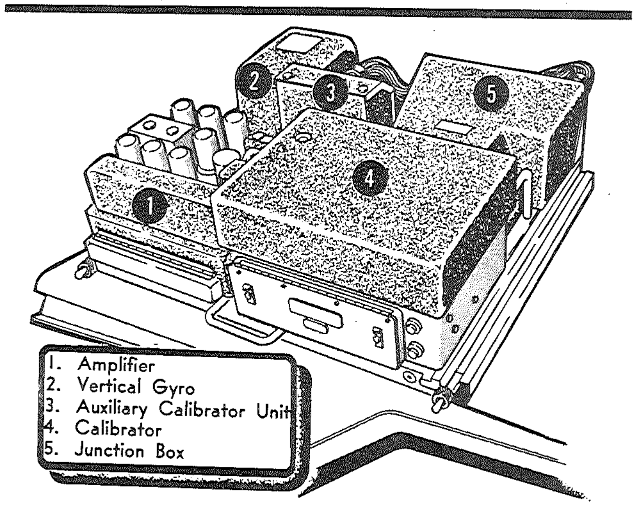
E-2 Turn Control Unit.

The E-2 turn control unit (4, figure 4-18) located at the radar observer's station consists of a turn control knob, a two-position mode selector switch, and an indicator light. When the aircraft commander transfers control to the radar observer, the indicator light will glow. If the mode selector is in MANUAL, the radar observer can maneuver the aircraft with his turn control knob. If the mode selector is in AUTOMATIC, the radar observer can maneuver the aircraft with the APQ-24.

CALIBRATION CONTROLS.

All calibration controls are located in the observer's compartment. The directional coupler amplifier assembly is located beneath the radar observer's table. Four calibration control knobs are located under the cover plate of this unit as shown in figure 4-25. The remainder of the calibration controls are located on the main chassis (figure 4-24) above the nose wheel well. Access to the control knobs is gained by removing the covers on the face of the units. The ratio, auto recovery, coordination, and E-FS control knobs are located on the calibrator unit. The control knobs for rudder gain, rudder roll rate, and aileron roll rate are located under the cover of the auxiliary calibrator unit.

Autopilot MAIN CHASSIS



69-155-A

Figure 4-24.

Sensitivity Knobs.

The sensitivity knobs establish the minimum signal level for which the amplifier will call for correction. In most cases, input signals come from the reference gyros which detect deviations in the atitude of the aircraft. They may, however, come from the autopilot control panel or from "second station" corrections. Under these conditions the induced signal is "nulled" by the gyros whenever the aircraft reaches the steady state of the maneuver. The sensitivity setting of the amplifier determines the amount the aircraft can deviate from a steady state attitude before a corrective maneuver is applied. The range of this adjustment is very small, and it should be carried as high as possible on each axis.

Ratio Knobs.

The settings on these knobs determine the amount of control surface deflection applied for each unit signal that goes into the amplifier or the dynamic response of the aircraft. The range of adjustment on these knobs is great and their settings are quite delicate under most conditions.

Throttling Knobs.

The settings of these knobs determine the speed at which the servos drive and consequently the speed at which the control surfaces move. They are in effect electronic brakes. The higher the setting, the greater the braking action, and the slower the movement of control surfaces.

Automatic Recovery Knobs.

The auto-recovery switch is covered and taken out of the circuit on most airplanes. The knobs are still carried at five to maintain bridge balance in the circuit.

E-FS and FS Knobs.

These knobs were used to coordinate formation stick turns. They are still in the circuit. Moving E-FS will change the pitch attitude of the aircraft.

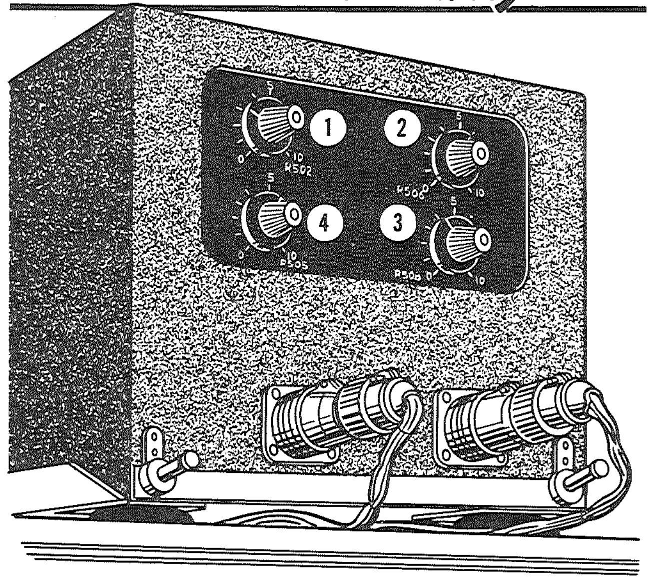
TC Coordination Knob.

This knob is carried at zero. Turns are coordinated with rudder gain in the auxiliary calibrator.

Bomb Coordination Knob.

This knob is used to coordinate turns made from the bombsight.

DIRECTIONAL COUPLER AMPLIFIER *Assembly*



1. COMPASS MAXIMUM BANK
2. COMPUTER MAXIMUM BANK
3. PROPORTIONAL RANGE
4. CURVATURE

G1-389-A

Figure 4-25.

Rate Coordination Knob.

This knob is used to "damp" the action of the rudder. It is the electrical equivalent of a mechanical "dashpot." Rudder ratio must be kept high enough to insure flying a good heading. It is a characteristic of most aircraft that rudder ratio must be so high that the aircraft is on the verge of overcorrecting. For this reason the rudder needs "damping."

Up-Elevator Coordination Knob.

This knob is used to control the pitch attitude of the aircraft while it is in a bank.

Rudder Gain Knob.

This knob is used to coordinate turns made either by the pilots' turn control knob or "second station." Its setting determines the amount and direction of rudder applied per degree of bank. With the knob at ten, the autopilot puts in its maximum value of bottom rudder; with the knob at zero, the autopilot puts in its maximum value of top rudder.

Aileron Roll Rate Knob.

This control acts the same way in the aileron axis as the rate coordination control acts in the rudder axis. It "damps" the action of the ailerons while the aircraft is rolling in or out of turns. It also helps to keep the ailerons from overcorrecting when in straight and level flight. Its action puts in opposite aileron for any roll.

Rudder Roll Rate Knob.

This control attempts to coordinate the rudder while rolling in and out of turns. While the effect of this control is not too obvious, it aids in smoothing out turns particularly at higher air speeds.

Compass Maximum Bank Knob.

This knob is not used as a functional control.

Computer Maximum Bank Knob.

This control sets the maximum bank angle the airplane can reach in correcting for a large steering signal from the ground position computer.

Curvature Knob.

The effect of this control is similar to the throttling control on the E-6 amplifier. This knob setting should be carried as high as possible to keep course corrections proportional to the amount of remaining error.

Proportional Range Knob.

This control sets the heading correction signal required for the airplane to reach the maximum bank angle established by compass maximum bank or computer maximum bank. This could also be considered as the rate of amplifier response to the input signal.

RECOMMENDED CALIBRATION CONTROL SETTINGS.

The control settings shown in figure 4-26 are recommended for satisfactory autopilot performance. All settings, except those which vary with altitude, should remain constant throughout the flight range.

Note

Slight deviations from settings shown may be necessary for individual airplanes.

OPERATION.

Before Engaging the Autopliot.

1. Attain a safe altitude and manually trim the airplane for straight and level flight. Check with flight instruments.
2. Request radar observer to level stabilizer by centering the bubble in the level mounted on stabilizer body.
3. Autopilot on-off switch—OFF.
4. Turn control knob—In detent.
5. Rudder, elevator, and aileron trim knobs—Center.

Engaging the Autopilot.

Note

On airplanes equipped with the type N-1 high latitude compass turn on the compass before turning on the autopilot so that it can warm up with the autopilot.

1. Place the autopilot on-off switch in the ON position; then wait until the two green indicator lamps begin to flicker before performing step 2 below.

Note

The autopilot will be ready for operation approximately 3 minutes after it is turned on.

2. Autopilot engage switch—Press firmly.

CAUTION

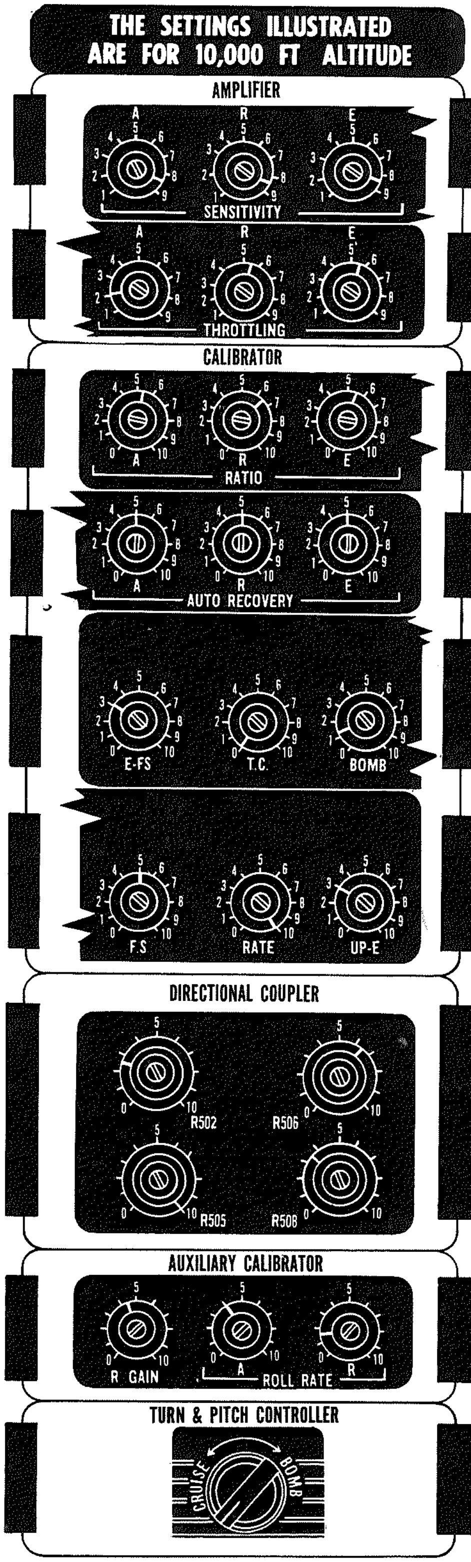
Do not engage the autopilot while the airplane is turning.

Note

On airplanes equipped with a slaved gyro magnetic compass, clear the annunciator window before engaging the autopilot. Also, do not adjust the PUSH TO SET POINTER knob of the compass while the autopilot is engaged, because it will affect the directional stability of the airplane.

3. After the autopilot is engaged, check the flight instruments. Carefully readjust the autopilot trim

RECOMMENDED AUTOPILOT CALIBRATION CONTROL *Settings*



CONTROL	SETTINGS 10,000 FT	SETTINGS 25,000 FT	SETTINGS 40,000 FT
AILERON SENSITIVITY	8 to MAX	8 to MAX	8 to MAX
RUDDER SENSITIVITY	8 to MAX	8 to MAX	8 to MAX
ELEVATOR SENSITIVITY	8 to MAX	8 to MAX	8 to MAX
AILERON THROTTLING	2.0	2.0	2.0
RUDDER THROTTLING	5.5	5.5	5.5
ELEVATOR THROTTLING	5.5	5.5	5.5
AILERON RATIO	5.5	4.0	1.0
RUDDER RATIO	6.5	6.5	6.5
ELEVATOR RATIO	5.5	5.5	5.5
AILERON RECOVERY	5.0	5.0	5.0
RUDDER RECOVERY	5.0	5.0	5.0
ELEVATOR RECOVERY	5.0	5.0	5.0
E. F. S.	3.0	3.0	3.0
TURN COORDINATION	0	0	0
BOMB COORDINATION			
A-1 DIRECTIONAL PANEL	3.5	2.0	2.0
A-4 DIRECTIONAL PANEL	1.5	1.0	1.0
F. S. COORDINATION	5.0	5.0	5.0
YAW RATE COORDINATION	10.0	10.0	10.0
UP ELEVATOR COORDINATION	3.0	3.0	3.0
COMPASS MAXIMUM BANK	2.5	2.5	2.5
COMPUTER MAXIMUM BANK	6.5	6.5	6.5
PROPORTIONAL RANGE	3.5	4.0	6.0
CURVATURE	10.0	10.0	10.0
RUDDER GAIN	4.5	3.0	2.0
AILERON ROLL RATE	4.0	4.0	4.0
RUDDER ROLL RATE	1.5	1.5	1.5
BOMB-CRUISE			
A-1 DIRECTIONAL PANEL	7 O'CLOCK	10 O'CLK	2 O'CLK
A-4 DIRECTIONAL PANEL	7 O'CLOCK	8 O'CLK	10 O'CLK

HI-163-A

Figure 4-26.

knobs on the control panel until the airplane is flying straight and level.

WARNING

Never manually adjust the trim tab on any axis while the axis is engaged. Also, do not adjust the synchronizer knob on the N-1 high latitude compass (group 1 airplanes) unless the two-position switch on the E-2 turn controller is in the MANUAL position. When this switch is in AUTOMATIC, the autopilot receives its directional reference signals from the AN/APQ-24 radar set which in turn receives signals from the high latitude compass. Therefore, adjusting the synchronizer knob when the switch is in AUTOMATIC may throw a violent correction into the autopilot.

4. To make coordinated automatic turns, rotate the turn control knob in the desired direction.

Note

If the airplane turns in the opposite direction when the turn control knob is moved out of detent, check manual trim. If it is found to be satisfactory, remove the undesired trim with the autopilot trim knobs.

Disengaging the Autopilot.

1. To temporarily disengage the autopilot, press the release button on either the aircraft commander's or the pilot's control column. This action will release all servo motors simultaneously, but the autopilot will remain on.

2. To disengage the servo motors individually, press the center of the autopilot trim knob for the axis to be disengaged.

3. To stop autopilot operation, place the autopilot on-off switch in the OFF position.

Retrimming.

1. If extensive retrimming of the airplane is required, push the center of the electrical trim knob on the axis to be retrimmed. This will release the servo motor.

2. Trim the surface manually.

3. Re-engage the servo motor by pressing the engage switch.

Operation from Radar Observer's Station.

1. Wait for the indicator light to glow indicating that aircraft commander's transfer switch is in the RADAR BOMB position.

CAUTION

Do not atempt to move mode selector switch to AUTOMATIC until light comes on indicating that the aircraft commander has transferred control.

2. Leave mode selector switch in MANUAL to maneuver aircraft with the turn control knob.

3. Move the mode selector switch to AUTOMATIC to maneuver aircraft with the APQ-24.

Regaining Control from Radar Observer's Station.

To regain control, the aircraft commander must do one of the following:

1. Move the N-2 transfer switch to PILOT.
2. Disengage the autopilot.
3. Disengage the aileron axis.
4. Shut off the autopilot.

Note

The N-2 transfer switch will automatically move back to PILOT when either step 2, 3, or 4 is accomplished, and the autopilot must be re-engaged before the N-2 transfer switch can again be placed on RADAR BOMB.

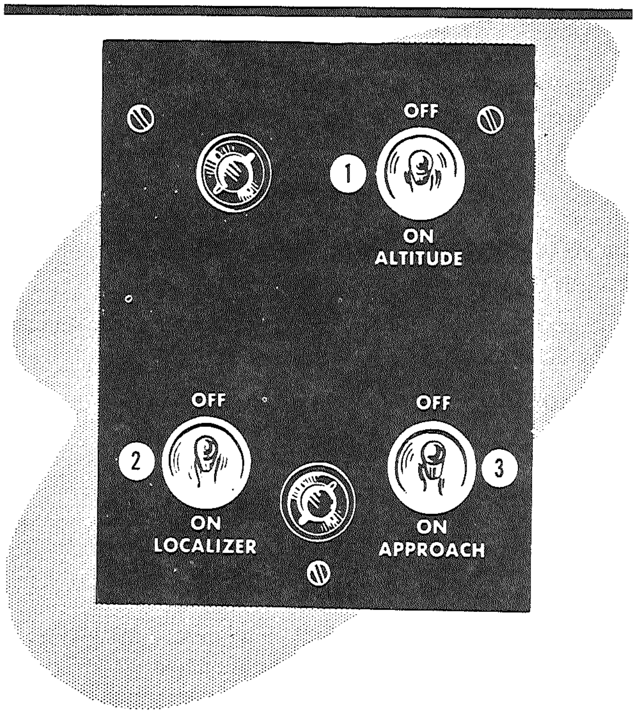
ALTITUDE CONTROL UNIT.

On some airplanes an altitude control unit is provided for use in conjunction with the autopilot in maintaining the aircraft at any desired pressure altitude. The unit is essentially a sensitive barometric pressure sensor that supplies control signals to the autopilot system. When engaged, it provides automatic elevator control for changes in angle of attack resulting from power changes or gross weight variations. The altitude at the time of engagement is the reference altitude. A slip clutch maintains reference altitude even if the control range (approximately ± 145 feet) is exceeded. Extreme pressure changes can result in loss of air speed as the unit seeks its reference altitude. The unit is controlled by an on-off switch (1, figure 4-27) located on the automatic approach and altitude control panel. This panel is mounted on the right side of the pilots' jet control panel. Placing the control switch in the ON position engages the unit.

Note

Before the altitude control unit will engage, the autopilot elevator axis must be operating (engaged).

AUTOMATIC APPROACH AND ALTITUDE CONTROL PANEL



1. Altitude Control Switch
2. Localizer Switch
3. Approach Switch

H1-452-A5

Figure 4-27.

The unit can also be used in conjunction with the autopilot to provide altitude control during the localizer phase of the ILAS approach. It allows smooth transition into the glide path phase.

Note

If the altitude control unit is used in conjunction with the automatic approach coupler during the localizer phase of the approach, it will automatically disengage when the approach function of the coupler is placed ON.

AUTOMATIC APPROACH COUPLER UNIT.

Some airplanes are equipped with an automatic approach coupler unit which provides a means of making an automatic ILAS approach. The unit consists of a localizer coupler, a glide path coupler, and two control switches. The coupler unit receives information from the glide path (AN/ARN-5B) and the AN/ARN-14 sets. By modifying this information, the coupler provides signals to the autopilot to furnish directional guidance along the runway heading and vertical guidance down the correct descent angle to the runway.

Controls.

The coupler unit is controlled by two spring-loaded on-off switches which are located on the automatic approach and altitude control panel. This panel is mounted on the right side of the pilots' jet control panel. The switches are spring-loaded in the ON position. When the instrument approach equipment is on and the autopilot is engaged, placing a function switch in the ON position engages its function and the switch is locked in the ON position by a solenoid. Disengaging the autopilot or turning the instrument approach equipment off will disengage the coupler unit and the switch (or switches) will automatically return to OFF.

Localizer Switch. When this switch (2, figure 4-27) is locked in the ON position, the localizer function is engaged. This function supplies signals to the autopilot to hold the aircraft on the beam heading during the localizer and glide slope portions of the landing.

Approach Switch. When this switch (3, figure 4-27) is locked in the ON position, the approach function of the coupler is engaged. This function provides elevation control to center the aircraft on the glide slope beam to give the correct descent angle required to land on the runway.

Operation.

1. Turn the instrument approach equipment on and engage all three axes of the autopilot.
2. When the localizer beam is intersected and the vertical needle of the course indicator leaves its full scale stop, place the localizer switch in the ON position.

Note

The altitude control unit can be used during this phase of the approach.

3. When the center of the glide slope beam is intersected, place the approach switch in the ON position.
4. Maintain normal approach speeds and normal rate of descent.
5. When it is desired to control the aircraft manually, disengage the autopilot.

Note

For automatic approach procedure refer to figure 9-4.

NAVIGATION EQUIPMENT.

MAGNETIC COMPASS.

A magnetic compass is located directly above the pilots' instrument panel.

J-1 SLAVED GYRO MAGNETIC COMPASS SYSTEM (AIRPLANES NOT IN GROUP 1).

This system provides a gyro-stabilized compass which can be used for either normal navigational purposes or as a directional reference to the AN/APQ-24 radar set. The compass indicates the airplane's magnetic heading without northerly turning error and the gyro is free from tilt and drift requiring no resetting. The system consists of a master directional indicator located at the pilots' instrument panel, a repeater indicator located on the photo-navigator's and the photographer's instrument panels, and a direction sensing unit called a flux valve located in the left wing tip. When the compass is electrically connected to the flux valve, it is said to be "slaved." Operating in this condition, the flux valve senses its position with respect to the earth's magnetic meridian and transmits a signal to the master directional indicator which gives magnetic heading.

The master directional indicator pointer is stabilized by a gyro. Electrical action prevents the gyro from precessing.

An annunciator window on the upper right corner of the master directional indicator shows whether the gyro is aligned with the heading detected by the flux valve. If the window is clear of any image they are aligned. Misalignment is evidenced by a dot or cross in the window, depending on the direction of misalignment. When this condition occurs the system will eventually correct itself; however, the PUSH TO SET POINTER on the master directional indicator is used to make an immediate alignment. A compass slaving switch (11, figure 4-49) is located on the photo-navigator's instrument panel. This permits the photo-navigator to deslave the compass when the flux valve sends erroneous signals to the master directional indicator. This condition occurs in certain polar regions where a magnetic compass is unreliable.

Note

In the unslaved condition the compass acts as a directional gyro.

Slaved Gyro Magnetic Compass Operation.

The slaved gyro magnetic compass system may be operated as follows:

Note

The system is directly connected to the airplane's power supply and is on at all times when there is power on the airplane.

1. Turn on the AN/APQ-24 radar set.
2. Position the navigator's compass deslaving switch to IN.

Note

The compass will automatically be deslaved by the AN/APQ-24 at all times when the airplane is banking in excess of 2 degrees.

3. Before take-off or with the airplane in straight and level flight align the master indicator pointer with the flux valve by pushing in and turning the PUSH TO SET POINTER knob. This will cause the dot or cross to disappear from the annunciator window.

CAUTION

When using PUSH TO SET POINTER knob during autopilot operation be sure to have the E-2 turn controller two-position switch on MANUAL. If the switch is on AUTOMATIC and the autopilot is on AN/APQ-24 radar set operation, positioning the PUSH TO SET POINTER knob may throw a violent correction into the autopilot.

CAUTION

Turn the PUSH TO SET POINTER in the direction indicated on the knob depending on whether you see a dot or a cross in the window.

4. When the dot or cross disappears, release the knob.
5. Turn the SET COURSE knob to turn the course indicator to the magnetic heading to be flown.
6. Fly the airplane so that the two pointers remain aligned.

Note

During flight, it is normal for the dot and cross to alternate continuously because of oscillations in the flux valve.

7. When making turns, the SET COURSE knob should be positioned to the new heading and the airplane turned until the pointer and indicator align.

N-1 HIGH LATITUDE COMPASS (GROUP 1 AIRPLANES).

The N-1 high latitude compass system is designed to alleviate the problem of polar navigation and to provide a source of directional reference to the AN/APQ-24 radar set. It provides two methods of operation: (1) When flying through the high latitudes where the magnetic compass becomes unreliable, the N-1 system operates as a directional gyro that is constantly being corrected for the effects of the earth's rotation by a latitude correction device. (2) On flights in the lower latitudes, the system serves as a gyro stabilized magnetic compass.

The high latitude compass system includes a master indicator at the navigator's station, repeater indicators on the pilots' and photographer's instrument panels, and a flux valve located in the left wing tip. In addition, the system actuates the rotating compass cards on the radio magnetic indicators at the pilots' and photo-navigator's stations. (Refer to "Radio Receiver AN/ARN-14" of this section.)

When operating as a magnetic compass, the system is "slaved" (electrically connected) to the flux valve. The flux valve senses its position with respect to the earth's magnetic meridian and transmits a heading signal to the master indicator. A synchronizer knob on the master indicator is used to synchronize the indicator quickly with the flux valve when the system is initially put into operation. An annunciator pointer on the master indicator shows in which direction the synchronizer knob must be turned to align the indicator with the flux valve. Movement within the small window on the master indicator shows that a misalignment is being corrected. When this movement ceases, the indicator and flux valve are synchronized.

The N-1 high latitude compass system receives electrical power through two on-off switches which are ganged together on the photo-navigator's instrument panel.

Operation as a Slaved Magnetic Compass.

1. Turn the N-1 high latitude compass power switch to the ON position.

Note

From 10 to 15 minutes are required for the gyro to reach a synchronous speed and erect.

2. Turn the latitude correction knob on the master indicator counterclockwise as far as possible.

Note

The small latitude pointer will move to the OFF position, rendering the latitude correction device inoperative and slaving the compass to the flux valve.

Note

During flight, the compass will be temporarily deslaved by a slaving control gyro when the airplane is turning at a rate in excess of approximately 25 degrees per minute.

3. Center the annunciator pointer by using the synchronizer knob. Lack of movement in the annunciator window indicates that the flux valve and indicator are synchronized.

CAUTION

Be sure to turn the synchronizer knob to the left or right as indicated by the annunciator pointer, since it is possible to center the pointer with the compass 180 degrees off the magnetic heading. A check with the pilots' standby compass will verify the accuracy of the adjustment.

The transition to high latitude operation can be made by turning the latitude correction knob until the latitude pointer indicates the actual latitude. This action deslaves the flux valve and starts the operation of the high latitude drift correction device. Continual movement in the annunciator window indicates that latitude correction is being made. Except for a random wander of 1 degree or less per hour, the indicator will continue to indicate the correct magnetic heading.

CAUTION

The basic magnetic reference will be lost if the synchronizer knob is moved.

Operation as a Directional Gyro.

1. Compass Power Switch—ON.
2. Latitude Correction Knob—Clockwise until pointer indicates latitude of aircraft position.
3. As the airplane changes latitude in flight, reset the latitude pointer to the new latitude.

Note

Setting of the mid-latitude every 2 degrees is sufficient for proper operation.

4. Engage and rotate the synchronizer knob to the gyro heading reference desired.

Note

Check rotation of the small white dot. The indicator rotates clockwise in northern latitudes and counterclockwise in southern latitudes.

CELESTIAL NAVIGATION PROVISIONS.

Sextant.

Stowage provisions for a periscopic sextant and support have been installed on the left side of the airplane on the floor just aft of the forward wall of the radio operator's compartment. Provisions have been made for the installation of the sextant at the navigator's sighting station.

METEOROLOGICAL EQUIPMENT.

On some airplanes weather reconnaissance is made possible by the installation of an aerograph set, radiosonde equipment, and a radio altimeter. (See "Communications and Associated Electronic Equipment" of this section for information concerning the radio altimeter.)

The aerograph provides the weather observer with humidity and temperature readings of the atmosphere immediately surrounding the airplane. These readings, in conjunction with the radio altimeter readings, provide a reference point for interpretation of humidity, temperature, and atmospheric pressure readings transmitted to the radiosonde operator by the radiosonde unit when it is dropped from the airplane. This data serves as a basis for preparing weather forecasts to be used in planning combat missions.

AEROGRAPH SYSTEM.

The AN/AMQ-7 aerograph system consists principally of a probe which is installed on the right side of the nose of the airplane, a humidity indicator and a temperature indicator located at the weather observer's station, two amplifiers, and an ON-OFF power switch. The probe contains a heater and sensing elements. The sensing elements are connected to the amplifiers, which in turn actuate the humidity and temperature indicators.

Controls.

Aerograph System Power Switch. This ON-OFF switch (figure 4-28) is located on the aerograph control panel at the weather observer's station. When placed in the ON position, 115-volt a-c power is supplied to the aerograph sensing elements and amplifiers.

Aerograph Heater Switch. This ON-OFF switch (figure 4-28) is located on the aerograph control panel at the weather observer's station. When it is positioned at ON, 28-volt d-c power is suppiled to the heating element in the aerograph probe.

Indicators.

Aerograph Heater Lamp. An indicator lamp (figure 4-28) on the aerograph control panel at the weather observer's station glows when the aerograph probe heater is on.

Humidity Indicator. The humidity indicator installed at the weather observer's station (figure 4-28) indicates relative humidity sensed by the aerograph probe.

Temperature Indicator. The temperature indicator at the weather observer's station (figure 4-28) indicates outside air temperature sensed by the aerograph probe.

RADIOSONDE EQUIPMENT.

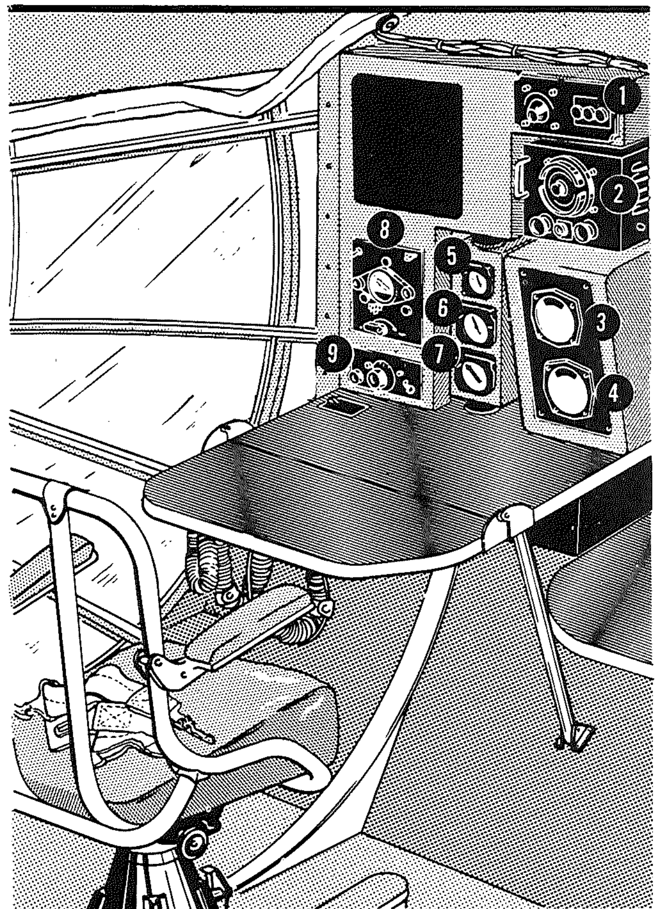
The radiosonde equipment installed on this airplane consists of the following: radiosonde units which transmit by radio the measurement of pressure, temperature, and relative humidity of the column of air through which they pass when dropped from the airplane; a dispenser unit; a control panel which is located at the lower right aft scanner's station; and a whip antenna which is stowed in the tail cone prior to takeoff and landing. During operation of the radiosonde equipment the antenna is installed in a mounting base which is permanently located on the floor of the tail cone.

The lower right aft scanner acts as the radiosonde operator. A BC-454-( ) receiver enables him to receive and record the radiosonde signals.

Radiosonde Unit.

Stowage for nine type AN/AMT-3 units is provided in a rack on the forward wall of the aft cabin over the IF and MF ECM observers' tables. A radiosonde unit consists of the following major components: a transmitter and modulator; temperature, humidity, and pressure sensing elements; two dry-cell batteries; and a parachute assembly. When the radiosonde unit is ejected from the airplane, the parachute opens and extends the antenna load line, which supports the instrument. Measurements of pressure, temperature, and humidity are transmitted approximately nine times per minute in Morse code signals, which can be received in the airplane by the radiosonde operator from the BC-454-( ) receiver.

WEATHER OBSERVER'S *Station*



1. AEROGRAPH CONTROL PANEL
2. RADIO ALTIMETER
3. TEMPERATURE INDICATOR
4. HUMIDITY INDICATOR
5. CLOCK
6. ALTIMETER
7. N-1 REPEATER COMPASS
8. OXYGEN PANEL
9. INTERPHONE PANEL

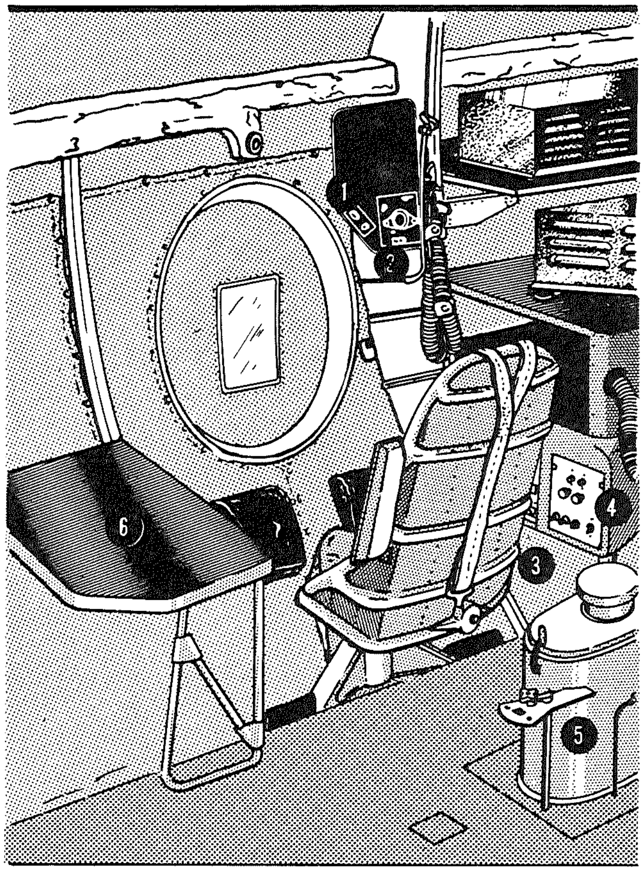
68-173-A

Figure 4-28.

Dispenser Unit.

The type MA-1 dispenser is installed in the aft cabin at the lower right aft scanner's station. (See figure 4-29.) Ejection of the radiosonde from the dispenser is accomplished by the pressure differential between the aircraft cabin and the inside of the dispenser acting upon the ejection piston contained in the loading door. A pressure regulating valve (12, figure 4-30) controls the rate at which the inside of the dispenser assembly is either pressurized to aircraft cabin pressure or depressurized to outside atmosphere. This valve is mounted adjacent to the dispenser unit body. The ejection door in the lower chamber assembly permits the ejection of the unit from the airplane. The radiosonde can be released electrically by two release latch solenoids controlled by an eject switch located on the radiosonde control panel (figure 4-30) or by manual operation of the ejection door control lever.

LOWER RIGHT AFT SCANNER'S *Station*



1. INTERPHONE PANEL
2. OXYGEN PANEL
3. BC-454-( ) RECEIVER
4. RADIOSONDE CONTROL PANEL
5. RADIOSONDE DISPENSER
6. LOWER RIGHT AFT SCANNER'S TABLE

68-174-A

Figure 4-29.

Controls.

Radiosonde Power Switch. This ON-OFF switch is mounted on the lower left side of the radiosonde unit and is reached through a tab opening on the lower housing. When the switch is in the ON position battery power is supplied to the transmitter and the modulator.

Chamber Light Switch. This ON-OFF switch (6, figure 4-30) is located on the radiosonde control panel. When in the ON position the switch supplies 28-volt d-c power to light the interior of the dispenser unit.

Valve Heater Switch. The ON-OFF valve heater switch (7, figure 4-30) located on the radiosonde control panel controls 28-volt d-c power to the dispenser control valve heater.

Radiosonde Eject Switch. This spring-loaded ON-OFF eject switch (8, figure 4-30) is on the radiosonde control panel. When held in the ON position the switch supplies 28-volt d-c power to the dispenser unit release latch solenoids and effects release of the radiosonde unit .

Dispenser Unit Control Lever. This lever (13, figure 4-30) is a part of the dispenser assembly. When placed in the LOAD AND EVACUATE position the ejection door is closed. Moving the lever to the EJECTION DOOR OPEN position opens the door.

Dispenser Pressure Regulating Handles. These handles (12, figure 4-30) operate the valve which pressurizes and evacuates the ejection chamber. Pulling the handle marked PRESSURIZE allows the ejection chamber of the dispenser to equalize with cabin pressure. Pulling the EVACUATE handle allows the chamber to equalize with outside pressure in preparation for ejection of the radiosonde unit.

Indicators.

Door Open Indicator Lamp. This lamp (4, figure 4-30) is located on the radiosonde control panel at the lower right aft scanner's position. The lamp glows when the ejection door of the dispenser unit is open.

Chamber Evacuated Indicator Lamp. This lamp (3, figure 4-30) is on the radiosonde control panel at the lower right aft scanner's position. The lamp glows when the dispenser unit chamber is evacuated.

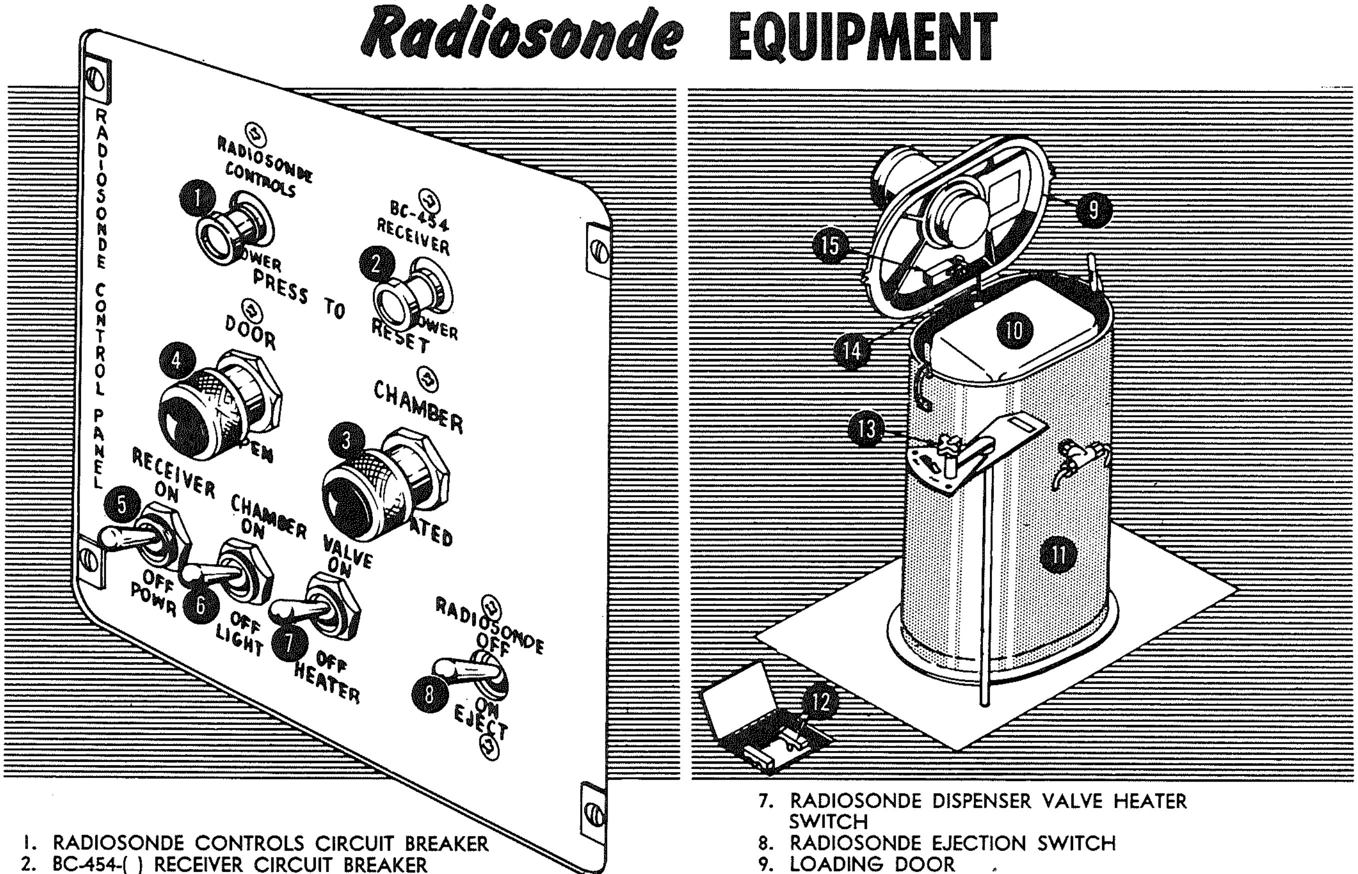
Operation.

Loading. The radiosonde unit is installed in the dispenser unit for dropping as follows:

Note

Place the BC-454-( ) receiver in operation at least fifteen minutes before launching operations are started so that it can warm up.

Radiosonde EQUIPMENT



1. RADIOSONDE CONTROLS CIRCUIT BREAKER
2. BC-454-( ) RECEIVER CIRCUIT BREAKER
3. RADIOSONDE DISPENSER CHAMBER EVACUATED INDICATOR LAMP
4. RADIOSONDE DISPENSER EJECTION DOOR INDICATOR LAMP
5. BC-454-( ) RECEIVER POWER SWITCH
6. RADIOSONDE DISPENSER CHAMBER LIGHT SWITCH
7. RADIOSONDE DISPENSER VALVE HEATER SWITCH
8. RADIOSONDE EJECTION SWITCH
9. LOADING DOOR
10. RADIOSONDE UNIT
11. DISPENSER UNIT
12. DISPENSER PRESSURE REGULATING VALVE HANDLES
13. DISPENSER CONTROL LEVER
14. RADIOSONDE STATIC LINE
15. STATIC RELEASE LATCH

68-175-A

Figure 4-30.

1. Close the ejection door of the dispenser unit by moving the control lever to the LOAD AND EVACUATE position.

2. Pull the PRESSURIZE handle on the regulating valve and wait for the CHAMBER EVACUATED lamp on the panel to go out, indicating that the chamber is pressurized.

3. Release the door latches and open the loading door.

4. Load the radiosonde, seating it firmly against the release latches.

5. Engage the static ring on the radiosonde static line with the static release latch of the dispenser unit as follows:

a. Engage the static ring and hold it down against the housing.

b. Depress the plunger.

c. Release the static ring to latch with the plunger. When the ring is latched, the plunger will remain in.

6. Turn on the radiosonde and tune in the signal on the BC-454-( ) receiver. Log the dial setting for the radiosonde frequency and record signals.

Note

A garbled message prior to launching may be due to the vibration of the airplane causing the electro-mechanical pick-up to oscillate over the surface of the record. This condition can be ignored.

7. Close and latch the loading door.

8. Pull the EVACUATE handle on the pressure regulating valve and wait for the indicator lamp to light, indicating that the chamber is evacuated.

9. Open the ejection door by moving the control knob to the EJECTION DOOR OPEN position stop.

Note

Before releasing the radiosonde, allow a period of 3 or 4 minutes to pass after the chamber has been evacuated to allow the unit to adjust itself to the outside atmosphere. A check of the radiosonde signals which are being recorded will show when the unit is stabilized.

Normal Release. When the altitude and position at which the radiosonde is to be launched are reached, hold the airplane at constant air speed and altitude until all reference level readings have been recorded and the launching of the radiosonde has been completed. Three minutes prior to launching the radiosonde and again at the moment of launching, the weather observer will record the following:

1. Radio altimeter indication to the nearest 10 feet
2. Pressure altimeter setting
3. Pressure altimeter indication
4. Humidity reading
5. Outside temperature reading
6. Indicated air speed

Release the radiosonde unit by depressing the RADIOSONDE EJECT switch.

Note

The radiosonde operator will record pressure, temperature, and humidity code groups received from the radiosonde during descent.

When the radiosonde has been dropped, proceed as follows:

1. Close the ejection door of the dispenser unit by moving the control lever to the LOAD AND EVACUATE position.
2. Pull the PRESSURIZE handle on the regulating valve and wait for the CHAMBER EVACUATED lamp on the panel to go out, indicating that the chamber is pressurized.
3. Release the door latches and open the loading door. Remove the static line and cord which remain from the launched radiosonde.

Emergency Release. To release the radiosonde unit manually, raise the control lever and force the handle to the MANUAL RELEASE position.

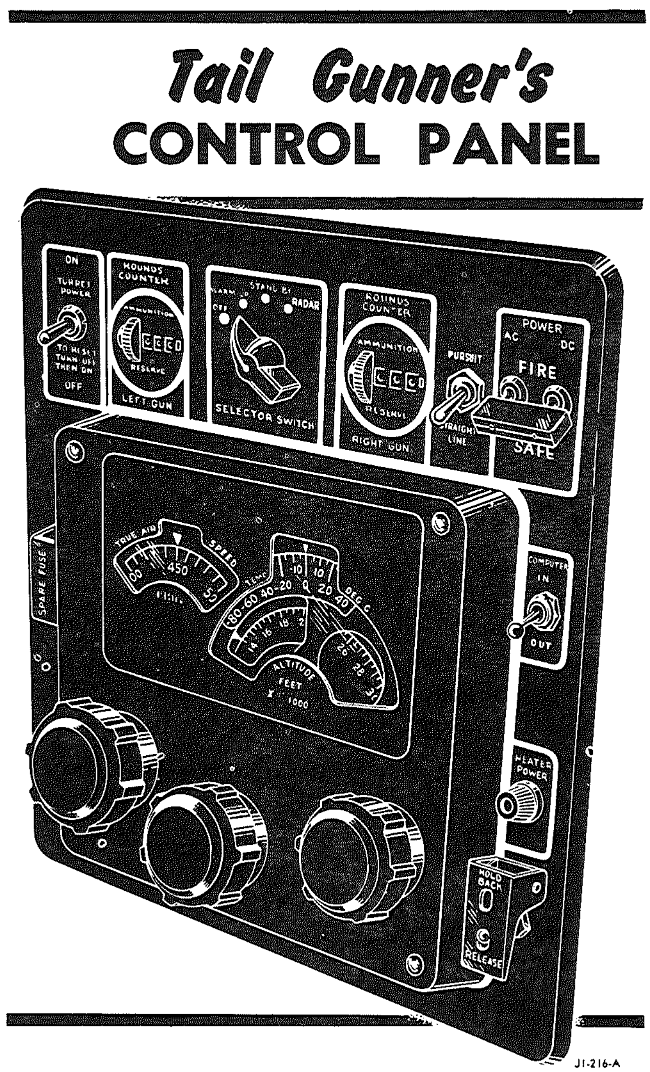
GUNNERY EQUIPMENT.

The airplane is equipped with one nonretractable, radar-controlled gun turret located in the tail of the airplane. The turret is controlled by the APG-32 radar set, the controls of which are located in the aft cabin. The turret is equipped with two 20-mm cannons. Provisions are made in the turret for 600 rounds of ammunition per cannon. The tail gunner's station is furnished with a remote gun sight, a turret control panel, and oxygen and interphone controls. The equipment is started by turning the selector switch on the control panel from OFF or WARM UP to STAND BY. The switch is then turned from STAND BY to RADAR for operation. The equipment will begin to operate after a 3-1/2 minute warm up period. The equipment is completely stopped by turning the switch to the OFF position.

CAUTION

Before turning the selector switch to OFF, place the altitude knob in the maximum altitude position. This applies to B-2 armament equipment.

For detailed information refer to "Tail Gunner's Amplified Check List," Section VIII.



J1-216-A

Figure 4-31.

1. AN/APS-54 Radar Warning
2. Fire Control Panel
3. Radio Selector Switch
4. Interphone Control Panel
5. Oxygen Panel
6. Radar Pressurization Gage
7. Radar Pressurization System Controls
8. AN/APG-32 Range Azimuth Indicator
9. AN/APG-32 Antenna Hand Control

72-257-A

72-257-A

Figure 4-32.

NORMAL CONTROLS.

Turret Safety Switch.

This two-position switch is located on the turret junction box. When it is ON, the 28-volt d-c circuit from the thyratron controller to the turret power switch is closed.

Turret Power Switch.

This two-position d-c switch-type circuit breaker on the turret control panel is in series with a turret safety switch in the system junction box; this switch controls all d-c power to the turret system.

Tail Turret System Selector Switch.

This four-position switch is on the tail gunner's control panel (figure 4-31) to control the turret and radar circuits. The four positions are OFF, WARM UP, STAND BY, and RADAR. All circuits are de-energized when the switch is in the OFF position.

In the WARM UP position the switch supplies 120-volt single-phase a-c power to the gun and feeder heaters, the computer and resolver input unit heaters, and the heaters in the azimuth and elevation gyros.

In the STANDBY position the switch supplies power to the computer, antenna selsyns, the gyro drive selsyns, the thyratron controller, the control indicator, the frequency converter, the stow transformer, turret drive motor fields, and gyros.

The RADAR position supplies d-c power to the radar control indicator and the antenna drive motors.

A-C and D-C Power Switches (Safe-Fire).

These SAFE-FIRE switches are ganged together on the control panel. When the a-c power switch is placed in the FIRE position, it allows a-c power to be supplied to the free fire control box circuits. When the d-c power switch is placed in the FIRE position, it turns on the gun firing circuit. Placing this switch in SAFE turns off the gun firing circuit.

Note

The gang bar simultaneously places both switches in the SAFE position only.

Altitude — Air-Speed Handset Unit.

This unit is located on the control panel (figure 4-31). It incorporates three knobs and three dials to be used in setting up data for the computer. The dails consist of true air speed in mph, temperature in degrees centigrade, and altitude in thousands of feet. Proper setting of knobs and dials will furnish the computer with true air speed of the aircraft and air density to aid in properly computing lead prediction and ballistic corrections during turret operations.

Action Switch.

This switch is located on the antenna hand control. Actuating this switch controls the movement of the turret to follow the antenna in manually tracking a target. When the switch is released, the turret will automatically return to the stowing position.

Computer Switch.

The computer switch is a two-position switch with positions marked IN and OUT. When this switch, located on the gunner's control panel, is in the IN position, ballistic, parallax, and lead prediction are automatically computed and fed into the turret control circuit for corrected gun fire.

Attack Factor Switch.

This two-position switch, marked STRAIGHT LINE and PURSUIT, is located on the control panel. The position in which this switch is placed is determined by the type of approach being made by an attacking aircraft. The STRAIGHT LINE position provides signals to the computer to correct for a straight-line approach. The PURSUIT position provides additional signals to the computer to correct for a pursuit-curve approach.

Gun Charging Switch (Group 1 Airplanes).

A guarded two-position switch, marked HOLD BACK and RELEASE, is located on the lower right corner of the gunner's control panel. When the switch is in the HOLD BACK position, the bolts of both guns of the turret are held back, leaving the breech empty. In the event of a gun jam, placing the switch to HOLD BACK may clear the jam. Placing the switch in RELEASE position allows normal operation of the guns.

INDICATORS.

Heater Power Fuse.

This fuse is located on the control panel. In addition, a spare fuse holder is located on the opposite side of the control panel. Insertion or removal of this fuse controls heater power to the gun and feeder heaters when required to do so.

Ammunition Counter Dials.

Two dials on the turret control panel will indicate reserve ammunition for each gun.

RADAR PRESSURIZATION.

Either one or two 115-volt, a-c motor-driven pressure pumps are located on the right side of the aft cabin to provide pressurized air for the radio frequency unit, the modulating unit, and the radio frequency line (wave guide) of the gun laying set. The system is controlled by a pressure pump switch located on the pressure system indicator control. Operation of the system is identical to that of the AN/APQ-24 radar set.

BOMBING EQUIPMENT.

The airplane is equipped with three bomb bays, bays 2, 3, and 4. Bomb bay 2 will accommodate 41 type T-86 photo flash bombs and bay 3 will carry 39. A bomb bay fuel tank can be carried in bay 3 instead of flash bombs when a mission requires additional fuel capacity, and provisions are made for the installation of a universal bombing system in bay 2. An inspection window in the communication tube and one in the aft wall of the camera compartment are provided for checking to see whether bombs have hung or jammed in the bomb bay during a bomb drop. The double-folding, gate-action bomb bay doors are hydraulically operated. (See figure 4-34.) The all-electric photo flash bomb release system is based on the type A-5 bomb rack release and consists of four individual circuits: a bomb bay door circuit, a bomb salvo circuit for release with nose fuse automatically safe, a circuit for normal release with nose fuse automatically armed, and a bomb indicator lamp circuit. A bombing control panel (figure 4-33) is located at the photo-navigator's station (figure 4-38) for controlling the system.

NORMAL CONTROLS.

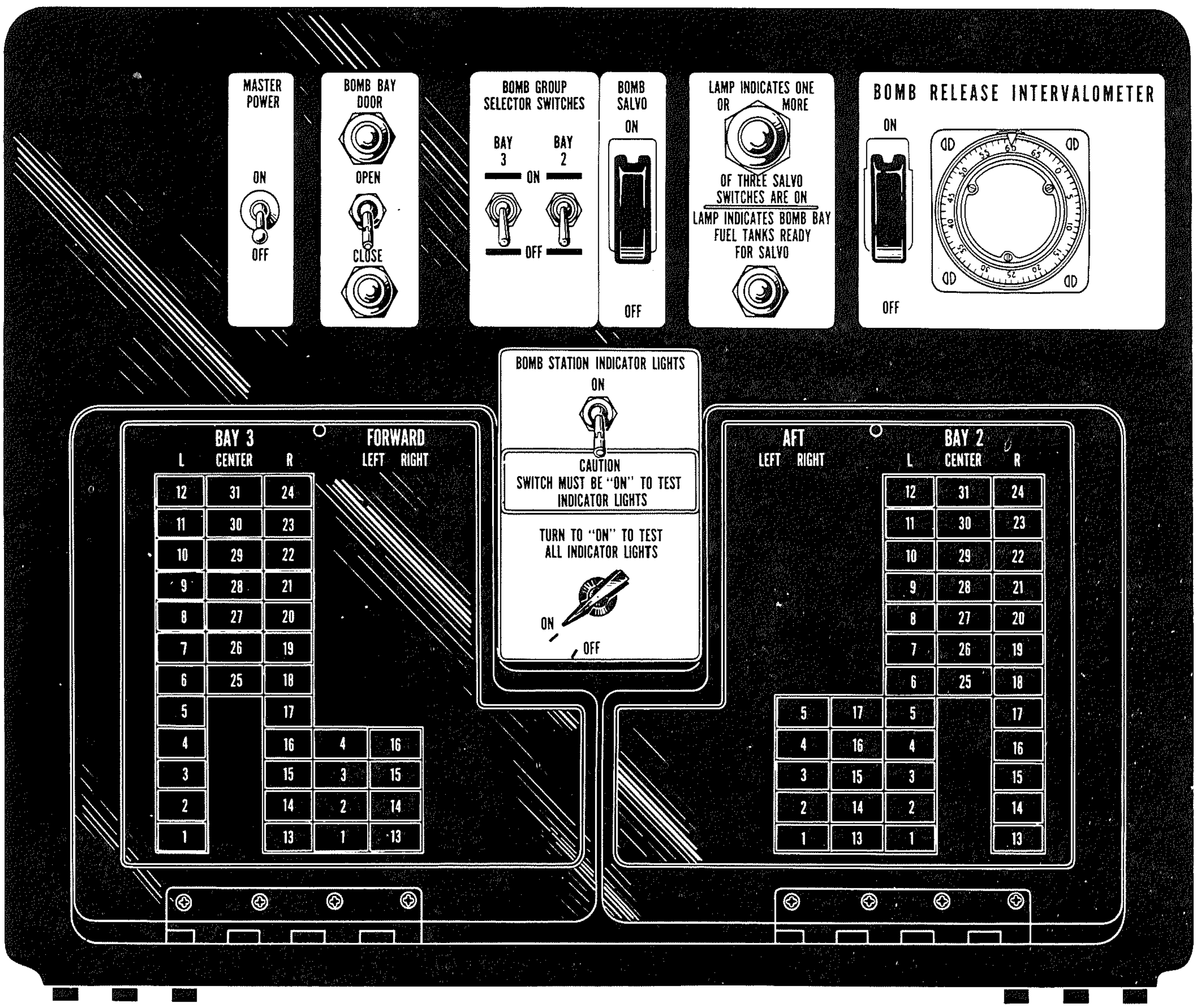
Master Power Switch.

The master power switch is a switch-type circuit breaker with two positions marked ON and OFF. It completes a 28-volt d-c circuit to the circuit breakers for the bomb release switches, intervalometer control switch, and the bomb bay door switches. The bombsight stabilizer and the bomb salvo switches are the only bombing controls which receive power when the switch is in the OFF position.

Bomb Release Switches.

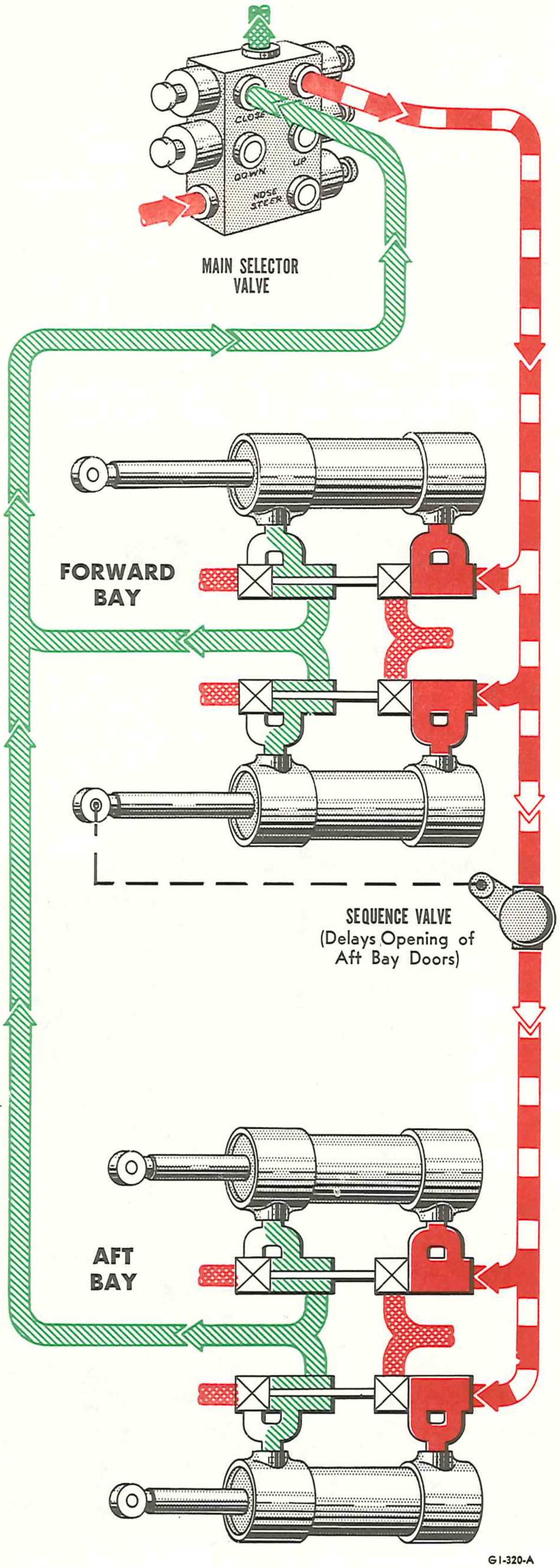
On airplanes not in group 1, only the photo-navigator's station is equipped with a type D-2 bomb release switch. On group 1 airplanes, a D-2 switch is also provided for the radar observer. Bombs can be released manually by means of these switches, regardless of the position of the bomb release selector switch. The D-2 switches will effect either train or select bomb release, depending on the position of the intervalometer control switch. Train release is stopped by placing the intervalometer control switch at SELECT AND STOP.

Bomb Release Selector Switch (Group 1 Airplanes). The bomb release selector switch is a two-position switch marked RADAR and BOMBSIGHT and located on the photo-navigator's bombing control panel. With this switch in the RADAR position and the intervalometer control switch in TRAIN or SELECT AND STOP, the bomb bay doors are opened and train or select release of bombs is accomplished automatically from the AN/APQ-24.



1206

Figure 4-33. Bombing Control Panel



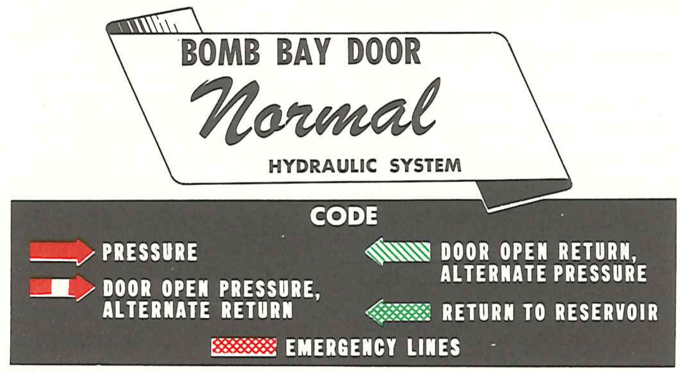


Figure 4-34.

Note

The doors must be closed with the bomb bay door switch.

When the switch in in BOMBSIGHT position, a circuit is set up for bomb release from the bombsight. Train release of bombs is broken by placing the intervalometer control switch in the SELECT AND STOP position.

Bomb Group Selector Switches.

Two on-off selector switches (figure 4-33) are located on the photo-navigator's bombing control panel. Placing these switches ON completes a 28-volt d-c circuit to the bomb racks.

Bomb Bay Door Switches.

Two spring-loaded switches marked OPEN and CLOSE, one on the bombing control panel (figure 4-33) and one on the pilots' panel (32, figure 1-13), control the bomb bay doors. Placing one of these switches in the OPEN position completes a 28-volt d-c circuit to position the main hydraulic selector valve for bomb bay door open operation. The doors are closed in a like manner when one of the switches is placed in the CLOSE position.

Bomb Station Indicator Lights Switch.

When this switch is placed ON, each indicator light will burn as long as its bomb rack release unit is cocked. This switch is provided on the bombing control panel to test all bomb station indicator lights.

Intervalometer.

A type B-5A or B-9 intervalometer installed on the bombing control panel provides an electrical impulse at regular intervals to the bomb release controls. A calibrated dial on a knob assembly indicates the time interval between pulses. The time interval depends on the setting of the knob assembly and ranges from 1/2 to 60 seconds in 1/2-second increments when using 60-second dial indicator.

Note

A 120-second dial indicator may be installed with some internal changes to the intervalometer. When using the 120-second dial indicator, the time interval ranges from 1 to 120 seconds in 1-second increments.

Note

The calibrated knob assembly has an OFF position which is inoperative.

Intervalometer Control Switch (Airplanes not in Group 1). A two-position switch located adjacent to the intervalometer controls the operation of the unit. Placing this switch ON completes a 28-volt d-c circuit to the motor assembly of the intervalometer and starts the electrical impulses.

Intervalometer Control Switch (Group 1 Airplanes). The intervalometer control switch provides alternate control for the release of flash bombs. When the switch is in the TRAIN position, the intervalometer controls the interval of bomb release. Placing the switch in the SELECT AND STOP position transfers the control of bomb release to either the bombsight or the AN/APQ-24 radar set, depending on the position of the bomb release selector switch, and to the D-2 bomb release switches.

INDICATORS.

Bomb Bay Door Lamps.

Two bomb bay door lamps (figure 4-33) are provided for each bomb bay door switch. The lamps indicate when the bomb bay doors are fully open or fully closed.

Bomb Station Indicator Lights.

Eighty bomb station indicator lamps, one for each station, are located on the bombing control panel. With the master power switch ON, each light will burn as long as its bomb rack release unit is cocked. Each light will go out as the bomb at its station is released.

HYDRAULIC FLUID TEMPERATURE CONTROL.

Provisions for maintaining proper hydraulic fluid temperatures for operation of the bomb bay doors are incorporated in the main hydraulic system. Operation of the system is fully automatic, provided the switch-type circuit breaker (1, figure 1-36) on the engineers' table is in the ON position. In this condition, a circuit is set up to a thermal switch located in the system. The switch then reacts to hydraulic fluid temperature as follows: When the fluid temperature drops to approximately — 18°C (0°F) the thermal switch engages. This in turn starts one of the main hydraulic system pump motors and energizes the door-close solenoid of the main selector valve. Fluid is then circulated through the system until it reaches a temperature of approximately 38°C (100°F) at which time the thermal switch opens, the pump stops, and the door-closed solenoid is de-energized.

Note

Actuation of a bomb bay door switch will render the hydraulic fluid temperature control inoperative.

RADAR BOMB SCORING TONE DEVICE.

The radar bomb scoring tone device eliminates the possibility of human error in radar bomb scoring for training crews. The bomb scoring tone control box has a spring-loaded ON-OFF toggle switch, two connector mounting type sealed relays, and an indicator light. It is located adjacent to the radar observer's auxiliary control panel.

To operate the bomb scoring tone device, proceed as follows: Press the spring-loaded toggle switch to the ON position momentarily. This action starts a 1000-cycle tone from either command set transmitter and lights the tone control box indicator lamp. The tone will remain on until a bomb release signal is received at the tone control box. This signal stops the tone and turns off the indicator lamp. The tone may also be stopped by momentarily pressing the spring-loaded switch to the OFF position.

CAUTION

If the bombs are aboard the aircraft the RBS safety check list under "Radar Observer," Section VIII, will be accomplished prior to the tone check.

EMERGENCY RELEASE CONTROLS.

Bomb Salvo Switches.

Two bomb salvo switches are provided, one at the pilots' and one at the photo-navigator's station (28, figure 1-14 and figure 4-33). Each switch has a spring-loaded ON and OFF position. Salvo can be accomplished by momentarily holding either of the switches in the ON position.

CAUTION

Normally both the salvo circuit breaker for the photo-navigator's salvo switch and the one for the pilots' switch must be in before salvo can be effected from the pilots' switch. However, if the bomb bay doors are open, salvo can be accomplished from the pilots' switch even though the photo-navigator's salvo circuit breaker is pulled.

If a bomb bay fuel tank is being carried, it can be salvoed with the bombs, provided the bomb bay tank release selector switch (33, figure 1-13) is in the CAN SALVO position. A lamp, adjacent to each salvo switch, will light when the salvo cycle begins and will go out when the bombs are salvoed and the bomb bay doors are closed.

Note

After salvo, the bomb bay doors must be closed with the bomb bay door switches.

Note

During normal bomb release operation, the bombs are automatically armed; during a salvo or emergency release, the bombs are automatically safe.

Bomb Bay Tank Release Selector Switch.

This two-position switch, marked NO SALVO and CAN SALVO, is provided on the pilots' instrument panel to determine whether or not the bomb bay fuel tank can be released during salvo. When the switch is in the NO SALVO position, the bomb bay fuel tank cannot be salvoed. When it is in the CAN SALVO position, a green indicator lamp (33, figure 1-13) adjacent to the switch will glow, indicating that the fuel tank can be salvoed. An indicator lamp is also provided on the bombing control panel.

SALVO RELEASE.

Bomb Salvo Release.

To salvo the bombs proceed as follows:

1. Pilots' and Photo-Navigator's Salvo Circuit Breakers—Pushed in.
2. Bomb Bay Tank Release Selector Switch—NO SALVO.
3. Bomb Salvo Switch—Momentarily ON.

Note

Once the salvo circuit is completed, it takes approximately 3 seconds to salvo the bombs. The salvo cycle can be stopped by reactuating either of the salvo switches.

WARNING

If the two salvo switches are actuated at approximately the same time, the salvo will be incomplete; therefore, only one salvo switch must be actuated when it is necessary to salvo bombs.

4. Bomb Bay Door Switch—CLOSE.

WARNING

The bomb salvo switch-type circuit breakers in the bomb bay must be ON because all electrical impulses to the racks go through these switches.

Bomb Bay Fuel Tank Salvo Release.

To salvo the bomb bay fuel tank, proceed as follows:

1. Bomb Bay Fuel Tank Booster Pump Switch—OFF.
2. Bomb Bay Fuel Tank Valve—CLOSE.
3. Pilots' and Photo-Navigator's Salvo Circuit Breakers—Pushed in.
4. Bomb Bay Fuel Tank Release Selector Switch—CAN SALVO.
5. Bomb Salvo Switch—Momentarily ON.
6. Bomb Bay Door Switch—CLOSE.

WARNING

The bomb salvo switch-type circuit breakers in the bomb bay must be ON because all electrical impulses to the racks go through these switches.

UNIVERSAL BOMBING SYSTEM.

This bombing system comprises a universal bomb rack (the U-2 pneumatic rack) and associated equipment installed in the forward bomb bay, an emergency manual release cable system with a release handle at the photo-navigator's station, an arming control manual safe system with a control handle on the right side of the aft wall of the forward cabin, and the necessary controls at the photo-navigator's and pilots' stations. An IFI operator's station equipped with oxygen, interphone, and heater connections is provided at bulkhead 6.0 in the forward bomb bay.

Normal Controls.

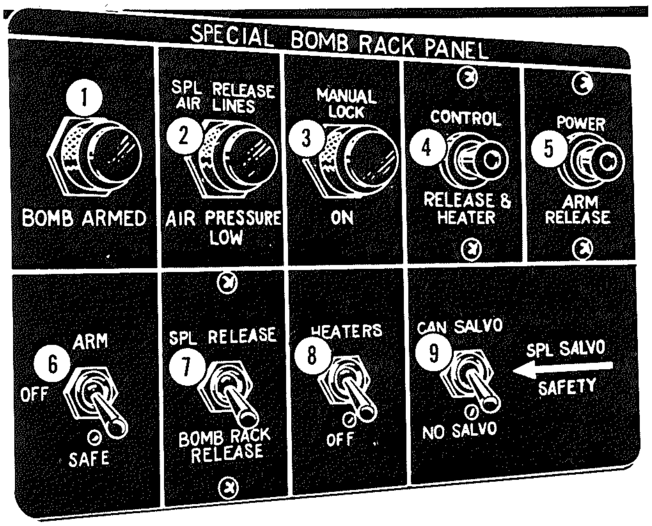
The special bomb rack panel for the universal bombing system is located at the photo-navigator's station (figure 4-35).

Special Release Switch. The special release switch (7, figure 4-35) has two positions, SPECIAL RELEASE and BOMB RACK RELEASES. When placed in the SPECIAL RELEASE position the switch disconnects the normal bomb racks from the release circuit and makes release from the special bomb racks possible.

Rack Heater Switch. The two-position heater switch (8, figure 4-35) receives 28-volt power through the CONTROL-RELEASE HEATER circuit breaker (4, figure 4-35). When the switch is placed in the HEATER position, it supplies power to the U-2 rack and arming control heaters.

Arm-Safe Switch. This spring-loaded three-position switch (6, figure 4-35), marked ARM and SAFE, receives power through the POWER-ARM RELEASE

SPECIAL BOMB RACK *Panel*



1. BOMB ARMED INDICATOR LAMP
2. PRESSURE WARNING LAMP
3. MANUAL LOCK LAMP
4. CONTROL-RELEASE HEATER CIRCUIT BREAKER
5. POWER-ARM RELEASE CIRCUIT BREAKER
6. ARM-SAFE SWITCH
7. SPECIAL RELEASE SWITCH
8. RACK HEATER SWITCH
9. SALVO SAFETY SWITCH

F1-787-B2

Figure 4-35.

circuit breaker (5, figure 4-35). When the switch is in the ARM position, it supplies power to the arming control solenoid. When it is in the SAFE position it supplies power to the safe control solenoid. The switch returns to the neutral OFF position when not in use.

Salvo Safety Switch. The salvo safety switch, (9, figure 4-35), marked CAN SALVO and NO SALVO, controls salvo operation of the universal bombing system. Placing the switch in the CAN SALVO position permits salvo from the U-2 rack by means of the normal salvo system in the airplane.

Indicator Lamps.

Manual Lock Lamp. The MANUAL LOCK-ON warning lamp (3, figure 4-35) glows when the manual lock pin is inserted in the bomb rack.

Pressure Warning Lamp. The low air pressure warning lamp (2, figure 4-35) glows when the pressure in the system drops below 625 (±40) psi.

Bomb Armed Indicator Lamp. The indicator lamp (1, figure 4-35) for the ARM-SAFE switch glows when the switch is in the ARM position.

Emergency Controls.

Emergency controls for the universal bombing system include a salvo safety switch (42, figure 1-13) on the pilots' instrument panel, a salvo safety switch (9, figure 4-35) on the photo-navigator's special bomb rack panel, and an emergency release handle located on the floor of the photo-navigator's station. Placing either salvo safety switch in the CAN SALVO position permits salvo from the U-2 rack by means of the normal salvo system in the airplane.

The emergency release handle can be used to release bombs when the pneumatic release system in inoperable.

BOMB BAY DOOR EMERGENCY CONTROLS.

Manual Selector Controls.

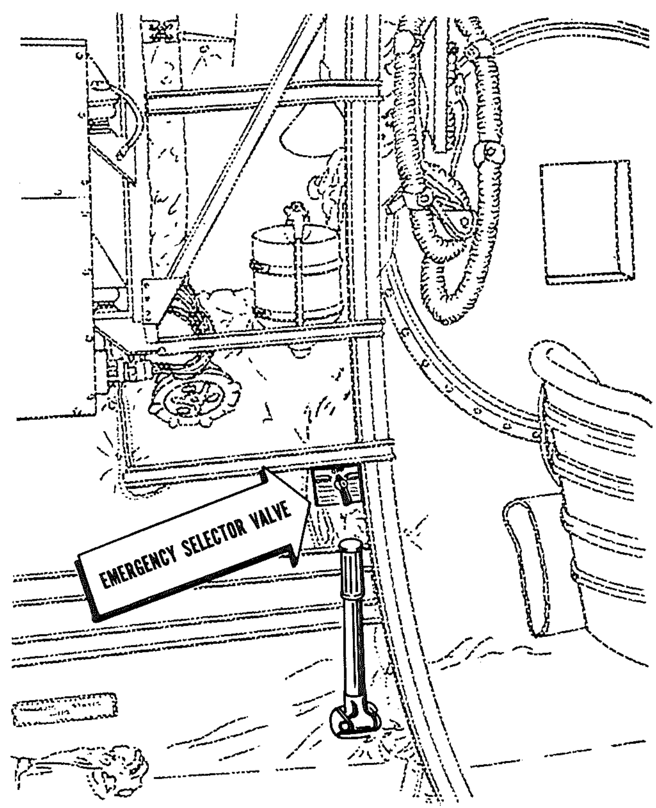
The hydraulic system main selector valve is provided with an OPEN and CLOSE plunger for operation of the bomb bay doors. The plungers are used in conjunction with the hydraulic pump override switch. (See "Hydraulic Pump Override Switch," Section I.)

Manual Operation of Main Selector Valve. (See figure 3-14.)

CAUTION

Do not open the bomb bay doors until the aft turret doors are open.

1. Pilot—Bomb Bay Door Circuit Breaker—Pull out.



67-152-A

Figure 4-36. Bomb Bay Door Emergency Hydraulic System Controls

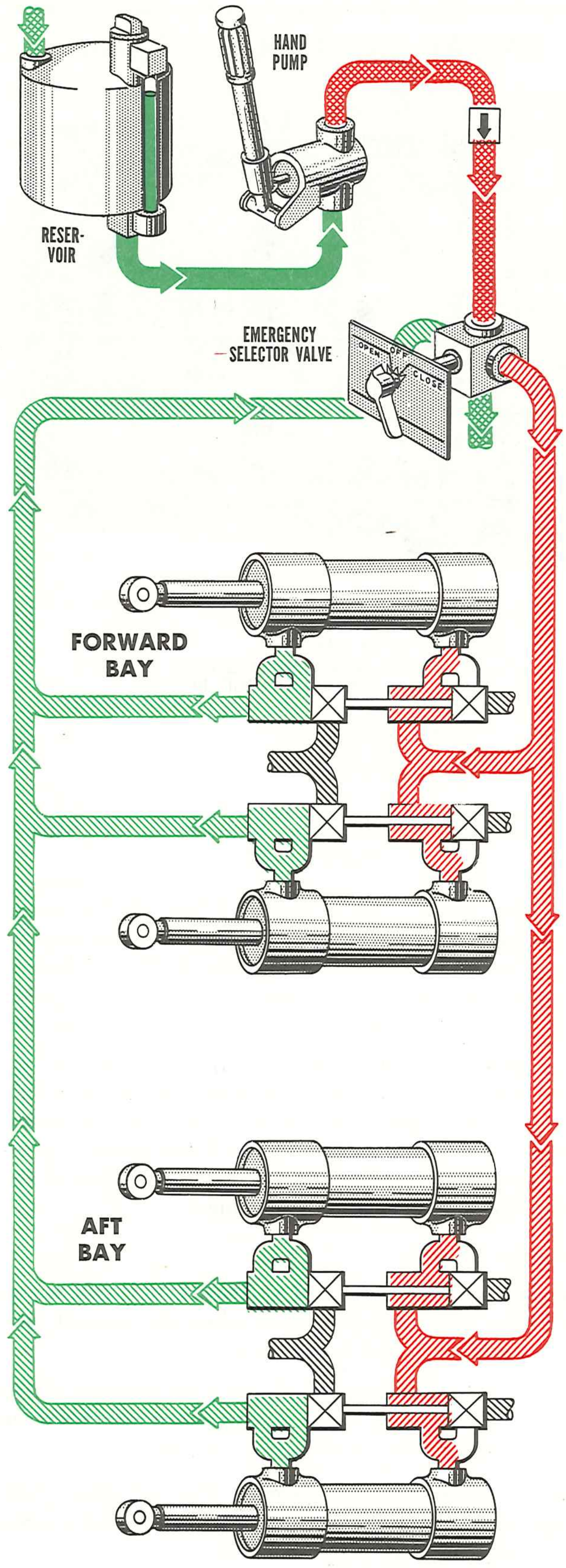


Figure 4-37.

2. Photo-Navigator—Bomb Bay Door Circuit Breaker—Pull out.

3. Engineer—Hydraulic Fluid Temperature Control Switch—OFF.

4. Crew Member—Main Selector Valve OPEN or CLOSE Plunger—Hold in until desired action is completed.

5. Engineer—Hydraulic Pump Override Switch—ON.

6. Engineer—Hydraulic Pump Override Switch—OFF, after desired action is complete.

Bomb Bay Door Emergency Hydraulic System.

A fluid supply, a hand pump, and a bomb bay door emergency selector valve (figure 4-36) are the main components of the emergency bomb bay door system. With the selector valve in the OPEN or CLOSE position, operation of the hand pump produces the selected action.

WARNING

When not in use, the emergency selector valve lever must be left in the OFF position. Operation of the normal bomb bay door system with the lever in any position other than OFF will result in flooding the emergency system reservoir and consequent loss of fluid.

Operation of Bomb Bay Door Emergency Hydraulic System. (See figure 4-37.)

CAUTION

Do not open the bomb bay doors until the upper and lower aft turret doors are open.

Note

When the bomb bay door hydraulic system is inoperative, the turret doors may be operated by the following procedure:

1. Pull the fuses (six on the right main a-c power panel) for hydraulic pump No. 1.

2. Momentarily position the bomb bay door control switch to OPEN. This action initiates a 28-volt d-c pulse to open the turret doors.

3. Close the turret doors by moving the bomb bay door control switch to the CLOSE position. (The turret doors can be closed only when the bomb bay doors are closed.)

1. Pilot—Bomb Bay Door Circuit Breaker—Pulled.

2. Photo-Navigator—Bomb Bay Door Circuit Breaker—Pulled.

3. Engineer—Hydraulic Fluid Temperature Control Switch—OFF.

4. Crew Member—Emergency Selector Valve—OPEN or CLOSE as desired.

5. Crew Member—Hand Pump—Operate until the doors are in the desired position.

6. Crew Member—Emergency Selector Valve—OFF.

PHOTOGRAPHIC EQUIPMENT.

Photographic equipment is provided in the airplane for use in photo reconnaissance and in conjunction with ECM operations.

AERIAL CAMERA SYSTEM.

Aerial photography is accomplished from seven camera stations in a pressurized, temperature-controlled camera compartment. (See figure 1-3.) Five of the stations —the trimetrogon, vertical, split vertical, multi, and forward oblique are remotely controlled from either the photographer's (figure 4-44) or the photo-navigator's (figure 4-38) station after the camera has been prepared for operation by the photographer. The left and right side oblique cameras are controlled by switches at those stations (figure 4-41) and are operated by the photographer. The vertical camera station can also be used for night photography when the target is illuminated by photo flash bombs. A photocell trip unit is installed which causes the camera shutter to be tripped through action of the bomb flash on the photocell.

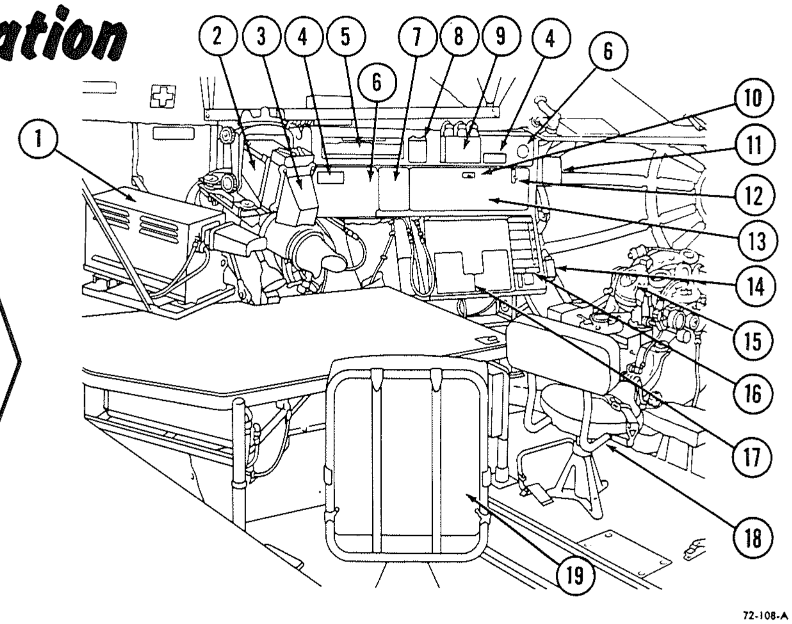
Through a combination of air speed, altitude, and intervalometer settings the desired photograph overlap can be obtained with the remote controlled cameras. A vacuum system, a defrosting system, and electrically operated camera doors form an integral part of the aerial camera system. Each system must be in operation before photography can normally be performed. Emergency controls are provided in the event of a system malfunction. A work table and curtain (figure 1-3) provide a dark room for use in reloading the film magazines. Provisions are made for the installation of five K-40 type cameras at the multicamera station.

A functional breakdown of the cameras is listed as follows:

Station	*Camera*	*Focal Length-Inches*	*Quantity*	*Use*
Trimetrogon	K-17C	6	3	Charting and Mapping
Vertical	K-17C, K-37, K-22A, or T-11	6, 12, or 24	1	Mapping, Intelligence, and Night Photography
Split Vertical	K-38	24	2	Mapping, Reconnaissance, and Intelligence
Multi	K-38 or K-40	36 or 48	5	Reconnaissance and Intelligence
Forward Oblique	K-22A	12	1	Reconnaissance and Intelligence
Left Oblique	K-22A	12 or 24	1	Reconnaissance and Opportunity
Right Oblique	K-22A	12 or 24	1	Reconnaissance and Opportunity
Navigator's, Radar Observer's, and ECM Stations	O-15		6 (Airplanes not in group 1)	Radar Scope Photography
Navigator's and Radar Observer's Stations	O-15		2 (Group 1 airplanes)	Radar Scope Photography

PHOTO-NAVIGATOR'S *Station*

1. LORAN SET
2. PORTABLE RADAR SCOPE
3. O-15 CAMERA
4. INTERPHONE PANEL
5. CIRCUIT BREAKERS
6. OXYGEN PANEL
7. RADIO COMPASS CONTROLS
8. RADAR CAMERA MASTER CONTROL BOX
9. P-3B CONTROL BOX
10. COMPASS SLAVING SWITCH
11. DURATION CONTROL
12. DIRECTIONAL GYRO CONTROL SWITCH
13. INSTRUMENT PANEL
14. DRIFT ANGLE CONTROL
15. BOMBSIGHT
16. CAMERA CONTROL PANEL
17. BOMBING CONTROL PANEL
18. PHOTO-NAVIGATOR'S SEAT
19. NAVIGATOR'S SEAT



72-108-A

Figure 4-38. (Sheet 1 of 2)

Aerial Camera Controls.

Camera Master Power Switches. Two camera master power switches, one on the photographer's camera control panel (3, figure 4-48) and one on the engineers' panel (38, figure 1-20) are provided to energize the main camera bus. Placing both switches in the ON position supplies 28-volt direct current to the various switch and signal circuits of the camera control system. When both switches are in the ON position, indicator lamps on the camera control panels of the photo-navigator and the photographer will glow indicating that power is on.

Note

Both switches must be placed ON to energize the main camera bus.

Alert Switches. Five on-off alert switches (1, figure 4-39), one for each of the remote-controlled camera stations, are located on the photo-navigator's camera panel to control 28-volt direct current to the alert lamps. Placing these switches in the ON position lights corresponding alert lamps on the camera control panels of the photo-navigator and the photographer, indicating the camera stations which are to be prepared for operation.

Alert Warning Horn Switch. This push-button switch (5, figure 4-39) on the photo-navigator's camera control panel, when depressed, energizes the photographer's alert warning horn with 28-volt direct current to give the photographer an audible warning to prepare for operation of camera stations indicated by the alert lamps.

Intervalometer. A type B-9 intervalometer (12, figure 4-48) is located on the photographer's control panel for each of the five remote-controlled camera stations. At selected intervals the intervalometer closes its contacts, connecting 28-volt direct current to the camera system for shutter and magazine operation. The interval of exposure is set up by positioning the intervalometer control knob as desired.

Camera Door Switches. Five two-position switches (14, figure 4-48), one for each of the remote-controlled camera stations, are provided on the photographer's camera control panel to open and close the camera doors. The switches are marked OPEN and CLOSE. Placing a switch in either position, supplies 28-volt direct current to a relay which supplies 115-volt a-c power to the camera door actuator.

Note

The vertical and split vertical camera stations use the same set of doors and the forward oblique and multicamera stations use the same set of doors. When a set of doors which is shared by two camera stations is open they cannot be closed from one of the stations unless the door control switch of the other station is in the CLOSE position.

Side Oblique Camera Door and Master Power Switches. A three-position switch (figure 4-41) marked OPEN, OFF, and CLOSE is located on the oxygen equipment panel of each side oblique camera station. Placing the switch in either the OPEN or CLOSE position directs 115-volt a-c power to the related side oblique camera door actuator. This opens or closes the door and energizes a 28-volt d-c circuit to the related camera power switch. The OFF position permits camera door operation to be stopped in an intermediate position in the event of door malfunction.

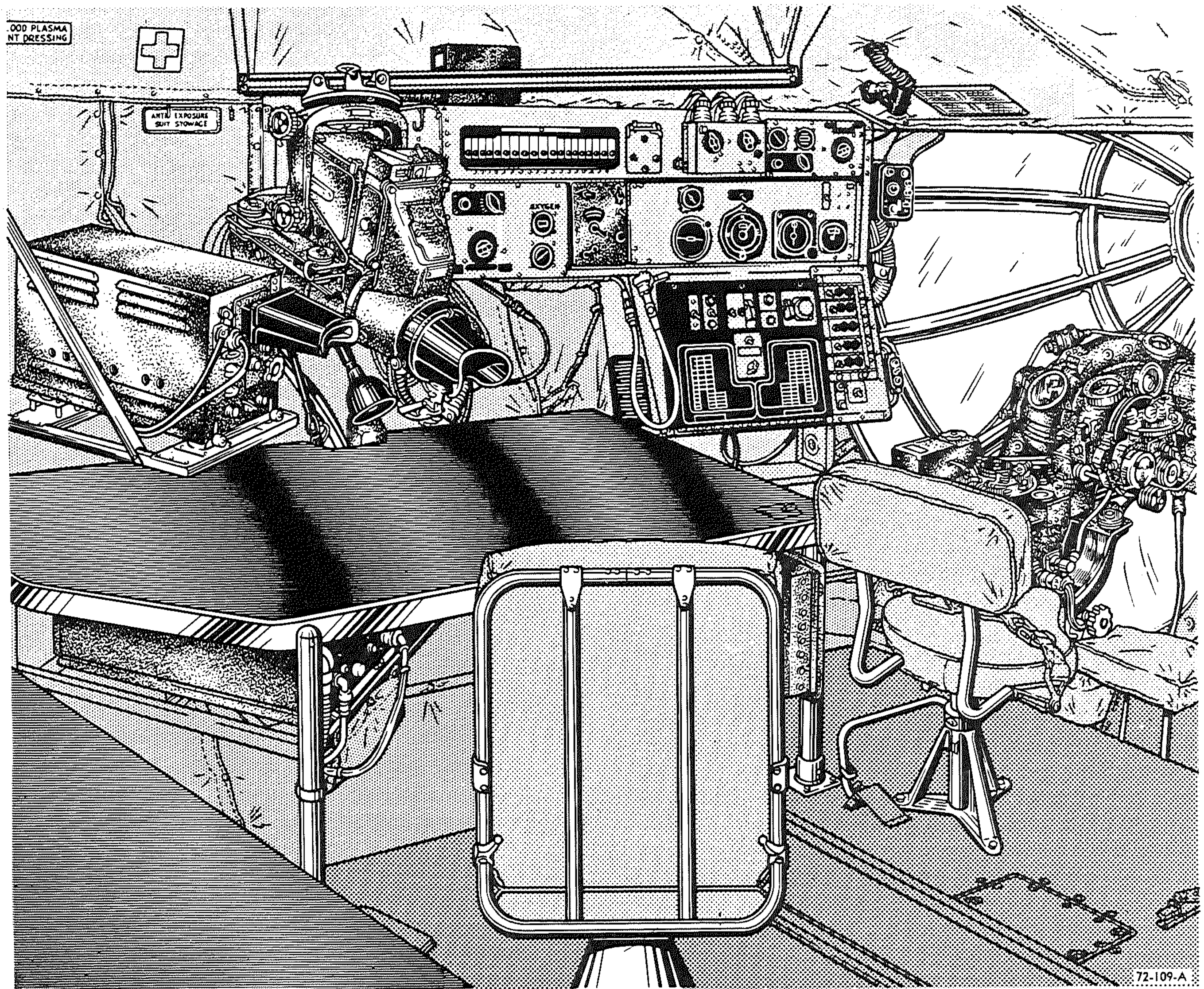


Figure 4-38. (Sheet 2 of 2)

Side Oblique Camera Power Switch. An on-off camera power switch is located on the oxygen equipment panel of each side oblique camera station. Moving the switch to the ON position supplies 28-volt d-c power to the camera and to the vacuum solenoid, provided the master power switch is ON and camera door switch is in the OPEN position. The indicator lamp lights when the camera is ready for operation.

Side Oblique Camera Control Switches. A push-button type switch (5, figure 4-41) is provided on the right handle of each side oblique camera to control 28-volt d-c power for camera operation.

Vacuum Bypass Test Switch. This on-off switch (23, figure 4-48) on the photographer's camera control panel permits camera system operation without vacuum system operation. This switch is guarded in the off position.

Door Bypass Test Switch. This on-off switch (22, figure 4-48), located on the photographer's camera control panel, permits test operation of the cameras without opening the camera doors. The switch is guarded in the off position.

Pilots' Intervalometer Warning Selector Switch. A selector switch (5, figure 4-48) having six positions —OFF, MULTI K-38, VERTICAL, TRI-MET, K-40, and SPLIT VERTICAL—is provided on the photographer's camera control panel. Moving the switch from OFF to the position of the camera station to be operated sets up a 28-volt d-c electrical circuit to a camera alert warning lamp located on the pilots' instrument panel, and to the camera exposure lamp which is located on the photo-navigator's camera control panel.

Initiation Switches. A two-position initiation switch (4, figure 4-39 and 17, figure 4-48) for each of the remote-controlled camera stations is located on the photo-navigator's camera control panel and on the photographer's camera control panel.

Placing the switch on either control panel in the START position introduces 28-volt d-c power into the camera circuit and initiates operation of the camera or cameras at the selected station, provided the cameras have been prepared for operation by the photographer. Placing the switch on the photo-navigator's camera control panel in the STOP position stops camera operation, provided the switch on the photographer's control panel is in the STOP position.

Note

Each set of initiation switches can be placed in the START position simultaneously by means of a gang bar located on each camera control panel.

Mode Selector Switches. A mode selector switch (15, figure 4-48) having three positions—AUTO, MAN., and OFF—is provided on the photographer's camera control panel for each remote-controlled camera station. When the switch is in the AUTO position, the rate of exposure of the camera is controlled by the intervalometer. When the switch is on the MAN. position, the cycling speed of the camera determines the rate of exposure.

A-18 Magazine Control Panel. This panel (figure 4-42) at the photographer's station is provided to control the film speed in the A-18 magazines when they are used with K-17, K-22, or K-37 vertical cameras. Film speed control is accomplished through a logarithmic potentiometer in the panel. This panel contains an altitude and ground speed adjustment knob, a focal length adjustment knob, an altitude range indicator, a power switch, a camera switch, two indicator lamps, and an exposure counter. The adjustment knobs change the settings of the computer and the potentiometer. The altitude range indicator interprets the operating ranges of various focal length lenses in terms of altitude and ground speed. It has a knob which changes the readings for each focal length. The POWER ON-OFF switch operates the initiate and ready relays and the magazine motor. The green lamp indicates when the film is in motion within the magazine, and the amber lamp flickers when the film speed is correctly synchronized for the computer setting. The counter indicates the approximate number of exposures remaining in the magazine.

Note

The CAMERA ON-OFF switch is inoperative.

A dial assembly in the center of the panel contains dials for altitude, ground speed, focal length, film speed, and synchronizing angle. The dials provide a reading of the adjustments made in the computer by the control knobs.

A-18 Magazine Selector Switch. This on-off switch (18, figure 4-48), located on the photographer's camera control panel, is provided for use with the vertical station camera when the A-18 magazine is to be used. Placing the switch in the ON position transfers control of the vertical camera to the A-18 control panel.

A-28 Stabilized Mount Control Panel. This control panel (figure 4-43) provides a means of drift correction for the vertical camera and is located on the photographer's camera control panel.

Indicators.

Camera-Ready Indicator Lamps. A ready lamp (3, figure 4-39 and 11, figure 4-48) for each of the remote-controlled camera stations is located on the camera control panel of the photo-navigator and the photographer. When on, the lamps indicate that the cameras at the selected stations are ready for operation.

Exposure Counter Dials. A dial (13, figure 4-48) for each remote-controlled camera is located on the photographer's camera control panel, and indicates the number of remaining exposures in the camera magazine at that station. An exposure counter dial is also located on each of the camera magazines making a record available of the number of remaining exposures available in each side oblique camera magazine.

Camera Operation Indicator Lamps. An indicator lamp (16, figure 4-48) for each remote-controlled camera is located on the photographer's camera control panel. When a camera is operating, its corresponding indicator lamp will blink at the rate of exposure.

Camera Alert Exposure Warning Lamps. A white warning lamp (27, figure 1-13), located on the pilots' instrument panel, and an identical lamp (11, figure 4-39), located on the photo-navigator's control panel, light two seconds before an exposure is made. These lamps are controlled by the pilots' intervalometer warning switch, and their primary purpose is to warn against making corrections in the airplane's attitude during film exposure. (Refer to "Pilots' Intervalometer Warning Switch" of this section.)

Camera Initiation Warning Lamp. This green warning lamp (27, figure 1-13), located on the pilots' instrument panel, lights when any of the camera initiation switches are placed in the START position.

Aerial Camera Operation.

During normal camera operation the photo-navigator instructs the photographers to prepare the aerial cameras for operation, and furnishes all needed data for the photographer to make the settings. In night photography the photo-navigator acts as bombardier in dropping photo flash bombs.

Operation of the cameras for reconnaissance, mapping, and charting is accomplished as indicated in the following paragraphs.

SECTION VIII

CREW DUTIES

68-133-A

Each crew member of the airplane has primary and alternate duties. Generally, the primary duties of the crew member are explained by his station title. Each crew member has additional duties which must be performed to insure proper flight of the airplane and to support crew safety and comfort during ground operation and flight.

The aircraft commander's, the pilots', and the first and second engineer's preflight inspections and duties are covered in "Normal Procedures," Section II. Additional duties and responsibilities of other crew members, including the aircraft commander, are assigned in the following text. It is your individual responsibility to be familiar with each item of equipment and to be able to inspect it thoroughly for any irregularities. Don't let this inspection become so routine that you check it off as completed without doing a thorough job. Remember, it is not just your life at stake but also the lives of your fellow crew members.

AIRCRAFT COMMANDER.

The aircraft commander is responsible for the issuance of instructions governing all phases of flight operation. His duties and preflight inspection are given in "Normal Procedures," Section II. His responsibilities with regard to formal crew briefing are discussed in the following paragraphs.

RESPONSIBILITIES.

A formal crew briefing should be conducted by the aircraft commander as soon as possible after detailed mission planning. The first item that the aircraft commander should cover in his crew briefing is a recapitulation of the mission plan to insure that all crew members are completely familiar with the requirements to be accomplished. In case of doubt in any crew member's mind, the aircraft commander should completely review that phase of the mission. He should discuss personal equipment to be carried and assign additional duties such as compartment commanders, and the drawing of extra parachutes, water jugs, and lunches to the various crew members. Before dismissing the crew, he should again check to make certain that each member is aware of the schedule for reporting to the aircraft, of station time, and of take-off time. If the aircraft commander has paid close attention to the premission planning and has conducted his briefing well, one of the most difficult phases of flying a mission will have been accomplished successfully.

Personal Equipment Requirements.

Personal equipment plays such an important part in the safety and comfort of the crew during a flight that the aircraft commander must never assume that all crew members are adequately equipped. It is his responsibility to make certain prior to flight that each crew member knows what equipment he must carry. He will perform a formal crew inspection before boarding the aircraft. Personal equipment used in the RB-36 is similar to that used in several other aircraft. In the briefing that you will attend prior to flight, either the operations officer or the aircraft commander will specify the equipment needed on the specific flight for which you have been briefed.

Common sense will tell you that if you are scheduled for any altitude work you will need heavy clothing, oxygen equipment, and bail out bottles plus your normal gear. Keep the cabin heat at a minimum when flying over cold regions so that your crew may wear their heavy clothing with comfort. In this manner, if an emergency occurs, the crew will be properly clothed for survival. Oxygen masks will be carried on all flights by all crew members regardless of altitudes to be flown. The following additional minimum clothing and equipment will be carried by each crew member on all flights above 28,000 feet:

1. Oxygen mask, pressure demand (type A-13, A-13A, or A-15) with adapter for use with H-2 emergency cylinder (bail out bottle). Demand oxygen mask, type A-14, may be substituted when foregoing types are not available, but only for flights up to 34,000 feet. No attempt will be made to use the type A-14 as a pressure breathing mask.
2. Emergency oxygen cylinder, type H-2, attached to parachute.
3. Helmet, flying, intermediate, type A-11, standard.
4. Goggles, type B-8, for eye and face protection in case of a high altitude bail out.
5. Jacket, flying, winter, type B-11, standard, or M-1.
6. Trousers, flying, winter, type A-10, standard.
7. Gloves, flying, winter, type A-9A, or gloves, flying, intermediate, type A-11A, insert glove, rayon.
8. Shoes, flying, intermediate, type A-6A.

For overwater flights the following minimum personal equipment will be carried in addition to the above:

1. Mae West for each crew member.
2. Gibson Girl radio.
3. One-man life raft for each crew member.
4. One 20-man life raft for crew.
5. Anti-exposure suit for each crew member.
6. Applicable survival kits.

Time Schedules.

It is very important that all crew members know crew inspection time, when to complete their preflights, final crew briefing, etc. The aircraft commander, assisted by the pilot and copilot, should see that all crew members meet these schedules; nothing makes a crew more slovenly than stragglers. Insist on promptness!

PRIMARY NAVIGATOR.

The primary navigator operates the installed navigational equipment. Following is an abbreviated check list for this position:

PREFLIGHT

1. Mission Planning
   a. Mission Requirements .... UNDERSTOOD
   b. Weather .... CHECKED
   c. No Wind Flight Plan .... COMPLETED
   d. Maps and Charts .... CHECKED AND ANNOTATED
   e. Target Study .... COMPLETED
   f. Navigation Kit & Aux Equipment .... CHECKED
2. Preflight (Day Preceding Flight)
   a. Form 781 (Form 1) .... CHECKED
   b. Circuit Breakers (As Desired) .... IN
   c. Oxygen Equipment & Pressure .... CHECKED
   d. Interphone (Normal & Private) .... CHECKED
   e. Lights (Table, Dome & Fluorescent) .... CHECKED
   f. Compass, Altimeter, and Air-Speed Calibration Cards (When Applicable) .... CHECKED
   g. Compasses .... CHECKED
   h. Loran .... CHECKED
   i. Standby Gyro .... CHECKED
   j. Radio Compass .... CHECKED
   k. Accessible T-R Unit (When Applicable) .... CHECK WIRING, SECURITY, FOREIGN MATERIAL AND FAN OPERATION
   l. Aircraft Clocks (When Applicable) .... CHECKED
   m. Pilot's Magnetic Compass .... CHECKED
   n. Astro Position Interphone .... CHECKED
   o. Astro Position Oxygen Equipment .... CHECKED
   p. Astro Panel (Applicable Aircraft) .... CHECKED
   q. Periscopic Sextant Mount Alignment .... CHECKED
   r. Periscopic Sextant .... CHECKED AND STOWED
   s. Loran Antenna .... CHECKED
   t. Static Ports (Open and Clean) .... CHECKED
3. Preflight Station (Day of Mission)
   a. Form 781 (Form 1) .... CHECKED
   b. Equipment (Personal & Navigational) .... STOWED
   c. Circuit Breakers (As Required) .... IN
   d. Oxygen Equipment & Pressure .... CHECKED
   e. Oxygen Report (To Radio Operator) .... COMPLETE
   f. Interphone (Normal & Private) .... CHECKED
   g. Lights (Table, Dome & Fluorescent) .... CHECKED
   h. Safety Belts .... CHECKED
   i. Compasses (See N-1 Compass Preflight) .... CHECKED
   j. Loran .... CHECKED
   k. Altimeter Setting 29.92" .... COMPLETED
   l. Standby Gyro (Caged & Off) .... CHECKED
   m. Aircraft Clocks (If Applicable) .... CHECKED
   n. Astro Position Interphone .... CHECKED
   o. Astro Position Oxygen Equipment .... CHECKED
   p. Astro Position Panel (Applicable Aircraft) .... CHECKED
   q. Periscopic Sextant Mount .... CHECKED
   r. Periscopic Sextant .... CHECKED & STOWED
   s. Time Hack (Obtained at Navigator's Convenience) .... OBTAINED
   t. Static Ports (Open and Clean) .... CHECKED
4. Crew Inspection .... COMPLETED

INFLIGHT

1. Initial Heading .... TO A/C
2. Navigational Methods as Described in SAC Manuals
3. RCT Information to Crew (When Applicable)

BOMB RUN CHECK

1. Prior to Pre-IP
   a. Direct Aircraft to Pre-IP .... AS BRIEFED
   b. Compute TAS .... CHECKED WITH VO AND FE
   c. At Pre-IP Direct Aircraft to IP .... AS BRIEFED
2. Prior to IP
   a. Check True Heading .... CHECKED
   b. Using VO Latest Wind, Compute Mag Heading From IP to Target, Notify Pilot .... COMPLETED
3. Bomb Run
   a. At Bombs Away Record Time and True Heading .... COMPLETE
   b. Compute Bombs Away Wind and Inform VO COMPLETED

POSTFLIGHT

1. Turn Off All Switches and Equipment .... COMPLETE
2. Police Station .... COMPLETE
3. Record All Nav Write Up in Form 781 (Form 1) COMPLETE
4. Turn in All Maps, Charts, Logs and Forms Required .... COMPLETE

PHOTO-NAVIGATOR.

Following is an abbreviated check list for this position, and a preflight check list for the Universal Bombing System:

1. Oxygen supply and equipment. Check normal interphone using helmet and oxygen mask; verify side tone.
2. Check private interphone with regular headset; verify side tone.
3. Stow personal equipment.
4. All nose windows for cleanliness.
5. Perform bombsight preflight in accordance with photo-navigator's SOP.
6. Operation of alert lights and warning horn in conjunction with photographer's.
7. Photoflight line indicator.
8. All lights.
9. All circuit breakers above navigator's position—IN.
10. Nose cabin heater (on aircraft power, if possible).
11. Settings on E-6 autopilot calibration and amplifier units for comparison with recommended settings. (Photo-Navigator's SOP.)
12. First aid kit, spare bulbs, escape rope (if installed), and static line at left forward escape hatch.
13. Security of left forward escape hatch.
14. Inspect the following for completeness:
    a. Procedure folder.
    b. Flight plan.
    c. Logs and forms.
    d. Maps.
    e. Tools.
    f. Project specifications.
    g. Spare octant.
15. Inspect step 15 on radar observer's check sheet jointly with him.
16. Inspect step 16 on radar observer's check sheet jointly with him.
17. Notify aircraft commander of any items that may affect results of the mission.

RADAR OBSERVER.

Following is an abbreviated check list for this position.

1. Oxygen supply and equipment. Check normal interphone using helmet and mask; verify side tone.
2. Check private interphone using regular headset; verify for side tone.
3. Stow personal equipment.
4. Form 781 (Form 1) and radar set maintenance log. Sign off Form 781 (Form 1).
5. Radar observer's desk lamp.
6. Inspect fuse panels and junction boxes for condition of fuses and sufficient spares in the following:
    a. Fuses (installed and spare) in P-3B control boxes (to O-15 cameras).
    b. J-218 fuses (installed and spare).
    c. J-1766 fuses (installed and spare).
    d. Left forward cabin power panel (3 fuses and spares).
    e. Auxiliary O-15 camera junction box fuses (installed and spare).
    f. Internal-external power switch (set for normal power).
7. Inspect pressure pump for manual operation and manual pressure bleed.
8. Cleanliness of beam splitter and reflecting mirror in periscope assembly; also, acetate filter on indicator face.
9. Intensity setting of data chamber lights. (Ref. radar SOP.)
10. Compare inner exposure counter with one on camera face for like settings. If desired, zero. (Ref. radar SOP.)
11. Radar set turn on, preflight check, and turn off (in accordance with radar SOP). Complete performance check sheet.
12. Operation of O-15 camera, magazines and control boxes while radar set is in operation. Run test film strip during acceptance check.
13. Sign radar acceptance sheet and note any discrepancies found and corrected, prior to take-off.
14. Inspect the following for completeness:
    a. Procedure folder.
    b. Flight plan.
    c. Logs and forms.
    d. Maps (RBS folder, if required).
    e. Repair tools.
    f. Inflight parts kit and Maggie.
    g. Film required.
    h. Project specifications.
15. When bombs are to be loaded, the radar observer and photo-navigator accomplish the following (with armament personnel present during acceptance check):
    a. Operation of normal release bombsight (if required).
    b. Operation of toggle release. (Photo-navigator and radar observer positions.)
    c. Operation of salvo circuit.
    d. Operation of photo-navigator's intervalometer.
    e. Operation of release circuit through radar set.
16. When bombs are loaded radar observer and photo-navigator check the following (at station time).
    a. Bomb salvo switch-type circuit breakers in bomb bays—OFF.
        (1) Bulkhead 6.0 d-c power panel.
        (2) Bulkhead 8.0 d-c power panel (turned on prior to take-off).
    b. Salvo circuit breakers—IN.
        (1) Photo-navigator's panel.
        (2) Pilot's panel.
    c. Bomb bay tank selector switch—OFF.
    d. Bomb bays for proper loading.
        (1) Shackles and release boxes.
        (2) Arming wires.
        (3) Proper setting (flash bombs).
        (4) Pins removed (also, shipping wires and striker stop on flash bombs).
17. Condition of radome (interior, exterior, and drain hole).
18. Notify aircraft commander of any item that may affect results of the mission.
19. Before taxiing, check the following:
    a. Aircraft power checked with engineer.
    b. Forward entrance ladder, stowed.
    c. Nose wheel down lock, stowed.
    d. Forward entrance hatch, closed.
    e. Circuit breaker and switches, as briefed.

PREFLIGHT CHECK OF THE UNIVERSAL BOMBING SYSTEM.

The following check of the universal bombing system should be performed 24 to 48 hours prior to loading:

1. Check that the armament section has installed a new drier cartridge.
2. Check Form 781 (Form 1).
3. Bomb bay doors open; ground locks installed.
4. All circuit breakers at bulkhead 6 and SALVO, NORMAL RELEASE and GUNFIRE CONTROL circuit breakers at bulkhead 8—OFF.
5. U-2 release hook—Latched.
6. Manual lock—Installed (Lock light on).
7. Bomb panel master switch—ON.
8. Intervalometer—OFF.
9. Photo-Navigator's circuit breaker panel—BOMB RELEASE, BOMB SIGHT STAB—ON.
10. Special Bomb Rack Panel:
    a. Power-arm release circuit breaker—In.
    b. Special release switch—BOMB RACK RELEASE.
    c. Control release heater circuit breaker—In.
    d. Rack heater switch—HEATERS

e. Arm-safe switch—SAFE

f. Salvo safety switch—NO SALVO

11. Manual release handle pulled—Rack should not release.

12. Manual lock removed—Light out.

13. Manual release handle pulled—Rack should release.

14. Hook relatched, D-2 switch pressed—Rack should not release.

15. Special release switch—SPECIAL RELEASE.

16. Photo-Navigator's D-2 switch depressed—Rack should release.

17. Hook relatched.

18. Radar Observer's D-2 switch depressed—Rack should release.

19. Hook relatched.

20. APQ-24 release impulse initiated—Rack should release.

21. Hook relatched.

22. Norden bombsight release impulse initiated—Rack should release.

23. Bomb bay doors—Locks removed; doors cleared.

24. Bomb door circuit breaker—In; doors closed.

25. D-2 switch depress—Rack will not release.

26. Bomb door and bomb release circuit breakers—Out.

27. Manual release handle pulled—Rack should not release.

28. Bulkhead 6 special system salvo circuit breaker—In.

29. Bulkhead 8 bomb salvo circuit breaker—In.

30. Safe-arm switch—ARM (Light on; arming shaft goes to arm position).

31. Arming shaft pulled—Light goes out.

32. Safe-arm switch—ARM.

33. Manual safe handle pulled—Arming shaft should go to safe position; light should go out.

34. Safe-arm switch—ARM (Light on).

35. Safe-arm switch—SAFE (Light goes out).

36. Rack heater switch—ON; circuit breaker—In.

37. Arming control heaters—Checked.

38. Rack heater switch—OFF; circuit breaker pulled.

39. Photo-Navigator's circuit breaker panel—BOMB RELEASE, BOMB SIGHT STAB, BOMB DOORS AND SALVO—Out.

40. Pilot's salvo safety switch—CAN SALVO.

41. Bomb bay contents checked, impossible to salvo.

42. Bomb bay doors—Clear.

43. Pilot's bomb salvo circuit breaker—In.

44. Pilot's salvo switch—ON; No salvo should occur.

45. Photo-Navigator's salvo circuit breaker—In.

46. Pilot's salvo switch—Actuate; bomb bay doors open; then racks should release.

47. Pilot's salvo switch held momentarily in ON position to clear the salvo control unit. (Must de-energize within 5 seconds)

48. Pilot's salvo safety switch—NO SALVO.

49. Hook relatched.

50. Special bomb rack panel salvo safety switch—NO SALVO.

51. Photo-Navigator's salvo switch held in ON position. No salvo should occur.

52. Special bomb rack panel salvo safety switch—CAN SALVO

53. Salvo switch held in ON position; rack should release.

54. Salvo switch held momentarily in ON position to de-energize the salvo control unit. (Must de-energize within 5 seconds.)

55. Bomb bay door ground locks—Installed.

56. Bulkhead No. 8 SALVO, NORMAL RELEASE and GUNFIRE CONTROL circuit breakers and all bulkhead No. 6 circuit breakers—Off.

57. Record the discrepancies in Form 781 (Form 1).

SWITCH POSITIONS FOR SAFE BOMB LOADING (SPECIAL WEAPON OR CONVENTIONAL BOMBS).

1. Bomb bay door ground locks—INSTALLED.
2. Bulkhead No. 8 SALVO, NORMAL RELEASE and GUNFIRE CONTROL circuit breakers and all bulkhead No. 6 circuit breakers—OFF .
3. Master power switch—OFF.
4. Bomb bay door circuit breakers (Pilot's and Photo-Navigator's)—OUT.
5. NORMAL RELEASE, STAB POWER, and SALVO circuit breakers on Photo-Navigator's panel—OUT.
6. Special Bomb Rack Panel

   a. Special release switch—BOMB RACK RELEASE for loading special weapons—SPECIAL RELEASE when loading conventional bombs.

   b. Circuit breakers—Out.

   c. Photo-Navigator's and Pilot's salvo safety switches—NO SALVO.
7. Salvo switches—OFF.
8. Bomb group selector switches—OFF.

SWITCH POSITIONS FOR SPECIAL BOMB RELEASE.

1. Manual lock—Removed.
2. Bulkhead No. 6 and No. 8 circuit breakers—On.
3. Master power switch—On.
4. Bomb door circuit breaker—In
5. Bomb release circuit breaker—In.
6. Intervalometer—Off.
7. Special bomb rack panel.

a. Circuit breakers—In.

b. Special release switch—SPECIAL RELEASE.

c. Rack heater switch—HEATER.

d. Photo-Navigator's and Pilot's salvo safety switches—NO SALVO.

WEATHER OBSERVER.

PREFLIGHT

1. CREW INSPECTION
   a. Weather kit .... COMPLETED
2. COMBAT MISSION
   a. Oxygen and interphone .... CHECKED
   b. Personal equipment .... STOWED
   c. Safety belt .... CHECKED
   d. Preflight inspection of weather instruments .. COMPLETED
3. CREW DUTIES
   a. Element of outside temperature gage .... CHECKED
   b. Final crew briefing ... REPORT DISCREPANCIES TO A/C

INFLIGHT

1. PREPARE FOR LANDING
   a. Auxiliary and miscellaneous equipment .... SECURED

POSTFLIGHT

1. AFTER LANDING
   a. Interphone cord .... STOWED
   b. Oxygen panel settings and oxygen hose .... SECURED
   c. Malfunctions .... REPORTED
   d. Weather forms .... COMPLETED

FIRST RADIO OPERATOR.

The first radio operator operates the high frequency communications equipment, the defensive ECM equipment and the IFF. The following is a check list for this position.

Although these duties are primarily the responsibility of the first radio operator, he may delegate any of these duties to the second radio operator as required.

VISUAL FLIGHT

1. Exterior of Aircraft
   a. Location and Type of ECM Antenna .... CHECKED
   b. Liaison, Compass, ILS, Loran, Marker Beacon, VHF, UHF, IFF and ARN-14 Antennas, Insulators and Mounts .... CHECKED
   c. Static Dischargers .... CHECKED
2. Form 781 (Form 1) and "G" File .... CHECKED
   a. Coaxial Cable Connections to IFF on "J" Station Antennas on Top of Battery Access Panel .... CHECKED

PREFLIGHT OPERATIONAL EQUIPMENT CHECK

1. Hydraulic Selector Valve .... CHARGE BRAKES
2. Hydraulic Tank Level (and Spare Fluid) .... CHECKED
3. Compartment and Tunnel Lights .... CHECKED
4. All Plugs, Cables and Connections .... CHECKED
5. All Fuses, Spare Fuses and Circuit Breakers .... CHECKED
6. Spare Bulbs .... CHECKED
7. All Defensive ECM Equipment Installed .... CHECKED
8. All Interphone Equipment and Stations in Radio Compartment, Nose Compartment, and Flight Deck Including Speakers, Amplifiers and/or Channel 3 and 4 power Supplies, if Applicable (AN/AIC-10); Emergency D-C Power Supply Relay Fuse (Engineers' Fuse Panel), and Operation of D-C power Supply with AC Off .... CHECKED
9. AN/ARC-8 or ARC-21X and Antenna Connections .... CHECKED
10. IFF (Including Detonator Circuit, Fuses and Counter Readings) .... CHECKED
11. AN/ARC-3 and ARC-27 (All Channels) .... CHECKED
12. AN/ARN-5A or AN/ARN-18 (If Applicable) .... CHECKED
13. RC-103A (If Applicable) .... CHECKED
14. AN/ARN-14 (If Applicable) .... CHECKED
15. BC-453 (If Applicable) .... CHECKED
16. AN/ARN-6 or ARN-7 (Both Stations) .... CHECKED
17. AN/ARN-12 .... CHECKED
18. Radio Operator's T-R Unit .... CHECKED
19. C-1 Amplifier (If Installed in Forward Compartment) .... CHECKED

CREW INSPECTION

1. As Outlined in Section II, Normal Procedures ... COMPLIED
2. All Required Personal Equipment .... CHECKED
3. Radio Operator's Kit, Including Coding and Identification System .... CHECKED
4. Tool Kit and VHF Crystals Necessary for Flight ... CHECKED

PREFLIGHT (DAY-OF-FLIGHT)

1. Operational Check (Radio Operator's Compartment)
   a. Load Aircraft and Stow Equipment .... CHECKED
   b. All Required Circuit Breakers .... IN
   c. Check Normal and Private Interphone Using Oxygen Mask and Helmet, Verifying Side-Tone . CHECKED
   d. Oxygen Station (and Mask) .... CHECKED
   e. Mixer Amplifier, All Switches .... CHECKED
   f. ECM Defensive Equipment .... CHECKED
   g. AN/ARC-3 Crystals .... INSTALLED
   h. AN/ARC-27, Channelization .... CHECKED
   i. Hydraulic Selector Valve .... CHARGE BRAKES
   j. Compartment and Tunnel Lights .... CHECKED
   k. Communication Tube Cart .... CHECKED
   l. Cabin Pressure Regulator .... ON
   m. Cabin Pressure Relief Valve .... CLOSED
   n. Cabin Pressure Air Manual Shutoff Valve .... OPEN
   o. Nose Latching Hook .... STOWED
   p. Cabin Heater .... CHECKED
   q. IFF .... CHECKED
2. Operational Check (Flight Deck)
   a. Circuit Breakers on Pilot's Panel .... IN
   b. VHF, All Channels .... CHECKED
   c. UHF, All Channels .... CHECKED
   d. Liaison .... CHECKED
   e. Radio Compass .... CHECKED
   f. ILS (AN/ARN-5B and RC-103B, or AN/ARN-18 and RC-103B or AN/ARN-14 and AN/ARN-5B, Whichever Is Installed) .... CHECKED
   g. Mixer Amplifier Switches (Left and Right Seat) .... CHECKED
   h. Range Filters (Pilot and Copilot) .... CHECKED
   i. Marker Beacon Lamp .... CHECKED
   j. Engineers' Interphone Circuit Breakers and Wing Crawlway Interphone Lamp ... CHECKED IN & OFF
   k. RBS Tone Switch and Automatic tone .... CHECKED WITH OBSERVERS
3. Operational Check (Nose Compartment)
   a. Radio Compass .... CHECKED
   b. Circuit Breakers and Fuses .... IN

FINAL CREW BRIEFING

1. As Outlined in Section II, Normal Procedures .... CHECKED
2. A/C Informed of Discrepancies .... CHECKED

STATIONS (START ENGINES)

1. On Private Interphone .... STANDBY
2. Liaison Set Tuned to Tower Frequency .... CHECKED
3. Alarm Bell, Oxygen, Interphone .... REPORTED

TAXI

1. Interphone Compartment Report (Normal) .... READY
2. Observers at Both Upper Forward Escape Hatches With Aldis Lamps (Night) .... CHECKED
3. Nose Compartment Clear, Hatches Closed and All Personnel in Take-Off Position .... REPORTED

TAKE-OFF

1. Safety Belt .... FASTENED
2. Parachutes .... ON
3. Nose Gear and Doors .... REPORTED UP

CRUISE

1. Mission .... AS BRIEFED
2. Parachute and Oxygen Equipment as Regulation Requires .... COMPLIED

LANDING

1. On Normal Interphone .... STANDBY
2. Emergency Hydraulic Selector Valve ..... CHARGE BRAKES
3. Nose Gear Down and Locked After Engineer Reports "Pressure Relieved" .... REPORTED
4. Nose Strut (As Required) .... BLED
5. Liaison Set Tuned to Tower Frequency .... CHECKED
6. Nose Compartment Clear and Personnel in Landing Position .... REPORTED
7. Parachute .... ON

TAXI

1. Observers at Both Upper Forward Escape Hatches With Aldis Lamp (Night) .... CHECKED

POSTFLIGHT

1. All Equipment .... OFF
2. Radio Logs and ECM Forms .... COMPLETED & SIGNED
3. Form 781 (Form 1) .... COMPLETED
4. Relief Containers .... EMPTIED
5. Radio Compartment .... CLEANED

ECM OBSERVER (LOW FREQUENCY).

An abbreviated equipment check and duty list for this station follows:

1. Oxygen supply and equipment. Check normal interphone using helmet and oxygen mask; verify side tone.
2. Check private interphone with regular headset; verify side tone.
3. Stow personal equipment.
4. Visual inspection of forward radome and antenna stubs through station 665 for cracks, cleanliness, and proper security.
5. Visual inspection of ECM equipment installed in forward ECM bay.
6. All ECM component parts in photo compartment.
7. All ECM component parts in APQ-24 radome area.
8. All ECM component parts in bomb bays 2 and 3.
9. Perform a visual and operation inspection of the following equipment in accordance with existing directives:
   a. Receiver APR-4 (low and high) with necessary tuning units.
   b. Indicator APA-17.
   c. Control box C-324.
   d. Recorder ANQ-1A.
   e. Receiver ARR-8.
   f. Analyzer APA-11A.
10. After preflight turn off all ECM equipment.
11. ECM crew member folder and professional equipment aboard
12. Two hot cups and one liquid container aboard.

AERIAL PHOTOGRAPHER.

An equipment check and duty list for this position is presented in the following paragraphs.

PREFLIGHT OPERATIONAL EQUIPMENT CHECK.

1. The following items of equipment are necessary to complete the operational equipment check:
   a. Check list.
   b. Headset and microphone.
   c. Tool kit.
   d. Flashlight.
   e. Window cleaning materials.
2. The necessary camera magazines will be loaded with film prior to the preflight operational equipment check.
3. Check the Form 781 (Form 1) for previous discrepancies.
4. Check engineer's camera power switch ON.
5. Check the photo-navigator's control panel for proper switch and circuit breaker positioning.
6. Proceed to the photo compartment.
7. Secure the entrance ladder.
8. Check all oxygen regulators in the compartment.
9. Check normal and private interphone using regular headset, verifying side tone.
10. Recharge all walk-around bottles.
11. Check the following emergency equipment:
    a. First aid kits.
    b. Fire extinguisher.
    c. Fire axe.
    d. Manual door opening tool and extension.
    e. Photographers blow-out straps.
12. Check manual shutoff valve (OPEN and safetied).
13. Check dump valve (NORMAL and safetied).
14. Check vacuum relief valve.
15. Check all door and hatch surfaces for proper sealing.
16. Check all safety belts, shoulder harnesses and parachute static line.
17. Check compartment dark room for light leaks and proper zipper operation.
18. Check vacuum fuses in right main a-c power panel.
19. Check fuses in bulkhead 6.0 d-c power panel.
20. Check vacuum pump and vacuum inlet at bulkhead 6.0.
21. Check all compartment fuse panels for proper fuse rating, security and spare fuses.
22. Check all compartment lights (overhead, camera wells, trouble lights and spare bulbs).
23. Panel circuit breakers—As required, all switches—OFF.
24. Master power switch—ON.

25. Master temperature switch—ON.
 a. Check heating controls in all positions.
 b. Check auxiliary heater fan for proper direction of travel.
 c. Check temperature control valve arm in forward bomb bay for full travel.
26. Check defrosters in NORMAL position.
27. Master temperature switch—OFF.
28. Check defrosters in EMERGENCY position.
29. Defrosters—OFF.
30. Vacuum switch—ON.
 a. Check vacuum pressure.
 b. Pump stop switch to STOP.
 c. Emergency vacuum switch—ON.
 d. Emergency vacuum switch—OFF.
 e. Vacuum switch—OFF.
 f. By-pass switches—CHECKED.
31. Check all panel lights (push to test).
32. Open all camera doors (clear doors visually, open one set of doors before initiating another). Check green door open lights.
33. Master power switch—OFF.
34. All camera windows—cleaned.

OPERATIONAL CHECK.

1. The following check will be accomplished with one photographer at the operator's panel and another at the particular station being checked.
2. Procedures 3 thru 12 will be applied to all camera stations in the compartment from front to rear, side obliques being last.
3. Before electrical power is applied, manually wind (where applicable) and trip all cameras at the station being checked. Check for possible binding and proper shutter operation.
4. Check cameras for security in the mount and for proper safety wiring.
5. Check the security of all camera power cables.
6. Check the lens elements for cleanliness and proper installation.
7. Check camera shutters for timing (where applicable).
8. Check camera motor for security.
9. Apply electrical power to the station being checked and initiate only one camera at a time and check the following: Proper electrical operation, each shutter speed and diaphram stop.
10. Check intervalometers.
11. Connect the exposure indicator cable to the magazine. After seating the magazine on the camera, manually wind the camera through until the case drive coupling has engaged (where applicable).
12. After all magazines at the station have been seated, initiate the vacuum pump, test the vacuum hoses and connect to the camera magazines.
13. Apply electrical power and check each camera for electrical operation.
14. In the event the photo-navigator is absent from his position, the photographer will proceed to the nose section and check the following:
 a. Depress photographer's alert warning horn.
 b. Alert lights—ON.
 c. Check ready lights.
 d. Initiate each camera station individually.
 e. Check pilot's exposure warning light.
15. Clear and close all camera doors.
16. Enter all discrepancies in the Form 781 (Form 1).

PREFLIGHT.

1. Entrance ladder—SECURED.
2. Form 781 (Form 1)—CHECKED.
3. Oxygen and interphone check—ALL STATIONS.
4. All fuse panels—CHECKED.
5. All switches—OFF.
6. Circuit breakers—As required.
7. Auxiliary and allied equipment—CHECKED.
8. Photographer's Panel—CHECKED.
9. All camera stations—CHECKED.
10. Static Pressure Valve—CLOSED.
11. Exterior of photo compartment—CHECKED.
12. Equipment—STOWED.
13. Preflight in Form 781 (Form 1)—SIGNED OFF.

BEFORE TAKE-OFF.

1. All compartment occupants—READY FOR TAKE-OFF.

AFTER TAKE-OFF.

1. Forward Bomb Bay—CHECKED FOR FUMES AND HYDRAULIC LEAKS.

POST FLIGHT

1. Camera shutter tension—RELEASED.
2. Relief can—DRAINED.
3. Compartment—CLEANED.
4. Auxiliary equipment—STOWED.
5. Personal equipment—UNLOADED.
6. Window covers—REPLACED (if power is available).
7. Discrepancies—IN Form 781 (Form 1).
8. Exposed film—DELIVERED.
9. Debriefing—ATTENDED.

ECM PROJECT OFFICER.

The ECM project officer is the senior ECM observer of the crew. An abbreviated equipment check and duty list for this crew member follows:

1. ECM offensive and defensive system inspected under his supervision (according to local directives).
2. Enter discrepancies correctly on SAC Form 137-5.
3. One tool kit (minimum) aboard.
4. Spare fuses aboard.
5. Initiate big-photo warning message (SAC Reg. 51-6).
6. Simulator standby notification.
7. Complete ECM flight plan according to local directives.
8. Folder including sufficient logs and forms (engineering and technical), according to local directives.
9. Notify aircraft commander of any items that may affect the results of the mission.

ECM OBSERVER (INTERMEDIATE FREQUENCY).

An abbreviated equipment check and duty list for this position follows:

1. Oxygen supply and equipment. Check normal interphone helmet and oxygen mask, verify side tone.
2. Check private interphone with regular headset; verify side tone.
3. Stow personal equipment.
4. Visual inspection of IF, MF, and HF radomes and antenna stubs for cracks, cleanliness, and proper security.
5. Coordinated inspection of antenna bay with the MF and HF-ECM observers of all ECM component parts.
6. Perform a visual and operational inspection of the ECM equipment at this station according to local directives.
7. After preflight, turn off all ECM equipment.
8. ECM crew member folder and professional equipment aboard.

ECM OBSERVER (MEDIUM FREQUENCY).

An abbreviated equipment check and duty list for this position follows:

1. Oxygen supply and equipment. Check normal interphone using helmet and oxygen mask; verify side tone.
2. Check private interphone with regular headset; verify side tone.
3. Stow personal equipment.
4. Coordinated inspection of antenna bay with the IF and HF-ECM observers of all ECM component parts.
5. Perform a visual and operational inspection of the ECM equipment at this station according to local directives.
6. After preflight turn off all ECM equipment.
7. ECM crew member folder and professional equipment aboard.

ECM OBSERVER (HIGH FREQUENCY).

An abbreviated equipment check and duty list for this position follows:

1. Oxygen supply and equipment. Check normal interphone using helmet and oxygen mask; verify side tone.
2. Check private interphone with regular headset; verify side tone.
3. Stow personal equipment.
4. Coordinated inspection of antenna bay with the IF and MF-ECM observers of all component parts.
5. Perform a visual and operational inspection of the ECM equipment at this position according to local directives.
6. Visual and operational inspection of dual automatic chaff dispenser installation according to local directives.
7. After preflight, turn off all ECM equipment.
8. ECM crew member folder and professional equipment aboard.

LEFT SCANNER.

This crew member is the secondary tail radar gunner and is held responsible for assisting the tail gunner with the preflight of the tail radar equipment. The left scanner's technical requirements are the same as the requirements for the tail gunner.

PREFLIGHT

1. Gunnery Equipment Preflight and Loading ....ASSIST TAIL GUNNER AS REQUIRED
2. Crew Inspection
   a. Spare Parachute (Bail-Out Bottle Attached) ...CHECKED
   b. First Aid Kits (Aft Cabin) ....CHECKED
   c. Battle Splints and Blood Plasma ....AS REQUIRED
3. Combat Station
   a. Oxygen and Interphone ....CHECKED
   b. Personal Equipment ....CHECKED
   c. Trouble Light ....CHECKED
   d. Hatches for Proper Installation, Cracks and Cleanliness ....CHECKED
   e. Safety Straps Floor Attachments ....SECURED
   f. Safety Belt and Shoulder Harness ....SECURED
   g. Aldis Lamp ....CHECKED
4. Crew Duties
   a. Emergency Escape Rope ....CHECKED
   b. Fire Extinguisher ....GAUGE PRESSURE 150-175 LBS.
   c. Emergency Hydraulic Reservoir ..OIL LEVEL & LEVER OFF CHECKED
   d. Parachute Static Line ....CHECKED
   e. Left Aft Cabin Power Panel ..FUSES, CIRCUIT BREAKERS 3-PHASE LIGHTS—SECURED
   f. Aft Cabin Dome Lights ....CHECKED
   g. Aft Cabin Pressure Regulator ....SAFETY WIRED IN OPEN POSITION
   h. TR Unit ....SECURITY OF MOUNT, DAMAGE AND BLOWER ACTION
   i. Tunnel Door and Flange Valve ....PROPER FIT
   j. Tunnel Cart (Trial Run) ....CHECK FOR PROPER OPERATION
   k. Left Wall Heat & Pressurization Duct ....SECURITY AND CONDITION CHECKED
   l. Upper Panels (Right and Left)—Proper Installation ....CHECKED
   m. Check Removal of Rudder Locks ....AS REQUIRED

NOTE

IF REQUIRED TO REMOVE RUDDER LOCKS, USE AVAILABLE CREW MEMBERS TO ASSIST IN REMOVAL.

   n. Final Crew Briefing ....REPORT DISCREPANCIES IN FORM 781 (FORM 1) AND TO A/C
   o. Left Gear Safety Lock ....REMOVED
5. Prior to Take-Off
   a. Flap Report ....AS REQUIRED
   b. Safety Belt and Shoulder Harness ....FASTENED

INFLIGHT

1. After Take-Off
   a. Flap and Landing Gear Report ....AS REQUIRED
   b. Engine and Intercooler Checks ....AS REQUIRED
2. Engine Check Intervals
   a. Daylight Engine Checks ....EVERY HOUR
   b. Night, High Power, High Altitude Cruise, Weather Engine Checks ....EVERY 30 MINUTES
   c. Engineering Malfunctions ....REPORTED
3. Prepare for Landing
   a. Landing Gear and Flap Report ....AS REQUIRED
   b. Engine Report ....AS REQUIRED
   c. Safety Belt and Shoulder Harness ....FASTENED

POSTFLIGHT

1. After Landing
   a. Station Area .... CLEANED
   b. Interphone Cords .... SECURED
   c. Oxygen Panel Settings and Oxygen Hose .... SECURED
   d. Left Gear Safety Lock .... REPLACED

RIGHT SCANNER.

This crew member is the aircraft electrician and is responsible for aircraft electrical maintenance and trouble shooting. He must also know how to operate the tail radar equipment as may be required.

PREFLIGHT

1. Gunnery Equipment Preflight and Loading .... ASSIST TAIL GUNNER AS REQUIRED
2. Crew Inspection
   a. Spare Oxygen Equipment .... AS REQUIRED
   b. Heated and Insulated Liquid Containers (Aft Cabin) .... FILLED
   c. Mattresses, Pillow and Blankets (Aft Cabin) .... AS REQUIRED
3. Combat Station
   a. Oxygen and Interphone .... CHECKED
   b. Personal Equipment .... CHECKED
   c. Trouble Light .... CHECKED
   d. Hatches for Proper Installation, Cracks and Cleanliness .... CHECKED
   e. Safety Straps Floor Attachments .... SECURED
   f. Safety Belt and Shoulder Harness .... SECURED
   g. Aldis Lamp .... CHECKED
   h. Radiosonde equipment (if installed) .... CHECKED
4. Crew Duties
   a. Emergency Escape Rope .... CHECKED
   b. Auxiliary Cabin Heaters (2)—Switches OFF .... CHECKED AND SECURED
   c. Right Wall Heat & Pressurization Duct (Security and Condition) .... CHECKED
   d. Right Aft Cabin Power Panel—Fuses, Circuit Breakers, 3-Phase Lights .... SECURED
   e. Cabin Pressure Manual Shutoff Valve .... SAFETY WIRED OPEN
   f. Cabin Pressure Relief and Dump Valve .... SAFETY WIRED NORMAL
   g. Vacuum Relief Valve and Strap .... CHECKED
   h. Hand Axe .... CHECKED
   i. Aft Bomb Bay Lights .... CHECKED
   j. Bomb Bay Entrance Door .... PROPER FIT
   k. Door Interlock Switch (ON) .... CHECKED
   l. Final Crew Briefing .... REPORT DISCREPANCIES IN FORM 781 (FORM 1) AND TO A/C
   m. Right Gear Safety Lock .... REMOVED
5. Prior to Take-Off
   a. Flap Report .... AS REQUIRED
   b. Safety Belt and Shoulder Harness .... FASTENED

INFLIGHT

1. After Take-Off
   a. Flap and Landing Gear Report .... AS REQUIRED
   b. Engine and Intercooler Checks .... AS REQUIRED
2. Engine Check Intervals
   a. Daylight Engine Checks .... EVERY HOUR
   b. Night, High Power, High Altitude Cruise, Weather Engine Checks .... EVERY 30 MINUTES
   c. Engineering Malfunctions .... REPORTED
3. Prepare for Landing
   a. Landing Gear and Flap Report .... AS REQUIRED
   b. Engine Report .... AS REQUIRED
   c. Safety Belt and Shoulder Harness .... FASTENED

POSTFLIGHT

1. After Landing
   a. Station Area .... CLEANED
   b. Interphone Cords .... SECURED
   c. Oxygen Panel Settings and Oxygen Hose .... SECURED
   d. Right Gear Safety Lock .... REPLACED

TAIL GUNNER.

This gunner is responsible for preflight and use of gunlaying radar equipment. This gunner accomplishes the following duties:

NOTE

FOR AMPLIFICATION OF THESE DUTIES, REFER TO "AMPLIFIED CHECK LIST" OF THIS SECTION.

PREFLIGHT AN/APG-32( )

1. GUNNERY EQUIPMENT PREFLIGHT AND LOADING.
   a. VISUAL INSPECTION.
      (1) Check Turret Status.
      (2) All Switches OFF or SAFE, Heater Power Fuse Removed.
      (3) Spare Bulbs.
      (4) Check Desiccant.
      (5) Fuses and Circuit Breakers (Indicator, Aft Power Panel).
      (6) All Units in Pressurized Compartment.
      (7) Remove Thyratron and Radar Central Covers, Check Thyratron Fuses and Tubes.
      (8) External Turret Safety Switch OFF.
      (9) Remove Gun Enclosure Assembly.
      (10) All Radar Units in Unpressurized Compartment.
      (11) Boosters and Ammo Cans.
      (12) Remove Feeder and Check That Gun Is Cleared of Round in Chamber.
      (13) Remove Breechblocks, Inspect Guns and Chargers. Re-Install Breechblocks.
      (14) Inspect Feeders and Link Chutes.
      (15) Install Feeders and Operating Levers Connected.
      (16) Brass and Ammo Chutes.
      (17) Limit Switches, Actuators and Mechanical Stops.
      (18) Selsyns and Drive Motors.
      (19) Complete Brass Chute Inspection (Outside).
      (20) Inspect and Engage Feeder Winders.
      (21) Complete Gun and Turret Inspection (Outside).
      (22) Turret Movement (Manual).
      (23) Brakes Locked.
   b. OPERATIONAL CHECK.
      (1) Turret Clear for Operation.
      (2) Selector Switch WARM UP, Heater Fuse IN, Check Heaters.
         (a) After Heater Check, Remove Fuse.
         (b) External Turret Safety Switch ON.
      (3) Wave Guide Shutter Action.
      (4) Selector Switch Standby and Check Thyratron and All Radar Blowers.
      (5) Thyratron Controller Timed Out.
      (6) Radar Central Timed Out.
      (7) 28.5 V DC Check.
      (8) Selector Switch RADAR.
      (9) Scope Presentation.
      (10) Indicator Unit Controls.
      (11) 1 and 31 speed Operation. Check Thyratron Tubes Firing.
      (12) Check Wave Guide and RF Head for RF Leakage.
      (13) Safe-Fire Switches FIRE.
      (14) Gun Charger Booster and Feeder Winder Operation.
      (15) Antenna and Turret Limit Switches, Backout and Stowing Circuits.
      (16) OOSFI.
      (17) Pressure System Check. Dump Pressure After Check.

PREFLIGHT AN/APG-32 ( ) (Cont'd)

(18) Disconnect Chargers at Guns.
(19) Firing Circuit Check.
(20) Reconnect Chargers and Safe-Fire Switches SAFE (Safety Wired).
(21) Computer Check.
(22) All Switches OFF or SAFE.
(23) Replace Thyratron and Radar Central Cover.
(24) External-Normal Switch to EXTERNAL.

c. LOADING AMMUNITION AND ARMING GUNS.
(1) External Turret Safety Switch OFF.
(2) Inspect Ammunition.
(3) Load Ammunition.
(4) Arm Feeders.
(5) Final Turret Checks.
(6) Replace Gun Enclosures and Access Panels.
(7) Set Round Counters.
(8) External Turret Safety Switch ON.
(9) Place Warning Signs on Control Panels, Forward and Aft Hatches.
(10) Proper Entry in Form 781 (Form 1) and Form F.

2. CREW INSPECTION
a. Hot Cups .... CHECKED
b. Toilet Paper .... CHECKED
c. Paper Cups .... CHECKED

3. COMBAT STATION
a. Oxygen and Interphone .... CHECKED
b. Personal Equipment .... STOWED
c. Trouble Light .... CHECKED
d. Indicator Unit, Radar Set and Control Panel Switches .... OFF
e. Aft Cabin Altimeter (If Installed) .... SET AT 29.92 INCHES HG
f. Safety Belt .... SECURED

4. CREW DUTIES
a. Emergency Escape Rope (Under Catwalk) ..... CHECKED
b. Walk-Around Bottle .... FILLED & IN PLACE
c. Aft Cabin Entrance Door .... CHECKED
d. Relief Can Clean (Valve Closed) & Relief Tube .... CHECKED
e. Tail Cone Entrance Door Proper Fit .... CHECKED
f. Visual Inspection of Tail Turret .... CHECKED
g. External Turret Safety Switch .... ON
h. Turret Safety Switch .... ON
i. Final Crew Briefing .... REPORT DISCREPANCIES IN FORM 781 (FORM 1) AND TO A/C
j. Nose Gear Safety Lock .... REMOVED

CAUTION

CHECK LATCH ROD AND EMERGENCY RELEASE PIN FOR PROPER INSTALLATION ON NOSE GEAR.

5. PRIOR TO TAKE-OFF
a. Ladder .... REMOVED & STOWED
b. Aft Cabin Entrance Door .... CLOSED
c. Safety Belt .... FASTENED

INFLIGHT

1. GUNNERY EQUIPMENT OPERATION AND AERIAL FIRING
a. Safe-Fire Switches .... SAFE
b. External-Normal Switch .... NORMAL
c. Pressure System .... AUTOMATIC
d. Heater Power .... ON & OFF AS REQUIRED
e. Turret Power Switch .... ON
f. Round Counters .... SET
g. Handset Unit .... SET
h. Computer .... IN
i. Attack Factor Switch .... SET AS REQUIRED
j. Selector Switch .... STANDBY

CAUTION

ALLOW FOUR MINUTES FOR NECESSARY WARM-UP TIME DELAY BEFORE TURNING SELECTOR SWITCH TO RADAR POSITION.

k. Selector Switch .... RADAR
l. Indicator Unit, Radar Set, Antenna and Turret Operation .... CHECKED
m. Safe-Fire Switches .... FIRE

CAUTION

SAFE-FIRE A-C WARM-UP SWITCH REQURES 3-MINUTE WARM-UP PERIOD PRIOR TO FIRING. THIS APPLIES EVERY TIME SWITCH IS TURNED ON. NOT APPLICABLE TO SYSTEMS UTILIZING FREE FIRE BOX.

n. Burst Control .... AS REQUIRED

2. GUNNERY PORTION OF MISSION COMPLETED
a. Safe-Fire Switches .... SAFETY WIRED SAFE
b. Heater Power Fuse .... REMOVED
c. Guns Cooled .... 20 MINUTES
d. Turret Stowed .... COMPLETED
e. All Switches .... OFF
f. Handset Altitude Knob (B System Only) .... MAX ALTITUDE
g. Pressure System .... OFF

3. PREPARE FOR LANDING
a. Auxiliary and Miscellaneous Equipment .... SECURED
b. Safety Belt .... FASTENED

POSTFLIGHT

1. AFTER LANDING
a. Sighting Station and Area .... CLEANED
b. Interphone Cords .... SECURED
c. Oxygen Panel Settings and Oxygen Hose .... SECURED
d. Indicator Unit Cover .... REPLACED
e. Guns and Gunnery Equipment Secured .. TURRET SAFETY SW-SAFE AND WARNING SIGNS POSTED
f. Nose Gear Safety Lock .... REPLACED
g. Malfunctions .... REPORTED FORM 781 (FORM 1)
h. Gunnery Forms and Radar Report .... COMPLETED

AMPLIFIED CHECK LIST.

Tail Gunner's AN/APG-32( ) Equipment Amplified Check List.

The following check list is an amplification of the abbreviated check list presented in this section.

Visual Inspection.

1. Check status of turret and gunnery equipment before commencing preflight.

2. All switches OFF or SAFE and heater fuse REMOVED.

a. Turret power switch OFF.

b. Selector switch OFF.

c. Safe-fire switches SAFE.

d. All indicator controls fully CCW.

e. Heater power fuse REMOVED. Check for continuity.

f. External-normal switch to NORMAL.

g. Turret safety switch SAFE.

h. Pressure system switch OFF.

i. Computer switch OUT.

j. Charger switch RELEASE.

3. Spare bulbs. Check spare bulbs on indicator.

4. Check desiccant. Check desiccant blue down to change line.

5. Fuses and circuit breakers.

a. Check indicator circuit breakers IN.

b. Right aft cabin power panel circuit breaker IN.

c. Check fuses in right aft cabin power panel for proper rating and spares.

(1) RCT 3 fuses—40 amps.

(2) Pressure pump fuse—10 amps.

(3) Tail radar fuse—one 10 amp, one 20 amp.

6. All units in pressurized compartment. Check electrical cables for damage and connectors for tightness. Check units for proper installation, damage and loose or missing parts.

a. Antenna hand control.

b. Range, azimuth indicator.

c. Voltage regulator.

d. Pressure pump system connections.

e. Computer, resolver input unit, and gyro drive unit.

f. System junction box and fire control box.

g. Control panel.

h. Thyratron controller.

7. Remove thyratron and radar central covers.

a. Thyratron.

(1) Check all fuses for proper installation and continuity.

(2) Check power thyratron tubes for proper installation and that tube plates are not damaged.

b. Radar Central.

(1) Check all electrical cables for damage and connectors for tightness.

(2) Check that all sub-units are tight and all tube shields are in place.

(3) Check CAL-NORMAL switch to NORMAL.

(4) Check antenna control switch (S901) to ON.

(5) AFC-MANUAL switch to AFC.

(6) SCAN-CONTROL switch (S-902) for clockwise position.

8. External turret safety switch OFF.

CAUTION

This switch must always be placed in the OFF position when personnel are on or at the turret. The only exceptions to this rule are indicated on the check list (OPERATIONAL).

9. Remove gun enclosure assembly.

a. Check for dents, fasteners, clearance, and security.

b. Place the enclosure in a safe place where it will not be damaged.

10. All radar units in unpressurized compartment.

a. All cable connections at bulkhead 12 for damage.

CAUTION

At bulkhead 12, be careful not to step on cables near tail cone entrance door. These are coaxial, IFF, etc, cables which are very delicate.

b. Check pressure system lines for damage in tail cone.

c. Check wiring along fuselage to tail unit.

d. Radar modulator and RF head.

(1) Check electrical cables for damage, connectors for tightness, and units for bonding straps.

(2) Inspect hat, ring, and clamp for damage.

(3) Check for paint peeling on units.

(4) Check blowers for freedom of rotation.

e. Wave guide assembly.

(1) Check that caps on bidirectional coupler are tight.

(2) Check rubber on flexible wave guide for damage.

f. Check that antenna screen door is closed and S-1709 is in the ON position.

11. Boosters and ammo cans.

a. Check for proper rotation.

b. Check ammunition cans for cleanliness, dry condition, and damage.

12. Remove the feeder and check that the gun is cleared of the round in the chamber. Inspect that the chamber is CLEARED. If there is a round in the chamber, use the following procedure: Remove the driving spring; unlock the breechblock with the unlocking tool and extract the round.

13. Remove breechblocks and inspect guns and chargers.

a. After the gun has been cleared, remove the rear buffer assembly and breechblock group. Check gun tube for obstructions.

b. Check guns for the following:

(1) Receiver and tube clean and excess oil removed.

(a) Receiver interior for burrs, deformation, and general condition.

(b) Presence of lug on carrier slide (Rhode-Lewis or Johnson Firebox Chargers).

(2) Round sensing switch and plunger for proper spring tension.

(3) Breechblock contact properly installed and safety wired.

(4) Disassemble the breechblock and inspect for the following:

(a) Broken, loose, or worn parts.

(b) Burrs and deformation.

(c) Insulation worn or missing.

(d) All parts wiped dry and re-assembled.

(e) Re-install the breechblock in the receiver. Replace the rear buffer and driving spring assemblies.

(5) Security of mount and attachment.

(6) Scribe marks are aligned on the magazine slide and receiver.

(7) Magazine slide anchor secured and anchor nuts tight.

(8) Firing leads moving freely for gun recoil (no clamps).

(9) Presence of cotter keys, lock washers, and safety wire.

c. Check gun chargers for the following:

(1) Security of mount and attachment.

(2) Charging stud installed and charging stud retainer in place (GE charger only).

(3) Charger switch in NEUTRAL position.

d. Check cables and AN connectors for good condition on guns and chargers.

14. Inspect feeders and link chutes. Check for the following:

a. Links or ammo in the feeder.

b. Feeder mouth for burrs and deformation.

c. Operating lever locks in down position.

d. Feeder for excess oil or grease.

e. Feeder cover or adapter of proper series.

f. Link deflectors and link chutes for obstruction or damage.

g. Link chute installed with wide side away from the feeder.

h. Cartridge guides, control pawl, and holding dog for freedom of movement.

i. Star wheels and link strippers for damage.

j. Connectors for damage.

k. Presence of cotter keys and safety wire.

15. Feeders installed and operating levers connected.

a. Install the feeder and make sure that the magazine latch locks it to the gun.

b. Connect the operating lever to the bracket on the gun and lock it.

16. Brass and ammo feed chutes.

a. Check the ammo chutes for proper mount, bent or damaged links, proper configuration, and cleanliness.

b. Check brass chutes for obstruction, damaged areas, and security of mount; check that sliding deflectors are secured; check deflector springs.

17. Limit switches, actuators, and mechanical stops. Check azimuth and elevation limit switches for security of mount, damage, and proper spring operation when actuated manually. Check actuators and mechanical stops for proper installation.

18. Selsyns and drive motors.

a. Check selsyns and selsyn caps for tightness, contactor plugs for proper installation and security, and selsyn covers for proper installation.

b. Check drive motors. Check brush holders for security of mount, electrical cables for damage, and connectors for tightness. Check security of mount.

19. Complete brass chute inspection (outside). See paragraph 16 to complete the remainder of brass chute inspection which could not be accomplished from inside of aircraft.

20. Inspect and engage feeder winders. Inspect for the following:

a. Damaged electrical cables and tightness of connectors.

b. Security of mount and attachment.

c. Free wheeling.

d. Proper operation of locking device.

21. Complete gun and turret inspection (outside). See paragraph 13 to complete gun inspection which could not be accomplished from inside the aircraft.

22. Turret Movement (manual). Disengage turret drive motor brakes and check that turret moves smoothly and freely in azimuth and elevation.

23. Brakes locked; re-engage drive motor brakes.

Operational Check.

1. Turret clear for operation. Check that personnel and stands are cleared of turrets before operating. Be sure that turret is cleared of ammunition and that power is available. Do not load guns until operational check has been completed and units do not require maintenance.

2. Selector switch WARMUP, heater fuse IN; check heaters. When the feeder and gun heater become warm, remove the heater fuse.

CAUTION

Heaters should be left on just long enough to check operation.

External turret safety switch ON; turret power and turret safety switches ON.

3. Wave guide shutter action. Check operation of the wave guide shutter by switching from WARMUP, to STANDBY to WARMUP. Have an observer check for clicking action of wave guide shutter at the transmission line.

CAUTION

Always make sure the wave guide shutter is operational before checking pressure.

4. Selector switch STANDBY. Check thyratron and all radar blowers.

a. Check the thyratron blower for operation.

b. Check radar central, RF head, and modulator external blowers for operation. Check internal blower by placing hand on unit.

CAUTION

If thyratron or any radar blowers are not operating, turn system OFF. Do not let fingers come in contact with rotary fans.

5. Thyratron controller timed out. After 100 (±30) seconds, check to see whether thyratron controller times out.

6. Radar central timed out. After 3 minutes and 45 (±10) seconds, check that radar central times out. Observe that the AFC XTAL current oscillates, indicating that the radar central has timed out.

7. 28.5-volt d-c check. Check line 143 at turret junction box for 28.5-volt d-c output; if necessary, adjust R-43 in thyratron controller to get desired voltage.

CAUTION

Use extreme caution to avoid shorting out other wires in turret junction box. While assistant is checking 28.5-volt d-c output at turret junction box do not close action switch.

Note

If turret junction box does not have a test jack for checking d-c voltage, use the external turret safety switch as a checking point. Voltage should read 28.5-volt dc. If no external turret safety switch is installed on the aircraft, check test jack J-66 at the thyratron controller for 31.5-volt d-c voltage reading.

8. Selector Switch RADAR. Adjust intensity.

CAUTION

An intense spot may burn the screen of the cathode ray tube.

9. Scope Presentation.

a. Check the search pattern by observing the azimuth motion of sweep and elevation UP and DOWN lights.

b. Check that jizzle width is 30 degrees.

c. Check azimuth deflection amplitude.

d. Check range sweep amplitude.

e. Check vertical and horizontal centering.

f. Check for normal ground presentation.

g. Check that the alarm lamp is lit when the sweep passes over a target or ground return.

Note

If many targets are present, the ALARM lamp may be lit continuously.

10. Indicator unit controls.

Note

A two-man team is needed for the following checks.

a. Check L.O.—MANUAL control. Tune manually for best targets. Maximum current and best targets should occur together, and current should be approximately 0.7 to 0.9 ma. Switch to L.O. Targets and current should be approximately the same as in MANUAL. AFC light should then be OUT.

b. Check operation of range search limit control.

(1) Turn IF gain fully clockwise.

(2) Turn range search limit fully clockwise.

(3) Depress action switch. The jizzle width should now be approximately 7 degrees and the range gate should now sweep from zero to 8000 yards repeatedly.

(4) Turn range search limit fully counterclockwise, but do not actuate the switch. The range gate should now sweep from zero to 2000 yards repeatedly.

(5) Turn range search limit fully counterclockwise, actuating the switch. The Range Gate should now disappear.

c. IF gain, alarm, AGC and lock-on check.

(1) Turn IF gain control counterclockwise until targets begin to appear. Alarm light will light as targets appear.

(2) Check that the range gate locks on weak targets.

(3) Turn IF gain fully CCW, actuating the switch. Lock on strong target; observe weak targets disappear. Lock on distant target; observe that guns do not spiral or hunt.

d. Check range IN—OUT switch for proper operation.

e. Depress the search button. Check that the turret returns to stow position and the antenna goes into automatic search.

f. Check operation of long range-short range switch.

11. 1 and 31 speed operation and thyratron tubes firing.

a. Press action switch.

b. 31 speed check. Slowly move hand control; the antenna, indicator sweep, and turret should follow the hand control smoothly. Check both directions, in azimuth and elevation.

c. 1 speed check. Slew hand control; turret should follow rapidly. Check both directions in azimuth and elevation.

d. While turret is being operated, check to see that all azimuth, elevation and d-c power thyratron tubes are firing properly. No excessive overheating and no cross-firing should occur. Check for a bluish purple color while firing. No firing should occur above the plate or at the base of the tube.

Note

A pinkish orange or whitish color indicates a bad tube which should be replaced.

12. Check wave guide and RF head for RF leakage.

13. Safe-fire switches FIRE.

14. Gun charger, booster, and feeder winder operation.

a. At the turret, place charger switch to HOLD-BACK position; charger should charge and hold the breechblock to the rear position. Place switch to NEUTRAL position; the charger should release breechblock. Place the charger switch to CHARGE position; the charger should automatically charge and release breechblock.

b. At control panel, place charger switch to HOLD-BACK position. Charger should charge and hold breechblock to the rear position. Place charger switch to RELEASE position. Charger should release breechblock.

c. Press firing button. Chargers and boosters should operate and feeder winders rotate in proper direction.

15. Antenna and turret limit switches; backout and stowing circuits.

a. Press the action switch and move the antenna and turret into a limit. The turret should stop and then the antenna. Press the firing button; the boosters, chargers, and feeder winders should not operate. Check that the turret does not drift at extreme antenna position.

b. Move hand control in the opposite direction, keeping the firing button actuated. Antenna and turret should move off the limits smoothly; boosters and chargers should operate. Release the firing button and action switch; the turret should stow and the antenna should go into automatic search.

c. Repeat this procedure right and left in azimuth, up and down in elevation.

Note

Elevation turret limits may not always be actuated by use of hand control movement because of positioning of antenna limits.

16. OOSFI.

a. Depress action switch; move guns into azimuth limit.

b. Slew the guns toward opposite azimuth limit and depress firing button. Do not go into the limit.

c. Chargers and boosters should not operate until guns are within 3 degrees of alignment with antenna.

d. Repeat the above for elevation.

17. Pressure System Check.

a. Place system in SEARCH.

b. Press manual switch ON and build pressure up to "40" as indicated by tail radar pressure gage.

c. Check for leakage by observing the pressure gage. The gage reading should not drop lower than "39" within a period of 15 minutes.

d. While pressure is built up to "40," check for ballooning of flexible wave guide.

e. If leakage is within tolerance, push the DRAIN pressure button and drain pressure until gage again reads "30."

Note

The pressure will increase slightly due to heating of units, this increase in pressure will vary in different geographical locations.

18. Disconnect chargers at guns.

CAUTION

When disconnecting or reconnecting gun charger cables be sure that turret safety switch or external turret safety switch is in OFF position.

19. Firing Circuit Check.

a. Close action switch; point guns to an unrestricted area.

CAUTION

Be sure that breechblock is in battery position before inserting magic wand. Use extreme caution in placing any part of the body in front of gun muzzles.

CAUTION

Do not release action switch any time during this check.

b. Have an assistant insert firing circuit tester in tube of gun and push it against firing pin. (This will prevent firing pin from grounding out on the firing pin port.)

c. Depress firing button and have assistant check that gun fires. Check other gun by same method.

WARNING

While checking firing circuit make sure that when triggers are released the firing circuit is OUT. If there is an indication that the firing circuit is still functioning after the firing button is released, get it repaired *immediately* and *do not load* the guns until it has been repaired.

d. After firing circuit check, release action switch and put system in SEARCH.

20. Reconnect chargers; safe-fire switches SAFE and safety wired in SAFE position before continuing with other checks.

21. Computer Check.

a. Range check.

(1) Computer switch IN and attack factor switch PURSUIT.

(2) Set range beyond 1000 yards. Jog RANGE IN-OUT switch downward until range gate locks on the 1000 yard marker. The computer range dial should read 1000 (±20) yards.

(3) LOCK on the 500 yard marker. Computer range dial should read 500 (±10) yards.

(4) With the attack factor in STRAIGHT-LINE position, the readings for 500 yard marker should read 477 (±10) yards. 1000 yard marker should read 982 (±20) yards.

(5) Check ballistic dial changes with range movement.

b. Set altitude MINIMUM, air speed MAXIMUM at handset unit and lock range 1000 yard marker.

(1) Lead check. Close action switch and track steadily for some distance. Stop the hand control abruptly and observe the movement of the turret. The turret should stop when the hand control is stopped and then creep in the opposite direction. Check both directions in azimuth and elevation.

(2) Windage check. Close action switch. Move antenna as close to broadside as possible without getting turret on a limit. Place computer switch to OUT. Guns should swing slightly to the rear, place computer switch to IN. The windage correction should come back IN and move the guns slightly forward.

(3) Gravity check. Move the antenna and turret straight aft and zero degrees elevation. Move computer switch to OUT; guns should move down slightly. When the computer switch is moved IN, the guns should jump up slightly.

c. Check that the resolver input unit dials correspond to movements of antenna.

d. Check that elevation and azimuth correction dials follow antenna movement.

e. Computer switch OUT.

f. CAL-NORMAL switch to NORMAL.

CAUTION

Do not turn selector switch to off position when action switch is actuated, as it may cause a computer malfunction.

22. All switches OFF or SAFE.

a. Turn intensity control fully counterclockwise.

b. Turret power switch OFF.

c. Selector switch OFF.

d. Turn external turret safety switch OFF.

23. Replace thyratron and radar central covers.

24. External-normal switch to EXTERNAL.

Loading Ammunition and Arming Guns.

1. External turret safety switch OFF.

2. Inspect ammunition.

a. Check rounds and links for cleanliness, corrosion, scratches, loose primers, loose projectiles, bent or major dented cases; inspect links for broken stripping ears or bent areas.

b. Check that linkage is set at 2-9/32 (±1/16) inches.

c. Check that the belt is flexible and all rounds are held securely in position.

3. Load ammunition.

a. Disconnect the ammunition feed chutes from the booster assembly.

b. Remove the ammunition can covers.

c. Place the proper link end of the belt in the can first. (Make sure a round is in the double link end of the belt or a single link is bent or secured in a manner to prevent the link from catching on the ammunition feed chute.) This depends on the type of belt used.

Note

Ammunition cans will be loaded as shown by decals on the cans.

d. Lay the ammunition in the can as evenly as possible.

Note

Never fill the ammunition cans so full that the can cover must be forced in place. The ammunition will be jammed.

e. When the cans are filled, thread the belt through the booster and replace the ammunition can cover; reconnect the ammunition chute.

4. Arm feeders.

a. Before loading the feeder mechanism, check that the operating lever is inserted in the operating lever bracket and the magazine latch is locking the feeder to the gun.

b. Place the proper link end of the belt into the feed mechanism. Place the rounds over the star wheel so that the link stripping ears are riding over the link strippers.

c. Wind the feeder mechanism until the clutch slips. Three links should be stripped in the process of winding the feeder mechanism.

Note

If the double link is fed into the feeder, only two links will be stripped.

5. Final turret checks. Make the final check of the drive motor brakes engaged, operating levers engaged, and driving spring retainers locked. Firing and charging leads connected. Feeder winders should be locked.
6. Replace gun enclosures and access panels.
7. Set round counters. Set at number of rounds loaded per gun.
8. External turret safety switch ON.
9. Place warning signs on control panels and forward and aft hatches. WARNING: HOT GUNS.
10. Proper entry Form 781 (Form 1) and Form F. The tail gunner will insure that the total number of rounds loaded on the aircraft are entered in Form 781 (Form 1). The tail gunner will advise the engineer of the ammunition load so that it will be entered on Form F.

WARNING

Do not load the guns HOT.

Note

In the event circumstances necessitate postponement of the mission for more than 48 hours after the turret system perflight has been completed, the guns will be unloaded and ammunition withdrawn to the ammunition cans. The turrets will be extended, the firing circuits will be checked, and the ammunition will be reloaded into the guns within 24 hours of the rescheduled take-off time.

Gunnery Operation.

Inflight Gunnery Procedures.

Prior to Take-Off. Check that all switches on the control panel are at OFF, SAFE, RELEASE, or OUT.

Gunnery Equipment Operation and Aerial Firing. Do not operate the turret or turn the firing switches ON until directed by the aircraft commander after the airplane is on the firing range. On training missions where the turret is not loaded with ammunition, practice turret operation, search and fire area techniques, and target reporting.

1. Turn the external-normal switch to NORMAL and the pressure system to AUTOMATIC as soon as practical after take-off.
2. Switching procedure. Before entering a zone in which turret use is anticipated, request permission from the aircraft commander prior to energizing the RCT systems. Turn on the system and notify aircraft commander by interphone. Before reaching the firing range establish the following conditions:

a. Safe-fire switches to SAFE.

b. Heater power.

(1) Turn on guns and feeder heaters no longer than 30 minutes prior to firing. Leave heaters on during firing.

(2) If condition exists where firing of guns is delayed, operate gun and feeder heaters in cycles of no longer than 30 minutes OFF and 30 minutes ON until firing is resumed. When firing is resumed, turn on heaters immediately and leave on during firing.

(3) Turn heaters off when gunnery portion of missions is completed.

c. Turret power switch to ON.

d. Round counters set at number of rounds loaded.

e. Handset unit. Adjusted in accordance with information received from the navigator. These settings will be true air speed, corrected outside air temperature, and pressure altitude.

Note

Some handset units require true air speed in KNOTS and others in MPH. Be sure to check handset unit for required type air speed before requesting air speed from navigator. If there is a change of ±5 MPH or KNOTS, ±500 feet of altitude or ±5 degrees of temperature deviation from the setting on the handset unit, a new setting must be established.

f. Computer switch IN as required.

g. Attack factor switch set as required. Normally this position is PURSUIT.

h. Selector switch to STANDBY.

CAUTION

Allow 4 minutes for necessary warm-up time delay before turning selector switch to RADAR.

i. Selector switch to RADAR.

j. Indicator unit, radar set, antenna, and turret operation checked.

k. Safe-fire switch to FIRE. Only when permission has been granted by aircraft commander and aircraft is over firing range.

CAUTION

Whether in combat or training, the following will be accomplished prior to firing. The safe-fire a-c warm-up switch requires a 3-minute warm-up period prior to firing. This applies every time the switch is turned on. (Not applicable to systems utilizing the free fire box.)

Cooling Guns and Burst Control. Conservation of equipment and other conditions require that restrictions be placed on missions conducted for training.

1. Aim guns away from own aircraft and other friendly aircraft.

2. Fire in 2- to 3-second bursts with a cooling period of 45 to 60 seconds between bursts.

Note

The purpose of the firing burst and cooling in step 2 above is to conserve the life of gun tubes during training flights.

3. Aim guns to a clear area while cooling between bursts.

4. Aim guns to a clear area when ordered to cease firing or when gun firing has been completed.

a. Turret power switch OFF.

b. Safe-fire switch SAFE.

5. Safety precautions to avoid damage by runaway guns.

a. Aim guns away from friendly aircraft.

b. Set safe-fire switch to SAFE and gun charger switch to HOLDBACK.

c. If above procedure does not stop runaway gun, let it fire and keep the other gun ready for action.

CAUTION

Do not release action switch or turn turret power switch off during this condition.

Gunnery Portion of Mission Completed.

1. Safe-fire switch SAFE.
2. Cool guns 20 minutes prior to stowing.
3. Turret moved to stow position and stowed.
4. All switches OFF or SAFE.

Note

Place pressure system in NEUTRAL prior to landing.

After Landing Procedures.

Before Leaving Aircraft.

1. Gun clearance procedure.

a. Check that gunnery control panel switches are OFF and turret safety switch is SAFE.

b. Place red flag with white lettered words HOT GUNS on control panel selector switch.

c. Place a larger red flag with white lettered words HOT GUNS at the forward and aft hatches.

d. Clearance of live ammunition from the guns will be accomplished by an armament analysis team only.

2. Report RCT discrepancies. Enter equipment discrepancies in Form 781 (Form 1). Report other discrepancies to the engineer.

3. Tail gunner will complete gunnery report forms.

4. Tail radar inflight report. The tail gunner will insure that the report is properly filled out and turned in to appropriate personnel.

Combat Operations.

The principles outlined below must be followed under combat conditions.

Approaching the Combat Area. Enroute to the target, gunnery equipment will be tested and guns fired at low altitude only. You will be briefed or the aircraft commander will direct when to accomplish this operation. The tail gunner will perform the switching procedure. The guns will be positioned in an unrestricted area and test fired a short burst. So far as possible, any malfunctions indicated will be corrected. After the operation is completed, switches will be turned OFF or SAFE.

Reaching the Combat Area. When enemy fighters appear, the following conditions should prevail:

1. Gunners handset unit preset in accordance with information received from the navigator. These settings will be true air speed, corrected outside air temperature, and pressure altitude.

Note

In combat, this information should be checked every 10 minutes.

2. Turret in stow position.

3. System energized.

4. Gun and feeder heaters warm; heater fuse IN as far as possible. The cycle of heater use (IN for 30 minutes and OUT for 30 minutes) will be followed.

The fuse should be left in during firing.

5. Computer switch IN.

6. Attack factor switch set at PURSUIT.

How to Report. Target reporting will be by the clock system. Report both enemy and friendly aircraft. Talk clearly; don't shout. Use only the following standard words and phrases—no other—and make a definite pause between each phrase as indicated. Repeat each message once. "NUMBER AND TYPE, pause, CLOCK AND ELEVATION POSITION, pause, WHAT THEY ARE DOING." Never fail to report when fighters appear.

How to Fire From Radar Tail Position. Whenever an attack develops from this sector, opening fire must be performed at the maximum range of just short of 1500 yards. Firing will be in bursts of 2 to 3 seconds. A mandatory cooling period between bursts is not required. Efficient operation of the gun laying radar system requires emphasis on the following:

1. APG-32 operator must remain in search until the

last possible moment. Then he must switch to hand control and lock on the target in such a manner that he can and will open fire at maximum range.

a. The APG-32 operator must be adept at interpreting the scope presentation. He must recognize the time when a fighter abandons the attack or the fighter has been hit.

b. As soon as this condition happens the operator must switch to search and be ready to immediately lock on any other target that may have appeared.

Cooling Guns. During lulls in firing, sufficient control of the guns and turret must be maintained to insure that they always point at an unrestricted area (in formation). Keep guns in designated cooling position a minimum of 20 minutes prior to stowing.

After the Mission. After landing, guns must be cleared of ammunition. This requirement does not necessarily mean gunners will clear the guns of ammunition. Duration of flight and locally established policies will determine responsible personnel:

SECOND RADIO OPERATOR.

The second radio operator assists the first radio operator in any way necessary, and in addition, will be responsible for the following:

VISUAL PREFLIGHT

1. Form 781 (Form 1) ..... CHECKED

PREFLIGHT OPERATIONAL EQUIPMENT CHECK

1. Walk-Around Bottles and Filler Hose ..... CHECKED
2. All Interphone Equipment and Stations in Bomb Bay, Aft Compartment, and Tail, Including Speakers, Amplifiers and/or Channel 1 and 2 power supplies (AN/AIC-10) (If Applicable) ..... CHECKED
3. Radome (Applicable ECM Balun Units and IFF Inertia Switch) ..... CHECKED
4. All Fuses and/or Circuit Breakers in Aft Compartment and Tail ..... CHECKED
5. AN/ARN-6, cables, plugs, for Security (If Applicable) ..... CHECKED
6. AM-203/ARA-19, Cables, Plugs, for Security, (If Applicable) ..... CHECKED
7. ID-251/ARN, Cables, Plugs, for Security, Heading Checked With Gyros On, Against Pilot's Magnetic Compass or N-1, With Magnetic Heading Set In (If Applicable) ..... CHECKED
8. DY-66 ( )/ARN-14, Cables, Plugs, for Security (If Applicable) ..... CHECKED
9. RT-178/ARC-27, Cables, Plugs, for Security (If Applicable) ..... CHECKED
10. R-252 ( )/ARN-14, Cables, Plugs, for Security (If Applicable) ..... CHECKED
11. AN/ARC-21, Cables, Plugs, for Security (If Applicable) ..... CHECKED
12. Chaff Dispensers Checked and Loaded ..... AS REQUIRED

CREW INSPECTION

1. As Outlined in Section II, Normal Procedures ..... CHECKED
2. All Required Personal Equipment ..... CHECKED

PREFLIGHT (DAY OF FLIGHT)

1. Check Private and Normal Interphone Using Oxygen Mask and Helmet, Verifying Side-Tone (If Applicable) ..... CHECKED
2. Walk-Around Bottles and Filler Hose ..... CHECKED
3. Oxygen Mask and Oxygen Station ..... CHECKED
4. Facility Charts (VOR and LF/MF), Supplementary Flight Information Book, Pilots, ILS, East-West Handbooks (Foreign As Required) Corrected to Date ..... CHECKED
5. Fire Axe, First Aid Kits, and Fire Extinguishers ..... CHECKED
6. Gibson Girl and URC-4 (If Applicable) ..... STOWED
7. Spare Parachute and Oxygen Equipment ..... STOWED
8. Hot and Cold Liquid Containers and 2 Hot Cups ..... STOWED
9. Upper Forward Turret Doors ..... OPEN

FINAL CREW BRIEFING

1. According to Section II, Normal Procedures ..... CHECKED
2. A/C Informed of Discrepancies ..... CHECKED

STATIONS (START ENGINES)

1. At Emergency Hydraulic Pump, on Interphone If Possible (Private) ..... STANDBY

TAXI

1. At Emergency Hydraulic Pump, on Normal Interphone ..... STANDBY

CRUISE

1. Upper Forward Turret Doors ..... CLOSED
2. Mission ..... AS BRIEFED
3. Parachute and Oxygen Equipment as Regulation Requires ..... COMPLIED

LANDING

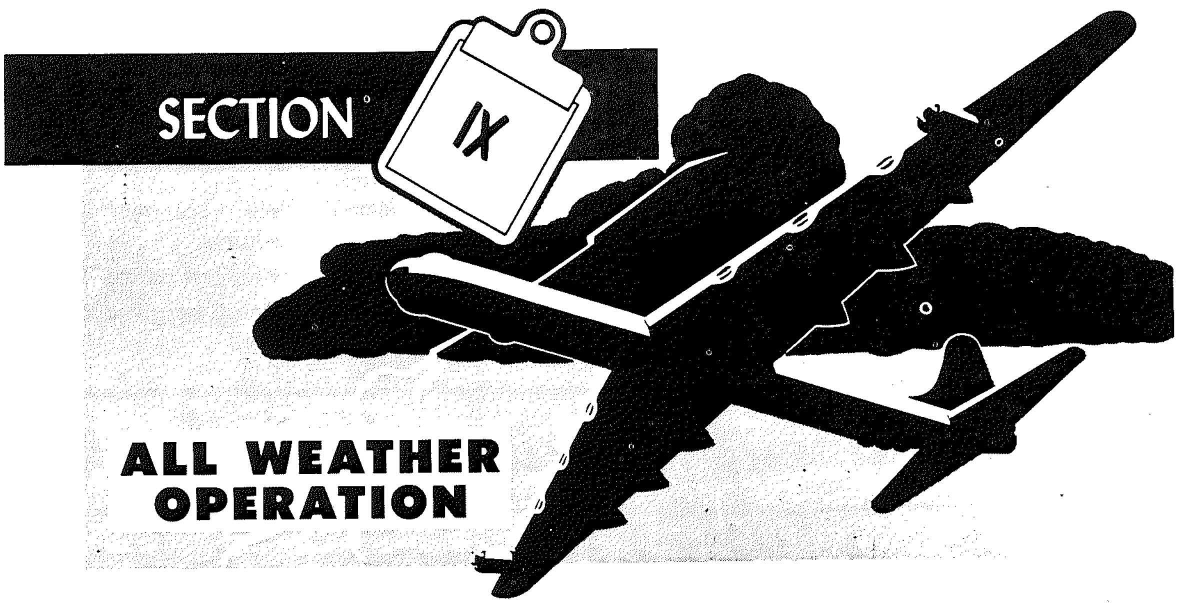
1. Upper Forward Turret Doors ..... OPEN
2. In Landing Position, Parachute On ..... READY

TAXI

1. At Emergency Hydraulic Pump, on Interphone If Possible ..... STANDBY

POSTFLIGHT

1. Oxygen Station ..... SECURED
2. Compartment ..... CLEANED
3. Malfunctions Reported to First Radio Operator ..... CHECKED



72-129-A

This section contains discussions and specific procedures pertaining to operation of the airplane at night, under instrument conditions, in thunderstorms, in cold weather, in hot weather, and in the desert. The normal operating instructions of Section II are repeated only when the unity of this section requires duplication. Operation of the various systems and equipment is discussed in Section VII.

• Night Flying Procedures •

69-161-A

Night flying and instrument flying are identical in many points of technique. Take-off, climb, and landing will require instrument reference when visual orientation becomes uncertain. Since most missions involve night flying, the following items should be checked prior to each flight.

1. Taxi lights.
2. Landing lights.
3. Position lights.
4. Formation lights.
5. Wing crawlway lights.
6. Instrument panel lights.
7. Flight deck flood lights.
8. Aldis lamps (1 in forward compartment, 2 for aft scanners).
9. Spare bulbs.
10. Flashlights.
11. Night-flying curtains.
12. Flight instrument switches—ON.
13. Flight indicators and instruments operating.
14. VHF, UHF, low frequency, ILAS, radio compass, and VOR.
15. N-1 compass uncaged and erecting (group 1 airplanes).

NIGHT TAKE-OFF.

1. Keep cockpit lights dim to protect night vision.
2. Use night-flying curtain to permit engineer to illuminate his panel.
3. Check flight instruments during taxi turns.
4. Be particularly alert for taxi strip obstructions. Use Aldis lamp or dispatch wing walkers to check clearances with flashlights.
5. Line up with runway; have nose wheel straight.
6. Landing lights extended and ON.
7. Set gyro to zero or to 5-degree mark nearest runway heading.
8. Perform usual checks.
9. During the ground run, the aircraft commander should maintain visual contact, and the pilot should watch instruments.
10. After the "getaway," aircraft commander should go on instruments, and pilot should maintain visual contact to prevent airplane from settling back onto the runway.

NIGHT CLIMB.

1. Use nose down trim after leaving ground effect if climb becomes too steep.

2. Retract flaps in the usual 5-degree increments, retrimming between retractions.

Note

Flap retraction technique for take-off gross weight in excess of 300,000 pounds is discussed in Section VI, "Flight Characteristics."

3. Landing lights retracted and OFF.
4. Maintain take-off power until airplane is "clean" and altitude is between 500 and 1000 feet above the terrain.
5. Maintain optimum climb speed.

NIGHT LANDING.

1. Make normal checks. Scanners should use Aldis lamps for visual inspections.
2. Use landing lights for last part of final approach.
3. Use caution in judging height over the end of the runway.

• Instrument Flying Procedures •

69-163-A

The instrument flight characteristics of this airplane are conventional. Operation of flaps and landing gear do not cause pitch changes that would be dangerous at any stage of instrument flight.

Duplicate flight instrumentation is provided along with all standard electronic aids to instrument navigation and approach. The limiting factor will usually be availability of ground facilities. You will have to consult applicable radio and navigational charts for specific local equipment and procedures.

BEFORE STARTING ENGINES.

Prior to starting the engines and with the portable power cart operating, check the following:

1. Windshield wiper operation and blade contact.
2. Pitot heater operation.
3. Navigation lights.
4. Flight instrument switches—ON.
5. Flight indicators operating and instruments erecting.
6. Cockpit lights and flashlights.
7. VHF, UHF, low frequency, ILAS, radio compass, and VOR.
8. N-1 high latitude compass uncaged and operating (group 1 airplanes).
9. Slaved gyro magnetic compass uncaged and operating (airplanes not in group 1).
10. Position cockpit heat and anti-icing valves for maximum windshield defrost.
11. Place pilots' ventilating fans ON to aid windshield defrost.

AFTER STARTING ENGINES.

Check the anti-icing equipment for proper operation and then turn OFF after starting the engines.

DURING TAXI.

During taxi, check:

1. Landing lights.
2. Turn needles.
3. Gyros and compass (for proper swing and operation).

BEFORE TAKE-OFF.

Check the following items before take-off:

1. Radio receivers turned to proper stations.
2. Altimeter and gyros set.
3. Pitot heater ON (if icing conditions exist).

CAUTION

Flight instruments require a maximum of 15 minutes to warm up.

TAKE-OFF.

The aircraft should be flown off the ground as during a visual take-off; however, instrument take-off should not be attempted unless there is sufficient visibility to aid in steering the aircraft during the initial take-off roll.

In aircraft equipped with J-8 attitude indicator, because of the high angle of pitch on take-off, the horizon bar will ride near the bottom of the indicator, and only limited pitch and roll information will be displayed. Therefore, during the instrument take-off, the air-speed indicator will have to be used to provide additional pitch information. Since the aircraft accelerates rapidly after becoming airborne, use caution to prevent exceeding the maximum flap speed.

The following instrument take-off procedure is recommended:

1. Visually align the aircraft on the center line of the runway with nose wheel straight.

2. Use normal elevator tab and flap settings.

3. Set miniature aircraft reference on attitude indicator as desired.

4. Set gyro to zero or to 5-degree mark nearest runway heading.

5. Position cockpit heat and anti-icing valves for maximum flow to pilots' enclosure in the event icing conditions are encountered on take-off.

6. Advance power and make normal VFR take-off.

7. Retract landing gear after becoming definitely airborne.

8. Retract flaps in accordance with the procedure in Section VI, if your take-off gross weight exceeds 300,000 pounds.

9. Apply nose-down trim as required between flap retractions.

10. Establish climb configuration.

11. Anti-Icing equipment ON (if required).

INSTRUMENT CLIMB.

1. Maintain optimum climb speed.

INSTRUMENT CRUISING FLIGHT.

Extended operation on instruments can usually be avoided by cruising at high altitude. As you increase your flight level, the number of cloud types that can exist is substantially reduced. While you are cruising on instruments, the following points are significant:

CAUTION

> At no time should the aircraft be permitted to enter an unusual attitude which might result in exceeding the critical Mach number and entering the buffet or compressibility range.

1. Trim airplane "hands off" before engaging autopilot.

2. Repeat "hands off" trimming operation every half hour to compensate for cg changes.

3. Avoid extreme turbulence if possible.

4. If you cannot avoid turbulence, disengage autopilot and fly "attitude" rather than "altitude."

5. Cross check all instruments and electronic aids.

SPEED RANGE.

The rapidity with which you must scan all flight instruments varies with the speed of flight. While this airplane has a very wide speed range for a bomber, normal operating speeds are not high enough to make instrument flight more difficult. Ordinarily, the speeds established by cruise control requirements will be the desirable instrument speeds.

RADIO AND NAVIGATION EQUIPMENT.

The dependability of electronic aids to instrument flight and navigation is closely related to the influence of the various types of static. Man-made static, precipitation static, and dust static can be controlled or suppressed. Crash static from active storm areas, however, cannot be controlled. This accounts for the increased dependence on very high frequencies which are comparatively immune to this type of interference. Electrical disturbances will affect equipment with frequencies below 75 mc within a radius of several thousand miles. Therefore, under severe instrument conditions, VHF equipment will offer greater dependability.

TABLE OF ELECTRONIC *Aids*

Low to High Frequency	Very High Frequency or Above
Liaison Radio	Instrument Approach Indicator
Radio Range Receiver	Command Sets
Radio Compass	Marker Beacon Receiver
Loran Set	Radar Equipment

H1-287-A

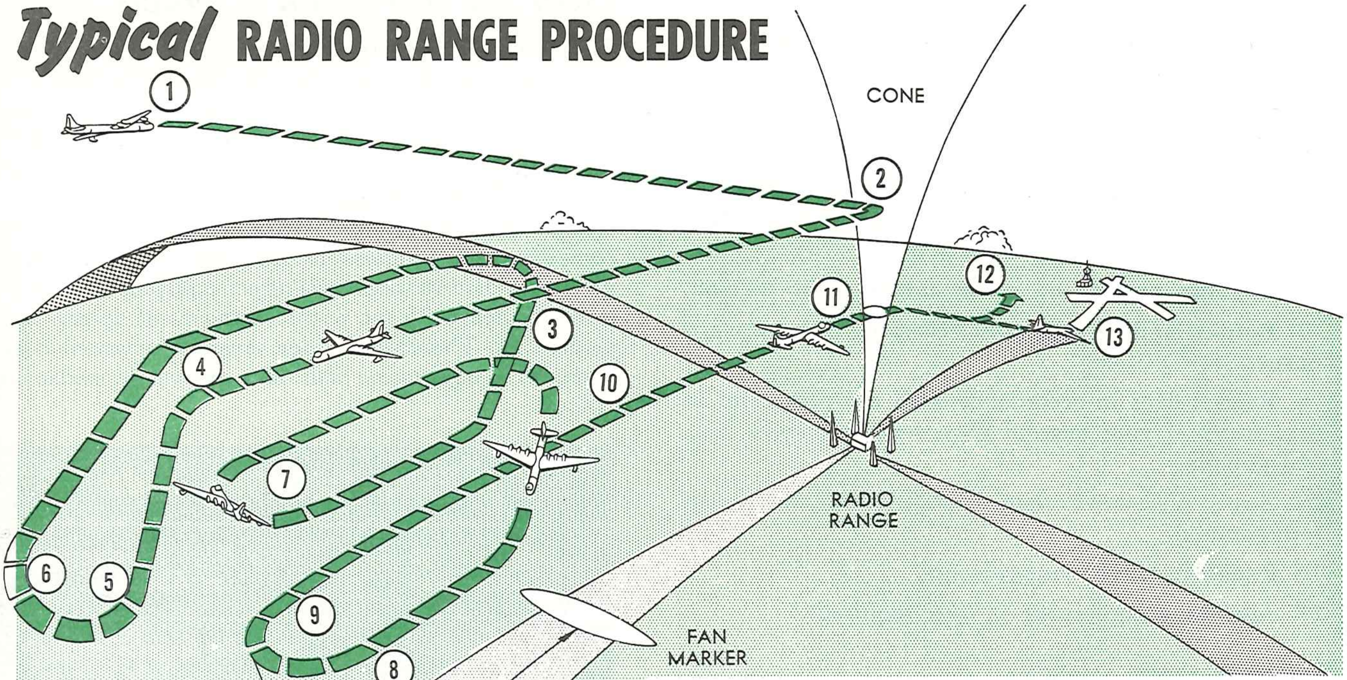
AIRBORNE RADAR.

This equipment permits visual or contact flight precision under instrument conditions. The amount and accuracy of information obtained through radar scope interpretation depend largely on the skill of the operator. Distinctive terrain features can be used for navigation regardless of prevailing visibility. Relative bearings and distances can be read directly from the scopes; relative altitudes can be determined by comparing flight altitude with map elevation lines or color codes. When the radar system is used for navigation, radar-observed drift corrections can be coupled directly from the radar ground position computer to the autopilot. Grid navigation in latitudes above the 70th parallel can also be accomplished with certain parts of the radar system. A great circle path between the high latitude entry and exit points can be followed by reference to a free gyro rather than magnetic field of the earth in the polar regions.

At low altitude, the strong ground echo and the greater apparent speed of the airplane relative to the ground make accurate scope interpretation almost impossible. For this reason, instrument low approaches accomplished exclusively by airborne radar are not recommended.

Turbulence does not provide a discontinuity that would show up on the radar scope. Thunderstorm research, however, shows that rain and turbulence are

Typical RADIO RANGE PROCEDURE



Range procedures will remain fundamental until new techniques are developed. More precision is offered by GCA and ILAS for low approaches, but preliminary orientation and holding on the radio range are usually required.

1. Obtain approach clearance upon entering control area.
2. Hold as directed–Monitor all conversations.
3. Report leaving each assigned altitude promptly.
4. Note outbound drift correction.
5. Standard turn procedure.
6. Cross check needle frequently during last 90° of turn toward inboard heading–adjust turn to give "on course" indication when turn is complete.
7. Report reaching and leaving each assigned holding fix.
8. Time your holding pattern to put you over the holding fix at expected approach time.
9. Complete check list prior to this point except:
   a. Flaps–extended 10°.
   b. IAS–150 or 135% stall–whichever is greater.
10. Extend flaps 20°–stabilize IAS at final approach speed.
11. Establish proper rate of let down by reducing M.P.(on 6 engines) 1" for each 100 ft /min rate of descent desired.
12. If you are not contact at specified minimum, use "missed approach" procedure.
13. Flaps–extend 30° on final approach to the runway after reaching visual flight conditions.
14. Report "below" all clouds as soon as possible.

Figure 9-1.

related. Consequently, you can pick the smoothest path through a thunderstorm area by avoiding strong rain echoes. This path should be selected before entering the storm area. Heavy local rain will temporarily block the radar scope with strong echoes.

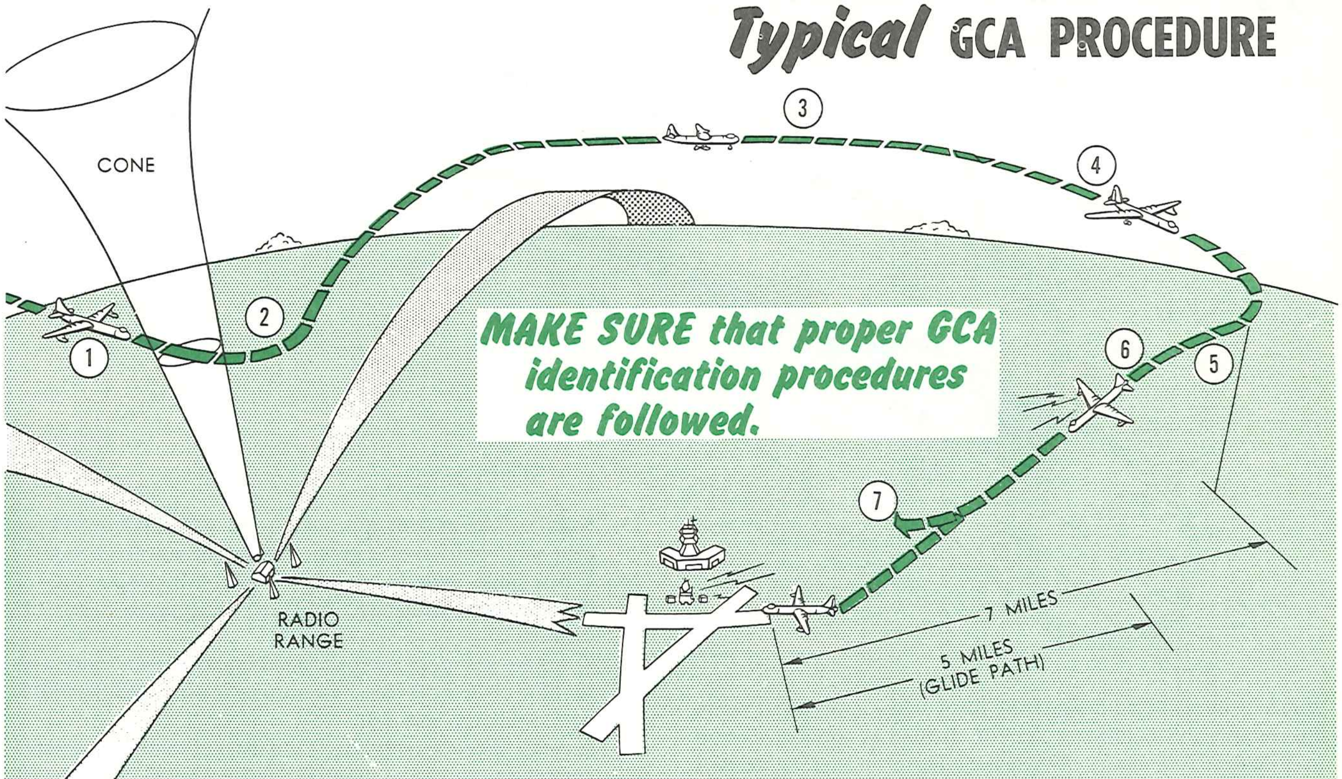
Absolute altitude can be read from the radar scope with a degree of accuracy that depends on the terrain. When the ground is smooth, accuracy is best; when the ground is rough or hilly, the scope shows altitude above an "average" ground level. The radial distance on the scope to the first ground echo is the altitude index.

DESCENT.

Descent under instrument conditions will be in accordance with normal procedures discussed in Section II unless atmospheric conditions dictate changes in power settings. Rapid drops in CHT should be avoided, and prolonged operation with CHT below 170°C can cause lead fouling and poor acceleration. If icing conditions exist, it will be necessary to change power settings to provide sufficient heat for carburetor, wing and tail de-icing.

HOLDING.

Endurance ordinarily is not critical. If you are required to hold while waiting for airways or approach clearance, use maximum endurance power settings for your gross weight and altitude. A typical holding procedure is shown in figure 9-1 in conjunction with the radio range procedure.



This system is usually referred to as GCA. The instrument publications should be consulted for procedure in obtaining a GCA channel. Low frequencies are usually available if VHF equipment is inoperative.

1. Turn as directed by GCA. Report leaving cone.

2. Descend as directed to GCA traffic altitude.

3. Complete check list prior to this point except:
    a. Flaps – extend 10°.
    b. IAS–150 or 135% stalling speed, whichever is greater.

4. Extend flaps 20° - stabilize IAS at 150 mph or 135% stall, whichever is greater – descend as directed to final approach altitude.

5. Level off at final approach altitude, stabilize IAS at final approach speed.

6. When you intercept glide path, reduce power on 6 engines approximately 1"M.P. for each 100 ft min rate of descent required. After air speed and descent rate stabilize, adjust power as required.

7. Flaps–extend 30° on final approach to the runway after reaching visual flight conditions.

73-162-A

Figure 9-2.

INSTRUMENT APPROACHES.

Equipment is provided for the reception of radio range, ILAS, and GCA signals. ILAS and omnidirectional range signals are interpreted by visual indicators. Approaches based on any combination of equipment are recommended for additional safety. See figures 9-1, 9-2, 9-3, and 9-4 for instrument approach procedures.

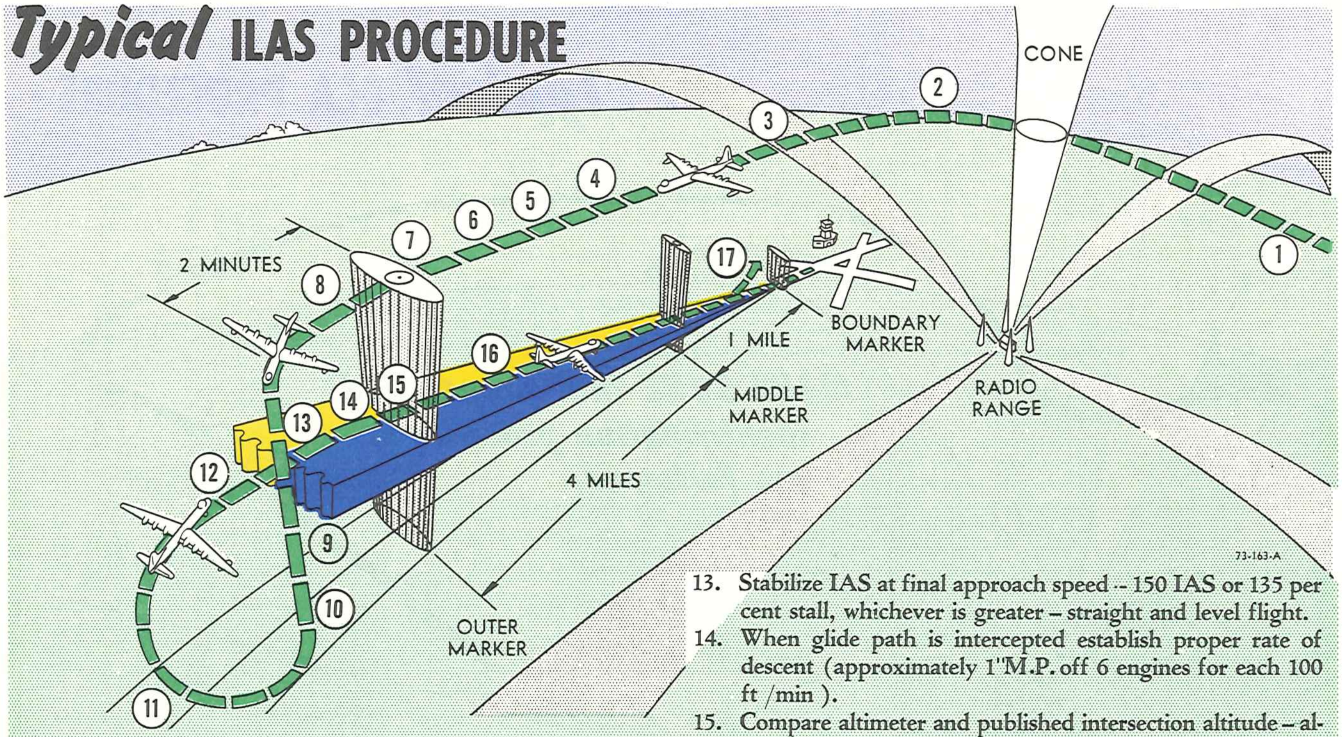
Some aircraft are equipped with an automatic approach system which provides a means of making an automatic ILAS approach. For information concerning the description and operation of this equipment, see "Automatic Approach Coupler Unit," Section IV.

The following points of technique will apply to all instrument approaches:

1. Consult applicable radio and navigational charts for specific local procedure.
2. Limit flaps to 20 degrees until landing is assured.
3. Pilot should double check aircraft commander's procedure.
4. Pilot should check for runway or high intensity approach light as aircraft commander reaches final stage of approach.

CAUTION

Do not change from your approach system until you are in the clear. Partial visibility can introduce serious errors in depth perception.



ILAS is the standard designation for this low approach system. Procedures and minimums are also defined in applicable radio and navigational charts. When both ILAS and GCA facilities are available, an ILAS with GCA monitor is desirable from the standpoint of safety. If signal strength is too low to give accurate needle deflections, red warning flags appear in the indicator.

1. After clearance has been received, descend to initial approach altitude.
2. Perform final landing check; set propellers, extend gear, and set flaps to 20°.
3. Use low frequency homing facility to aid interception of localizer beam outbound at an angle of less than 30°.
4. Bring ILAS cross pointer into normal sequence of cross-check (outbound deflections are reversed).
5. If interception is made close to localizer, turn to corrected published heading (use metro winds or drift calculated during holding procedure) until localizer needle settles to a steady indication.
6. Center the localizer needle (outbound).
7. Course should be established within 1 or 2 degrees. (Degrees of bank should not exceed degrees of correction indicated.)
8. Note outbound drift correction.
9. Complete check list prior to this point except:
   a. Flaps – extend to 30°
   b. IAS – 150 or 135% stall – whichever is greater.
10. Standard turn procedure.
11. Cross check needle frequently during last 90° of turn toward inbound heading – adjust turn to give "on course" indication when turn is complete.
12. Descend to final approach altitude.
13. Stabilize IAS at final approach speed – 150 IAS or 135 per cent stall, whichever is greater – straight and level flight.
14. When glide path is intercepted establish proper rate of descent (approximately 1"M.P. off 6 engines for each 100 ft/min).
15. Compare altimeter and published intersection altitude – allowable error is 50 feet. If error is excessive and ground is not visible, go around.
16. Increase speed of cross check and make smooth coordinated corrections as soon as pointers deviate – avoid over controlling.
17. Flaps–extend 30° on final approach to the runway after reaching visual flight conditions.

Figure 9-3.

ICE, SNOW, AND RAIN.

Proper technique is essential when flying in ice, snow, or rain. The various types of icing are probably the greatest hazard, but rain and snow can impair forward visibility to the extent that instrument technique will be required. If propeller icing is experienced, intermittent rapid increases in rpm should be made in an effort to rid the propeller of ice.

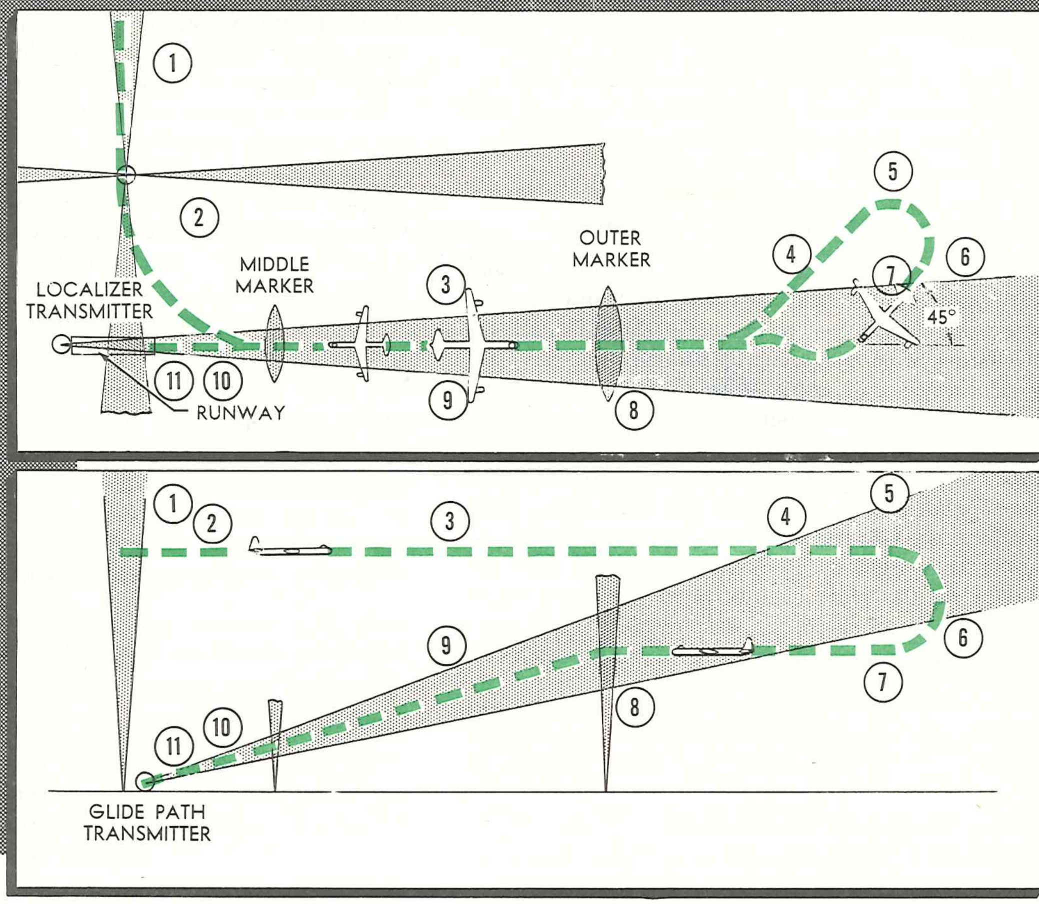
ICE.

The following configuration will provide maximum heat for wing, windshield, and tail de-icing.

1. Dual turbo.
2. High rpm.
3. High engine fan speed.
4. Low air speeds.
5. Maintain maximum allowable CHT and CAT.
6. Maintain maximum allowable anti-icing temperature.

When the anti-icing system is operated correctly during a severe icing condition and flow-back freezing is encountered, the anti-icing system has failed and every effort should be made to leave the icing area.

Automatic APPROACH PROCEDURE



The procedure for making an automatic approach is essentially the same as the ILAS procedure described in figure 9-3. Since the autopilot controls the flight attitude of the aircraft during the automatic portion of this procedure, its three axes must be engaged before this portion of the approach pattern is reached. The approach pattern is devised to allow the aircraft to approach the beam at a sufficient angle and a sufficient distance from the station to have the aircraft lined up on the localizer beam before the outer marker is passed. The altitude, which is automatically maintained if the altitude control unit is engaged, should be approximately 1500 feet if possible. This altitude permits interception of the localizer well below the glide path and allows sufficient time for the aircraft to align itself on the localizer course before the glide path is intercepted.

1. After clearance has been received, descend to initial approach altitude.
2. Perform final landing check–set propellers, extend gear, and set flaps to 20 degrees.
3. Use normal ILAS procedure in flying the outbound leg.
4. Use standard turn procedure.
5. Descend to final approach altitude and turn the altitude control switch on.
6. Approach the beam at approximately 45 degrees.
7. As soon as the localizer needle leaves its stop, place the localizer switch in the ON position.
8. When the glide path needle reaches its approximate center position, place the approach switch in the ON position.
9. Use throttles to maintain normal approach speeds.
10. After reaching visual flight conditions, disengage the autopilot and extend flaps to 30 degrees.
11. Complete the landing manually.

75-120-A

Figure 9-4.

The anti-icing system should be turned on before entering icing conditions. In severe icing conditions, flow-back freezing may be encountered, and this will result in a loss of air speed. Under these conditions, ice may also form along the bomb bay doors. Periodic opening and closing of the doors will break up this accretion. If windshield is icing or frosting, accomplish the following:

1. Position valves for maximum heat in forward compartment. (Refer to "Heat and Anti-Ice Systems," Section IV.)

2. Direct air flow to pilots' enclosure, and position pilots' air circulating fans for windshield defrosting.

3. Turn on booster fan to increase flow of air in pressure duct.

During flight in heavy icing conditions, especially in freezing precipitation and thunderstorms, icing of the induction system may be encountered. (Refer to "Carburetion," Section VII.)

Emergency Use of Carburetor Preheat.

Induction system icing can occur at carburetor air temperatures below + 15°C. In event it becomes necessary to add additional heat to maintain the CAT. above + 15°C throughout a descent to touchdown, the following procedure will apply. Use single turbo and a high turbo setting with part throttle down to the traffic pattern altitude, with carburetor preheat off. At traffic pattern altitude, with the carburetor preheat circuit breakers pulled, place the carburetor preheat switch to the ON position. Advance the throttle on one engine at a time to 37 inches M.P. and shift to dual turbo. As the shift occurs, push the carburetor preheat circuit breaker in for that engine. This procedure will maintain adequate CAT. during and after shifting from single to dual turbo.

CAUTION

In icing conditions, it is imperative to maintain the CAT. well above the icing range during the transition of the turbo shift. Repeat these steps for the other five engines.

CAUTION

If the landing is rejected, turn the carburetor preheat switch OFF as go-around power is applied.

Jet Engine Icing.

The jet engines can be seriously affected by icing. Ice forms on the fixed inlet screens and compressor inlet guide vanes and restricts the flow of inlet air. The reduced air flow causes a loss in thrust and a richer fuel-air mixture. As thrust decreases the rpm decreases and as the fuel-air mixture becomes richer the tail pipe temperature increases. In an attempt to maintain rpm the automatic fuel control routes a greater amount of fuel to the combustion chambers which further increases the tail pipe temperature. Once the ice begins to restrict the air flow and the tail pipe temperature starts to rise it may be only a matter of seconds until turbine failure occurs if corrective action is not taken. Critical ice build-up on inlet screens can occur in less than 1 minute and if the inlet screens are not installed critical ice build-up on the inlet guide vanes can occur in 4 minutes or less.

Icing of external surfaces cannot be regarded as an indication of jet engine icing because the engines can ice to a serious extent before external icing is evident. When flying at relatively low air speed and with a high power setting, as in a climb, the intake air is sucked, instead of rammed into the compressor inlet. This suction causes a decrease in air temperature, and air at ambient temperature above freezing may be reduced to sub-freezing temperatures as it enters the compressor inlet. Free moisture in this air may become super cooled and cause engine icing while no external icing is evident. The maximum temperature drop which can occur is approximately 5°C (9°F). This maximum drop occurs at high rpm on the ground. The drop will become less as rpm decreases or as air speed increases.

The initial indication of engine icing is an increase in tail pipe temperature and usually this is the only indication before complete engine failure. Since icing and failure can occur very rapidly the tail pipe temperature indicator must be watched closely when possible icing conditions are present.

Icing Prevention. To prevent jet engine icing the following should be observed:

1. Avoid atmospheric icing conditions whenever feasible.

2. If possible, avoid take-offs with jet engines operating when temperature is between —10°C (14°F) and 5°C (41°F) if fog is present or the dew point is within 4°C (7°F) of the ambient temperature. These are conditions under which jet engine icing can occur without external icing.

3. If the ambient temperature is in the range of 0°C (32°F) to 5°C (41°F) and the dew point is within 4°C (7°F) of ambient temperature, the jet engines should be shut down and the air plug doors closed.

Note

The above procedure should be used only to avoid icing when the temperature and dew point are conductive to the formation of ice caused by a drop in air temperature as it is sucked into the jet engine air intake. Do not follow this procedure if icing conditions already exist.

4. If icing conditions are encountered at freezing atmospheric temperatures, immediate action should be taken as follows:

Note

The rate of engine icing for a given atmospheric icing intensity with outside air temperature below freezing is relatively constant at the speeds this airplane flies. Ram pressure heating of air at high speeds does not offset the icing conditions.

a. If practical, change altitude rapidly by climb or descent in layer clouds or vary course as appropriate to avoid cloud formations.

b. If the jets are operating, shut them down.

CAUTION

It is permissible to use the jet engines while encountering ice if threatened with loss of aircraft due to shutting down of jet engines. A continuous surveillance of jet tail pipe temperature and such power reduction of the jet engines as may be required to hold these temperatures within the allowable limit is necessary to prevent the possibility of major damage to the aircraft. The rise in tail pipe temperature due to ice blockage can be very rapid and the consequences of not shutting down the jets are turbine buckets erupting through the jet pod nacelle.

c. Close the air plug doors.

d. Apply pod preheat, depending upon requirement for wing anti-icing.

Note

Do not apply heat to air plug doors.

Starting Engine After Leaving Icing Conditions. To start engines after leaving icing conditions proceed as follows:

1. Apply pod preheat if not already on.

2. Determine whether the rotor is free as follows (without cracking throttle):

a. Crack air plug doors.

Note

Tap tachometers for early rpm indication.

b. If rotor does not turn, open air plug doors fully.

CAUTION

Do not attempt to open air plug doors with ice visible on jet pod lips and doors. If ice is visible and ambient temperature is below 5°C (41°F), do not apply heat to the air plug doors. This temperature restriction is necessary to prevent ice melted at the air plugs from freezing in the compressor section and stopping engine rotation causing possible damage to the engine.

c. If rotor does not turn with doors fully open, apply starter for a maximum of 5 seconds.

CAUTION

Starter will burn out if operated over 5 seconds or if reapplied over three times in rapid succession with rotor locked.

d. With air plug doors fully open and the correct windmilling rpm, attempt a normal air start.

CAUTION

The pilot should be alert for excessive tail pipe temperatures due to intake air blockage or any indication that pieces of ice have damaged the compressor.

SNOW.

Impaired forward visibility is the main problem when flying in a snowstorm. Windshield wipers and maximum windshield defrost will improve forward visibility under this condition. Side visibility will not be greatly reduced. Optimum anti-ice configuraton should be maintained

RAIN.

Forward visibility in rain is also a serious problem. Side visibility will not be seriously impaired, but final approaches in heavy rain will be rather difficult. Proper windshield wiper blade contact will reduce the hazard considerably.

TURBULENT AIR AND THUNDERSTORM FLYING.

Flight through a thunderstorm should be avoided. However, since circumstances may force you to fly into a zone of severe turbulence, you should be familiar with the piloting techniques recommended for these conditions. Power setting and pitch attitude are the keys to proper piloting technique when flying in turbulent air. The power setting and pitch attitude required for the proper penetration air speed are established before entering the storm. This power setting and pitch attitude, if maintained throughout the storm, will result in a constant air speed, regardless of any false readings of the air-speed indicator. Specific instructions for preparing to enter a storm and flying in it are given in the following paragraphs.

CAUTION

On entering thunderstorms and areas of excessive precipitation, close surveillance of alternators must be maintained, because it is possible for the d-c exciter generator commutator to collect enough moisture that it will drown out completely. The volts and cycles will go to maximum negative readings and the alternator will not automatically come off the line. Re-excitation is possible and normal power can be restored after the airplane has emerged from the precipitation area and the d-c exciter generator has had time to dry.

APPROACHING THE STORM.

It is imperative that you prepare the airplane prior to entering a zone of turbulent air. If the storm cannot be seen, its proximity can be detected by radio crash static and strong rain echoes picked up by the airborne radar. Prepare the airplane as follows:

1. Disengage the autopilot.
2. Maintain sufficient CHT and CAT. to preclude the possibility of engine or carburetor icing.
3. Mixture controls—NORMAL.
4. Pitot heater switches—ON.
5. Carburetor preheat—As required.
6. Throttle—Adjust as necessary to obtain recommended penetration speeds. A safe, comfortable penetration speed in severe turbulence is 60 knots above stall for the weight and configuration being flown.
7. Check gyroscopic instruments for proper settings.
8. Safety belts—Tightened. (Check with crew members.)
9. Turn off radio equipment rendered useless by static.
10. At night, turn on the white flight deck flood lights to minimize the blinding effect of lightning.

WARNING

Do not lower the landing gear or the flaps as they merely decrease the aerodynamic efficiency of the airplane.

IN THE STORM.

1. Maintain power setting and pitch attitude (established before entering the storm) throughout the storm. Hold these constant and your air speed will be constant—regardless of what the air-speed indicator reads.
2. Devote all of your attention to flying the airplane.
3. Expect turbulence, precipitation, and lightning, but do not allow them to cause you undue concern.
4. Maintain attitude. Concentrate principally on holding a level attitude by reference to the artificial horizon.
5. Do not "chase" the air-speed indicator, since doing so will result in extreme airplane attitudes. If a sudden gust should be encountered while the airplane is in a nose-high attitude, a stall might easily result. A heavy rain may partially block the pitot tube pressure head, causing the reading on the air-speed indicator to decrease by as much as 70 mph.
6. Use as little elevator control as possible to maintain your attitude in order to minimize the stresses imposed on the airplane.
7. The altimeter is unreliable in thunderstorm flying because of differential barometric pressures within the turbulent area. A gain or loss of several thousand feet may be expected. Make allowances for this error in determining minimum safe altitude.

Note

Normally, the least turbulent area in a thunderstorm will be at an altitude of 6000 feet above the terrain. Altitudes between 10,000 feet and 20,000 feet are usually the most turbulent.

• *Cold Weather Procedures* •

69-165-A

The following procedures are written as a supplement to the instructions in Section II, "Normal Procedures," and should be complied with when cold weather conditions are encountered. The success of the next day's operation depends greatly on advanced planning and the preparations made during engine shutdown and postflight procedures. Because of their importance, these procedures will be treated first and at the same time a logical sequence of events will be maintained. Because of the mission of the B-36, which is long range, it would be normal for a flight to start in a warm climate and end in a cold climate. *Therefore, cold weather procedures start with engine shutdown and postflight procedures.*

ADVANCED PLANNING.

Proper advanced planning can mean success or failure of an entire cold weather operation. When planning, bear one thing in mind—"an ounce of prevention is worth a pound of cure."

1. The first part to consider is proper ground heating equipment. Each crew compartment should be heated, as well as the reciprocating engines and jet pods. Make sure there are the proper number of heaters, heater ducts, and electrical power plants for each aircraft. (Twenty heaters per aircraft desired.)
2. Make sure there are ample fueling facilities for the power plants and heaters.

3. If night work is anticipated, have ample supply of stand lights and drop lights.

4. All engineers and crew chiefs should be properly briefed on oil dilution during engine shutdown and engine starting in cold weather. This will be explained later in this section.

5. Snow and ice removal equipment should accompany each aircraft.

6. Two B-2 stands and two B-1 stands per aircraft are a minimum to be able to maintain an aircraft. More stands should be used if available. All stand steps and platforms should be coated with sheets of No. 3 grit sand paper. This is to prevent slipping when feet are wet.

7. Safety straps and ropes should be used while walking on slick wings.

8. A fuel tank repair crew should be set up to take care of existing leaks.

9. Aircraft servicing equipment should be checked and sumps drained before use.

10. A kit of cold weather handling equipment should be made up for each aircraft. This section relates the proper handling of this equipment.

POST FLIGHT PROCEDURES.

STOPPING RECIPROCATING ENGINES.

1. Air Plug Switches—OPEN.

2. Master Motor Speed Control Lever—FULL DECREASE.

3. Propeller Selector Switches—FIXED PITCH.

4. Alternator Controls—Positioned.

5. Dilute engine for anticipated temperature.

6. During the last minute of the dilution period specified in figure 9-5, in order to clean spark plugs, operate engines at 1600 to 1700 rpm and manually adjust to best power, provided oil temperature does not exceed 50°C and the cylinder head temperature does not exceed a maximum of 150°C. This clearing procedure will be abandoned if oil temperature reaches 50°C or cylinder head temperature rises above 150°C; however, the dilution period will be completed.

7. Close throttle.

Note

Never open throttles after shutdown.

8. Open air plugs to prevent post shutdown increase of engine temperature, which is conducive to subsequent condensation within cylinders.

9. Very slowly move the mixture control to IDLE CUT-OFF, thus allowing the chambers to be completely scavenged of moisture and carbon.

10. Fuel Tank Valve Switches—CLOSE.

11. Engine Fuel, Cross-Feed, and Manifold Valve switches—OPEN.

Note

Allowing these valves to remain open will prevent fuel expansion damage to the main manifold line.

12. Ignition Switches—OFF, after propellers have stopped.

13. Intercooler Shutter Switches—CLOSE, until intercooler shutters are fully closed.

14. Static Propeller Feather Check—Completed.

15. Engine Analyzer Power Switch—OFF.

16. Battery Switch—OFF.

OIL DILUTION.

To accomplish satisfactory starting of engines in cold weather, it is imperative that each engine oil system be diluted in accordance with the following procedure:

1. Stop engines, check oil level, and service if necessary. Allow engines to cool until oil temperatures are 10° to 50°C. While waiting for oil temperature to reduce to that required for dilution, service oil tanks and drain condensate from the oil tank sumps, oil cooler drains, and Y-drains. Experience has shown that in order to prevent accumulation of ice in the tank oil-out line, oil tank sumps must be drained from 15 to 45 minutes after shutdown.

Note

The sumps should not be drained after dilution. Draining the sumps after dilution would permit undiluted oil to enter the tank hopper and sump.

2. Restart the engines and idle at 1200 rpm.

3. Hold the oil dilution switches ON as long as required for proper oil dilution. The per cent dilution required will vary according to the lowest expected OAT. The dilution time required will vary according to whether diluent remains in the system from a previous dilution. If the engines have been operated for less than 1 hour following a full dilution it will be necessary to accomplish only a partial dilution when the engines are shut down to replace the diluent which has boiled off. Experience has shown that boil-off is influenced by CHT, oil temperature, bhp, and other factors and for this reason an exact determination for redilution following short engine runs is not practical. The two tables shown in figure 9-5 will give the required dilution at various OAT.'s and an approximation of the diluent remaining after certain periods of engine run.

The operation of the dilution system is indicated by a fuel pressure drop to approximately 20 psi. If this pressure drop is not obtained, investigate the cause. Pay particular attention to dilution solenoids which

OIL DILUTION *Tables*

Table I

EXPECTED OUTSIDE AIR TEMPERATURE	PERCENT DILUTION REQUIRED	DILUTION TIME REQUIRED (MINUTES)
4°C (40°F)	0	0
4°C (40°F) to –4°C (25°F)	10	2
–4°C (25°F) to —12°C (10°F)	15	3
–12°C(–10°F) to —21°C(–5°F)	20	4
–21°C(–5°F) to–29°C (—20°F)	25	6
–29°C (–20°F) to–37°C (–35°F)	30	8
–37°C(–35°F) to–53°C (–65°F)	35*	12

*MAXIMUM AVAILABLE

Table II

ENGINE RUN TIME (MINUTES)	PERCENT DILUENT REMAINING			ENGINE CONDITION
	35% DILUTION	25% DILUTION	15% DILUTION	
0	35	25	15	IDLE
1	32.5	23	14	IDLE
3	25	20	12	IDLE
5	19	18	10	IDLE
10	16	15	8	IDLE
15	15	11	7	MAG. CHECK
20	11	8	6	MAG. CHECK
25	9	6	5	OTHER CHECKS
30	7	5	5	OTHER CHECKS
35	6	5	4	OTHER CHECKS
40	5	4	3	OTHER CHECKS
45	4	3	3	OTHER CHECKS

For a full dilution use Table I. For a partial dilution obtain the percent diluent remaining from Table II and apply this value and the total percent dilution required to Table I to obtain the dilution times for these percentages. The difference in the time required, as indicated by Table I, will be the dilution time required to obtain the desired final dilution.

Example: If the expected OAT. is –29°C(–20°F) the dilution required will be 25 percent, as indicated on Table I. Then say the engine had been run at idle for 10 minutes and shut down. The diluent remaining would be 15 percent as indicated in the "Diluent Remaining, 25 Percent Dilution" column in Table II. Table I indicates that 6 minutes is required for 25 percent dilution and 3 minutes is required for 15 percent dilution. Therefore 3 minutes (6 minutes minus 3 minutes) is the dilution time required to replace the diluent lost during the previous engine operation.

NOTE

The required dilution for –53°C(–65°F), which is 40 percent, cannot be obtained on this aircraft but satisfactory operation can be obtained with the maximum dilution now obtainable, which is 35 to 37 percent.

79-118-A

Figure 9-5.

may be stuck, dilution lines which may be plugged, and restrictor fittings which may be reversed.

CAUTION

Do not allow the engine oil pressure to fall below 15 psi during dilution. If necessary, stop the engine until oil temperature drops to 10° to 50°C. If the oil temperature rises above 60°C during dilution, the engine must be shut down until the oil temperature drops sufficiently to allow completion of dilution on the next attempt.

4. Release the dilution switch at 500 rpm as the engine is being shut down and check for an increase in fuel pressure. This is important because only diluted oil must be circulated through the engine oil system.

5. Insure that the oil dilution valves are fully closed by performing the following check:

a. With fuel booster pumps ON, note fuel pressure and fuel flow indications.

b. Hold the oil dilution switch ON long enough to note fuel pressure drop and fuel flow increase.

c. Oil dilution switch OFF and observe fuel pressure rise to original value and fuel flow drop to original value. If either fails to return to the original value, the dilution valve did not close. In either case, corrective action must be taken.

Note

Under no circumstances will the oil dilution valves be used as a means of relieving trapped pressure in the fuel lines.

AFTER ENGINE SHUTDOWN.

After engine shutdown, the following procedure should be followed:

1. Drain fuel tank and booster pump drains before moisture freezes. If fuel tanks are kept filled, condensation in fuel lines and drains will be minimized.

2. Inspect turbo oil system vents and drains. Drain condensation.

3. Approximately 30 minutes after stopping engines, turn each propeller through 10 blades by energizing the starter continuously.

4. Install air intake ducts, engine, turret, nose compartment, blister, pilots' enclosure, and pitot mast covers. Install tape over static ports.

5. If wings are dry and no wind condition prevails, wing and elevator covers may be used. Wing covers should not be used if wings are wet because of the possibility of freezing the covers to the wings. If wing covers are available but surfaces are wet, coat surfaces with defrosting fluid and install covers. If wing covers are not available, section covers should be made locally.

6. Position the propeller blades so that two blades are down and one is up. Cover the tip of the blade that is up to prevent ice and snow from entering the anti-icing air exit opening.

7. Drain the overflow and filler lines for the roomette waste tanks. Drain all liquid containers.

POWER PLANT SERVICING.

The following is a list of oils that must be used in the engines and auxiliary power units during cold weather operations.

• SERVICE INFORMATION *Table* •

1. Reciprocating Engines • Specification MIL-L-6082, grade 1100 lubricating oil.

2. Jet Engines and Turbosuperchargers • Specification MIL-L-6081 grade 1010 or 1005 above −20°F, grade 1005 below −20°F.

3. Propellers

   Hub • MIL-0-6086 Grade M.

   Power Section • MIL-L-7870

4. Engine Instruments • Service the oil pressure lines of engine instruments with hydraulic oil, Specification MIL-0-5606 in accordance with instructions contained in T.O. 05-70-6.

5. Water Injection • 60 percent methyl alcohol and 40 percent distilled water, thoroughly mixed.

GI-732-A5

GI-732-A5

SNOW AND ICE REMOVAL.

The removal of ice and snow can present quite a problem if preparations have not been made prior to its arrival. The following is a list of do's and don'ts and the equipment needed in combating and removal of ice and snow.

1. It is necessary that all frost, snow, and ice be removed from the wings, tail surfaces, and propellers prior to flight. Even a slight amount of frost will disturb air flow over the air foil and reduce lift. Loose snow can be removed with a long-handled broom. Melted and refrozen snow is extremely difficult to remove.

WARNING

To insure free movement of control surfaces and wing flaps, the hinge points and the areas between the fixed and movable surfaces must be cleared of ice and snow.

2. Removal of frost and any light coating of ice may be accomplished by the use of defrosting fluid in accordance with Specification No. 3609. If snow or freezing rain is anticipated, the wing and control surfaces should be coated with defrosting fluid prior to arrival. Surfaces coated with de-icing fluid should be inspected every 4 hours and resprayed if necessary.

CAUTION

a. Due to the rapid evaporation characteristic of defrosting fluid, contact with the skin at low temperatures may cause serious frost bite.

b. Do not use picks, knives, or other sharp pointed objects to break ice as damage to the aircraft structure will result.

c. Use extreme caution when walking on surfaces after application of defrosting fluid.

d. The fluid should not be sprayed on engine surfaces or into engine air ducts leading to the carburetor or oil coolers.

e. After use of defrosting fluid, inspect surface hinge areas and remove deposits of slush; use heat if necessary.

f. Do not use defrosting fluid on sighting blisters or any other panes used for gun sighting.

g. During visual preflight, rotate the jet engines with the starter to assure freedom of movement. If ice is present, apply heat as soon as possible.

PREHEAT OF ENGINES AND AIRCRAFT.

1. Check the Y-drains and oil tank sumps for oil flow. If oil does not flow, apply external heat to Y-drain.

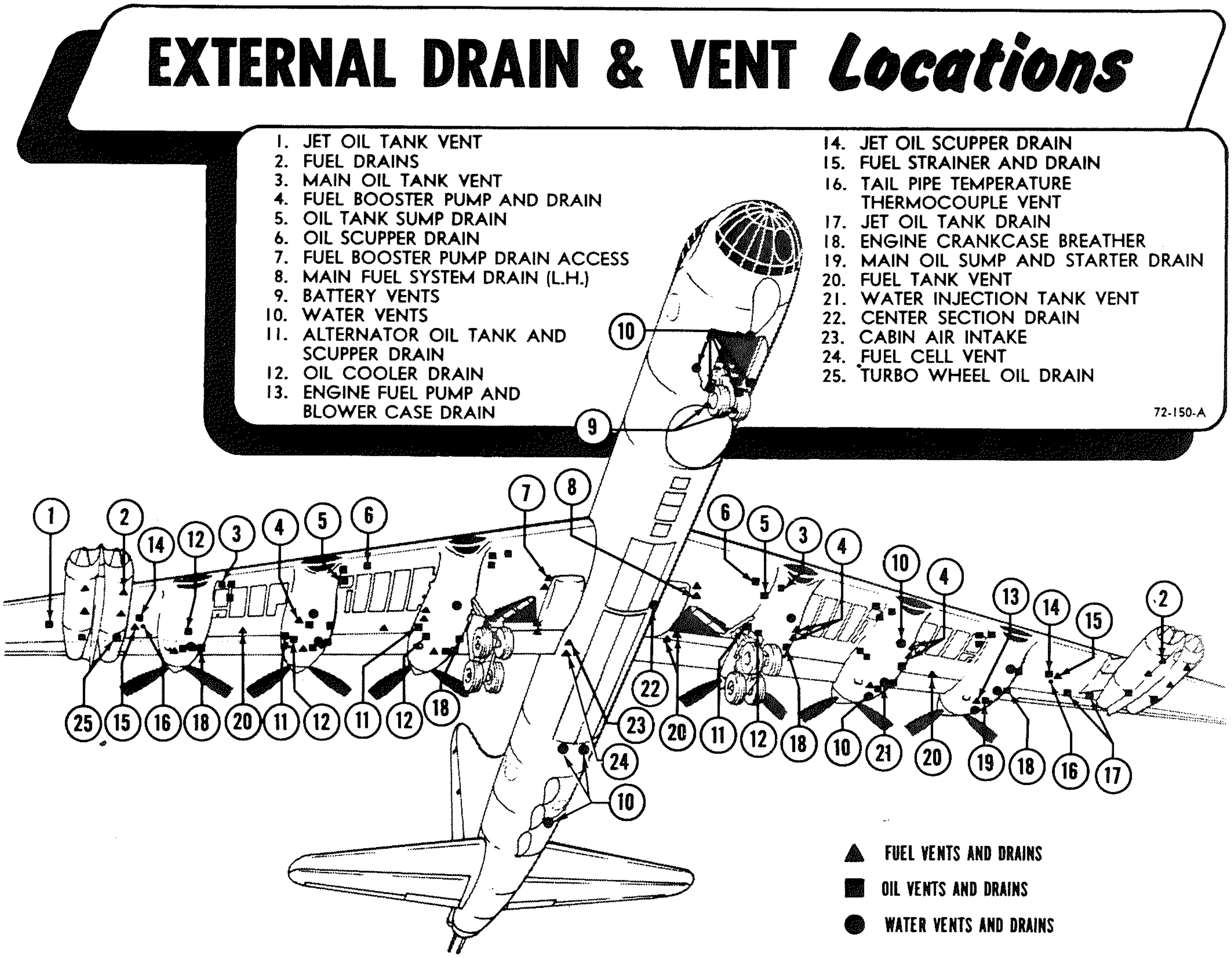


Figure 9-6.

CAUTION

Do not drain more than one-half pint in order to prevent undiluted oil from entering the oil line.

2. Oil screens should be checked before each flight during the early part of the cold weather period to remove engine sludge which has been washed down by oil dilution. After the first five or six oil dilutions, oil screens will be checked according to existing regulations.

3. Check turbo oil system drains for free flow and the turbo oil tank vents for freedom from frozen condensate. Insert a heavy wire in the vent line to check the first right angle bend in the line for freedom from ice.

4. Check all fuel, water, and oil tank vent lines and crankcase breathers for freedom from frozen condensate.

5. Apply external heat to the oil tank vent line aneroid valve for 30 minutes prior to starting. It has been found that during ground operation under cold weather conditions, ice forms in the aneroid valve, blocking the oil tank vent line. This results in excessive pressures being built up in the tank which will cause structural damage to the oil tank.

CAUTION

After engine start, observe the oil tank vents for 15 minutes for signs of escaping vapors which indicate that the aneroid valve is thawed and the line is open. If vapors are not observed, shut down the engine immediately and apply more heat to the aneroid valve.

It appears that the most critical period of operation is immediately after starting—probably the valve is warmed later on by hot gases from the engine being pumped back to the tank by the scavenge pumps.

6. Always preheat the engines any time oil dilution was not accomplished and OAT. is less than 0°C (32°F) or any time engines were diluted and OAT. is less than —9°C (16°F). Preheat as follows:

a. Connect two heater ducts to the air intake cover at the leading edge of the wings.

b. Install the engine cover (if not previously installed).

c. Connect one heater duct at the oil Y-drain access cover if temperature is below —40°C (—40°F).

d. Heat until cylinder head temperature indicates at least 0°C; oil will flow from the Y-drain and propellers can be pulled through. Always leave the air plug and intercooler shutters closed for all preheating.

7. Warm the oil supply by plugging in the external power source to the heating receptacle on the wing lower surface near each oil tank. The heaters heat the oil tank hopper and tank oil-out line. Use of heat is necessary when the OAT. is below the pour point of the oil which will vary from —7° to —18°C (+20° to 0°F).

OIL HEATING TIME *Requirements*

Outside Air Temperature	*Time*
−7°C (+20°F) to −23°C (−10°F)	10 minutes
−23°C (−10°F) to −29°C (−20°F)	20 minutes
−29°C (−20°F) to −34°C (−30°F)	30 minutes
−34°C (−30°F) to −40°C (−40°F)	40 minutes

73-136-A

The heaters must be completely covered with oil before using them to prevent coking of the oil and overheating of the heating elements. Therefore, do not operate the heaters if the oil level is below 145 gallons.

Note

To check for proper heater operation, see that the power consumption is 45 to 50 amperes for each heater installation; otherwise, because of their locations, it will be impossible to tell whether or not the heaters are functioning.

CAUTION

The hopper heaters heat only the oil in the hopper and tank oil-out line. The warm return oil from the engine will melt oil in the tank and if a serious oil leak develops the melting rate may not be of sufficient speed to replenish the oil in the hopper. This would result in an insufficient oil flow to the engine. Watch oil pressures closely since the oil level Liquidometer may be in congealed oil and may not show a change in oil level.

8. Turn on oil tank vent electric heaters 30 minutes prior to engine start. Operation of the heaters should be checked by inserting finger in the vent outlet 20 minutes after turning switch ON.

9. If low or no oil pressure is indicated after engine start, heat the oil-in line from the tank bulkhead to the oil shutoff valve. An effective method of heating the line is to cover the line with a piece of canvas and direct hot air under it.

10. Preheat the crew compartments to heat flight instruments, radios, dynamotors, rectifiers, radar, and other equipment within the airplane, and to retard the formation of frost on transparent areas when the crew enters the airplane.

CAUTION

Do not operate electrical cabin heaters unless two or more alternators are paralleled on the line.

11. To reduce engine power failure during flight due to fuel starvation when OAT. is low enough to cause ice crystals to form in the fuel system, the main strainers, carburetor and master control D chamber inlet screens, and all fuel system moisture drains should be drained prior to flight. This is especially true when single-point refueling is used, since experience has shown that moisture is more likely to be found after refueling by this method.

12. Check the fuel system for leaks and check all fuel drains for free flow. Apply heat where necessary to obtain flow.

13. Install warm battery or heat cold battery if it has not been removed after preceding flight.

14. Check the tires and shock struts for proper inflation.

CAUTION

Checking and servicing of tires and shock struts may result in valve leakage. Usually this can be corrected by applying external heat.

If the aircraft has been parked more than 48 hours in temperatures of —40°C (—40°F) or below, the tires must be heated and rotated. Heat should be left on the tires for at least 15 minutes after rotation to eliminate the flat spot.

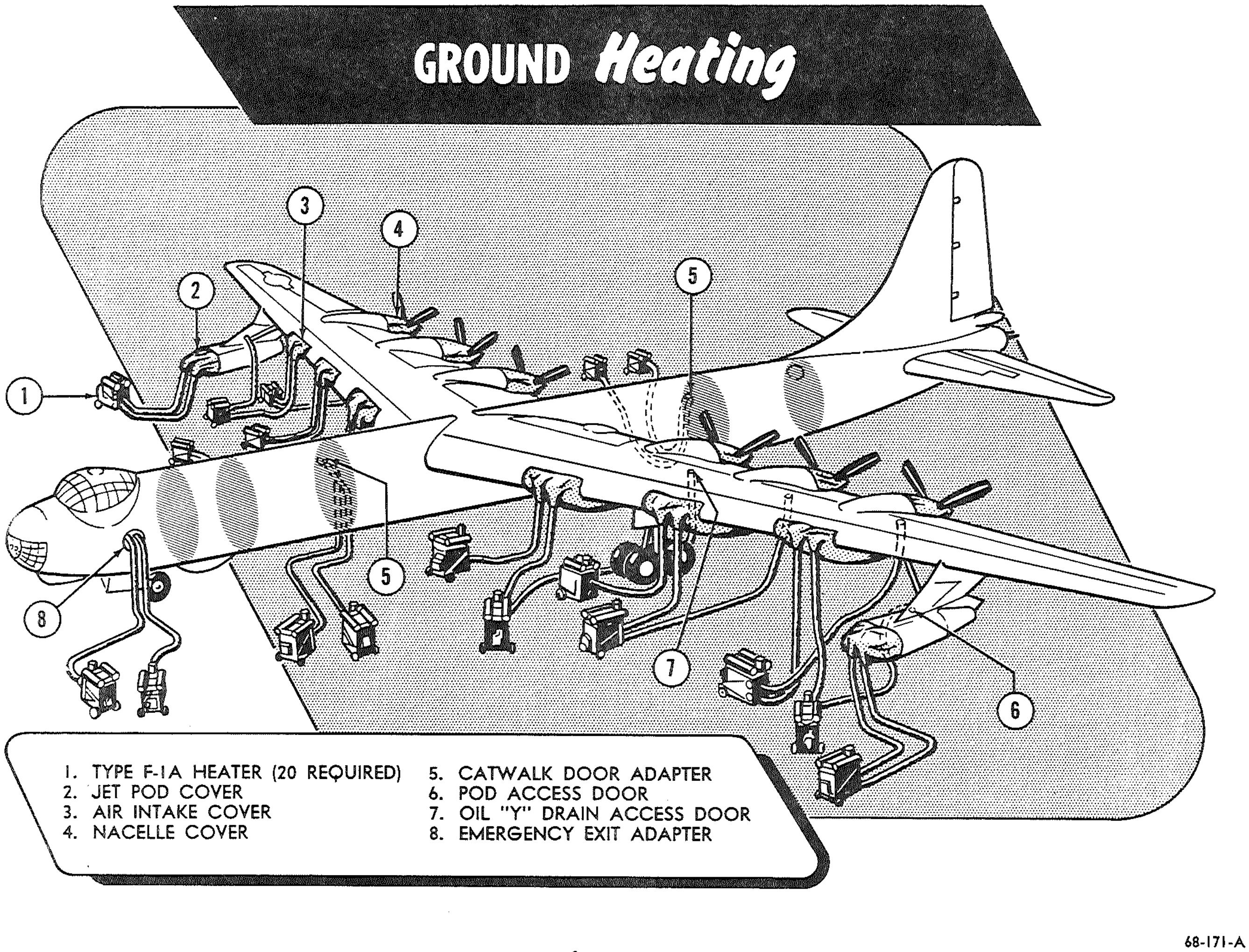


Figure 9-7.

15. Remove the covers of the engines, wing, tail, guns, pilots' enclosure, nose compartment, blisters, and pitot masts. Also remove tape from static ports.

16. Remove ice, snow, and frost from the fuselage, wings, and horizontal stabilizer. Inspect gun turret door tracks and remove ice and snow. Snow can be removed by brushing with brooms, use of portable heaters and alcohol, or by vibrating a rope across the wing surface. Ice must be removed carefully to prevent scratching or marring the wing surfaces.

17. Remove ice, frost, snow, and dirt from the landing gear shock struts, actuating cylinders, wheels, and brakes. After shock struts and actuating cylinders are clean, wipe with a hydraulic fluid soaked cloth.

BEFORE STARTING RECIPROCATING ENGINES.

Use the normal "Before Starting Check List," except omit items 14, 17, 18.

CAUTION

In the event the air plugs were inadvertently left open, do not attempt to close them until the engines are started and sufficient heat from the engine has warmed the air plug actuator and jackscrews. Do not open the air plugs, intercoolers, or inflight oil cooler doors until the cylinder head temperature reaches 170°C.

Note

Normal starts can be made when the cylinder head temperature reaches 0°C. No damage can result from prolonged heating, whereas considerable difficulties may result from insufficient heat.

STARTING RECIPROCATING ENGINES.

The engineer will start the engines as follows:

1. Engine Analyzer Power Switch—ON. This allows the analyzer time to warm up for monitoring the ignition system during starting.

2. Fuel Tank Valve Switches—OPEN. Use a minimum of two tanks containing fuel.

3. Booster Pumps of Tanks Being Used—ON. To provide positive fuel pressure (10 to 14 psi) to engine-driven fuel pump and fuel under pressure to primer. The primer is effectively inoperative without pressure.

4. Voltage and Frequency Selector Switch—No. 4 position. See that bus voltage provided by external power source is within limits by moving the selector switch to the bus position. Then move it to the No. 4 position. This will allow you to observe voltage and frequency of engine being started.

5. Throttle Levers—As required. If it becomes necessary to restart a relatively "hot" engine, a more open throttle setting may be required.

6. Inform ground observer, "Ready to start engines, clear No. 4."

7. Engine No. 4 Starter Switch—ON. Energize starter continuously for nine blades. Maintain contact with the observer for reports of propeller movement. This procedure is followed to minimize the possibility of damage in the event of a liquid (hydraulic) lock.

Note

Nine blades are necessary to provide an adequate liquid lock check.

8. No. 4 Engine Ignition Switch—BOTH after nine blades of propeller rotation.

9. Prime as required.

10. No. 4 Mixture Control Lever—NORMAL.

CAUTION

Maximum continuous cranking time is 1 *minute;* then allow the starter to cool a minimum of 3 *minutes.*

11. Report, "Alternator normal, oil and fuel pressure normal."

CAUTION

If oil pressure does not register 25 psi within 30 seconds, the engine will be shut down and the cause investigated.

Note

Minimum oil pressure at ground idle speed after oil has reached operating temperature is 25 psi.

Adjust voltage to 208 volts and check frequency for normal indication to allow control circuits to stabilize. Move the voltage and frequency selector switch to the number of the next alternator-equipped engine to be started.

Note

The frequency will increase with the temperature of the control circuit resistor.

Do not move the frequency control knob beyond the mechanical stop during ground operation. If the mechanical limit is exceeded overspeeding may occur.

CAUTION

a. If excitation of the alternator is not immediately apparent, the field will be flashed. If flashing the field fails to excite the alternator, shut down the engine. With no meter indication, malfunctions which might cause alternator damage would not be evident.

b. Alternators must be excited and properly governed before advancing the throttles above 1400 rpm. This is necessary so that the alternators can be checked when the engines are run up. If the frequency of any alternator increases with an increase in engine rpm and cannot be adjusted, then the affected engine must be shut down and the constant-speed drive unit checked. Otherwise an overspeed condition may be reached, causing the units to disintegrate and cause a serious fire.

12. Repeat steps 4 through 11 for starting engines 5, 6, 3, 2, and 1. Since No. 1 and 6 engines are not alternator-equipped, references to alternators in the starting procedure should be disregarded.

Note

If the engine stops running with the mixture control in NORMAL, the lever should be returned to the IDLE CUT-OFF position. After the starter has been allowed to cool, the starting procedure may be repeated.

ENGINE STARTING TROUBLES AND REMEDIES.

1. Possible starting troubles and the proper corrective action are shown in the table below.

2. If the oil pressure is too high after starting, or if it fluctuates and drops back with an increase of engine rpm, do not exceed idle rpm until the oil temperature reaches minimum allowable. Erratic or high oil pressures may be caused by the high viscosity of the oil due either to applications of insufficient preheat or to insufficient dilution after the last flight.

CAUTION

If fuel pressure is lower than normal, check for a stuck oil dilution valve.

3. If no indication of oil pressure is obtained within 50 seconds after starting, shut down. After approximately 5 minutes, make a restart and run an additional 50-second period. If pressure is still not obtained, shut down and check for oil flow at Y-drain. If no flow is obtained at the Y-drain apply heat in this area for 30 minutes. If flow is satisfactory from Y-drain, apply heat to oil lines between tank and oil shutoff valve for 30 minutes. The primary and most common causes for lack of oil pressure indications are:

a. Congealed oil in the engine oil-in line, usually near the tank.

b. Failure of oil pressure gage to indicate properly because of congealed oil in the pressure lines or transmitter.

Note

To minimize this type of trouble, purge the pressure lines with hydraulic fluid after every fifth start.

4. If oil pressure drops after a few minutes of ground operation, shut down the engine and check the following:

a. Y-drain for congealed oil or ice.

b. Blown lines or oil coolers.

c. Failure of pressure gage.

d. Oil strainers for foreign materials which might indicate that engine failure is the cause of low oil pressure.

e. Insufficient hopper heat.

Note

Oil dilution may be used to reduce viscosity of the oil if time does not permit normal engine warm-up or if the oil pressure is too high for a prolonged period.

CAUTION

Dilute oil with care because engine failure can result from overdilution.

ENGINE WARM-UP.

After engine start, with air plug and intercooler shutters closed, if the OAT. is —18°C (0°F) or below or if 170°C CHT cannot be obtained, the following engine warm-up procedure should be used:

1. Idle the engines at 1000 to 1200 rpm with carburetor preheat ON until oil-in temperature reaches minimum limits.

2. With the propeller master motor set at 2700 rpm, increase engine rpm to 1550 rpm.

3. After power has stabilized, reset master motor to 1550 rpm and increase M.P. to 30 inches.

Trouble	*Probable Cause*	*Corrective Action*
Failure to start	Frosted spark plugs	Additional preheat
Low fuel pressure	Faulty oil dilution valve	Check for stuck valve
Low oil pressure	Congealed oil in lines Faulty instrument pressure for lack of fluid in lines or congealed oil	Apply heat to lines Check instruments Check instrument system and bleed lines with hydraulic fluid
High oil pressure which falls off or fluctuates when rpm is increased	Heavy viscous oil	Additional preheat to tank and lines if pressure is below limits
Props not controllable	Stuck solenoids	Apply heat
Oil leakage from turbos into shrouds	Turbo oil tank vent obstructed with ice Faulty antileak valve	Clear vent Replace valve

4. When oil-in temperature reaches 60°C or above, increase rpm to 2000, maintaining 30 inches M.P.

Note

While waiting for the engines to warm up, make all field barometric pressure checks except high fan and magneto check.

5. When oil-in temperature reaches 70°C, turn carburetor preheat OFF and make high power checks.

CAUTION

Do not go above 2200 rpm until oil-in temperature reaches 70°C or above.

6. Attempt to maintain CHT from 210° to 225°C during all ground operation. This may require keeping the air plugs fully closed.

Note

It would require from 45 minutes to 1 hour of engine operation at normal temperatures to evaporate all the fuel in the diluted oil. Even though high oil inlet temperatures of 70°C (158°F) and above would shorten the period, this procedure is not recommended. Normal warm-up procedure will evaporate sufficient fuel to assure normal scavenging.

7. After several days layover, during which time the engine has been started and diluted several times, it is advisable to ground run the engine for at least 30 minutes at normal cylinder head and oil inlet temperatures prior to take-off. It is also recommended that the oil level be checked; it may have fallen considerably due to evaporation of gasoline. The ground run will tend to eliminate any excess dilution which might otherwise cause oil discharge through the breathers or loss in oil pressure during high power take-off or operation.

DURING ENGINE WARM-UP.

1. Ignition Switch Check—Idle rpm.
2. Engine-Driven Fuel Pumps—Check.
3. Heat and Anti-Icing Check—Completed.

Note

To prevent overheating of the tail structure do not allow the temperature of the tail anti-icing air to exceed 105°C (221°F) during ground operations. Use the cabin heat and tail anti-icing control switches to reduce the temperatures of the tail anti-icing air.

4. Alternator Checks—Completed.
5. Engine Oil-In Temperature—Minimum 70°C.
6. Check all instruments for proper operation.
7. To prevent the flight instruments from cooling and to aid in windshield defrosting, operate the cabin heating system as follows:

a. Increase the manifold pressure on the inboard engines until a good cabin heat air flow is obtained. If the air thus supplied is insufficiently warm for defrosting, turn on the tail anti-icing system and place the cabin booster fan switch in the LOW RPM position to raise the temperature of the cabin heating air at the secondary heat exchanger.

b. Increase cabin temperature and aid defrosting by utilizing the auxiliary cabin heaters.

CAUTION

To avoid overloading the a-c system because of the high power requirements of the auxiliary cabin heaters, do not operate these heaters unless two or more alternators are on the line.

8. Check windshield wiper operation.
9. Operate the wing flaps and bomb bay doors through at least one cycle.

ENGINE RUN-UP.

CAUTION

After engine start, observe the oil tank vents for 15 minutes for signs of escaping vapors which indicate that the aneroid valve is thawed and the line is open. If vapors are not observed, shut down the engine immediately and apply more heat to the aneroid valve.

Use normal engine run-up procedures as outlined in Section II.

STARTING JET ENGINES.

Use the normal starting procedure.

Note

A slightly longer cranking period will probably be required to bring the jets up to starting rpm than is required in warmer weather.

TAXIING AND PARKING.

1. Avoid use of brakes as much as possible during last part of taxiing and parking. This prevents the brakes from getting hot and then freezing. If brakes are frozen heat can be used, but the aircraft should be moved as soon as brakes are thawed to prevent re-freezing.

CAUTION

Under certain snow and ice conditions the use of differential power and braking may result in a skipping or lateral skidding action of the nose wheel. This skipping action can best be overcome by stopping the airplane, changing the nose wheel angle, and resuming taxiing. Light braking may be erratic and lack proper brake "feel"; therefore, control ground speed with one pair of propellers in reverse. Use propeller reversing with caution as the resulting snow cloud may blind the pilot.

2. Wheel covers should be installed when the airplane is parked and when snow and ice are present.

BEFORE TAKE-OFF.

1. Keep CHT as high as possible within allowable limits using the air plugs to control temperatures.

CAUTION

Flight indicators are not very reliable at temperatures below —43°C (—45°F). For this reason cabin heating is very necessary during warmup and take-off, and all flight instruments must be cross checked.

2. Frequent exercising of the brakes during power stabilization and prior to take-off may prevent brakes from freezing.

CAUTION

Brakes will not hold the aircraft during high power runs on ice and snow.

TAKE-OFF.

WARNING

Ice on the horizontal stabilizer can seriously reduce the effectiveness of the elevators to the extent that take-off altitude cannot be attained.

1. Turn on pitot heaters and the wing and tail anti-icing systems if precipitation is encountered or if icing conditions are anticipated at the beginning of the take-off roll. Icing conditions may exist where there is visible moisture in the air at outside air temperatures of 7°C (45°F) and below. Most severe icing conditions usually occur in the range from 0°C (32°F) to —15°C (5°F) OAT.

2. If oil dilution was used on previous engine shutdown, take-off can be made as soon as oil pressure is normal, engine operation is smooth, and CHT is up to 180°C. Precaution must be taken to insure that the oil pressure is normal. Oil pressure below normal may be due to overdiluted oil. Cold oil properly diluted has the same viscosity as warm undiluted oil and therefore the same ability to circulate and properly lubricate the engines. The term "overdilution" has been used to indicate any amount of dilution which causes the engine scavenging system to break down and discharge diluted oil through the engine breather.

3. In order to avoid overtaxing the engine on take-off or to avoid standing short on take-off horsepower available, it is essential to make the proper humidity and CAT. correction to manifold pressure. These corrections modify the value of M.P. necessary to develop the torque corresponding to 3500 bhp. This is especially true in cold weather operation where it is quite easy to take more than 3500 bhp out of the engine if normal day M.P. is used.

CAUTION

Do not pull more than 3500 bhp torque. Also, do not exceed the corrected M.P. while trying to attain 3500 bhp, since an engine malfunction may exist.

4. Under certain cold weather conditions water injection may cause drowning of cylinders and loss of power due to improper vaporization of the water mixture. Since limiting operating temperatures (CAT., CHT, water temperature, etc.) have not been established, *it is urgent that a test on at least one engine be performed prior to take-off to determine whether operation at wet take-off power is satisfactory.* This test period should be of at least 1 minute duration. The results of this check will determine whether water injection should be used for take-off. Loss of torque and rough running are indications of improper engine operation with water injection.

Note

Do not exceed 3250 bhp unless water injection is used.

5. It is advisable to maintain CAT. above freezing, if possible to do so without exceeding the maximum CAT. limit. The desired temperature range is from +20° to +35°C to avoid carburetor icing as well as to aid in vaporizing the fuel and water.

Note

The CHT measured on D-5 cylinders should be at least 225°C to also aid in vaporizing the fuel and water.

It is recognized that use of the carburetor preheat system may result in excessive CAT. at take-off power if used at ambient temperatures in excess of —12°C (10°F). At ambient temperatures higher than this the preheat system is not needed due to adequate temperature rise from turbo compression. It is suggested that under these conditions, CAT. be controlled by intercooler shutters.

For ambient temperatures of —12°C (10°F) or less, use of the preheat system should be attempted. The exact upper limit of outside air temperature at which preheat should be used has not definitely been established, but tests have been proposed to evaluate the preheat system at or near the previously defined upper limit of OAT. at which carburetor preheat could be used.

Although the CAT. may be within limits with carburetor preheat ON at the beginning of the take-off run, the application of full power may cause the CAT. to increase rapidly and exceed the safe range resulting in loss of manifold pressure and power. In view of this, *any aircraft operating in cold weather with an OAT. of —12°C (10°F) or lower should make a preliminary preheat evaluation by performing a simulated take-off and trying the system on one engine.* To do this the intercooler shutters should be OPEN, the CHT should be at the low limit, and the preheat system should be operated with the circuit breaker at the start of the take-off roll. *The results of this test will determine whether it is safe to use preheat on all six engines for take-off.*

If CAT. is maintained in the range specified, the worst icing that could be encountered would be in the small mixture control bleed at the bottom of the regulator resulting in an enrichment that can be easily controlled with the mixture control lever. *If CAT. is not kept above freezing there is danger of icing the entire induction system and metering elements of the carburetor. Icing of the impact tubes and/or passages can result in dangerous leaning which cannot be controlled.* Icing of the split mixture control bleed in the boost hanger will result in a very high enrichment that is difficult to control with the mixture control lever.

Note

> The engineer should watch the carburetor air temperature indicator and be ready to reduce CAT. by opening the intercooler shutter or by turning off the carburetor preheat system.

6. Turn off all auxiliary cabin heaters until after the landing gear and flaps are up.

7. Instruct the scanners to watch for locked wheels during take-off. Don't be alarmed if the brakes should lock temporarily while on snow and ice, because you will be able to retain control of the airplane. Ordinarily, the brakes will not hold the airplane on ice and snow above normal rated power.

8. If discharge through the oil breather is noted at take-off, reduce rpm as quickly as practicable and operate engines at moderate powers for 10 to 15 minutes before increasing rpm. Oil discharge should cease soon after the reduction in rpm. When most of the diluted oil has been expelled as indicated by normal oil pressure and temperature, normal engine operation can be resumed. If the oil discharge does not cease after reducing rpm, land and investigate the cause. Should the persistent discharge of oil be caused by high dilution of oil throughout the tank, drain the oil from the tank and refill with undiluted oil.

DURING FLIGHT.

For *all* operation, maintain the recommended range of CAT. to (1) aid in fuel vaporization, (2) reduce tendency to lead-foul spark plugs, and (3) improve fuel economy to extend range.

APPROACH.

1. Follow the normal procedure except use carburetor preheat as required and, if possible, employ a long, low approach to aid in keeping cylinder heads above critically low temperatures of 170°C and the oil temperature above 75°C.

2. Apply carburetor preheat as required during the entire landing operation. If a sudden acceleration is necessary, heat will be available for fuel vaporization regardless of how low cylinder head temperatures have dropped. However, should full power be required for a take-off or a go-around, keep carburetor air temperature below maximum allowable limit and be ready to reduce or shut off carburetor preheat. (See "Emergency Use of Carburetor Preheat" of this section.)

3. The air plugs should be closed during prolonged glides or approaches.

4. Temperature inversions are common in winter in arctic regions. Thus, the air may be from 15° to 30°C (27° to 54°F) colder on the ground than at altitude. Therefore, care must be taken to avoid rapid cooling when letting down. Extend the landing gear and use partial flaps to reduce air speed. Also, regulate the intercooler shutters to eliminate excessive engine cooling. Maintain cylinder head temperatures above 170°C minimum.

LANDING.

When landing on slick or icy runways and traction is poor, nose wheel steering may have little effect on directional control of the airplane, even though it is operating properly. When landing on a dry runway spotted with ice, it is possible to skid the nose gear on the ice and damage it by a full deflection. Directional control should be maintained with the throttles until the airplane is almost completely stopped. Practice this procedure on dry runways so as to become accustomed to the reverse action of the throttles when the propellers are in reverse thrust position. When landing in loose snow, exercise caution during reverse thrust application to prevent obscuring the runway with flying snow particles. Obscuring the runway with flying snow is especially possible below 50 mph.

The following precautions should also be observed:

1. Use the brakes with caution when landing on snow or ice.
2. When reversing propellers, apply only enough power to decelerate airplane without obstructing vision by blowing snow.
3. Toward the end of the landing roll, turn off the wing, empennage, and propeller anti-icing.
4. Approach the end of the runway very slowly to prevent skidding when turn is started.

KITS AND LOOSE EQUIPMENT.

The following is a list of kits and their components needed for smooth operation during arctic conditions:

1. Snow and Ice Removal Kit for Each Aircraft.
   a. Two brooms.
   b. Two squeegees with 6-inch handles.
   c. Two safety harnesses with 150 feet of rope for each harness.(For walking on slick wings.)
   d. 150 yards of cheese cloth.
   e. Wing and elevator covers if available.
   f. Two barrels of de-icing fluid, Specification No. 3609.
2. Engine and Aircraft Duct Cover Kit.
   a. Six air intake covers.
   b. Six engine covers.
   c. Six propeller tip covers.
   d. Two main landing gear strut covers.
   e. Eight main gear tire covers and two nose wheel tire covers.
   f. Six oil-in line covers. (These will have to be locally manufactured.)
   g. Electrical harnesses for oil tank hopper heaters.
   h. Four jet engine covers.
3. Miscellaneous Equipment.
   a. One rubber hose, 1-1/2 inches by 10 feet (for servicing auxiliary power units and heaters from bomb bay manifold stopcock).
   b. One large funnel, 6 inches by 1 inch.
   c. One 5-gallon bucket.
   d. Three drop lights with 100-foot cord for each.
   e. One complete copy of cold weather operating instructions.

CHECK LIST—COLD WEATHER.

PREHEATING.

1. Engine—Supply external heat through engine tunnel until D-5 cylinder reaches at least 0°C. Remove just before engine start.
2. Hopper Sump and Line—Use electrical heat 1 minute for each 1°F below 0°F, prior to engine start. Cut circuit just prior to engine start.
3. Oil Tank Vent Line—Use electrical heat at least 30 minutes prior to engine start and continue heat after start.
4. Flight Deck Instruments—Supply external heat to flight deck for at least 30 minutes prior to engine start to warm instruments.
5. Oil Tank Vent Aneroid Valve—If the OAT. is below 0°C (32°F), apply external heat to valve for at least 30 minutes prior to engine start.
6. Oil line—If the OAT. is below —40°C (—40°F), (1) supply external heat to the oil-in line from the shutoff valve to the oil tank. The most effective method for doing this is to cover the line with canvas and direct hot air under it for at least 30 minutes. (2) Supply external heat through the Y-drain access for at least 30 minutes. Leave heat on until oil pressure is satisfactory on starting.

Note

It is assumed that the oil was properly diluted prior to cold soak; if not, a longer period will be required.

BEFORE STARTING ENGINES.

1. Check turbo oil system drains for free flow and turbo oil tank vents for frozen condensate.
2. Check all fuel, water, oil tank, and crankcase breather vents for frozen condensate.
3. Check all fuel and oil line hose clamps for tightness.

OIL PRESSURES.

1. If oil pressure does not reach 25 psi in 50 seconds after engine start, shut down the engine and proceed as follows:
   a. Reinstall the engine tunnel heat ducts to continue engine preheat.
   b. Check for oil flow at the Y-drain. If no flow is obtained apply heat in this area. If flow is satisfactory from the Y-drain apply heat to the oil lines between tank and oil shutoff valve. Apply the heat as recommended under "Preheat of Engines and Aircraft," steps 6 thru 9 of this section.
   c. Supply hopper sump and line heat for at least an additional 30 minutes.
   d. Continue heat to flight deck.
   e. Purge the oil pressure indicating line with hydraulic oil, Specification MIL-O-5606, per instruction in T.O. 5P2-1-1 even if it has been previously purged.
   f. Supply external heat directly to oil pressure transmitter for at least 20 minutes.
   g. Check oil shutoff valve manually to make certain it is open.
   h. Prevent oil tank pressurization by method recommended under "Preheating," step 5.
2. Repeat engine starting procedure outlined under starting engines. If oil pressure does not reach 25 psi in 50 seconds on this second attempt, shut down and check for bad instrument or transmitter, or for obstruction in the oil-in line.

• Hot Weather Procedures •

GI-450-A

BEFORE ENTERING AIRPLANE.

1. Cool the crew compartments by the use of type A-1 portable coolers. The 15-foot refrigerant lines can be routed into the cabins through the entrance hatches.

2. Check all fabric surfaces and control surface hinge points for freedom from fungus. If fungus is evident, remove it from all surfaces, except the fabric surfaces, with a stiff brush or compressed air. Use a clean soft cloth for the fabric surfaces.

3. Inspect the oleo struts and tires for cleanliness and proper inflation.

4. Inspect all limit switches for moisture.

5. Remove the engine and air duct covers and other protective covers.

ON ENTERING AIRPLANE.

1. Operate all movable surfaces.

2. If necessary, warm electrical instruments with an external source of heat until all moisture is eliminated.

3. Inspect gun turret bays for excess moisture and remove by the application of heat.

4. Start the cabin ventilating fans as soon as the external power supply is connected.

5. Check the wing and fuselage drainage and ventilating holes.

STARTING RECIPROCATING ENGINES.

Use the normal starting procedure, except a more open throttle may be required.

1. Operate the engine-driven fans only in low ratio.

2. Do not overprime the engines.

3. Do not exceed cylinder head temperature limits during engine warmup.

DURING ENGINE RUN-UP.

Use normal run-up procedures as outlined in Section II. During hot weather operation, carburetor air temperatures in excess of 38°C will occur. Carburetor air temperatures as high as 60°C may be experienced when ambient air temperatures are 27°C and higher. However, this should have no detrimental effect on the engine. A combination of extreme high carburetor air temperatures and high CHT will possibly cause engine detonation.

STARTING JET ENGINES.

Use the normal starting procedure.

TAKE-OFF AND LANDING.

Extremely warm weather necessitates a long take-off and landing run, and increases the sinking speed of the airplane. Maximum cylinder head temperatures for take-off must be kept within limits. If high carburetor air temperatures are being encountered during ground run-up, use the following procedure:

1. Engineer—Make the propeller reverse safety check immediately after completion of the final engine check.

Note

The aircraft will be taxied into take-off position WITHOUT the use of propeller reversing.

2. Pilot—Set full take-off power on jet engines.

3. Engineer—Set "no boost" power on reciprocating engines. Report to aircraft commander, "Power is set."

4. Aircraft Commander—Release brakes.

5. Engineer—Advance TBS to full take-off power (corrected for humidity), water injection on.

6. Engineer—Report to aircraft commander prior to nose-up speed, "Power stabilized, propeller governing."

STOPPING ENGINES.

Stop the engines as soon as possible. Use normal procedure.

• Desert Procedures •

GI-451-A

BEFORE ENTERING AIRPLANE.

1. Cool the crew compartments by the use of two type A-1 portable coolers.

2. Make sure the carburetor air filters are installed and connected.

3. Check the operation of the filter doors.

4. Operate all movable surfaces.

5. Use a cloth moistened with hydraulic fluid to wipe the nose and both main gear shock struts and exposed portions of actuating cylinders free of dust and sand.

6. Check tires and shock struts for proper inflation.

7. Remove ground cooling ducts, engine and airplane covers.

ON ENTERING AIRPLANE.

1. Start the cabin ventilating fans as soon as the external power supply is connected.

2. Clean the instrument panels with a lint-free cloth to remove any dust or sand.

3. Operate all instruments that can be checked without engine operation by using an external source of power.

STARTING RECIPROCATING ENGINES.

Use the normal starting procedure, except a more open throttle may be required.

1. Operate engine-driven fans in low ratio only.
2. Do not overprime the engines.

ENGINE WARM-UP.

1. Conduct ground operation in a minimum amount of time.

CAUTION

Do not operate the engine-driven fans in high ratio during ground operation or take-off.

2. Do not exceed cylinder head and carburetor air temperature limits.

STARTING JET ENGINES.

Use the normal starting procedure.

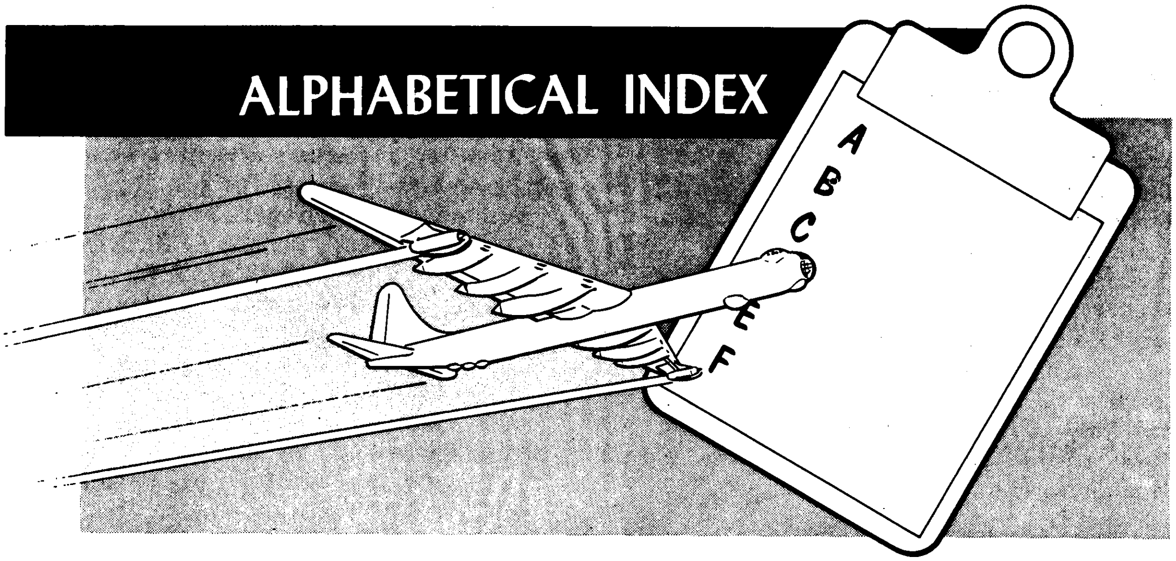
TAKE-OFF AND LANDING.

See "Take-Off and Landing" under "Hot Weather Procedures" of this section.

STOPPING ENGINES.

1. Park the airplane into the wind.

2. Stop the engines as soon as possible.



72-130-A

*Denotes Illustration

*Denotes Illustration

*Denotes Illustration

*Denotes Illustration

*Denotes Illustration

*Denotes Illustration

*Denotes Illustration

*Denotes Illustration

*Denotes Illustration

*Denotes Illustration

*Denotes Illustration

— G —

*Denotes Illustration

*Denotes Illustration

— J —

*Denotes Illustration

*Denotes Illustration

*Denotes Illustration

*Denotes Illustration

*Denotes Illustration

*Denotes Illustration

*Denotes Illustration

*Denotes Illustration

*Denotes Illustration

*Denotes Illustration

*Denotes Illustration

*Denotes Illustration

*Denotes Illustration

*Denotes Illustration

*Denotes Illustration

— U —

— V —

*Denotes Illustration

*Denotes Illustration