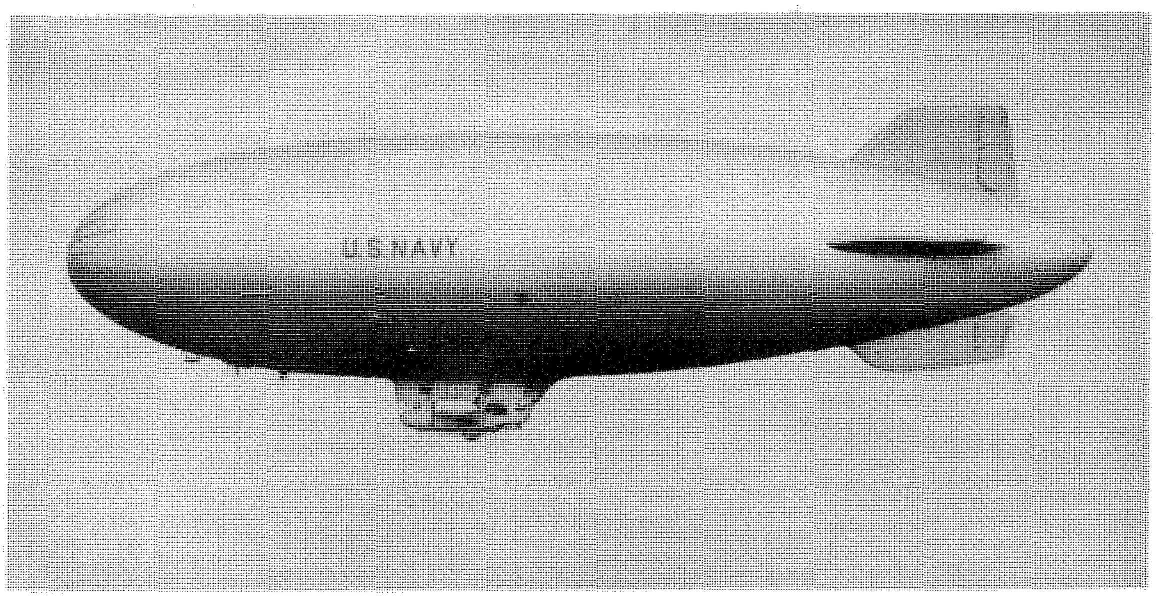
NAVAER 01-195PAC-501

Flight Handbook

NAVY MODEL

ZSG-4

AIRSHIP



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The supplement to this publication shall not be carried in aircraft on combat missions or when there is a reasonable chance of its falling into the hands of an unfriendly nation.

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1 April 1955

LIST OF REVISED PAGES ISSUED

INSERT LATEST REVISED PAGES. DESTROY SUPERSEDED PAGES.

NOTE: The portion of the text affected by the current revision is indicated by a vertical line in the outer margins of the page.

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INTERIM REVISION SUMMARY

The following Interim Revisions have been either canceled or incorporated in this Flight Handbook:

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Number	*Date*	*Purpose*

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FOREWORD

A BRIEF DESCRIPTION OF THE SCOPE AND FUNCTION OF THIS HANDBOOK

The primary function of this handbook is to furnish all the information required by each crew member to operate the ZSG-4 airship intelligently, safely, and efficiently. The handbook is not intended for use by pilots alone, but is a reference source for all crew members concerned in the operation of the airship. Each crew member should read thoroughly all sections to fully understand his responsibility and the relation of his function to the airship and the rest of the crew. Ground check all duties and procedures aboard the airship before attempting a flight. Keep the handbook readily available as a source of technical information and refer to it frequently.

Although crew duties are listed in section VIII of this handbook it should not be assumed that all the information a crew member needs to execute his duties is included in this section. It will be necessary to refer to all sections of the handbook. For example, the flight mechanic's duties are outlined in section VIII, but initial operation of the engines should not be attempted until the descriptions of the engine and power plant systems in section I are understood. Next, the mechanic should read the applicable portions of section VII covering engine, fuel system, oil system, and other power plant systems operation. Spark plug fouling, mixture leaning, cylinder head temperatures, fuel flow, oil cooling, and similar considerations are discussed in this section. Additional information of importance is contained in appendix I on the engine performance chart, the engine operating limits chart, and the combat allowance chart. Further information on power plant operating limitations is included in section V. Finally, the instructions in sections II and III for normal and emergency operation of the engines and related systems must be read thoroughly and understood. Special aspects of engine operation in cold or hot weather conditions are discussed in section IX. After studying all of the data related to his duties, the flight mechanic is prepared to make a ground check of operating procedures. Other crew members should use the handbook in a similar manner to learn their duties.

The technical information in this handbook reflects the most current data available at this writing and will be kept current by frequent revision of the handbook. However, since time delay is unavoidable in the processing of the books, flight crews are expected to keep abreast of pertinent technical directives covering critical flight restrictions or new techniques which have not yet been incorporated in the handbook.

It is assumed that crew members are trained lighter-than-air personnel who are familiar with certain basic types of equipment. Consideration has been given to new applications of familiar equipment to ensure correct operation of the equipment as used on the ZSG-4 airship. Flight instructions of a general nature are included only where necessary for clarity of description.

Descriptions, procedures, and illustrations applicable to all ZSG-4 airships are not coded in this handbook. Where differences in airship systems or component installations occur, the earliest installation is discussed first and discussion of later configurations follows in order. Identification of text or illustration material applicable to a limited number of airships is by BuAer airship serial number. The serial numbers, in parentheses, appear in the applicable paragraph headings, illustration titles, or illustration call-out lists to identify limited application of the subject matter. The serial numbers appear as a footnote on pages where space is insuffcent for direct notation. Unless specifically noted, all installations and procedures applicable to airship 131919 are applicable to 133639.

The handbook is divided into nine sections and an appendix as follows:

IMPORTANT

READ THESE PAGES CAREFULLY TO GAIN THE MAXIMUM BENEFITS FROM THIS HANDBOOK

SECTION I - DESCRIPTION. This section contains a description of the airship, the power plant, and all controls and systems essential to flight. Descriptions are presented in the following sequence: airship, engines, propellers, oil system, fuel system, constant speed drive, electrical power systems, air pressure system, helium system, surface controls, handling lines, water ballast system, landing gear, instruments, emergency equipment, and a list of auxiliary equipment.

SECTION II - NORMAL PROCEDURES. This section explains the sequence of procedures necessary to accomplish a complete flight. It includes all normal preflight, inflight, and post-flight procedures.

SECTION III - EMERGENCY PROCEDURES. Airship emergency procedures are covered in the following order: engine failure; propeller failure; engine fires; car fires; electrical fires; smoke and vapor elimination; envelope emergencies; landing gear failure; ditching and crash landings; emergency operation of fuel system, electrical system, air pressure system, surface controls, and landing gear; and constant speed drive failure.

SECTION IV - DESCRIPTION AND OPERATION OF AUXILIARY EQUIPMENT. Descriptions and the operating procedures for all equipment on the airship that is not essential to flight are included in this section. Discussed in the following order are: heating and ventilating, propeller anti-icing, communication and electronics, lighting equipment, autopilot, auxiliary power unit, armament system, galley, winch, and in-flight refueling. Coverage of other systems will be added as required.

SECTION V - OPERATING LIMITATIONS. Normal flight limitations are described in this section. Minimum crew requirement, instrument markings, engine limitations, propeller limitations, envelope limitations, and weight limitations are discussed. Additional limitations will be included in the section as the necessity arises.

SECTION VI - FLIGHT CHARACTERISTICS. The effectiveness and reaction of flight controls are discussed in this section. The discussion of flight characteristics will be expanded when data becomes available after flight test and service evaluation of the airship.

SECTION VII - SYSTEMS OPERATION. Instructions for operation of major systems in various conditions of flight are presented. Discussed in the following sequence are: operation of engines, propellers, oil system, fuel system, constant speed drive, surface controls, and ballast system. Also in this section are instructions for coordinated operations each as flight refueling, ballast pick-up, and sonar fish towing.

SECTION VIII - CREW DUTIES. The crew duties section of the handbook includes lists of the checks and jobs to be performed by each crew member in addition or incidental to the normal flight duties discussed in section II. All phases of airship operation are considered, but special emphasis is given the duties necessary to safe flight.

SECTION IX - ALL WEATHER OPERATION. Special procedures for the operation of the airship in extreme weather conditions are discussed in this section to supplement the normal and emergency operating instructions appearing elsewhere in the handbook.

APPENDIX I. The appendix includes all the necessary operating data for mission planning.

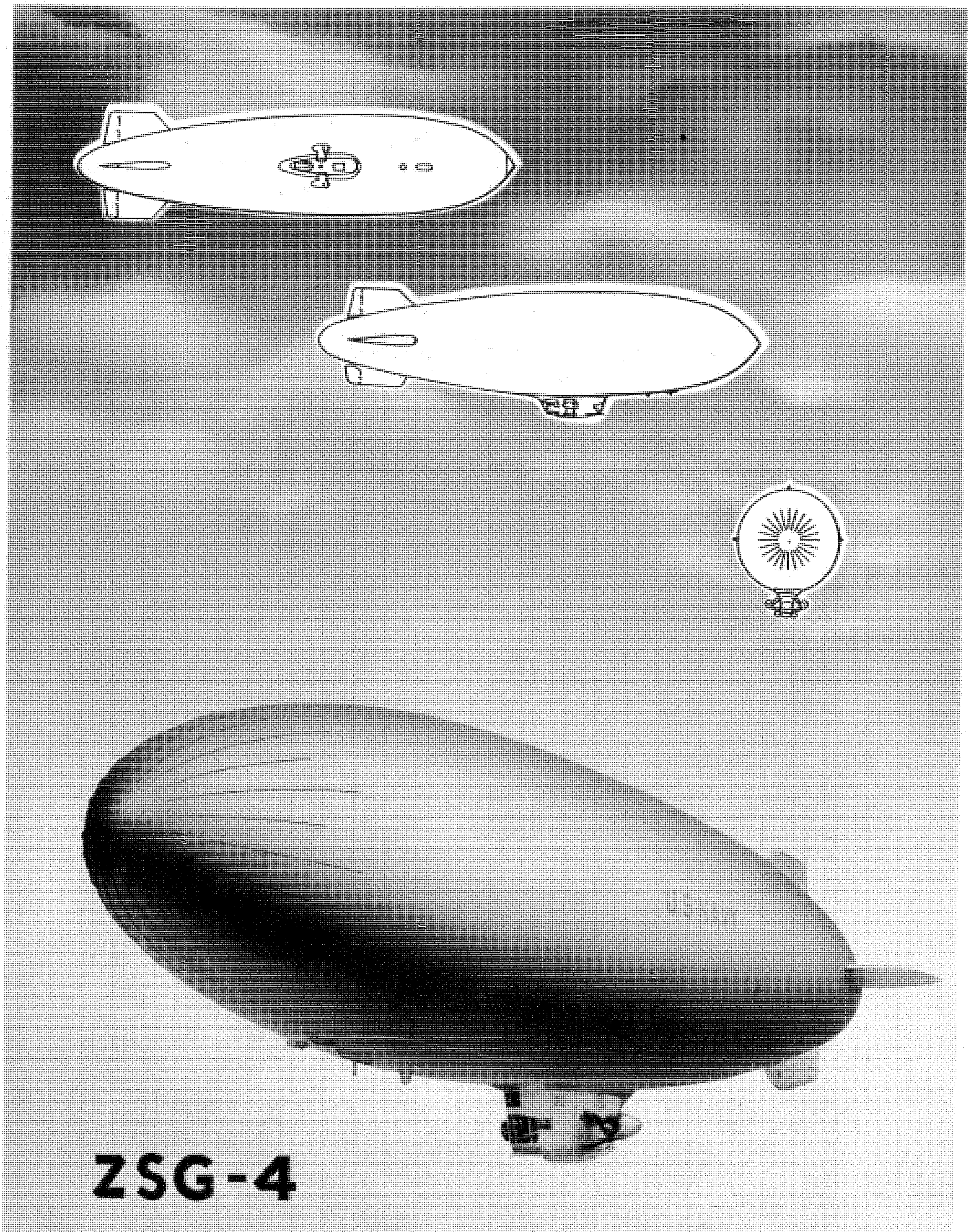
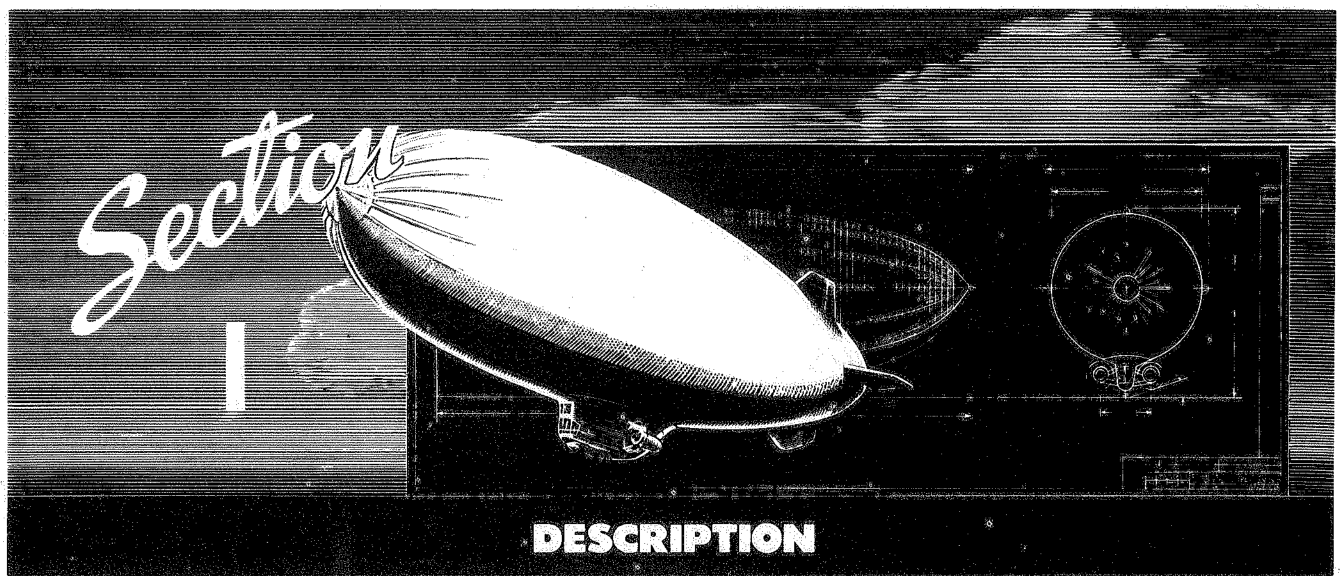


Figure 1-1. The Airship



THE AIRSHIP.

The ZSG-4 is a non-rigid airship designed for anti-submarine warfare in collaboration with other ASW air and surface craft. The airship is similar in size and general arrangement to the ZSG-3 airship. Two R-1340-46 engines mounted in outrigger nacelles power the airship. The engines are accessible to a limited extent during flight. "Beta" propeller control systems together with governed throttle controls permit precise thrust control through the full ranges of forward and reverse thrust operation. An automatic fuel transfer system simplifies fuel system management. A new type of surface control system provides for either dual control by pilot and copilot of both rudders and elevators or for separate control, with the pilot controlling the elevators and the copilot the rudders. The system includes an electric servo type of boost system and an automatic pilot. The main generators and the winch hydraulic system pump are driven by a constant speed drive so that electrical power and winch power are available during any condition of normal flight. No auxiliary power unit is permanently installed on the airship. Armament stores are carried in a bomb bay and on the lower outrigger struts. Provisions are made for replacing the armament with extra fuel carried in a bomb bay tank and drop tanks. A combustion type heater and forced air heating system supply heat for the car compartments.

Airship measurements (dimensions, volumes, weights, and clearances) and crew provisions are as follows:

DIMENSIONS.

Length	266.48 feet
Height	
Tire normally inflated and strut extended	83.58 feet
Tire deflated and oleo strut deflected	81.78 feet
Width	69.35 feet
Envelope diameter - maximum	62.10 feet
Envelope fineness ratio	4.24 feet

VOLUMES (Calculated).

Envelope	527,000 cubic feet
Forward Ballonet	60,700 cubic feet
Aft Ballonet	61,100 cubic feet
Percent envelope volume in ballonets	23 percent

TOTAL GROSS WEIGHT EMPTY (Calculated).

With three-ply envelope (D-519 and D-520)	24,854 pounds
With two-ply envelope	23,767 pounds

CLEARANCES.

Propeller to car	1.52 feet
Propeller to envelope	2.68 feet
Propeller to ground	3.37 feet
Clearance angle from landing gear to lowest point on empennage (tire deflated and oleo strut deflected)	9.3 degrees

CREW. Stations are provided for a crew of eight men with the following crew functions: pilot, copilot, navigator, sonar operator, radio operator, ECM operator, radar operator, and winch operator. Refer to figure 1-2 for general car arrangement.

ENGINES.

GENERAL. Two nine-cylinder, radial, air-cooled R-1340-46 engines power the airship. The R-1340-46 is a basic R-1340-AN2 engine with the accessory section modified for the addition of a throttle control system alternator and a sandwich gear box to accommodate a large capacity hydraulic pump. The added hydraulic pump supplies a high pressure hydraulic flow for the constant speed drive unit located in the starboard nacelle. Each engine is rated at 550 bhp at 2200 rpm. The compression ratio is 6 to 1. Internal supercharging results from an impeller in the blower section turning at 10 times crankshaft speed. Propeller reduction gears are incorporated in the engine so that the propeller

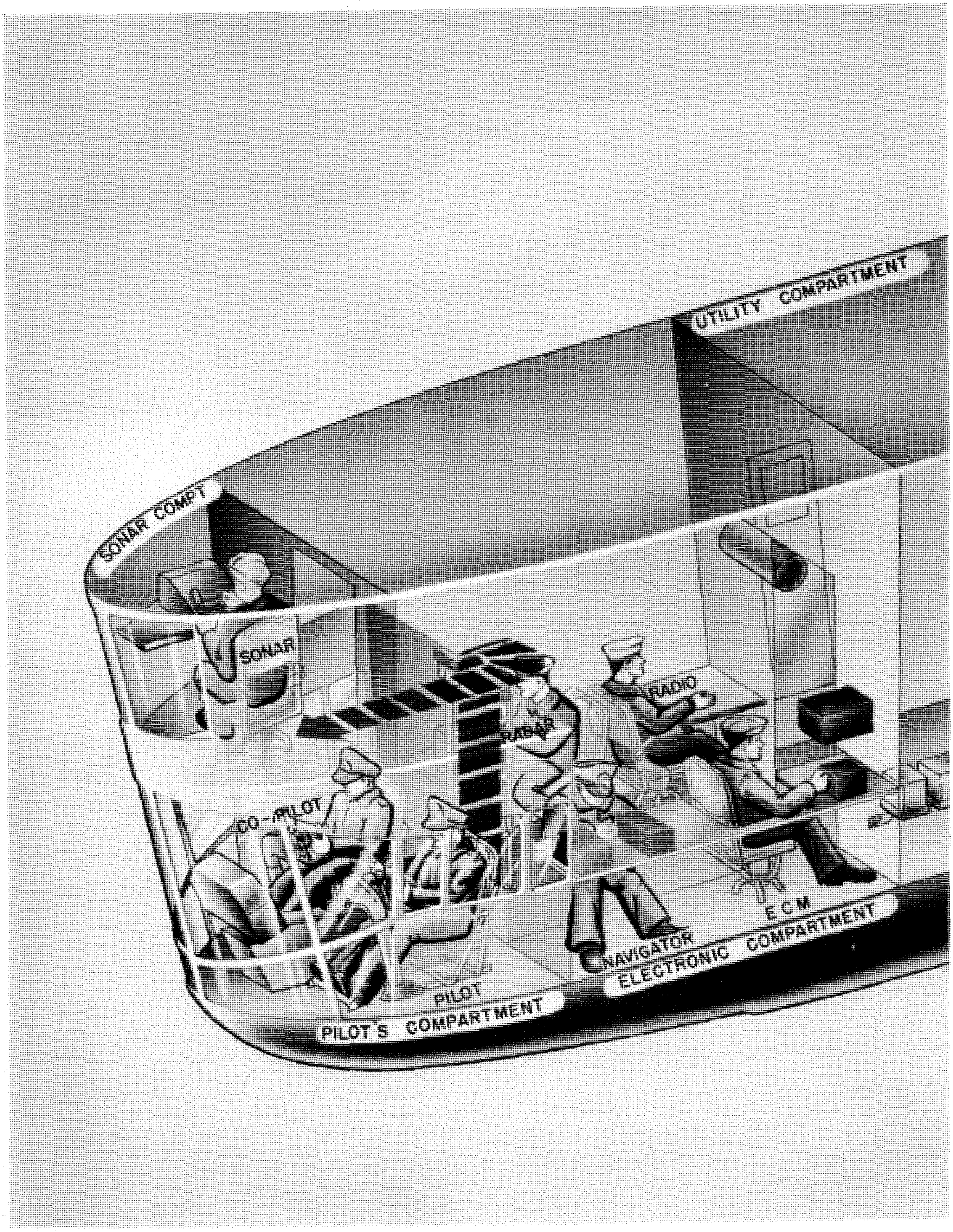


Figure 1-2. General Arrangement (Sheet 1 of 2)

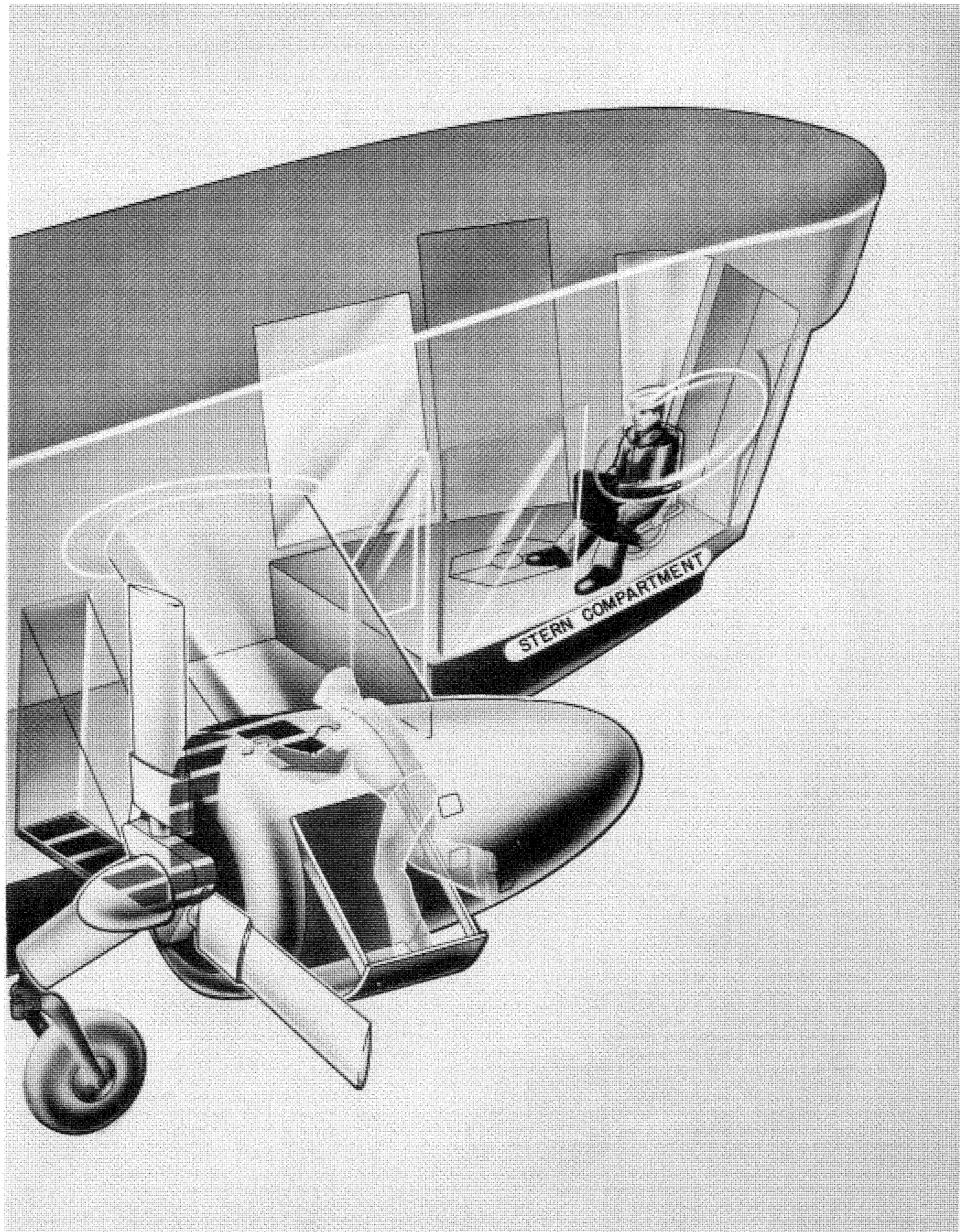
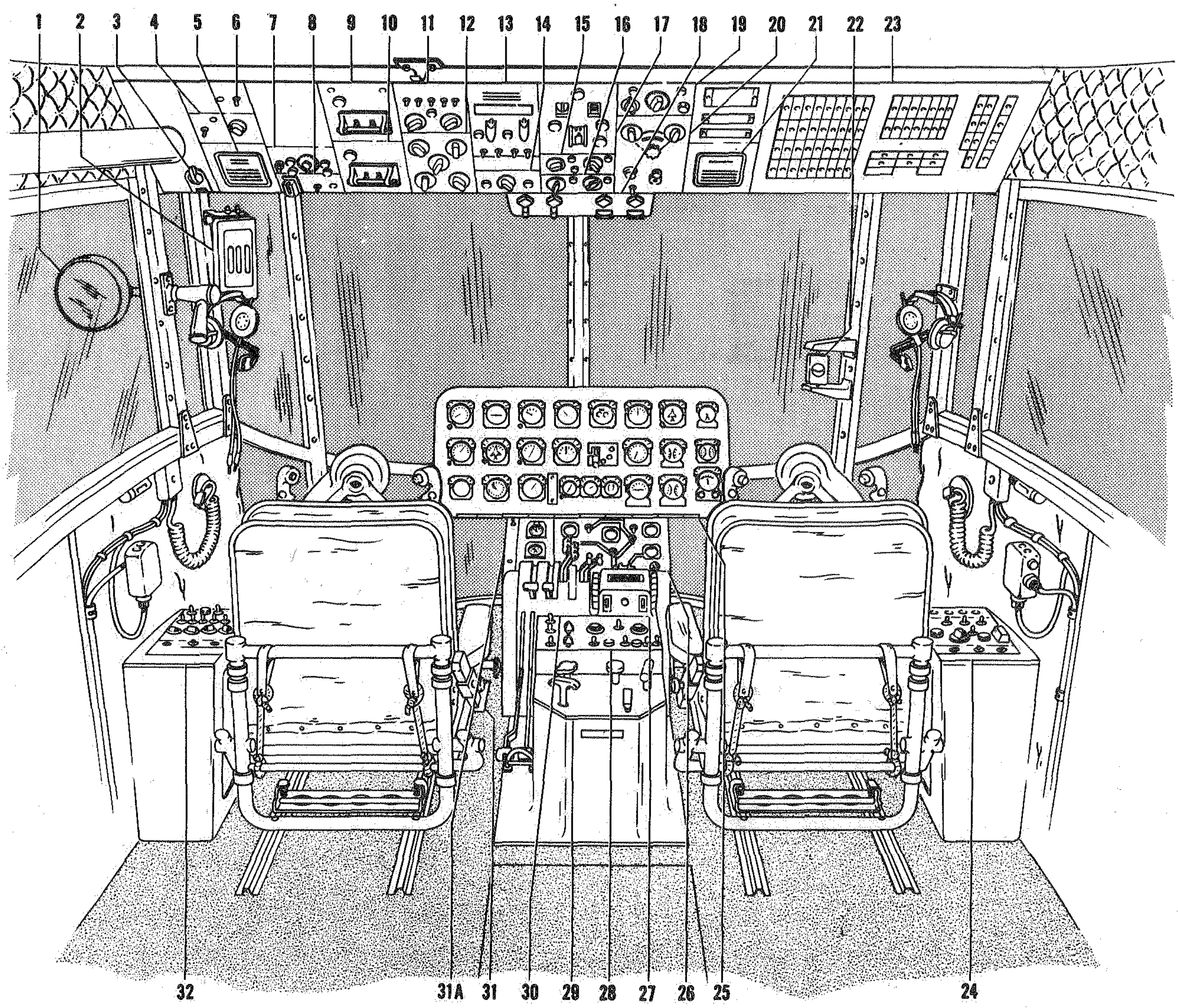


Figure 1-2. General Arrangement (Sheet 2 of 2)



1. Mirror
2. Liquid Manometer
3. Standby Lights Switch
4. Propeller De-Ice Panel
5. Landing Check List
6. General Quarters Horn Switch
7. Radio Receiver Panel
8. Armament Master Panel
9. Booster Engage Panel
10. Automatic Pilot Engage Panel
11. Exterior Lights Panel
12. Interior Lights Panel
13. Engine Fire Control Panel
14. Radio Altimeter Control Panel
15. High Frequency Transmitter Panel
16. High Frequency Receiver Panel
17. Booster Master Panel
18. Minor Controls Panel
19. UHF Control Panel
20. Radio Compass Control Panel
21. Take-Off Check List
22. Compass
23. Pilot's Circuit Breaker Panel
24. Copilot's Side Console
25. Instrument Panel
26. Fuel Control Panel
27. Pedestal Controller
28. Engine Accessory Panel
29. Console Aft Panel
30. Power Control Unit
31. Gust Lock Access Door

31A. AN/AQS-2 Indicator Panel (134019 and Subsequent)

32. Pilot's Side Console

Figure 1-3. Pilot's Compartment

Table I. Main Differences

FEATURE	ZSG-3	ZSG-4
527,000 cubic foot envelope	Three-ply cotton neoprene	Two-ply cotton neoprene, except for envelopes D-519 and D-520 which are three-ply cotton neoprene.
Engines	R-1340-AN-2 (2)	R-1340-46 (2)
Winch drive	Constant-ratio drive	Constant speed drive
Fuel tanks	Two main tanks Two drop tanks One slip tank	Two main tanks Two drop tanks One slip tank One bomb bay tank
Electrical power	Direct engine-driven generators	Main d-c and a-c generators are driven by constant speed drive. Two standby d-c generators are direct engine-driven.
Auxiliary electrical power	One APU in each outrigger	None. An APU pod can be attached for ground operation.
Control system	Elevatorman and rudderman system without boost	Wheel and column controls can be operated split or dual. Normally operated with electric servo boost. Shift into a manual emergency range is possible.
Heating	Engine tail-pipe heater with ram air circulation	Gasoline combustion heater with forced air circulation.
Car insulation	None	Complete
Sleeping accommodations	None	Two bunks

shaft turns at 0.667 times engine rpm. Each engine is mounted in a nacelle at the end of an outrigger and is accessible to a limited extent during flight.

THROTTLES. Each engine throttle is normally operated by an electrical control system. An electric actuator connected to the carburetor throttle valve shaft can be controlled directly by operation of a throttle selector switch or automatically by a throttle governor. The throttle governor maintains a selected engine rpm regardless of variation of propeller blade angle. The throttle automatic control system is used in conjunction with the propeller "Beta" control system. The automatic system provides the precise control of the throttle required to maintain constant engine rpm, within approximately 7 rpm, while propeller pitch is changing. The system employs a governor which consists of a discriminating circuit, magnetic amplifier, polarized relay, and feed-back circuit. A difference in the frequency output of an engine driven alternator (engine rpm) and the tuned frequency of a parallel resonant circuit (selected rpm) causes a signal in the discriminating circuit which is amplified and used to operate the polarized relay which controls the throttle actuator. Overshooting or hunting of the system is prevented by the feedback circuit. The throttles can be controlled manually in case of electrical control failure by engaging throttle override levers which are connected to the throttle shafts by cable systems.

THROTTLE SELECTOR SWITCHES. A throttle selector switch for each engine, located on the engine accessory panel (figure 1-4), is used to select the electrical control of the throttle actuator. Each switch has momentary OPEN and CLOSE positions which directly connect power to the throttle actuator. The throttle will open or close within limits until the switch is released. The actuator is stopped by the opening of a limit switch when the throttle valve reaches the fully open or fully closed position.

Each selector switch also has a LEVER OPER position in which the switch closes a circuit to a relay which operates to energize the throttle control governor and "Beta" propeller control system. To deactivate the automatic throttle control system, the switch must be placed in the center (off) position.

RPM CONTROL LEVERS. Each rpm control lever (2, figure 1-5) on the pilot's power control unit is used to set the engine rpm to be maintained by the throttle control governor. The name plate adjacent to the levers

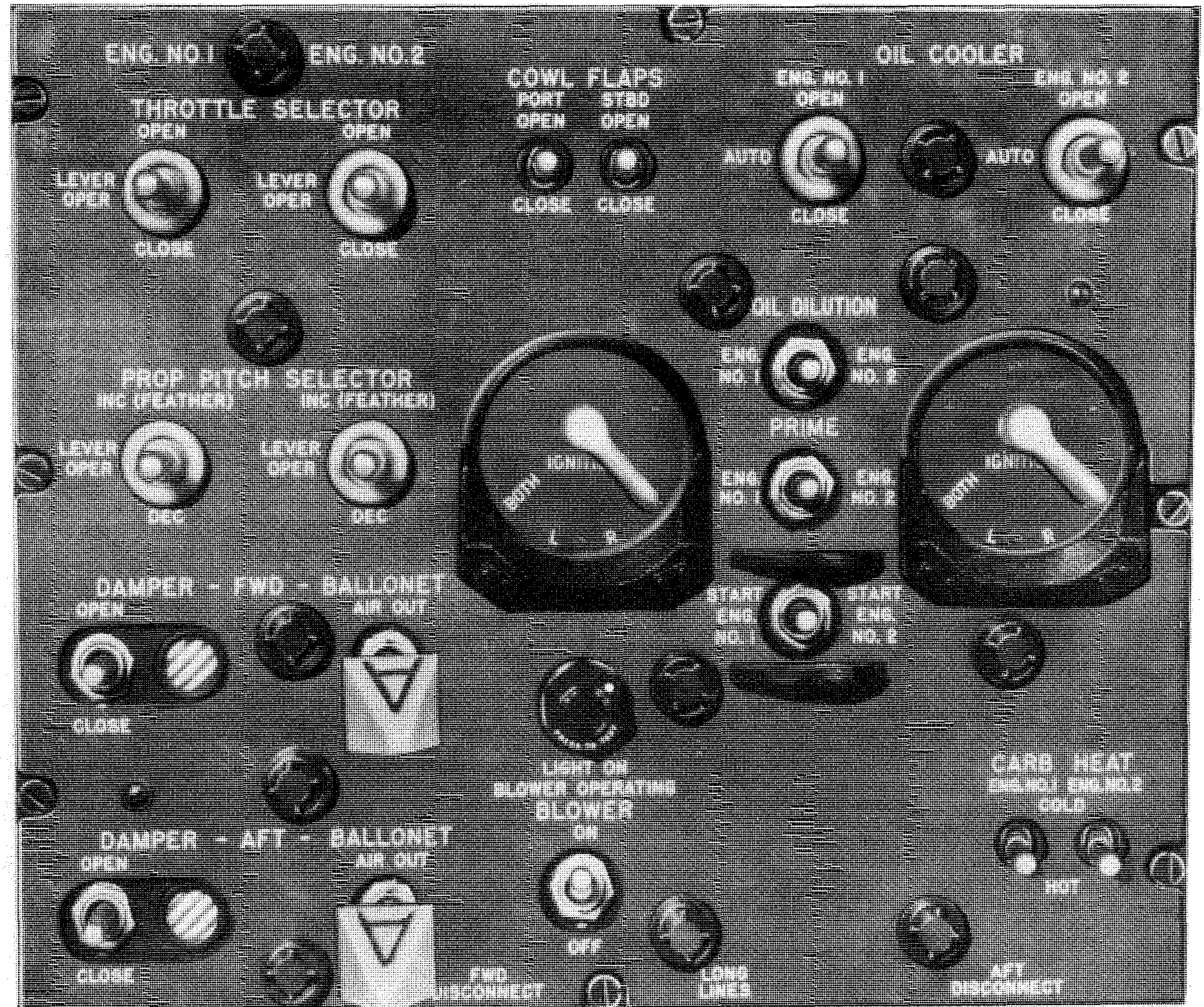


Figure 1-4. Engine Accessory Panel

is marked PROPELLER. The lever is effective only when the governor is energized by placing the throttle selector switch on the engine accessory panel in LEVER OPER position. The lever is pushed forward to increase the rpm setting and aft to decrease. The lever controls the setting of a variable inductance in a tuned parallel resonant circuit to establish a reference (desired engine rpm) for the throttle governor. The throttle governor controls the throttle actuator to maintain the desired engine rpm. No markings are provided for lever position; the lever is moved to and left at the position where desired rpm is obtained as indicated by the tachometer.

THROTTLE OVERRIDE LEVERS. The throttle override levers (6, figure 1-5) are used to mechanically control the throttle valves by a cable system in the event of failure of the throttle actuators or the electrical system. The levers are normally left down in closed position. When either lever is raised to a position corresponding to throttle valve position, a pin in a wheel on the throttle actuator shaft drops into a slot in the actuator shaft to engage the override system. The throttle valve can then be opened or closed by movement of the override lever.

Pulling up on the lever opens the throttle and pushing down on the lever closes the throttle. To disengage the override, it is necessary to pull the engage pin at the throttle actuator in the nacelle while pushing the override lever slightly beyond CLOSE position. Disengagement of the override is difficult and hazardous in flight.

CAUTION

The throttles should never be operated electrically with the override engaged. The throttle actuators cannot carry the load imposed by the override.

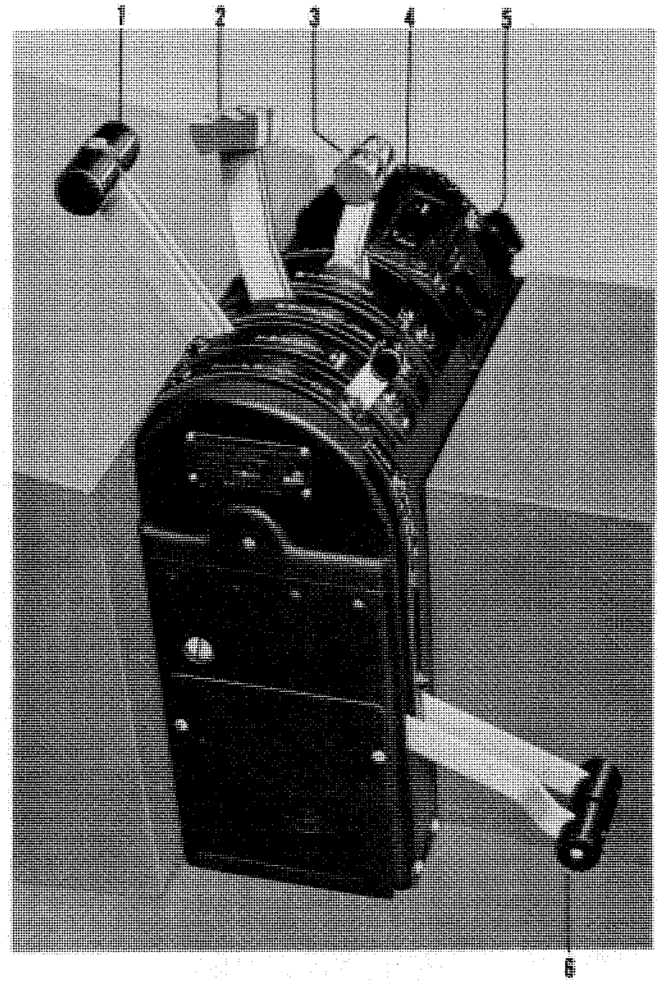
FRICTION LEVER. The friction lever (4, figure 1-5) on the power control unit is moved to increase or decrease the frictional force securing the rpm and thrust control levers in a fixed position. Moving the friction lever forward increases the force and pulling the lever aft decreases the force.

CARBURETOR CONTROLS. The carburetor controls are the mixture and the carburetor air controls. The carburetors are up-draft, float type, with back suction type of mixture control. The mixture is controlled through mixture control levers on the pilot's power control unit. The induction system is arranged so that cold air, preheated air, or any mixture of the two can be fed to the carburetor. Cold air enters the carburetor air duct through a screen in the lower cowl panel and flows through the duct, past a carburetor heat door, into the throat of the carburetor. Warm dry air from aft of the cylinders is further heated as it flows through a shroud over a portion of the exhaust collector ring to the carburetor heat door. The door can be positioned to block off either the cold air or the preheated air flow, and at intermediate positions can regulate the mixture of warm and cold air to control temperature. The actuator for the carburetor heat door is controlled by a switch on the engine accessory panel. A carburetor air temperature indicator on the pilot's instrument panel registers the temperature of the air entering the carburetor.

MIXTURE CONTROL LEVERS. Each mixture control lever (3, figure 1-5), located on the power control unit, is connected to the mixture control valve of the corresponding carburetor by a cable system. RICH and IDLE CUT-OFF positions are marked on a panel adjacent to the lever. Moving a lever aft from the RICH position increases the venturi suction applied to the float chamber of the carburetor. The metering force is thus reduced and less fuel is forced through the discharge nozzle. When the lever is pulled all the way aft into IDLE CUT-OFF while the throttle is closed, manifold suction is applied to the float chamber. The metering force then drops to zero and all fuel flow stops. The mixture levers are set as required to maintain optimum engine operation for various altitudes and power settings. Each lever rides on a ratchet so that the lever holds a position setting. The lever moves forward freely but must be lifted to be moved aft towards IDLE CUT-OFF.

CARBURETOR HEAT SWITCHES. The two carburetor heat switches (figure 1-4) are on the pilot's engine accessory panel. Each switch controls an electric actuator which drives the carburetor heat door in the corresponding carburetor air duct. When the switch is held in either HOT or COLD, the actuator turns until the switch is released or until the door reaches the extreme position. Limit switches in the actuator prevent overtravel of the actuator.

CARBURETOR AIR TEMPERATURE INDICATOR. A dual indicator (17, figure 1-6) on the pilot's instrument panel indicates carburetor air temperature for both engines. Each pointer responds to temperature changes detected by a bulb at the point where air enters the carburetor throttle body. The indications are used as a guide for operating the carburetor air controls to prevent icing and to maintain temperature within the limits

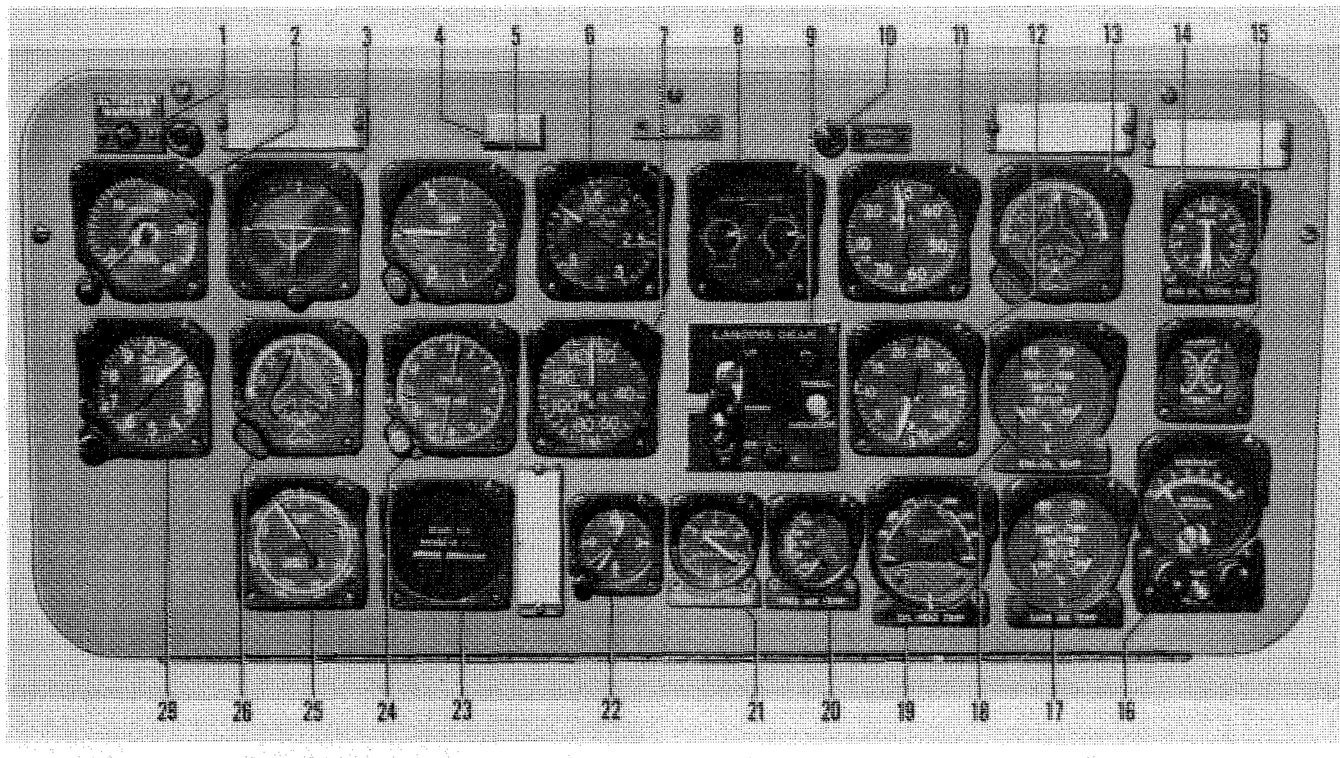


1. Thrust Control Levers
2. RPM Control Levers
3. Mixture Control Levers
4. Friction Lever
5. Autopilot Pedestal Controller
6. Throttle Override Lever

Figure 1-5. Power Control Unit and Autopilot Pedestal Controller

shown in section V. Engine operating limits also vary as carburetor air temperature varies. These limits are shown in figure A-9.

ENGINE COOLING. The engines and engine accessories are cooled by air forced through the cowl enclosures by the propellers. The volume of air available for cooling is determined by engine speed, propeller pitch, and adjustable cowl flap position. The cowl flaps are controlled electrically by switches on the engine accessory panel. When open, the cowl flaps create a low pressure area in the air stream aft of each flap so that the velocity and volume of cooling air flowing over the engine is increased. The flow of cooling air is not reversed when the propeller is in reverse pitch. The design of the propeller is such that positive pitch is maintained by the propeller cuff even though the propeller is in reverse pitch.



1. Altimeter Warning Indicator
2. Radio Altimeter
3. Gyro Horizon Indicator
4. Fire Master Indicator
5. Rate-of-Climb Indicator
6. Mechanical Manometer
7. Airspeed Indicator
8. Ballonet Fullness Indicator
9. Landing Gear Control Handle and Indicator
10. Marker Beacon Indicator
11. Manifold Pressure Indicator
12. Tachometer
13. Autopilot Repeater Compass
14. Engine Oil Pressure Indicator
15. Engine Oil Quantity Indicator
16. Superheat Indicator
17. Carburetor Air Temperature Indicator
18. Engine Oil Temperature Indicator
19. Cylinder Head Temperature Indicator
20. Free Air Temperature Indicator
21. Hydraulic Pressure Indicator
22. Clock
23. Sonar Fish Course Indicator (131919 through 131926)
24. Radio Compass Indicator
25. Winch Cable Footage Indicator
26. Autopilot Compass Repeater
27. (Deleted)
28. Sensitive Altimeter

Figure 1-6. Pilot's Instrument Panel

COWL FLAP SWITCHES. Two cowl flap switches (figure 1-4) on the engine accessory panel control the cowl flap actuators. Each switch has momentary contact OPEN and CLOSE positions which connect electrical power to the forward or reverse fields of the actuator motor. A single actuator in each nacelle operates all four controllable cowl flaps of the nacelle through a jackshaft and connecting linkage. When the switch is held in either OPEN or CLOSE position, the actuator operates until the switch is released or the cowl flaps reach the fully open or closed position. The amount of flap opening can thus be varied to maintain normal cylinder head temperature. Limit switches in the actuators prevent overtravel at either extreme of the cowl flap range.

IGNITION. An ignition switch (figure 1-4) for each engine is mounted on the engine accessory panel. Each switch has four positions, BOTH, L, R, and OFF. When in OFF position the switch grounds the primary circuit of both the left and right magneto of the engine. Any current produced in either magneto primary by turning of the magneto rotor or operation of the starting vibrator is then conducted to ground. When the switch is in L only the right magneto is grounded, when in R only the left magneto is grounded, and when in BOTH neither magneto is grounded. The left magneto supplies ignition current to the aft plugs of the engine and the right magneto supplies the front plugs.

PRIMERS. The primer switch (figure 1-4) is on the engine accessory panel of the pilot's console. When held in either ENG. NO. 1 or ENG. NO. 2 position, the switch closes an electrical circuit to open the corresponding primer valve. When open, the valve allows fuel to flow from the carburetor inlet line through a primer distributor, primer lines, and spray nozzles into the intake pipes of the upper cylinders. The fuel booster pump must be operating to pump the fuel through this system.

STARTERS. The starters are controlled by the starter switch (figure 1-4) on the engine accessory panel of the pilot's console. When the switch is held in either START ENG. NO. 1 or START ENG. NO. 2 position, a starter relay operates to connect the corresponding starter to main d-c bus electrical power. At the same time, a starting vibrator is energized. The vibrator supplies a pulsating dc through the primary of the right magneto so that the magneto can induce and distribute a high tension charge. The hot spark required for starting is thus produced across the electrodes of each front spark plug as the engine is cranked by the starter.

MANIFOLD PRESSURE INDICATOR. Manifold pressures for both engines are indicated on a dual indicator (11, figure 1-6) on the pilot's instrument panel. The indications are used to set the throttles or thrust handles to obtain desired power conditions. Manifold pressure limits are shown in section V.

ENGINE TACHOMETER. Engine rpm for each engine is indicated by one of two pointers on a single dial of the tachometer indicator (12, figure 1-6) on the pilot's instrument panel. The indicator also presents a synchroscope indication through a window in the dial face. The synchroscope dial rotates at a speed equal to the difference between engine speeds when the difference is less than 350 rpm.

CYLINDER HEAD TEMPERATURE INDICATOR. The cylinder head temperature indicator (19, figure 1-6) on the pilot's instrument panel is a dual indicator with a dial for each engine. Each gage responds to temperature changes detected by a gasket-type thermocouple installed at the aft spark plug of the No. 1 cylinder of the engine. Indications of excessive temperature are a warning of possible engine malfunctioning, excessively lean mixture, or inadequate cooling air. Temperature limits are shown in section V.

PROPELLERS.

GENERAL. The propellers are Curtiss Electric model C-432S-C2 modified by the use of 634-3C2-6 blades. They are three bladed, controllable pitch, reversible propellers having a diameter of 11 feet 6 inches. The blade angle (pitch) of each propeller is controlled by a separate control system. Blade angle can be controlled either directly by means of a selector switch to operate the propeller power unit motor or by a "Beta" control system. The "Beta" system permits controlling the blade angle indirectly by operating a thrust control lever. The purpose of the "Beta" system is to permit precise thrust control through the complete forward and reverse ranges of thrust by operating only one lever.

When the "Beta" system is operable, the throttle for the corresponding engine is being controlled by the throttle governor. Because the throttle is governor controlled to maintain constant engine rpm, propeller blade angle can be varied to any position in the normal range without danger of overspeeding or overboosting the engine. No fixed pitch positions are used for low pitch or hover, so thrust of any required amount in forward or reverse is attainable.

The propeller pitch control systems permit control of blade angle only by manual manipulation of controls. Blade angle is not controlled automatically as with other types of propeller systems. No instruments or control markings are provided for setting blade angles precisely with the controls. When specific power conditions are required, blade angle is set to obtain the required manifold pressure after the desired rpm has been selected with throttle controls. When a specific thrust condition is required, as for hovering or stopping a landing roll, the blade angle is varied to obtain desired ground speed.

Blade angle limits attainable for each propeller are -9 degrees (reverse) and +89.4 degrees (feather) when controlled by the selector switch. These limits are established by limit switches in the propeller power unit. When blade angle is controlled by the "Beta" system, the limits are -6.7 degrees and +28.4 degrees. These limits are set by cam stops in a blade angle control unit controlled by the thrust handle. Since high forward blade angles are attainable by using the selector switch because no high pitch limit switch is used, the pilot must use the selector switch cautiously to prevent propeller pitch from exceeding 40 degrees for normal operation.

PROPELLER PITCH SELECTOR SWITCHES. The propeller pitch selector switches (figure 1-4) are on the engine accessory panel. If a switch is thrown from the center off position to either INC (FEATHER) or DEC, operating power is connected directly to the propeller pitch change motor of the corresponding propeller. The motor operates to turn the propeller blades until the switch is released. If the switch is held in DEC without being released, the blades turn all the way to the reverse pitch angle before a limit switch stops the motor. If the switch is held in INC (FEATHER) without being released, the blades turn all the way to the feather angle before stopping. The INC (FEATHER) position of the switch is used in this way for feathering the propeller. No separate feather switch is provided.

If thrown to the left to LEVER OPER, the pitch selector switch connects power to contacts of a relay. The relay is not operative unless the throttle selector switch above the pitch selector switch is also in LEVER OPER. If both switches are in LEVER OPER, the relay operates in response to changes in position of the thrust control lever for the engine and connects operating power to the propeller pitch change motor. The LEVER OPER position of the pitch selector switch is used only in conjunction with the throttle selector switch to make the thrust control lever ("Beta" system) operable.

THRUST CONTROL LEVERS. Each of the thrust control levers (1, figure 1-5) on the power control unit controls the propeller pitch setting of one propeller. The lever is operative only when both the propeller pitch selector switch and the throttle selector switch for the related engine are in LEVER OPER. The lever is connected by cable to a wheel which positions movable electric contacts in a blade angle control unit in the propeller. The position of the lever establishes the desired blade angle. If the actual blade angle differs from the lever setting, the movable contacts close to operate a relay which connects operating power to the pitch change motor. The blades are then turned to the selected angle, and the motor stops when the con-

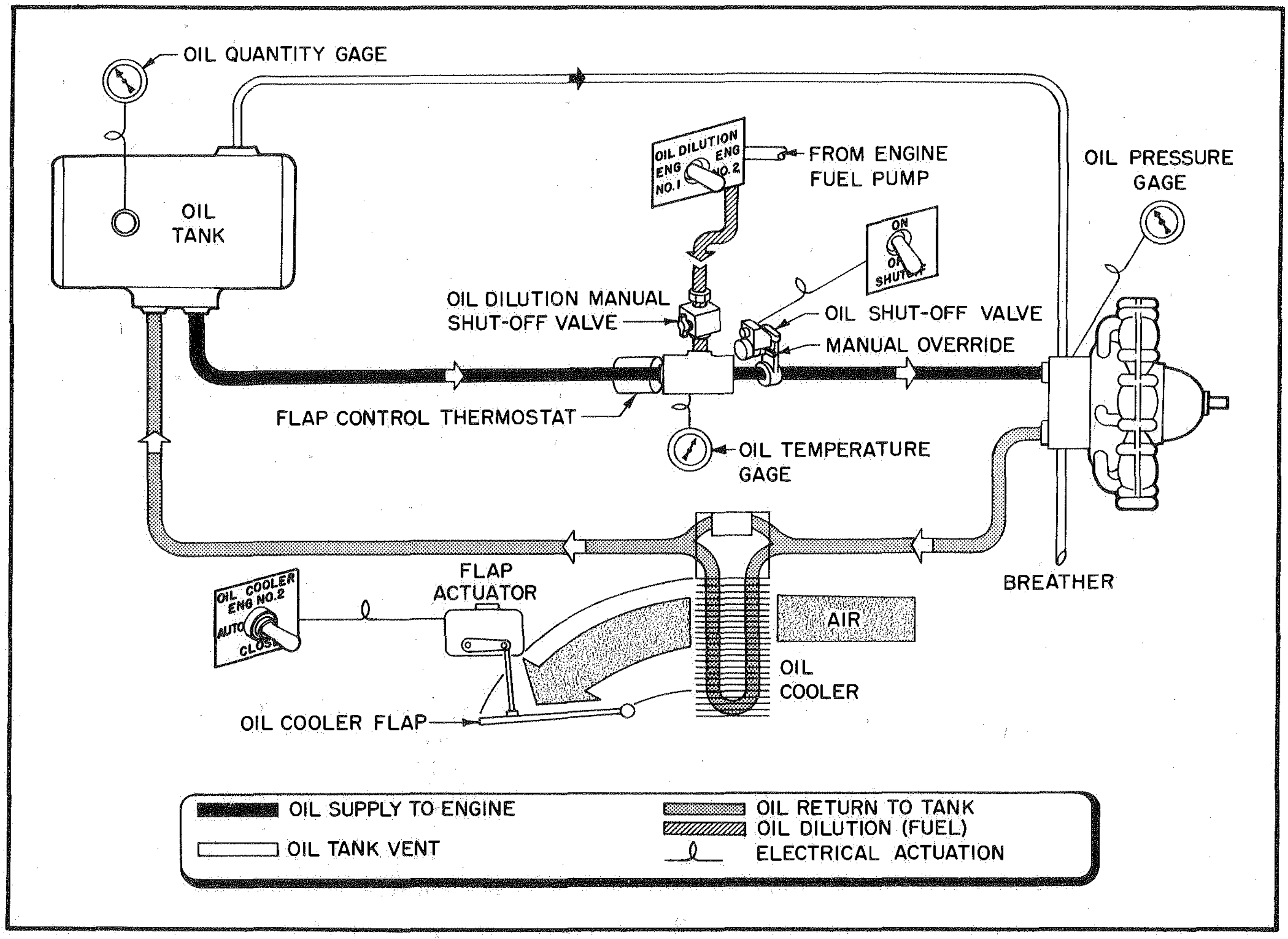


Figure 1-7. Oil System Schematic

tacts in the blade angle control open. The thrust lever is moved forward toward the FWD marking to increase the blade angle and thrust. When it is pulled aft, the blade angle and thrust decrease until the lever reaches the NO THRUST position. Pulling the lever farther aft toward REVERSE causes the propeller blades to assume a reverse pitch angle. The angle of the blades increases until a maximum angle of -6.7 degrees is reached when the lever is all the way aft.

OIL SYSTEM.

GENERAL. An independent oil system in each nacelle supplies oil to each engine. Each system consists of a 22-gallon tank, an oil cooler, a controllable oil cooler flap, an oil dilution system, and an electrical shut-off valve. The switches controlling the system are on the engine accessory panel and the engine fire panel in the pilot's compartment. Indicators showing oil quantity, pressure, and temperature are installed on the pilot's instrument panel. The specification and grade of oil are shown on the servicing diagram (figure 1-32).

Oil flows from the tank through a Y-adapter in the engine oil inlet line, through the oil shut-off valve, and into the engine. The hot oil flows from the engine, through the oil cooler, and back into the tank. The oil system drain valve is mounted on the bottom of the Y-adapter.

The oil cooler is in an air duct leading from the front of the engine cowling to an exit in the bottom of the center section of the nacelle. Air flow through the cooler is regulated by an electrically actuated flap in the duct. The flap actuator is controlled by a switch on the engine accessory panel for either automatic or manual control of oil temperature. There is no oil cooler flap position indicator; manual control of oil temperature consists of opening or closing the flap until the desired temperature is attained. Under automatic control a flap control thermostat, sensitive to the oil temperature in the Y-adapter, regulates the operation of the flap actuator to maintain oil temperature within an acceptable range. The flap is fully closed when the inlet oil temperature is 71°C (160°F) and fully open when the inlet oil temperature is 77°C (170°F). The oil by-passes the oil cooler through a built-in relief valve when the oil pressure exceeds 40 psi or when the return oil temperature is lower than 71°C (160°F). The relief valve is fully closed when the return oil temperature is higher than 85°C (185°F).

The oil shut-off valve, located aft of the fire seal partition in the nacelle between the engine and accessory section, seals off oil flow if an engine fire occurs. A switch on the engine fire panel controls the operation of the shut-off valve.

The oil dilution system consists of a solenoid valve and a manually operated valve in a fuel line which is tapped into the oil inlet line at the Y-adapter. The manual valve is normally in the closed position and must be opened prior to operation of the oil dilution system in cold weather. The solenoid valve is a normally closed valve and is opened for oil dilution by the oil ditution switch on the engine accessory panel. Fuel for oil dilution flows from the engine fuel pump, through the open solenoid valve and open manual valve, into the inlet oil line at the Y-adapter.

OIL COOLER FLAP SWITCHES. Two four-position toggle switches (figure 1-4) on the engine accessory panel electrically control the operation of the oil cooler flap actuators. When the switches are in the AUTO position, flap opening is automatically maintained by a thermostat. Each flap can also be positioned by direct electrical control during manual control of oil temperature. Each switch has momentary contact OPEN and CLOSE positions which can be used to secure any degree of flap opening. When released from either of these positions the switch returns to a neutral (off) position and the flap stops.

OIL SHUT-OFF VALVE SWITCHES. Two oil shut-off switches (figure 1-29) on the engine fire control panel control the electrical shut-off valves in the inlet oil lines. The valves are in the normally open position when the switches are ON. The valves can be closed in an emergency, such as engine fire, by placing the switches in the SHUT-OFF position (refer to section III).

OIL SHUT-OFF VALVE MANUAL OVERRIDE. The oil shut-off valves can be manually operated by an override handle on the valve. The handle is pushed up to open and down to close the starboard valve. The handle for the port valve is pushed down to open and up to close.

OIL DILUTION VALVE SWITCH. A spring-loaded, two position toggle switch (figure 1-4) on the engine accessory panel electrically controls the oil dilution solenoid valves for both oil systems. When the switch is held in either the ENG. NO. 1 or ENG. NO. 2 position, the corresponding solenoid valve opens and fuel supplied through the engine fuel pump enters the oil system if the oil dilution manual valve is open.

OIL DILUTION MANUAL SHUT-OFF VALVE. A manual shut-off valve is installed in the oil dilution line at the Y-adapter in the nacelle. A knob on the valve is rotated clockwise to close the valve. The valve can be closed to prevent inadvertent operation of the oil dilution system.

OIL TEMPERATURE INDICATOR. A dual oil temperature indicator (18, figure 1-6) on the pilot's instrument panel indicates the inlet oil temperature for both engines in degrees centigrade. The limits of safe operating temperatures are marked on the indicator as shown in figure 5-1.

OIL PRESSURE INDICATOR. A dual indicator (14, figure 1-6) on the pilot's instrument panel indicates the pressure of oil entering the engine. The normal range and maximum and minimum oil pressure limits are marked on the indicator as shown in figure 5-1.

OIL QUANTITY GAGE. A dual indicator (15, figure 1-6) on the pilot's instrument panel indicates the amount of oil in each oil service tank. The indications are transmitted electrically from a float transmitter in each tank.

OIL QUANTITY DIP STICKS. A dip stick installed in each oil tank scupper may be used to determine the quantity of oil in the tank. Each stick is marked to indicate 7.5, 11, 16.5, and 22 (FULL) U.S. gallons.

FUEL SYSTEM.

GENERAL. The arrangement of the fuel system is shown schematically in figure 1-8. The normal supply of fuel is carried in a forward tank, aft tank, and slip tank. Two drop tanks and a bomb bay tank can also be carried in lieu of armament. Bomb bay tank provisions can be installed after two of the bomb racks are removed from the bomb bay. The specification and grade of fuel are shown on figure 1-32. For information on fuel capacity, which depends on the tanks installed, refer to NAVAER 01-195PAC-501A Supplementary Flight Handbook.

Besides being used for the engines, fuel is used for oil dilution and the car heater. Airship fuel can also be used to feed the auxiliary power unit when it is attached to the car. Normally the engines are fed from the forward tank, and an automatic transfer system replenishes the supply in that tank. The engines can be fed when necessary from any other tank, and fuel can be transferred into the aft tank or slip tank without interrupting engine feed. Fuel can be dumped from the aft tank, and the drop tanks and the slip tank can be jettisoned during flight. In-flight refueling and single-point ground refueling provisions are included for refueling the forward, aft, and slip tanks.

The flow of fuel for engine feed is shown on the pilot's fuel control panel (figure 1-9). Normal feed is from the forward tank to both engines. A booster pump in the feed line is used to supplement or to substitute for the engine driven pumps to maintain positive feed pressure. An emergency feed control makes it possible to feed the engines from any other tank through an emergency feed line. When switched on, a transfer pump operates to maintain positive feed pressure through the emergency line. Flow of fuel to either engine can be shut off by closing a shut-off valve in the feed line. The valve can be closed electrically by the switch on the fuel control panel or by a firewall shut-off switch, and it can be operated manually if necessary.

Transfer of fuel is controlled automatically when normal feed from the forward tank is maintained. The automatic transfer controls turn on the transfer pump to pump fuel into the forward tank when the supply in the tank drops to approximately 100 gallons (600 pounds). The pump continues operating until the forward tank contains approximately 150 gallons (900 pounds) of fuel and then stops until the supply is again down to 100 gallons. The automatic transfer controls operate only while the transfer pump switch is in ON.

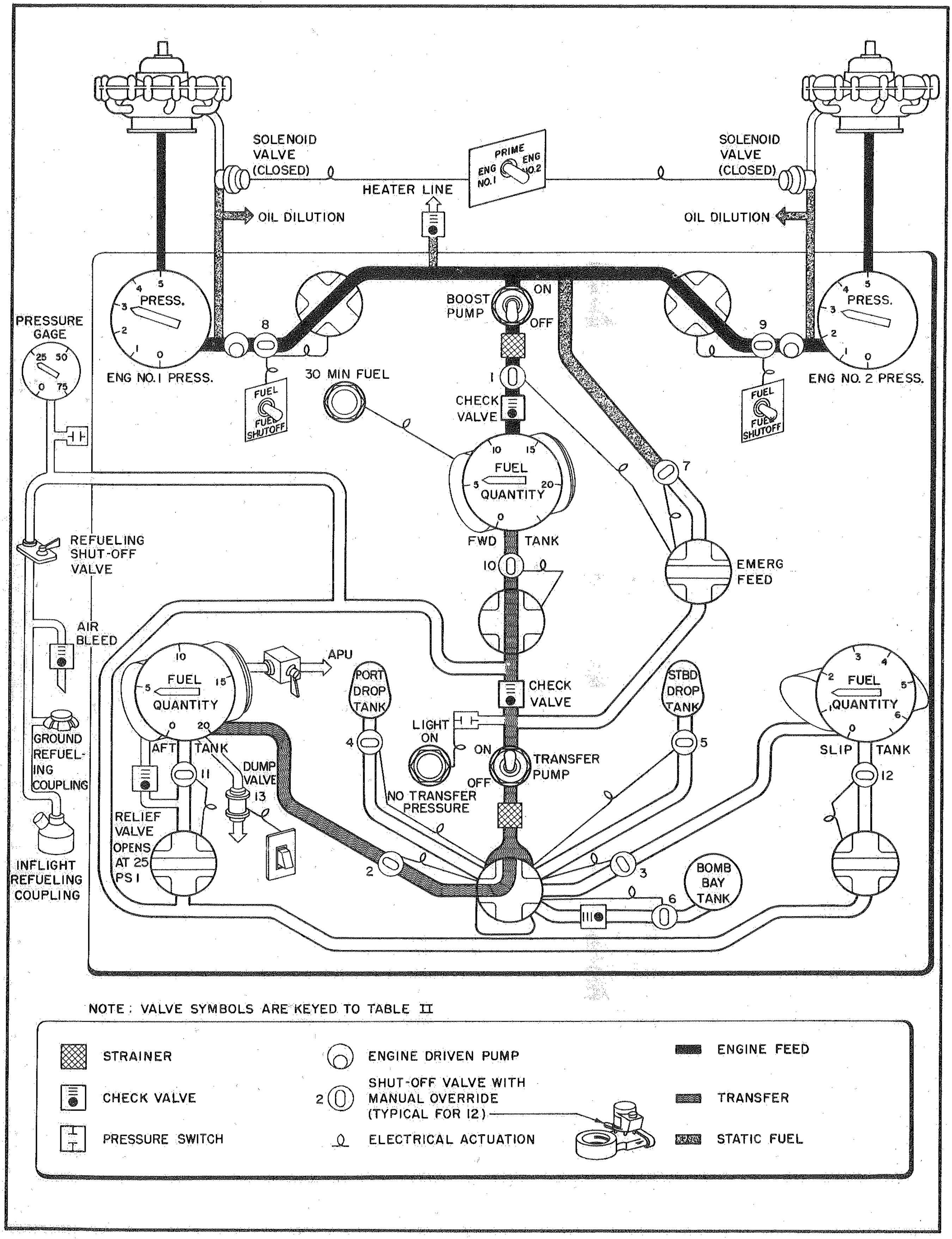
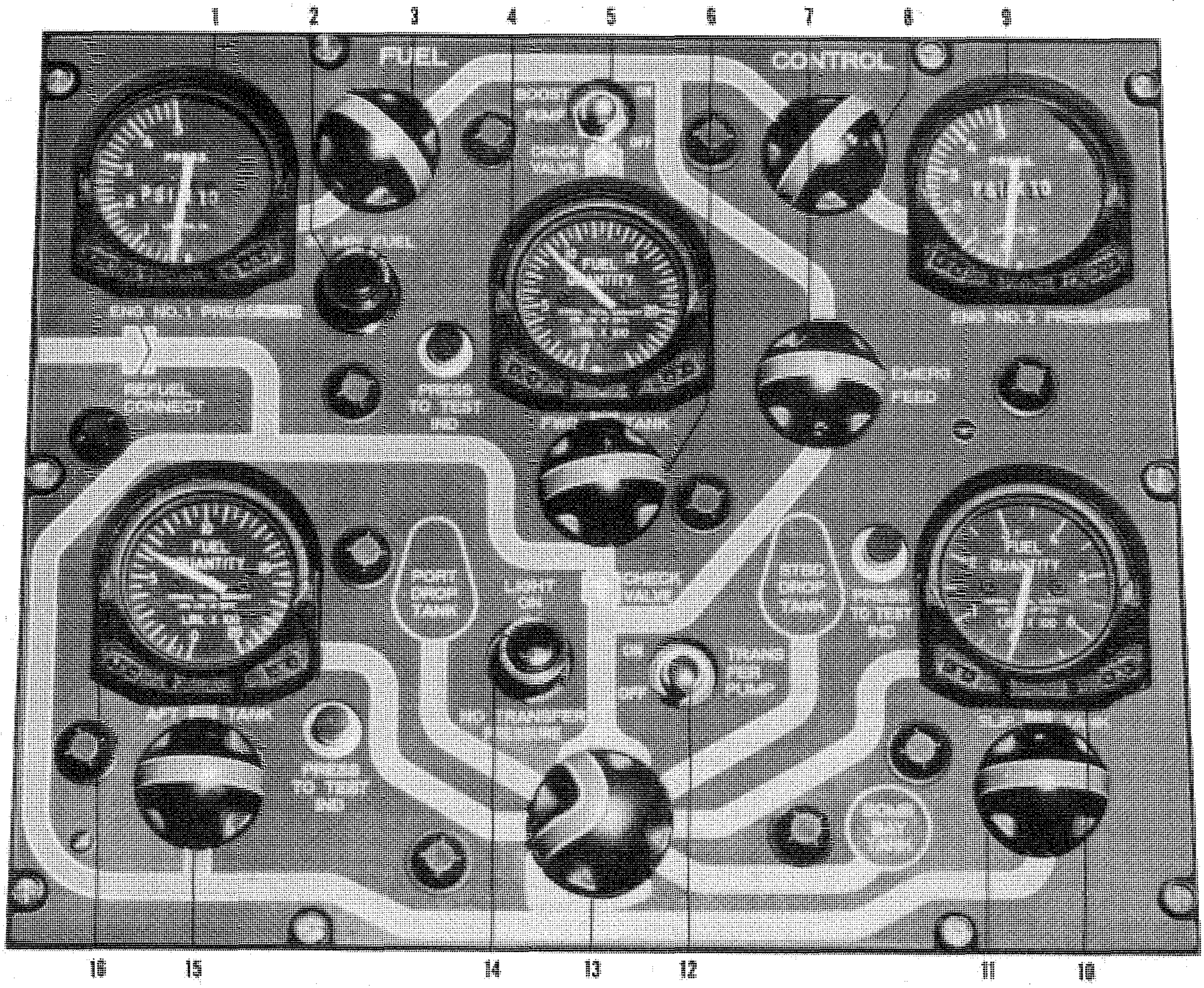


Figure 1-8. Fuel System Schematic



1. Fuel Pressure Indicator - Engine No. 1
2. 30-Minute Fuel Warning Light
3. Fuel Shut-Off Switch - Engine No. 1
4. Forward Tank Fuel Quantity Indicator
5. Boost Pump Switch
6. Forward Tank Refueling Switch
7. Emergency Feed Switch
8. Fuel Shut-Off Switch - Engine No. 2
9. Fuel Pressure Indicator - Engine No. 2
10. Slip Tank Fuel Quantity Indicator
11. Slip Tank Refueling Switch
12. Transfer Pump Switch
13. Selector Switch
14. No Transfer Pressure Light
15. Aft Tank Refueling Switch
16. Aft Tank Fuel Quantity Indicator

Figure 1-9. Fuel Control Panel

Fuel transfer flow is controlled by five transfer valves and three tank refueling valves which are normally controlled electrically. All five transfer valves are operated by one control so that only one valve is opened at a time, determining the tank from which fuel is to be transferred. Normal transfer is from the selected tank into the forward tank, and the forward tank refueling valve is left opened so that the transfer can be accomplished. The aft and slip tank refueling valves can be used in transferring fuel into one of these tanks from the tank which is feeding the engines. If, for example, the engines are being fed from the slip tank, the forward tank refueling valve can be closed and the aft tank refueling valve opened so that some of the flow from the slip tank enters the aft tank. Operation of the transfer pump is necessary to effect the transfer, which is accomplished at a low rate.

The tank refueling valves can also be closed automatically. If one of the tanks becomes full during refueling or fuel transfer, a float valve in the tank normally closes to stop flow into the tank. If the float valve does not operate and the tank continues to fill, the refueling valve is closed electrically. The valve is controlled in this instance by a fuel quantity transmitter in the forward and the aft tank or by a float switch in the slip tank.

The refueling system is arranged so that the forward, aft, and slip tanks can be refueled through the system whether the airship is on the ground or in flight. Fuel enters a refuel line through a ground refuel coupling or an in-flight refueling reception coupling. A manually-operated shut-off valve in the line is opened to permit flow through the line. Fuel flows from the refuel line into the tanks through the three tank refuel valves. During in-flight refueling, the flow of fuel is controlled by an electrical control system connected between the airship and the refueling source. This control system and the hydraulic system which controls the in-flight refueling reception coupling are described in section IV. The procedures for conducting the in-flight refueling operation are included in section VII.

FUEL SHUT-OFF SWITCHES. Engine No. 1 and engine No. 2 shut-off switches (3 and 8, figure 1-9) on the fuel control panel control the motor-actuated engine fuel shut-off valves. One of these valves is open when the line on the switch knob is aligned with the line on the panel line. The valve is closed when the knob line is at right angles to the panel line. The fuel-hydraulic shut-off valve switches on the fire control panel control the same fuel shut-off valves, and can be used to close the valves regardless of the position of the switches on the fuel control panel. The valves can also be positioned manually.

EMERGENCY FEED SWITCH. The emergency feed switch (7, figure 1-9) on the fuel control panel controls a "transfer to fuel feed" valve in the emergency feed line. It also controls a shut-off valve called the "forward tank fuel feed" valve in the forward tank to engine feed line. When the switch is in the closed position (line on the knob at right angles to the line on the panel), the transfer to fuel feed valve is closed and the forward tank fuel feed valve is open. Normal feed flow from the forward tank is thus established. When the switch is in the open position (line on knob aligned with line on panel), the transfer to fuel feed valve is open and the forward tank feed valve is closed. Emergency feed flow through the by-pass line is thus established. When in the open position, the switch also turns on the transfer pump if the transfer pump switch is in ON.

SELECTOR SWITCH. The selector switch (13, figure 1-9) on the fuel control panel controls the five tank transfer valves. By turning the switch so that the line on the knob connects the transfer line on the panel above the knob and one of the tank transfer lines represented on the panel, the transfer valve to the selected tank is opened. The other four tank transfer valves are closed at the same time. If the switch is turned to the extreme clockwise or counterclockwise position, all five tank transfer valves are closed. If the fuel slip switch has been operated to release the slip tank, the slip tank transfer valve cannot be opened by the selector switch. Any of the five tank transfer valves can also be operated manually if necessary.

TANK REFUELING SWITCHES. The three tank refueling switches (6, 11, and 15, figure 1-9) on the fuel control panel control the forward, slip, and aft tank refueling valves. The corresponding valve is closed when one of the switches is turned so that the line on the knob is at right angles to the refueling line represented on the panel. The valve is open if the line on the switch knob is aligned with the line on the panel. The valve is closed automatically when the tank is full. Manual control of the valves is also possible.

BOOST PUMP SWITCH. The booster pump switch (5, figure 1-9) on the fuel control panel is the only control for the booster pump. The switch is moved to ON or OFF to start or stop pump operation.

TRANSFER PUMP SWITCH. The transfer pump switch (12, figure 1-9) on the fuel control panel is placed in ON to make it possible for the pump to be controlled by other electrical controls. The switch does not directly control the pump. While the switch is on, the pump starts and continues to operate if the emergency feed switch is in the open position. The pump also starts operating while the switch is on if the emergency feed switch is in the closed position and the supply of fuel in the forward tank drops to approximately 100 gallons (600 pounds). The pump continues to operate until the supply in the forward tank is approximately 150 gallons (900 pounds). If the switch is moved to OFF, the pump stops. After the switch is returned to ON, the pump will not start operating until the level in the tank drops to 100 gallons (600 pounds).

FUEL SLIP SWITCH. A guarded fuel slip switch (4, figure 1-20) is on the minor controls panel of the pilot's overhead panel. When the guard is raised and the toggle switch pushed up, the bomb shackle release operates to drop the slip tank.

SLIP TANK EMERGENCY RELEASE. A toggle (12, figure 4-27) on the floor on the port side of the utility compartment is an emergency control for the slip tank release. The toggle is connected by cable to the slip tank bomb shackle release mechanism. A pin through the toggle prevents inadvertent operation. By removing the pin and pulling the toggle the slip tank can be released.

SLIP TANK LOCK PIN. The slip tank lock pin is inserted through a hole in the slip tank bomb shackle to prevent operation of the release mechanism of the shackle. The shackle is accessible through the slip tank access panel in the deck of the utility compartment. A red streamer is attached to the pin to warn that it is installed. The pin is stowed in the car when removed from the shackle before take-off.

FUEL DUMP SWITCH. A guard switch (5, figure 1-20) on the minor controls panel controls the aft tank dump valve. Raising the guard and pushing the toggle switch up causes the dump valve actuator to open the valve. The valve releases fuel at a rate of 2550 pounds per minute. The valve can also be opened manually if necessary.

DROP TANK RELEASE TOGGLES. The drop tanks are normally released by two hooded toggles (10, figure 4-27 and 15, figure 4-28) marked "MK-12 FUEL TANK RELEASE." One is on the port and the other on the starboard side of the utility compartment. Each toggle is connected by cable to the release of the corresponding bomb rack. Pulling the toggle releases the tank. The tanks can also be dropped by operating armament controls to release outrigger bomb station racks 4 and 5.

FUEL VALVE MANUAL CONTROLS. Any of the motor-actuated valves in the fuel system can be operated manually if necessary by moving a handle on the valve. The OPEN and CLOSE positions are marked on a plate below the handle. If the valve control circuits are energized, the electrical plug must be disconnected from the valve motor before the valve is turned manually. If the plug is reconnected the valve will move to a position corresponding to the position of valve controls. For a list of the valves with locations, functions, and electrical controls indicated, refer to table II.

FUEL QUANTITY INDICATORS. Fuel quantity indicators (4, 10, and 16, figure 1-9) on the fuel control panel indicate in pounds the quantity of fuel in the forward, slip, and aft tanks. Press-to-test buttons adjacent

Table II. Fuel System Valves

VALVE	LOCATION	FUNCTION	ELECTRICAL CONTROL
1. Forward Tank Fuel Feed Valve	Above deck on port side of utility compartment (8, figure 4-27)	Shuts off fuel flow from forward tank.	(Open when emergency feed switch on fuel control panel is in closed position)
2. Aft Tank Transfer Valve	Fuel feed line on starboard side of utility compartment (8, figure 4-28)	Shuts off fuel flow from aft tank.	Selector switch on fuel control panel
3. Slip Tank Transfer Valve	Slip tank valve access door (11, figure 4-27) in utility compartment deck	Shuts off fuel flow from slip tank.	
4. Drop Tank Transfer Valve	Drop tank valves access door (13, figure 4-28) in utility compartment deck	Shut off fuel flow from drop tanks.	
5. Drop Tank Transfer Valve			
6. Bomb Bay Transfer Valve	Access panel in deck at ECM station	Shuts off fuel flow from bomb bay tank.	
7. Transfer-to-Fuel Feed Valve	Fuel feed transfer valve access door (7, figure 4-27) in utility compartment deck	Opens emergency line for flow to engines direct from aft, slip, drop, or bomb bay tanks.	Emergency feed switch on fuel control panel
8. Engine Fuel Shut-Off Valve	Engine fuel valves access door (17, figure 4-28) in utility compartment deck	Shut off fuel flow to engines.	Engine No. 1 and Engine No. 2 shut-off switches on fuel control panel. Also shut off by Engine No. 1 and Engine No. 2 fuel-hydraulic shut-off switches on engine fire control panel
9. Engine Fuel Shut-Off Valve			
10. Forward Tank Refueling Valve	Forward tank inlet connection	Shuts off forward tank inlet. Valve must be open for automatic transfer system to operate. Opened for refueling forward tank.	Forward tank refueling switch on fuel control panel
11. Aft Tank Refueling Valve	Aft tank inlet connection - stern compartment	Shuts off aft tank fuel inlet.	Aft tank refueling switch on fuel control panel
12. Slip Tank Refueling Valve	Slip tank inlet line above deck starboard in stern compartment (25, figure 4-31)	Shuts off slip tank fuel inlet.	Aft tank refueling switch on fuel control panel
13. Fuel Dump Valve	Bottom of aft tank	Emergency dumping of fuel in aft tank.	Fuel dump switch on minor controls panel

to the indicators are pressed to check that the indicators are operating. The indicator needle should start to rotate counterclockwise when the button is depressed. The slip tank quantity indication is returned to zero by a simulator when the slip tank is dropped. Fuel quantity indicators are not provided for the drop and bomb bay tanks.

FUEL PRESSURE INDICATORS. Two fuel pressure indicators (1 and 9, figure 1-9) on the fuel control panel indicate the pressure of fuel entering the carburetors. The indications are multiplied by 10 to determine fuel pressure in psi. The indicators operate on a-c electrical power. Pressure limits are shown in figure 5-1.

30 MINUTE FUEL WARNING LIGHT. A press-to-test, 30-minute fuel warning light (2, figure 1-9) on the fuel control panel glows to indicate that the quantity of fuel in the forward tank is less than 60 gallons (360 pounds). At normal rated power, this quantity of fuel will operate the engines for approximately 30 minutes.

NO TRANSFER PRESSURE LIGHT. A red light (14, figure 1-9) adjacent to the transfer pump switch glows to warn that transfer fuel flow has stopped. The light thus indicates that the selector switch is positioned to an empty tank or that the transfer pump is not operating. Since the transfer pump is not controlled directly by the transfer pump switch, the light is controlled so that it does not light every time the pump switch is on and no fuel is flowing. It lights only when the emergency feed switch is also in open position or the automatic transfer system has closed the pump circuit but fuel is not flowing through the transfer line.

CONSTANT SPEED DRIVE.

GENERAL. The constant speed drive system drives the a-c generator, main d-c generator, and winch hydraulic pump. The drive maintains the speed required for the a-c generator to produce constant frequency power at 403 cps. The drive makes it possible to maintain constant generation of electrical power and output of winch system hydraulic power during low speed flight maneuvers. With both engines operating at minimum speed of 1000 rpm, the drive can be overloaded only by abnormal surge loads applied to the winch system or electrical systems.

The constant speed drive system is basically a hydraulic system which transmits engine power to a gear box on which the generators and winch pump are mounted. Two engine driven pumps, one on each engine, produce a flow of hydraulic fluid under high pressure. This flow of fluid drives a fixed-stroke hydraulic motor which drives the generators and winch pump through the gears of the gear box. The turning speed of the fixed stroke motor is held constant by a constant volume of flow through the motor, maintained by the action of a variable displacement motor controlled by a venturi speed control unit and an electrical acceleration compensating system. If engine rpm is low while loads on the drive are high, the variable displacement motor acts as a pump to increase the pressure of fluid driving the fixed stroke motor. If engine rpm is high while loads on the drive are low, the variable displacement motor acts as a motor to reduce the pressure of fluid driving the fixed stroke motor.

Assuming that engine rpm is constant, pressure in the constant speed drive system increases as loads carried by the drive increase. To protect the system from excessive pressure, which might occur when excessive loads are added to the drive while engines are operating at low rpm or only one engine is operating, a relief valve relieves the pressure when it reaches some point between 3300 and 3475 psi. Once the pressure is relieved, the drive slows until the generators are automatically disconnected from the busses. After the electrical loads are thus dropped, the drive speeds up until the generators are re-connected; then it slows again. This cycle is repeated, but the drive does not regain and hold operating speed unless stopped and reset. The procedure for resetting the drive is included in section III.

If the drive overspeeds as a result of malfunction, it is stopped automatically by an overspeed control system. This system senses the output frequency of the a-c generator and operates when the frequency reaches some point between 470 and 500 cps. The system opens a valve to vent the main relief valve, reducing pressure in the drive unit to stop the drive motor. The drive can also be stopped by operation of a stop button to effect the same results. A reset button is provided for closing the overspeed shut-off valve to restore drive operation.

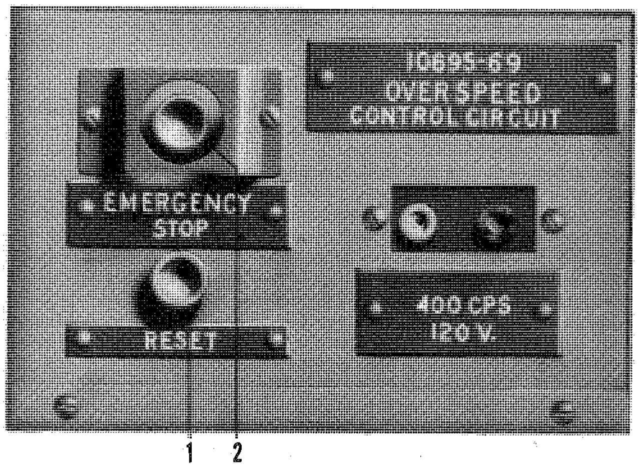
The major components of the drive system, except for the engine driven pumps, are located in the aft section of the No. 2 engine nacelle. One reservoir supplies hydraulic fluid for both the winch hydraulic system and the constant speed drive hydraulic system. The fluid used, hydraulic oil conforming to Specification MIL-O-5606, is inflammable; therefore electrically operated shut-off valves are installed so that flow of fluid to the nacelles can be stopped in case of fire. Since the drive components are in the No. 2 engine nacelle, shutting off fluid flow to that nacelle stops the constant speed drive completely.

The constant speed drive components and the main generators are cooled by a separate cooling system which operates automatically while the drive is operating. Cooling air is supplied by a blower driven hydraulically by a pump and motor system powered through the drive gear box. The cooling air is forced through a liquid cooler to cool the fluid in the drive system, and the air is also forced through the generators for generator cooling. Normally, the constant speed drive system operates automatically when one or both engines are operating. Instruments available to the crew indicate whether the drive is operating properly. Controls are provided only for stopping and starting the drive when necessary.

CAUTION

Never run up the engines while the constant speed drive is not operating. Never operate the engines when the winch hydraulic system reservoir is not pressurized to correct pressure. Either of these conditions can cause cavitation of the engine-driven hydraulic pumps, and the pumps can thus be damaged. Both fuel-hydraulic shut-off switches must be in ON when engine is operating, except in emergency conditions.

EMERGENCY STOP BUTTON. The constant speed drive unit can be stopped by depressing the emergency stop button (2, figure 1-10) on the overspeed control, located aft on the second shelf at the radio operator's station. When this button is depressed a solenoid-operated shut-off valve is opened to vent the constant speed drive system relief valve. Venting this relief valve causes it to open. With the relief valve open, the fluid on the high pressure side of the constant speed drive system by-passes the motors of the constant speed drive and flows into the low pressure side of the system. The fixed-stroke motor then stops turning. Thus, when the emergency stop button is depressed, the a-c generator, the main d-c generator, and the winch hydraulic pump stop and the constant speed drive unit is returned to automatic operation by depressing the reset button on the overspeed control.



1. Reset Button
2. Emergency Stop Button

Figure 1-10. Constant Speed Drive Overspeed Control

RESET BUTTON. The reset button (1, figure 1-10) is also on the overspeed control, located aft on the second shelf at the radio operator's station. The button is used to start the drive system after it has been stopped by automatic operation of the overspeed control system or by manual operation of the emergency stop button. When the reset button is momentarily depressed, the overspeed shut-off valve and the constant speed relief valve close. Pressure then builds up in the drive system and the drive is restored to normal operation. If the relief valve does not reseat immediately, the drive will surge. It must then be stopped by the emergency stop button, and can be reset after engine rpm is reduced.

NOTE

The drive will surge if the reset button is held depressed when the overspeed conditions still exist. Do not attempt to maintain operation of the drive by this method.

FUEL-HYDRAULIC SHUT-OFF SWITCHES. Four shut-off valves in the constant speed drive system are controlled by two switches (figure 1-29) on the engine fire control panel of the pilot's overhead panel. Three of the valves are installed in the lower port outrigger strut and shut off flow of hydraulic fluid to the No. 1 engine hydraulic pump. If these three valves are closed by throwing the engine No. 1 switch to SHUT OFF, the pump on the No. 1 engine is isolated from the drive system. The drive continues operating if loads on the drive are below the capacity limit of the No. 2 engine pump. The other valve is in the drive system replenishing line leading from the reservoir to the No. 2 engine nacelle. This valve and the other three valves all close and the drive stops when the engine No. 2 switch is moved to SHUT-OFF.

HYDRAULIC PRESSURE INDICATOR. Constant speed drive system hydraulic pressure is registered on an indicator (21, figure 1-6) on the pilot's instrument panel. The pressure indicated is the high pressure which drives the fixed stroke motor. This pressure varies with engine rpm and drive load variation. The effects on pressure of added loads on the drive are discussed in section V. Maximum pressure is marked on the indicator at 3300 psi as shown in figure 5-1. The indicator system operates on a-c power from the instrument transformer.

FREQUENCY METER. A frequency meter (figure 1-15) on the a-c distribution and circuit breaker panel is used with the hydraulic pressure indicator to check constant speed drive operation. If the drive is functioning properly, the meter indicates 403 cps or fluctuates between 400 and 405 cps when drive loads are changed. Refer to the description of the a-c electrical system in this section.

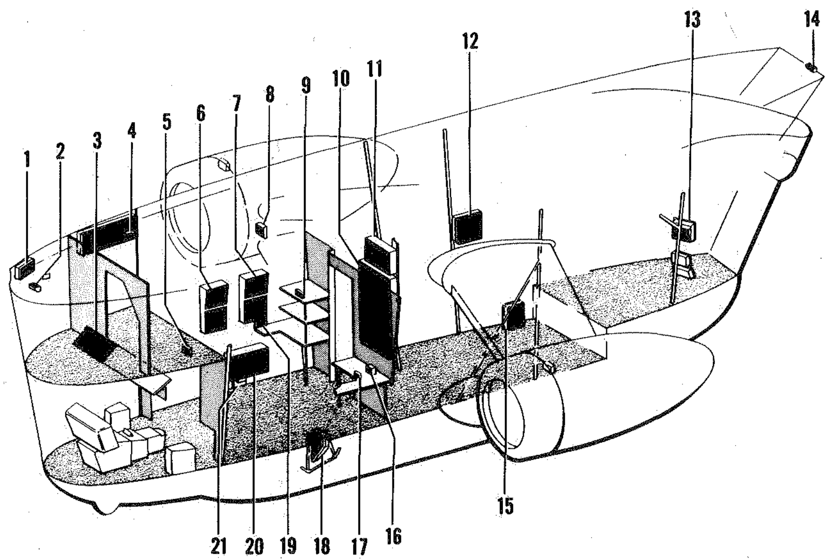
ELECTRICAL POWER SYSTEMS.

GENERAL. Both d-c and constant frequency a-c power are supplied for operation of airship equipment and control systems. The main generators are driven by a constant speed drive so that sufficient power output is maintained for operation of required equipment during most flight maneuvers requiring reduced airspeed. Emergency d-c power is available from engine-driven standby generators when the main d-c generator is not in operation, but no auxiliary power unit is carried on the airship during flight.

In addition to the descriptions of the d-c and a-c power systems, several illustrations and tables are included here to help explain the systems. Table III lists the electrically operated equipment by systems, together with the circuit breakers supplying power to the equipment in each system. The electrical system schematics (figures 1-12 and 1-14) show power sources, flow routes from sources to busses, bus arrangement, and loads connected to busses. The connected loads are shown in order of descending magnitude. Another illustration (figure 1-11) shows the location of the circuit breaker panels and junction boxes which are accessible during flight.

D-C ELECTRICAL POWER SYSTEM.

GENERAL. The power sources for the 28-volt d-c electrical system are two 24-volt, 24 ampere-hour batteries which are connected in parallel; one 300-ampere main d-c generator; two 50-ampere engine-driven



ITEM	LOCATION	REMARKS
1. Sonar Circuit Breaker Panel	Above sonar table	Current limiters behind panel with spare links. Spare light fuse on panel.
2. Forward Envelope Junction Box	Above sonar compartment window	
3. Pilot's Circuit Breaker Panel	Pilot's overhead panel above copilot	Current limiters behind panel with spare links. Spare fuses on panel.
4. Auto Pilot Junction Box	Starboard side of electronic compartment	
5. Radar Lights Fuse Panel	Radar operator's station	Spare fuse included.
6. A-C Distribution and Circuit Breaker Panel	Starboard side of electronic compartment	Primary control of a-c system.
7. D-C Distribution and Circuit Breaker Panel	Starboard side of electronic compartment	Primary control of d-c system. Current limiters above panel with spare links.
8. Mid-Envelope Junction Box	Overhead in electronic compartment	
9. Radio Lights Fuse Panel	Radio operator's station	Spare fuse included.
10. Main D-C Junction Box	Starboard side of utility compartment	Current limiters inside with spare links.
11. Main A-C Junction Box	Starboard side of utility compartment	AN/APS-33 fuses on inboard end with spare fuse included.
12. Starboard Strut Junction Box	Starboard side of utility compartment	Main a-c power circuit breakers (3) on bottom.
13. Winch Operator's Circuit Breaker Panel	Winch operator's station	Current limiters behind panel. Spare fuse on panel.
14. Aft Envelope Junction Box	Overhead in aft end of stern compartment	
15. Port Strut Junction Box	Port side of utility compartment	
16. ECM Station Junction Box	ECM operator's station	
17. ECM Lights Fuse Panel	ECM operator's station	Spare fuse included.
18. Bomb Salvo Relay Box	Aft end of bomb bay	
19. Antenna and Receiver Disabling and Sidetone Relay Box	Starboard side of electronic compartment	One fuse inside with spare fuse included.
20. Armament Junction Box	Port side of utility compartment	
21. Navigator Lights Fuse Panel	Navigator's station	Spare fuse included.

Figure 1-11. Circuit Breaker and Junction Box Locations

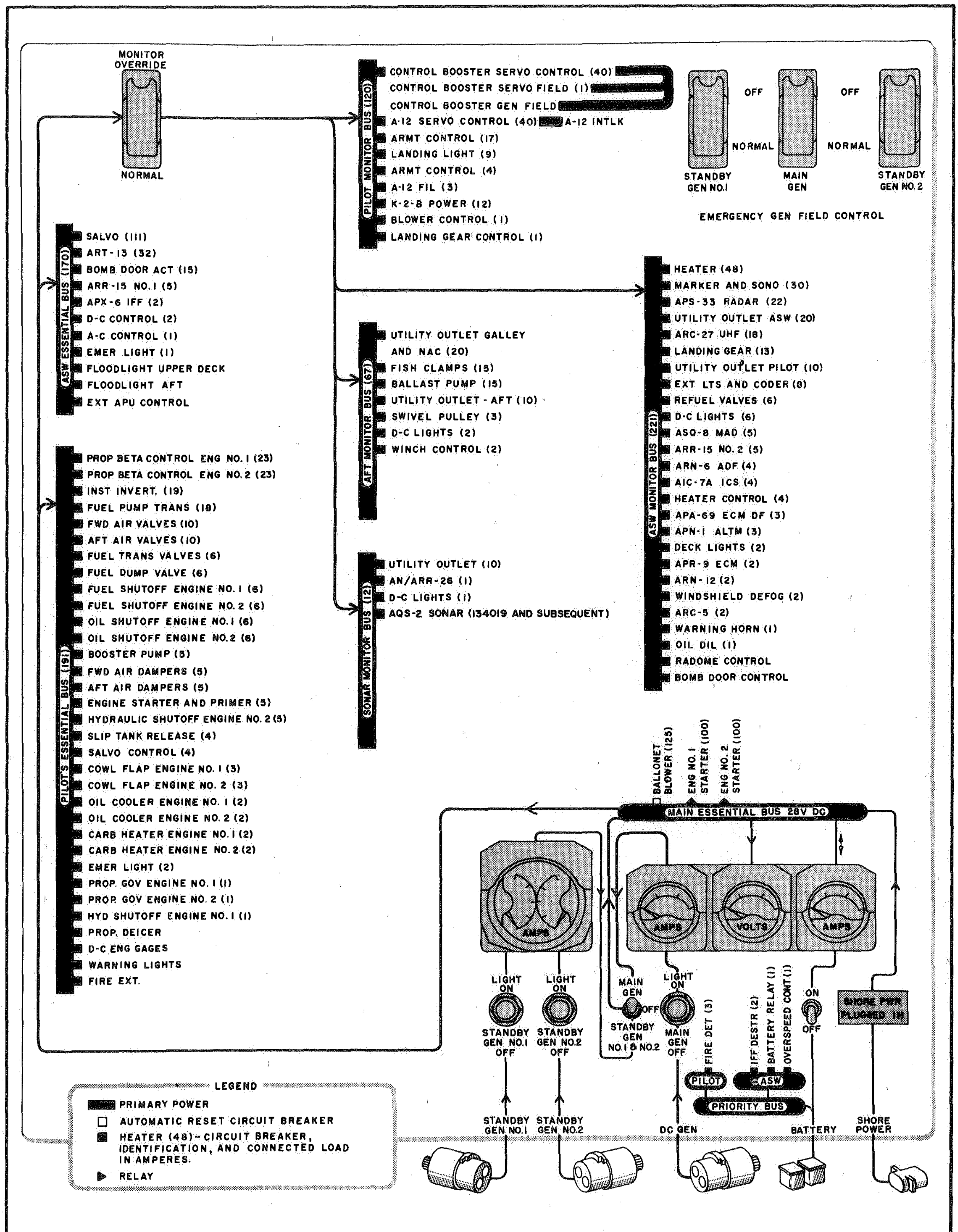


Figure 1-12. D-C Electrical System Schematic

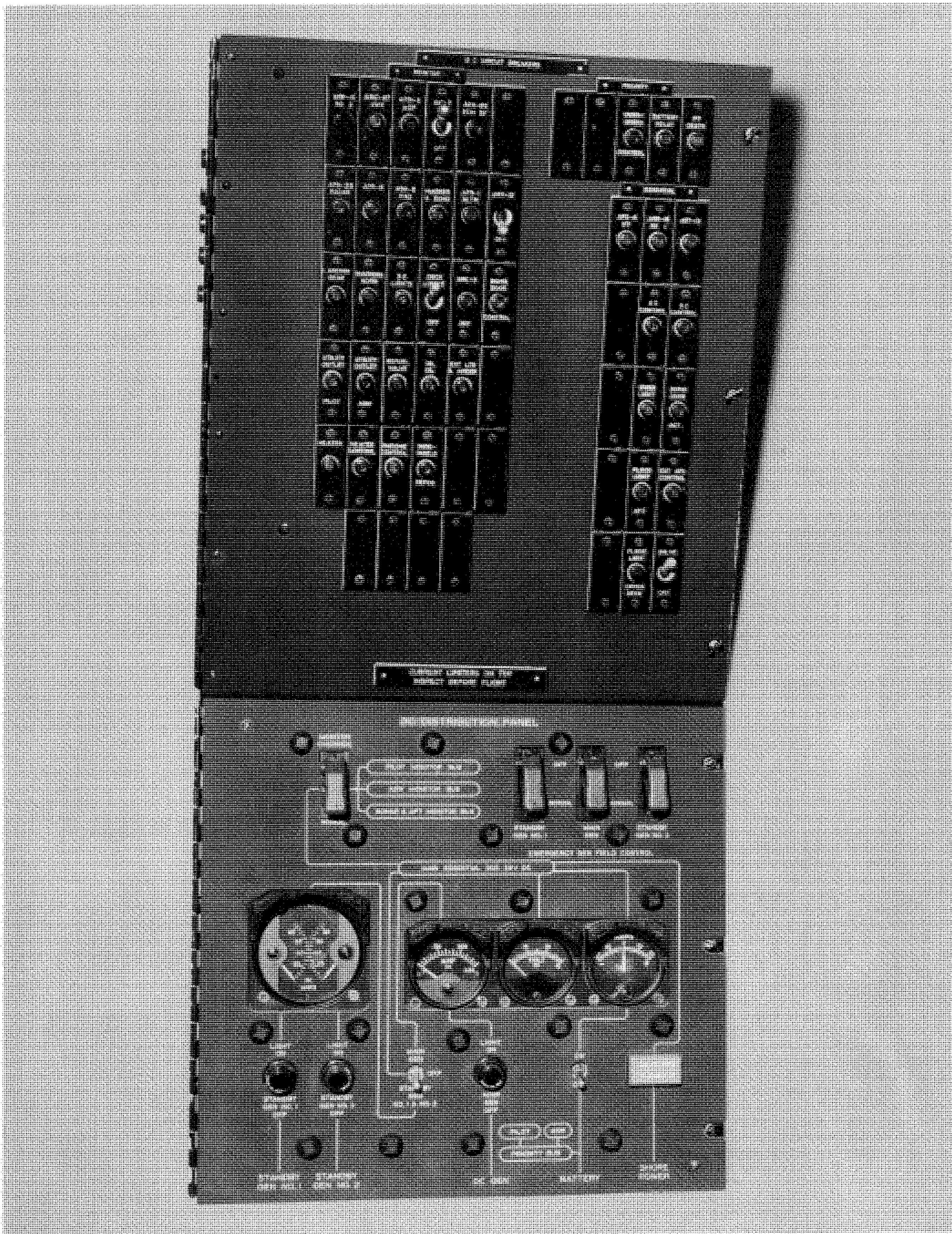


Figure 1-13. D-C Distribution and Circuit Breaker Panel

standby generators; and a 175-ampere auxiliary power unit generator, which is furnished for use only when the airship is on the ground. In flight the main generator normally supplies power for the entire d-c system. If this generator is not operating, a monitoring system automatically disconnects all but essential busses from the power sources. An override switch permits reconnecting the monitor busses so that specific equipment connected to those busses can be operated if necessary on power supplied by the standby generators or batteries.

The batteries are connected to the priority bus at all times and are also connected to the essential busses if the battery switch is on. When other power sources are supplying power to the essential busses, the batteries are charged if the battery switch is on. If no other power is available to the system, battery power can be used as required for operation of any other equipment in addition to the priority equipment always connected to the batteries; or the batteries can be protected from other loads during emergency conditions by turning the battery switch off.

The standby generators can be connected to the essential busses to supply power only by disconnecting the main generator from the busses. When supplying power to the busses, the two standby generators are in parallel and supply sufficient power for a 90-ampere total load. If it is necessary in an emergency to open the field circuit of one of the standby generators, the one remaining generator can supply sufficient power for a 50-ampere total load.

When the airship is on the ground, an external power source can be connected through an external power receptacle to supply power for all d-c powered equipment. An auxiliary power unit pod, which can be hung on a support structure on the aft starboard side of the car, is provided for use while the airship is on the mast. A control system for the auxiliary power unit is connected through a receptacle adjacent to the external power receptacle so that the auxiliary power unit can be started electrically. The batteries or generators of the airship can be connected to the essential busses to supply power for starting the auxiliary power unit.

The output of each generator (including the APU) is controlled by a voltage regulator. When both standby generators are operating, the load on each is equalized. Reverse current cutouts connect the generators to the busses and prevent reverse currents from flowing from the bus to a power source.

BATTERY SWITCH. The battery switch (figure 1-13) on the d-c distribution panel is a toggle switch with an ON and an OFF position. The ON position of the switch connects the batteries to the essential d-c busses. The OFF position of the switch isolates the batteries from these busses, leaving the batteries connected to the priority bus only.

MONITOR OVERRIDE SWITCH. The monitor override switch (figure 1-13) on the d-c distribution panel is a toggle switch with a red guard holding it in the NORMAL position. In NORMAL the switch causes the pilot, ASW, sonar, and aft monitor busses to be energized only when main generator or external d-c power is supplied to the d-c system. When main generator or external d-c power is not available, the monitor busses can be energized by the standby generators or the batteries if the switch is placed in the MONITOR OVERRIDE position.

MAIN-STANDBY GENERATOR SWITCH. The main standby generator switch (figure 1-13) on the d-c distribution panel is a three-position toggle switch. The MAIN GEN position of the switch causes the main generator to be connected to the airship d-c system. In the OFF position the switch causes both the main generator and the standby generators to be disconnected from the busses. The STANDBY GEN NO. 1 & 2 position causes the standby generators to be connected to the essential busses.

MAIN GENERATOR EMERGENCY FIELD CONTROL SWITCH. The emergency field control switch (figure 1-13) for the main generator is located on the d-c distribution panel. The two-position toggle switch is held in the NORMAL position by a guard. In the NORMAL position the switch permits normal control of the field of the generator. The OFF position is used only in an emergency to open the generator field under load.

STANDBY GENERATOR EMERGENCY FIELD CONTROL SWITCHES. The emergency field control switches (figure 1-13) for the two standby generators are on the d-c distribution panel. The two-position toggle switches are held in the NORMAL position by a guard. The OFF position of either switch is used only in an emergency to open the generator field under load.

GENERATOR OFF INDICATOR LIGHTS. A red indicator light (figure 1-13) for each generator is located on the d-c distribution panel. When lit, the "light on-main generator off" light indicates that the main generator is off or not connected to the busses. When lit, the "light on-standby generator No. 1 off" or the "light on-standby generator No. 2 off" light indicates that the generator switch is in the STANDBY GEN NO. 1 & 2 position, but the generator is off or not connected to the busses.

SHORE POWER PLUGGED IN INDICATOR LIGHT. A red indicator light (figure 1-13) next to the battery switch on the d-c distribution panel is lighted whenever an external power source is plugged into the external power receptacle and is supplying power to the airship d-c system.

BATTERY AMMETER. The battery ammeter (figure 1-13) on the d-c distribution panel indicates charging or discharging current of the batteries. The ammeter is inoperative when the starter switch is on.

MAIN GENERATOR AMMETER. The main generator ammeter (figure 1-13) on the d-c distribution panel indicates the current drawn from the main generator.

STANDBY GENERATORS DUAL AMMETER. The dual ammeter (figure 1-13) on the d-c distribution panel indicates the current drawn from each standby generator on a separate dial, the No. 1 standby generator being represented by the forward dial and the No. 2 standby generator by the aft dial.

D-C VOLTMETER. The d-c voltmeter (figure 1-13) on the d-c distribution panel registers the voltage of the ASW essential bus. It is connected to the bus through the d-c control circuit breakers.

D-C AMMETER TEST JACKS. The d-c AMMETER test jacks (figure 1-13) on the forward side of the d-c distribution and circuit breaker box, permit the connection of portable ammeters to the d-c system for test purposes. Standby generator No. 1, standby generator No. 2, main generator, and battery ammeter test jacks are provided.

D-C VOLTMETER TEST JACKS. A pair of bus voltage test jacks are located on the forward side of the d-c distribution and circuit breaker box to permit the connection of a portable voltmeter to check bus voltage. Five test jacks are located on the forward edge of the regulator shelf. Either of two jacks may be used for the ground side of a portable voltmeter; the positive side of the voltmeter may be connected to any one of the DC GENERATOR test jacks. The CONSTANT SPEED jack connects to the main d-c generator, the STBD STANDBY jack connects to the number two standby generator, and the PORT STANDBY connects to the number one standby generator. These jacks are used to determine generator terminal voltages.

D-C UTILITY OUTLETS. Eight d-c utility outlets are conveniently located throughout the airship for the operation of signal lights and other d-c equipment. Table IIA lists the location and load rating of each of these outlets.

Table IIA. D-C Utility Outlets

LOCATION	MAXIMUM RATED LOAD (Amperes)	
Port side of utility compartment forward bulkhead	20	Total load from three outlets must not exceed 20 amperes (560 watts).
Starboard nacelle, inside inboard access panel	20	
Port nacelle, inside inboard access panel	20	
Winch operator's circuit breaker box	10	
Overhead on port side of pilot's compartment	10	
Top electronics shelf aft of sonar operator's station	10	
D-c distribution and circuit breaker box	20	Total load from two outlets must not exceed 20 amperes (560 watts).
Navigator's table	20	

Table III. System Power Sources

CIRCUIT	A-C SYSTEM				D-C SYSTEM		
	CIRCUIT BREAKER OR FUSE	*	MAIN DISTRIBUTION CIRCUIT BREAKER	*	CIRCUIT BREAKER	*	BUS
AIR PRESSURE							
Forward Damper Actuators					FWD AIR DAMPERS	3	Pilot's Essential
Aft Damper Actuators					AFT AIR DAMPERS	3	Pilot's Essential
Damper Position Indication					D-C ENG GAGES	3	Pilot's Essential
Forward Air Valves Actuators					FWD AIR VALVES	3	Pilot's Essential
Aft Air Valves Actuators					AFT AIR VALVES	3	Pilot's Essential
Blower Control					BLOWER CONTROL	3	Pilot Monitor
Blower Indication					BALLONET BLOWER LIGHT (Fuse)	10	Main Essential
Blower					Remote Control Circuit Breaker		Main Essential
Ballonet Fullness Indication and Transmitter Heaters	BALLONET FULLNESS (Fuse)	6	INSTRUMENT BUS	6			
ARMAMENT							
Armament Indication					ARMT CONTROL(15A) D-C LIGHTS	3 7	Pilot's Monitor ASW Monitor
Indication Test					ARMT CONTROL(10A)	3	Pilot's Monitor
Arming Control & Indication					ARMT CONTROL(15A)	3	Pilot's Monitor
Bomb Bay Doors Control					BOMB DOOR CONTROL	7	ASW Monitor
Bomb Bay Doors Actuator					BOMB DOOR ACT	7	ASW Essential
Bomb Bay Doors Indication					ARMT CONTROL(10A)	3	Pilot's Monitor
Store Selector Control & Release					ARMT CONTROL(10A) ARMT CONTROL(15A) K2B POWER	3 3 3	Pilot's Monitor Pilot's Monitor Pilot's Monitor
Outrigger Bomb Racks Release					ARMT CONTROL(10A) ARMT CONTROL(15A)	3 3	Pilot's Monitor Pilot's Monitor

*Location of circuit breaker or fuse (see figure 1-11)

Table III. System Power Sources (Continued)

CIRCUIT	A-C SYSTEM				D-C SYSTEM		
	CIRCUIT BREAKER OR FUSE	*	MAIN DISTRIBUTION CIRCUIT BREAKER	*	CIRCUIT BREAKER	*	BUS
ARMAMENT (Cont)							
Salvo Release					SALVO CONTROL BOMB DOOR ACT SALVO	3 7 7	Pilot's Essential ASW Essential ASW Essential
Marker & Sonobuoy Release					MARKER AND SONO ARMT CONTROL(10A)	7 3	ASW Monitor Pilot's Monitor
Marker & Sonobuoy Indication					D-C LIGHTS ARMT CONTROL(10A)	7 3	ASW Monitor Pilot's Monitor
AUTO PILOT							
Amplifier Control & Repeater Compass Indication	AUTOPILOT	3	PILOT ØA	6	A-12 FIL	3	Pilot's Monitor
Servos					A-12 SERVO CONTROL A-12 INTLK	3 3	Pilot's Monitor
CONSTANT SPEED DRIVE							
Overspeed Control			PHASE B	12	OVERSPEED CONTROL	7	Priority
Acceleration Compensating Unit			PHASE A	12			
Hydraulic Shut Off Valves (3) - Engine No. 1					HYD SHUTOFF ENGINE NO. 1	3	Pilot's Essential
Hydraulic Shut Off Valves (4) - Engine No. 2					HYD SHUTOFF ENGINE NO. 2	3	Pilot's Essential
Hydraulic Pressure Indication	HYD PRESS (Fuse) INST TRANSF	3 3	INSTRUMENT BUS	6			
ELECTRICAL							
A-C Power Generator Control & Indication					A-C CONTROL	7	ASW Essential
Frequency Meter	FREQUENCY METER (Fuse)	12					
Instrument Inverter					INSTRUMENT INVERTER	3	Pilot's Essential
Instrument Bus Indication	INST PWR OFF WARNING (Fuse)	6	INSTRUMENT BUS	6	A-C CONTROL	7	ASW Essential
Shore Power Indication					A-C CONTROL	7	ASW Essential
D-C Power Battery Ammeter Disconnect Control					ENGINE STARTER & PRIMER	3	Pilot's Essential
Battery Control					BATTERY RELAY	7	Priority
Main & Standby Generators Indication					BATTERY RELAY	7	Priority
Voltmeter Control					D-C CONTROL	7	ASW Essential

* Location of circuit breaker or fuse (see figure 1-11)

Table III. System Power Sources (Continued)

CIRCUIT	A-C SYSTEM				D-C SYSTEM		
	CIRCUIT BREAKER OR FUSE	*	MAIN DISTRIBUTION CIRCUIT BREAKER	*	CIRCUIT BREAKER	*	BUS
ELECTRICAL (Cont)							
External APU Starting					APU EXT CONTROL	7	ASW Essential
ELECTRONIC							
Intercom Set					AIC-7A ICS	7	ASW Monitor
Sonar Operator's Call Light					DC LIGHTS	1	Sonar Monitor
UHF Radio Set					ARC-27 UHF	7	ASW Monitor
Liaison Transmitter					ART-13	7	ASW Essential
Liaison Receiver No. 1					ARR-15 NO. 1	7	ASW Essential
Liaison Receiver No. 2					ARR-15 NO. 2	7	ASW Monitor
Range Receiver					ARC-5	7	ASW Monitor
Marker Beacon Receiver					ARN-12	7	ASW Monitor
Radio Compass					ARN-6 ADF	7	ASW Monitor
Radio Altimeter					APN-1 ALTM	7	ASW Monitor
Loran	AN/APN-9	6	ASW ØB	6			
Radar Set	AN/APS-33F	6	ASW ØA	6	APS-33 RADAR	7	ASW Monitor
	AN/APS-33(Fuse)	11					
	AN/APS-33(Fuse)	11					
	POWER TRANSFORMER	6	ASW ØA				
	POWER TRANSFORMER	6	ASW ØB	6			
	POWER TRANSFORMER	6	ASW ØC	6			
Radome Control & Indication					RADOME CONTROL	7	ASW Monitor
Radome Retraction Actuator	RADOME RETRACT (Fuse)	6	ASW ØA	6			
	RADOME RETRACT (Fuse)	6	ASW ØB	6			
	RADOME RETRACT (Fuse)	6	ASW ØC	6			
Radar Identification	AN/APX-6	6	ASW ØC	6	APX-6 IFF	7	ASW Essential
Radar Identification Destruction					IFF DESTR	7	Priority
ECM Receiver	AN/APR-9	6	ASW ØC	6	APR-9 ECM	7	ASW Monitor
ECM Direction Finder	AN/APA-69	6	ASW ØA	6	APA-69 ECM DF	7	ASW Monitor
Sonobuoy Receiver	AN/ARR-26	1	SONAR ØA	6	AN/ARR-26	1	Sonar Monitor
Scanning Sonar (134019 and Subsequent)	AN/AQS-2 ØA	1	SONAR ØA	6	AQS-2 SONAR	1	Sonar Monitor
	AN/AQS-2 ØB	1	SONAR ØB	6			
	AN/AQS-2 ØC	1	SONAR ØC	6			
MAD	AN/ASQ-8	6	ASW ØA	6	ASQ-8 MAD	7	ASW Monitor
	AN/ASQ-8	6	ASW ØB	6			
	AN/ASQ-8	6	ASW ØC	6			

* Location of circuit breaker or fuse (see figure 1-11)

Table III. System Power Sources (Continued)

CIRCUIT	A-C SYSTEM				D-C SYSTEM		
	CIRCUIT BREAKER OR FUSE	*	MAIN DISTRIBUTION CIRCUIT BREAKER	*	CIRCUIT BREAKER	*	BUS
ENGINES							
Starter Control & Primer					ENGINE STARTER AND PRIMER	3	Pilot's Essential
Manifold Pressure Indication	MAN PRESS (Fuse) INST TRANSF (Fuse)	3 3	INSTRUMENT BUS	6			
Carburetor Air Temperature Indication					DC ENG GAGES	3	Pilot's Essential
Carburetor Heat Actuator - Engine No. 1					CARB HEATER ENGINE NO. 1	3	Pilot's Essential
Carburetor Heat Actuator - Engine No. 2					CARB HEATER ENGINE NO. 2	3	Pilot's Essential
Cowl Flap Actuator - Engine No. 1					COWL FLAP ENGINE NO. 1	3	Pilot's Essential
Cowl Flap Actuator - Engine No. 2					COWL FLAP ENGINE NO. 2	3	Pilot's Essential
FIRE DETECTION AND EXTINGUISHING							
Indication					FIRE DETECTOR	3	Priority
Fire Extinguishing Valve					FIRE EXT	3	Pilot's Essential
FUEL							
Refueling Valves					REFUEL VALVES	7	ASW Monitor
Fuel Shut-Off Valve (No. 1 Engine)					FUEL SHUT-OFF ENGINE NO. 1	3	Pilot's Essential
Fuel Shut-Off Valve (No. 2 Engine)					FUEL SHUT-OFF ENGINE NO. 2	3	Pilot's Essential
Fuel Transfer Valves					FUEL TRANS VALVES	3	Pilot's Essential
Booster Pump					BOOSTER PUMP	3	Pilot's Essential
Slip Tank Release					SLIP TANK RELEASE	3	Pilot's Essential
Fuel Dump Valve (Aft Tank)					FUEL DUMP VALVE	3	Pilot's Essential
Fuel Transfer Pump, Forward Tank Fuel Feed Valve, Transfer to Fuel Feed Valve, and No Transfer Pressure Light					FUEL PUMP TRANS.	3	Pilot's Essential
30-Minute Fuel Warning Light					WARNING LIGHTS	7	Pilot's Essential
Slip Tank Quantity Indication	FUEL GAGE - SLIP (Fuse)	3	INSTRUMENT	6			
Slip Tank Quantity Simulator					D-C ENG GAGES	3	Pilot's Essential
Aft Fuel Tank and Fwd Fuel Tank Quantity Indication	FUEL GAGE - AFT FUEL GAGE - FWD (Fuses)	3 3	INSTRUMENT BUS INSTRUMENT BUS	6 6			
Fuel Pressure Indication	FUEL PRESS INST TRANSF	3 3	INSTRUMENT BUS	6			

*Location of circuit breaker or fuse (see figure 1-11)

Table III. System Power Sources (Continued)

CIRCUIT	A-C SYSTEM				D-C SYSTEM		
	CIRCUIT BREAKER OR FUSE	*	MAIN DISTRIBUTION CIRCUIT BREAKER	*	CIRCUIT BREAKER	*	BUS
GALLEY							
Heating Elements	GALLEY ØA GALLEY ØB GALLEY ØC	6 6 6	ASW ØA ASW ØB ASW ØC	6 6 6			
Galley Outlet					UTILITY OUTLET GALLEY & NAC	14	Aft Monitor
HEATING AND VENTILATING							
Blower					BLOWER (on heating and ventilating panel) HEATER	 7	 ASW Monitor
Heater and Temperature Control	HEATER CONTROL	6	ASW ØA	6	HEATER CONTROL	7	ASW Monitor
Indication					HEATER CONTROL	7	ASW Monitor
HELIUM							
Helium Valve Indication					WARNING LIGHTS	3	Pilot's Essential
INSTRUMENTS							
Free-Air Temperature Indication					D-C ENG GAGES	3	Pilot's Essential
Gyro Horizon Indication	GYRO HORIZON(Fuse) GYRO HORIZON(Fuse) POWER TRANSFORMER POWER TRANSFORMER POWER TRANSFORMER	3 3 6 6 6	 ASW ØA ASW ØB ASW ØC	 6 6 6			
LANDING GEAR							
Actuator					LANDING GEAR	7	ASW Monitor
Control & Indication					LANDING GEAR CONTROL	3	Pilot Monitor
LIGHTING							
Interior Lights Refer to Tables VIII through XI							
Exterior Lights Navigation & Recognition Lights	EXTERIOR LIGHTS	6	ASW ØC	6	EXT LTS & CODER	7	ASW Monitor
Prop Lights					EXT LTS & CODER	7	ASW Monitor
Landing Light					LANDING LIGHT	3	Pilot's Monitor
MISCELLANEOUS							
General Quarters Alarm					WARNING HORN	7	ASW Monitor
Defogger Blowers					WINDSHIELD DEFOG	7	ASW Monitor

*Location of circuit breaker or fuse (see figure 1-11)

Table III. System Power Sources (Continued)

CIRCUIT	A-C SYSTEM				D-C SYSTEM		
	CIRCUIT BREAKER OR FUSE	*	MAIN DISTRIBUTION CIRCUIT BREAKER	*	CIRCUIT BREAKER	*	BUS
MISCELLANEOUS (Cont)							
D-C Outlet - Electronic Compartment Upper Deck					UTILITY OUTLET	2	Sonar Monitor
A-C Outlet - Electronic Compartment Upper Deck	UTILITY OUTLET	2	SONAR ØB	6			
D-C Outlet - D-C Circuit Breaker Box					ASW UTILITY OUTLETS	7	ASW Monitor
D-C Outlet - Navigator's Table					UTILITY OUTLETS ASW	7	ASW Monitor
Pilot's Signal Light D-C Outlet					UTILITY OUTLET PILOT	7	ASW Monitor
A-C Outlet - A-C Circuit Breaker Box	UTILITY OUTLETS	6	ASW ØA	6			
A-C Outlet - Navigator's Table	UTILITY OUTLETS	6	ASW ØA	6			
D-C Outlets - Port & Stbd Nacelles					UTILITY OUTLET GALLEY & NAC	14	Aft Monitor
D-C Outlet - Winch Opera-ator's Circuit Breaker Box					UTILITY OUTLET	14	Aft Monitor
A-C Outlet - Winch Opera-tor's Circuit Breaker Box	UTILITY OUTLET	14	AFT ØA	6			
OIL							
Oil Shut-Off Valve - Engine No. 1					OIL SHUT-OFF ENGINE NO. 1	3	Pilot's Essential
Oil Shut-Off Valve - Engine No. 2					OIL SHUT-OFF ENGINE NO. 2	3	Pilot's Essential
Oil Cooler Door Actuator Engine No. 1					OIL COOLER EN-GINE NO. 1	3	Pilot's Essential
Oil Cooler Door Actuator Engine No. 2					OIL COOLER EN-GINE NO. 2	3	Pilot's Essential
Oil Dilution Solenoids					OIL DIL	7	ASW Monitor
Oil Temperature Indication					D-C ENG GAGES	3	Pilot's Essential
Oil Pressure Indication	OIL PRESS (Fuse) INST TRANSF (Fuse)	3 3	INSTRUMENT BUS	6			
Oil Quantity Indication					D-C ENG GAGES	3	Pilot's Essential
PROPELLERS							
De-Icing Pump					PROP DE-ICER	3	Pilot's Essential
Blade Angle Change Motor - Engine No. 1					PROP BETA CON-TROL - ENGINE NO. 1	3	Pilot's Essential
Blade Angle Change Motor - Engine No. 2					PROP BETA CON-TROL - ENGINE NO. 2	3	Pilot's Essential

*Location of circuit breaker or fuse (see figure 1-11)

Table III. System Power Sources (Continued)

CIRCUIT	A-C SYSTEM				D-C SYSTEM		
	CIRCUIT BREAKER OR FUSE	*	MAIN DISTRIBUTION CIRCUIT BREAKER	*	CIRCUIT BREAKER	*	BUS
PROPELLERS (Cont)							
Thrust Lever Control Engine No. 1					PROP GOV ENG NO. 1	3	Pilot's Essential
Thrust Lever Control Engine No. 2					PROP GOV ENG NO. 2	3	Pilot's Essential
WATER BALLAST							
Pump					BALLAST PUMP	14	Aft Monitor
SURFACE CONTROL							
Booster Servos					CONTROL BOOSTER SERVO CONTROL CONTROL BOOSTER SERVO FIELD CONTROL BOOSTER GEN FIELD	3 3 3	Pilot's Monitor
THROTTLES							
Throttle Governor - Engine No. 1	NO. 1 PROP GOV CONT	3	PILOT ØC	6			
Throttle Governor Control and Carburetor Throttle Actuator - Engine No. 1					PROP GOV ENG NO. 1	3	Pilot's Essential
Throttle Governor - Engine No. 2	NO. 2 PROP GOV CONT	3	PILOT ØC	6			
Throttle Governor Control and Carburetor Throttle Actuator - Engine No. 2					PROP GOV ENG NO. 2	3	Pilot's Essential
WINCH AND ASSOCIATED EQUIPMENT							
Fish Clamp Actuator					FISH CLAMPS	14	Aft Monitor
Fish Clamp Control					WINCH CONTROL	14	Aft Monitor
Swivel Pulley Actuator					SWIVEL PULLEY	14	Aft Monitor
Temperature Indication					WINCH CONTROL	14	Aft Monitor
Towing, Hoisting, and Winch Footage Indication	FUSE (winch control panel) WINCH INST (Fuse) INST TRANSF (Fuse)	 3 3	INSTRUMENT BUS	6			
Winch Control					WINCH CONTROL	14	Aft Monitor
Cable Tension Indication	CABLE TENSION (Fuse) WINCH INST (Fuse) INST TRANSF (Fuse)	14 3 3	INSTRUMENT BUS	6			
Reel-In, Reel-Out Lights (134019 and Subsequent)					WARNING LIGHTS	3	Pilot's Essential

* Location of circuit breaker or fuse (see figure 1-11)

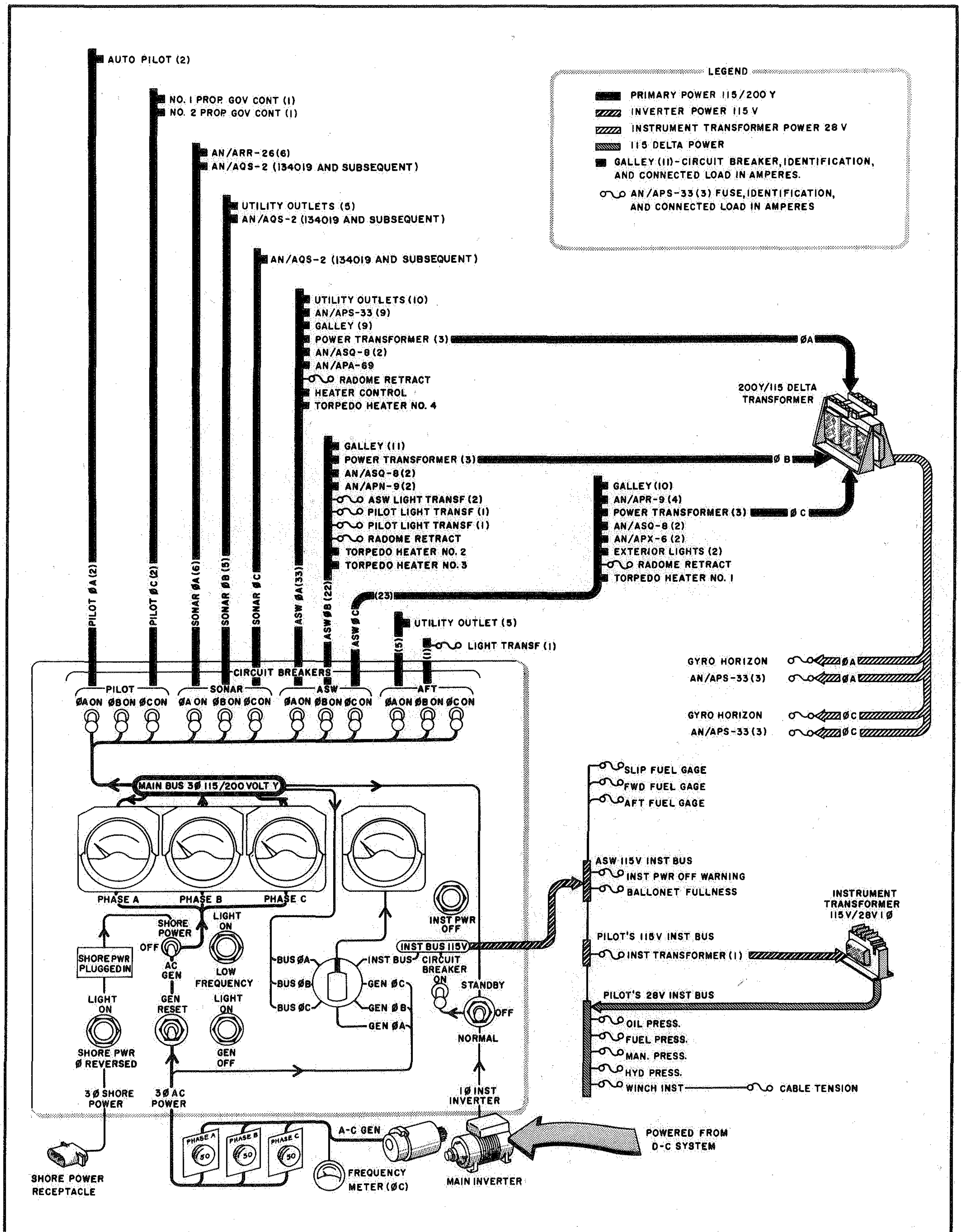


Figure 1-14. A-C Electrical System Schematic

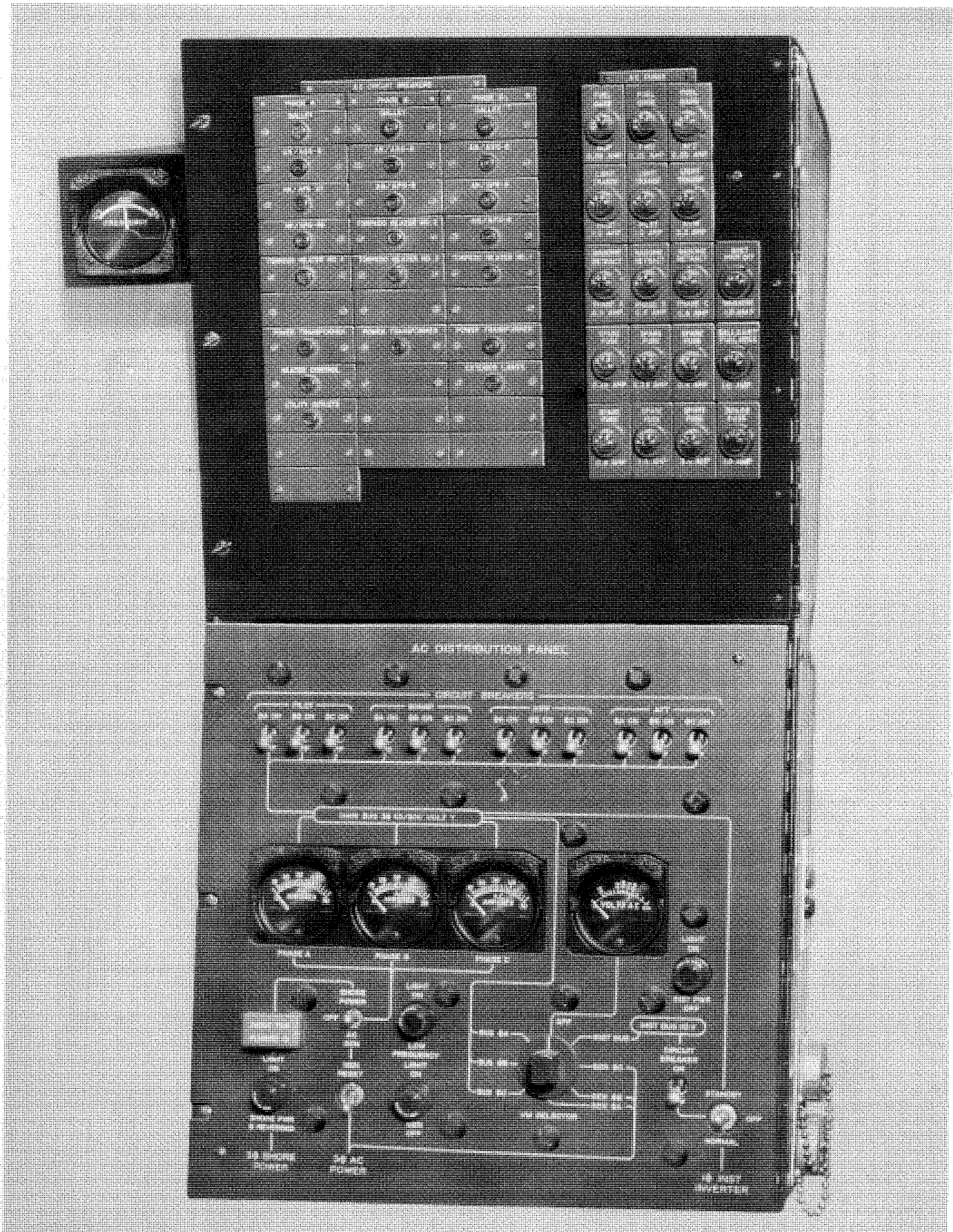


Figure 1-15. A-C Distribution and Circuit Breaker Panel

A-C ELECTRICAL POWER SYSTEM.

GENERAL. The power sources for the a-c electrical system are a 15 KVA generator which supplies 115/200-volt constant frequency (403 cps) power and a 250 VA inverter. An external power receptacle also provides for connecting an external source of a-c power to the airship system. The a-c generator normally supplies power for all a-c operated equipment except the equipment connected to the instrument bus. The instrument bus is normally energized by power supplied from the inverter but can be energized by power from the a-c generator or an external power source if the inverter is off.

A transformer transforms wye-connected, 200-volt, phase-to-phase power to delta-connected, 115-volt, phase-to-phase power for operation of the gyro horizon indicator and the radar. A 115/28-volt transformer transforms power from the instrument bus for operation of the winch instruments, constant speed drive hydraulic pressure indicator system, and the engine oil, fuel, and manifold pressure indicator systems.

A voltage regulator controls the output of the a-c generator, and the a-c operated equipment is protected from overvoltage and underfrequency output from the generator. The equipment is also protected from underfrequency and incorrect phase relationships when power from an external source is being supplied to the equipment. The a-c generator is protected from overload conditions. The generator terminal voltage is reduced to zero and the generator is disconnected from the busses in case of generator fault or overload, but it can be re-connected by a reset control if the fault is corrected. The generator output is also disconnected from the busses in case of underfrequency but it is automatically re-connected when the frequency returns to normal.

A-C GENERATOR-SHORE POWER SWITCH. The three-position toggle switch (figure 1-15), located on the a-c distribution panel, disconnects both the a-c generator and the external a-c power from the distribution system when in the OFF position. The AC GEN position causes the generator to be connected to the distribution system provided no fault condition exists. The SHORE POWER position causes the external a-c power source to be connected to the distribution system provided that the power is not under frequency and that the phase relationship is correct.

A-C GENERATOR RESET SWITCH. The generator reset switch (figure 1-15) on the a-c distribution panel resets the generator field relay which closes the generator contactor to re-connect the generator to the distribution system when the generator has been disconnected from the busses because of a fault condition. The contactor will not remain closed unless the fault condition is corrected.

MAIN A-C POWER CIRCUIT BREAKERS. The three main a-c power circuit breakers marked PHASE A, PHASE B, and PHASE C (7, figure 4-28), located on the bottom of the starboard strut junction box, protect the generator phase windings from system overloads. When the red bands around the circuit breaker buttons are exposed, the phase windings are no longer connected to the busses. When the red bands are not visible, the generator can supply the distribution system. Pushing in one of the buttons resets the breaker if the load on the bus has been reduced.

INSTRUMENT INVERTER SWITCH. The instrument inverter switch (figure 1-15), located on the a-c distribution panel, is a three-position toggle switch. The OFF position de-energizes the instrument bus and disconnects d-c operating power from the instrument inverter. The NORMAL position connects d-c operating power to the instrument inverter and connects the inverter output to the instrument bus through the instrument bus circuit breaker. The STANDBY position disconnects d-c operating power from the instrument inverter and connects phase A power from the a-c generator or shore power, whichever is supplying the a-c system, to the instrument bus through the instrument bus circuit breaker.

INSTRUMENT BUS CIRCUIT BREAKER. The instrument bus circuit breaker (figure 1-15) on the a-c distribution panel is a toggle switch type of circuit breaker. When the circuit breaker is switched to ON, the inverter, a-c generator, or external a-c power energizes the instrument bus through the instrument bus switch. When the circuit breaker is in OFF position, the instrument bus is not energized.

VOLTMETER SELECTOR SWITCH. The voltmeter selector switch (figure 1-15) on the a-c distribution panel is an eight-position, rotary selector switch. Three positions of the switch, BUS ØA, BUS ØB, and BUS ØC, are used to connect the voltmeter to any one phase of the main bus. Three positions, GEN ØA, GEN ØB, and GEN ØC, are used to connect the voltmeter to any one phase of the generator leads on the load side of the main a-c power circuit breakers. The INST BUS position is used to connect the voltmeter to the 115-volt instrument bus. The OFF position is used to disconnect the voltmeter from power.

VOLTMETER. The voltmeter (figure 1-15) on the a-c distribution panel indicates the voltages of the points selected by the voltmeter selector switch.

AMMETERS. The three ammeters (figure 1-15) indicate the current drawn from phase A, phase B, and phase C of the a-c generator or shore power, whichever is supplying the a-c distribution system.

FREQUENCY METER. A frequency meter (figure 1-15), located forward on the a-c circuit breaker panel, indicates a-c generator frequency. Since the generator is driven by the constant speed drive unit, the indications of the frequency meter are also used to check the operation of the drive unit. Normal indication is 403 cps; however, variations in engine speed or electrical loading may cause the needle to fluctuate between 400 and 405 cps. Rapid oscillation of the indicator needle does not mean that the generator or drive unit is malfunctioning. The instrument is sensitive to current changes. The indicator needle is not spring-loaded and will not return to the low side of the scale if the current is cut off abruptly. This occurs when a-c generator output is disconnected by placing the a-c generator-

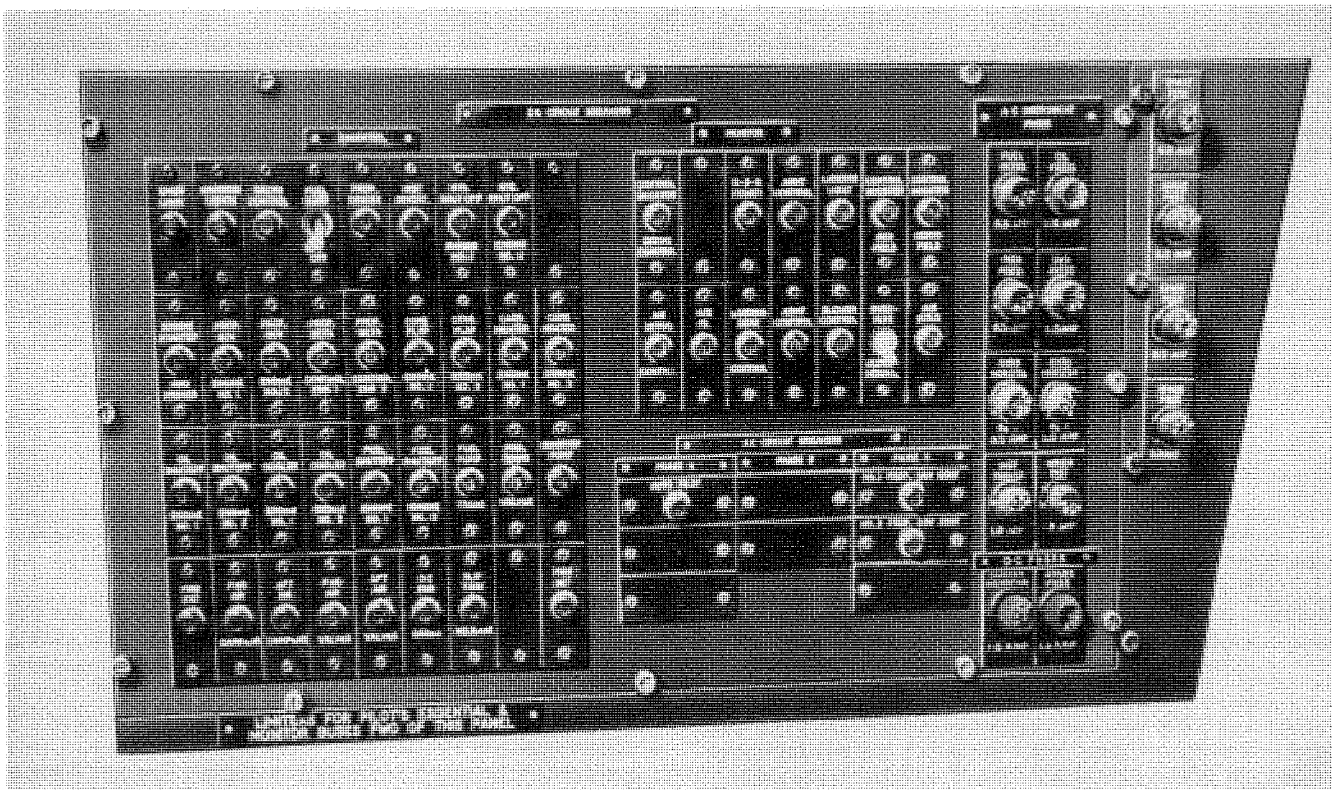


Figure 1-16. Pilot's Circuit Breaker Panel

shore power switch in the OFF position.

CAUTION

Do not attempt to jar the needle to the low side of the scale. Tapping will only damage the instrument.

LOW FREQUENCY LIGHT. The red low frequency light (figure 1-15) on the a-c distribution panel lights to indicate an underfrequency condition of the power supplied to the a-c distribution system. The light indicates shore power low frequency when the a-c generator shore power switch is in the SHORE POWER position and indicates a-c generator low frequency caused by underspeed of the constant speed drive when the switch is in the AC GEN position.

SHORE POWER PLUGGED IN LIGHT. The red shore power plugged in light (figure 1-15) on the a-c distribution panel lights when a plug is inserted into the a-c shore power receptacle. The light receives power from the airship d-c system.

SHORE POWER PHASE REVERSED LIGHT. If a-c shore power is plugged into the airship with incorrect phase relationships, a shore power phase reversed warning light (figure 1-15) located on the a-c distribution panel, glows red.

GENERATOR OFF LIGHT. The red generator off light (figure 1-15) on the a-c distribution panel lights only when the a-c generator has been tripped off by an overvoltage condition. The light is extinguished when the generator reset switch is operated to RESET.

INSTRUMENT POWER OFF LIGHT. The red instrument power off warning light (figure 1-15) on the a-c distribution panel is lighted whenever the instrument bus is de-energized. Failure of the inverter causes the light to illuminate, indicating to the operator that selection of the a-c generator ØA power through the STANDBY position of the instrument bus switch is necessary to energize the instrument bus.

VOLTMETER TEST JACKS. Four jacks, located on the a-c voltage regulator on the regulator shelf in the utility compartment, are used to determine the a-c generator output voltages with a portable voltmeter. The N jack connects to ground. The A, B, and C jacks connect to phase A, phase B, and phase C. Additional voltmeter test jacks are located on the aft side of the a-c distribution and circuit breaker box. These jacks permit comparison of the voltages indicated on the voltmeter on the a-c distribution panel with the indications of a portable voltmeter.

A-C UTILITY OUTLETS. Eight utility outlets are located throughout the airship. Each outlet is a two pole receptacle rated at 500 watts. The outlets are located in pairs on the a-c distribution and circuit breaker box, on the top electronic shelf aft of the sonar operator's station, on the navigator's table, and on the winch operator's circuit breaker box. The load on any pair of outlets should not exceed 500 watts.

AIR PRESSURE SYSTEM. (133639 and 131919 through 131921).

GENERAL. (See figure 1-17.) The air pressure system controls envelope pressure to maintain the shape of the envelope and to control airship trim. Pressure is normally maintained by varying the total volume of air in two ballonets. If helium is lost, envelope pressure can be increased by blowing air into the helium section of the envelope. Trim is controlled by shifting air from one ballonet to the other to move the center of buoyancy of the airship. Air enters the system through scoops in the upper outriggers and passes through check valves into an air chamber overhead in the center of the car. If the pressure of ram air accumulated in the chamber is insufficient for inflating ballonets at the required rate, additional air can be forced into the chamber by a blower which draws air through the starboard scoops. A damper for each ballonet is opened to allow air from the chamber to enter the ballonet, and three air valves release air from each ballonet. Two of these valves, called car valves, release air into ducts leading to louvers in the upper car skin. The other valve, called an envelope valve, releases air directly into the atmosphere. An air-to-helium sleeve with a rip panel can be opened when necessary to allow air flow directly from the air chamber into the helium section of the envelope.

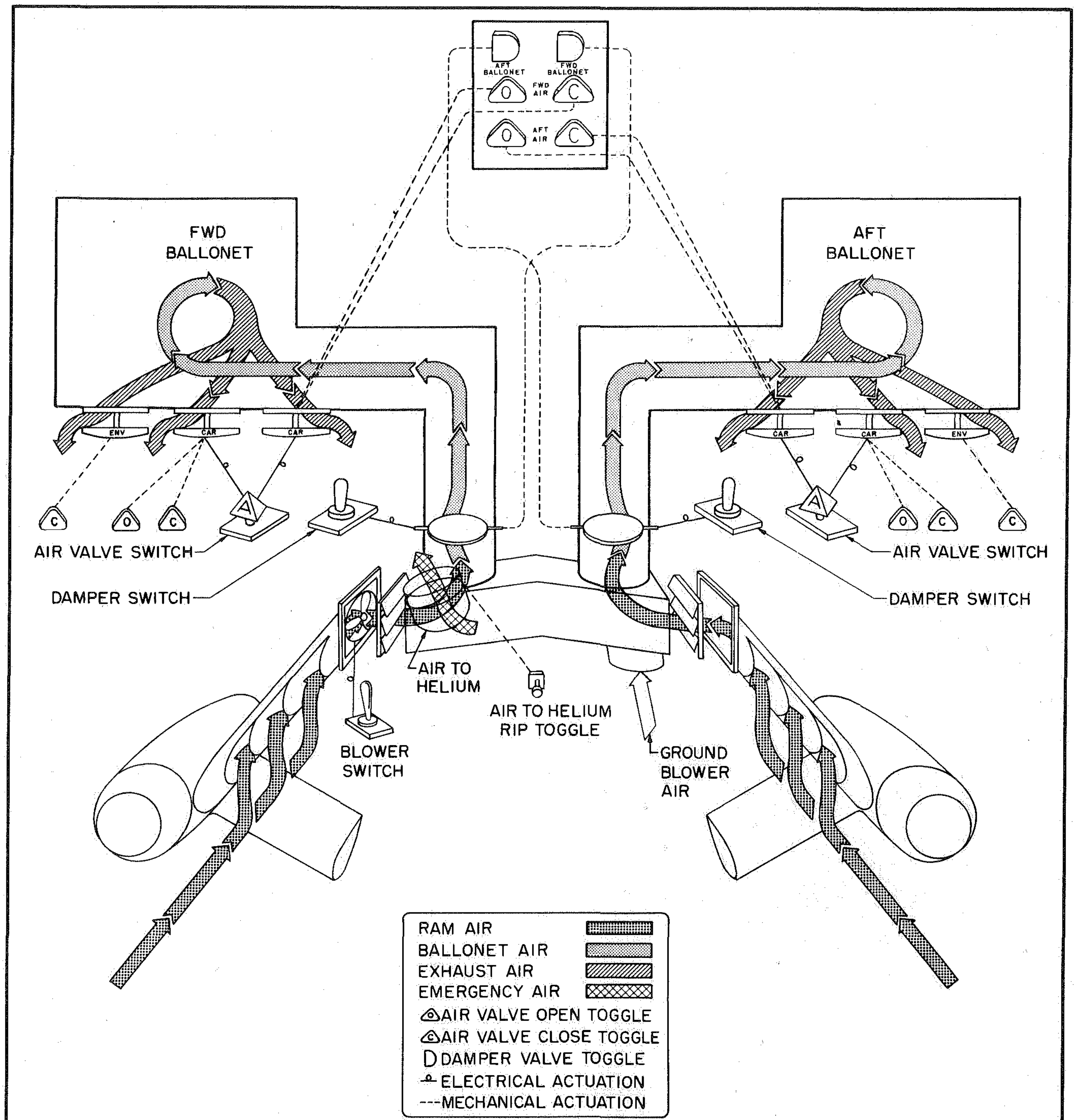


Figure 1-17. Air Pressure System Schematic

Air flow is controlled to increase or decrease the quantity and pressure of air in the ballonets by operation of the dampers and air valves and the blower. The air scoops are fixed openings. The dampers can be opened any amount required to regulate the rate of air flow into the ballonets. They are normally controlled electrically, and when partially opened are held in position by clutches in the damper actuators. The dampers can also be opened by emergency manual controls consisting of cables with toggles.

To operate the dampers manually, the hood over the damper toggles must be raised. When raised, the hood operates a switch to disengage the damper actuator clutches. The dampers are then free and spring closed unless held open manually. The air valves can be opened by pressure of air within the ballonets. The pressure settings at which the valves open are based on helium pressure in the envelope. The settings are 2.8 inches of water for both envelope valves, 1.9 inches of water for the two forward ballonet car valves, and 2.2 inches

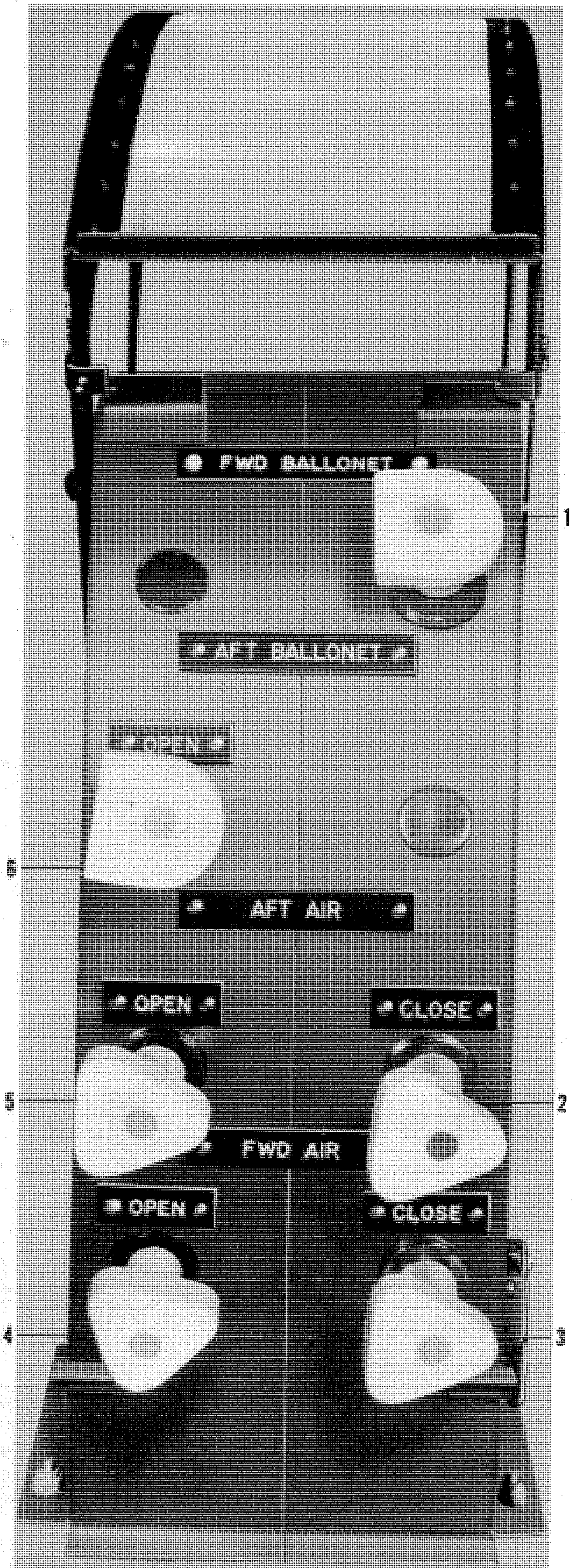


Figure 1-18. Air Pressure System Control Panel (133639 and 131919 through 131921)

of water for the two aft ballonet car valves. The car valves can also be opened electrically by actuators which open the valves fully and hold them open as long as the control switches are held on. When the actuators are de-energized the valves are closed by valve springs unless held open by air pressure. Manual emergency control cables are provided for opening the car valves and for closing both car and envelope valves. The closing controls are used to close a valve which is not seating properly or to hold valves closed when envelope pressure exceeds the valve opening settings. The blower can be turned on only when a damper has been opened.

The capacity of the air pressure system is sufficient to valve air for a maximum rate of ascent of 2400 feet per minute. Air is added to the ballonets at a rate sufficient for descent at 1200 feet per minute without blower operation. The blower must be operated to maintain minimum envelope pressure for descent at greater rates. The blower has a rated capacity of 8000 cubic feet per minute with pressure of 1.5 inches of water at the blower.

DAMPER VALVE SWITCHES. The forward and aft damper switches (figure 1-4) are on the engine accessory panel. Holding either switch in the OPEN position causes the corresponding damper actuator to drive open the damper. Holding the switch in the CLOSE position causes the actuator to drive the damper closed. When the switch is released, the damper stops. Overtravel is prevented by limit switches which break the damper switch circuit when the dampers reach extreme positions. Damper travel from closed position to open position requires approximately six seconds.

DAMPER POSITION INDICATORS. A three-position indicator (figure 1-4) for each damper is mounted adjacent to the damper switch on the engine accessory panel. OP appears on the tab-type indicator when the damper valve is fully open, CL when the valve is fully closed, and red and white diagonal stripes when the valve is in intermediate positions. The indicators are operative whether the dampers are manually or electrically controlled. In the event of electrical power failure or a break in the indicator circuit, the indicator shows the red and white stripes.

DAMPER MANUAL CONTROL TOGGLES. The D-shaped damper manual control toggles (figure 1-18) are on the air system control panel overhead in the utility compartment. The toggles are attached to cables on the dampers, so that pulling down on the toggles opens the dampers. The dampers are spring-loaded to close when the toggles are released. A bead swaged on the cable is engaged in a slot on the control panel to hold the damper open. A clear plastic hood over the damper toggles actuates a limit switch. When the hood

Key to Figure 1-18. Air Pressure System Control Panel (133639 and 131919 through 131921)

1. Forward Damper Toggle
2. Close Toggle - Forward Car Valve for Aft Ballonet
3. Close Toggle - Aft Car Valve for Forward Ballonet
4. Open Toggle - Aft Car Valve for Forward Ballonet
5. Open Toggle - Forward Car Valve for Aft Ballonet
6. Aft Damper Toggle
7. Hood (raised position)

is opened the limit switch completes a circuit energizing a disabling relay. The relay disconnects power from the actuator clutches so that the toggle can be pulled without damaging controls. The damper toggles must be held or tied to maintain intermediate damper settings.

BLOWER SWITCH. A blower switch (figure 1-4) on the engine accessory panel controls the operation of the blower. Placing the switch in the ON position energizes a blower power relay which connects power from the main d-c bus to the blower motor. Interlocking relays prevent operation of the blower unless either the forward or the aft damper valve is fully opened.

BLOWER OVERRIDE SWITCH. The blower override switch (figure 1-16) is an emergency switch on the pilot's circuit breaker panel. When held in the OVERRIDE position the switch overrides a thermal cut-off in the blower power circuit so that the blower can be operated temporarily, if necessary, after being tripped off.

BLOWER OPERATING LIGHT. A blower operating light (figure 1-4) is on the engine accessory panel above the blower switch. The light glows whenever the blower is operating.

AIR VALVE SWITCHES. Two pyramid-shaped air valve switches (figure 1-4) on the engine accessory panel control the electrical operation of the car air valves. The forward ballonet air valve switch controls the actuators of both forward ballonet car valves. The aft ballonet air valve switch controls the actuators of both aft ballonet car valves. Holding either switch in the AIR OUT position causes the ballonet valves to open fully and remain open until the switch is released. Actuator overtravel is prevented by limit switches on the air valves. When the switch is released the spring-loaded valves close unless pressure in the ballonet is sufficient to keep them open.

CAUTION

The duty cycle of the valve actuators is 3 minutes on and 17 minutes off. The actuators can be damaged by excessive operation of the valves during certain types of maneuvers and tests.

CAR AIR VALVE MANUAL CONTROLS. The car air valve manual controls are mounted overhead in the car near the valves. The toggles (figure 1-19) for one forward ballonet valve are mounted overhead just forward of the radio operator's station. The toggles (2, 3, 4, and 5, figure 1-18) for the aft car valve in the forward ballonet and the forward car valve in the aft ballonet are on the air pressure system control panel. The toggles for the aft car valve in the aft ballonet are overhead in the stern compartment aft of the winch operator's seat. The valves are opened by pulling down on the OPEN toggles. An open toggle must be held down or the spring-loaded valve will close. The CLOSE toggle is used to assure proper seating of the valve. The opening pressure of a valve can be increased by weights on the CLOSE toggle cable. Never tie down an air valve closing toggle.

NOTE

Car valve opening pressure increases approximately 0.1 inch of water for every 2.2 pounds of weight attached to the CLOSE toggle cable.

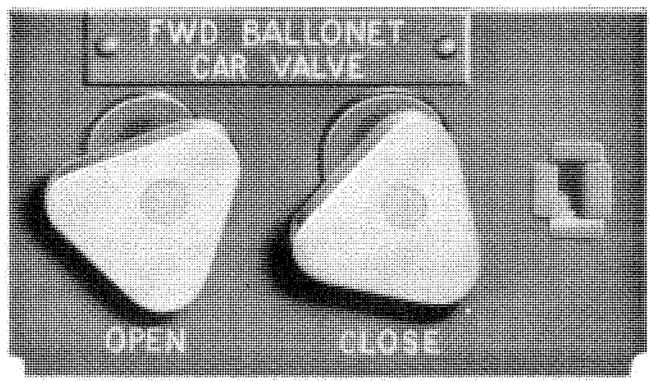


Figure 1-19. Forward Ballonet Air Toggles

ENVELOPE VALVE CONTROL TOGGLES. Close toggles for the forward and aft envelope air valves are mounted adjacent to the forward and aft car valve manual control toggles. Envelope valves cannot be electrically operated, and opening toggles are not provided. The envelope valve close toggles are used to assure proper seating of the valve. The opening pressure of the valves can be increased by hanging weights on the toggle cables. Never tie down an air valve closing toggle.

NOTE

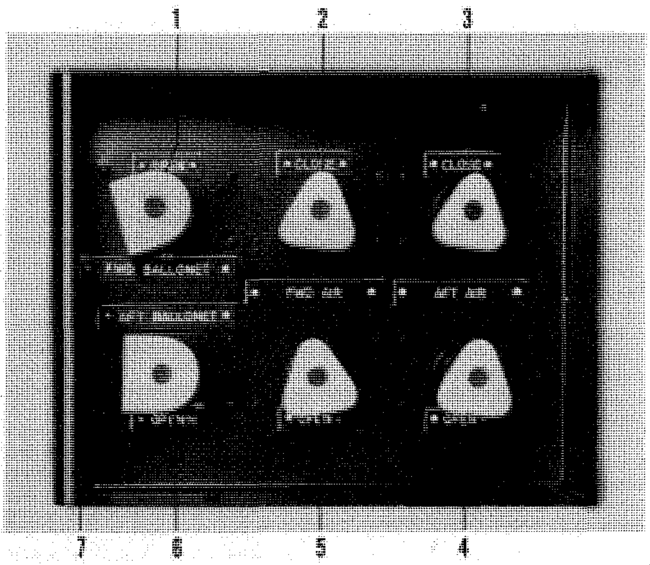
Envelope air valve opening pressure can be increased 0.1 inch of water for every 1.2 pounds of weight attached to the envelope valve closing toggle.

LIQUID MANOMETERS. Three manometers in a single case (2, figure 1-3) are shock-mounted to a port window frame in the pilot's compartment. One manometer indicates the air pressure in the forward ballonet, one indicates the helium pressure in the envelope, and one indicates the air pressure in the aft ballonet. The manometers indicate the difference between the pressure within the envelope or ballonets and the static air pressure inside or outside the car. A selector valve below each manometer tube is rotated to select the static air pressure source or to connect the pressure from the ballonet or envelope to both ends of the manometer tube for zero checking the instrument. A wheel below each selector valve provides limited adjustment of each manometer. When rotated the wheel raises or lowers the manometer tube within the manometer scale.

MECHANICAL MANOMETER. A mechanical manometer (6, figure 1-6) on the pilot's instrument panel indicates the difference between helium pressure in the envelope and static pressure at the pitot-static tube. The dial is calibrated in inches of water. The indications should equal the indications of the helium tube of the liquid manometer when outside air pressure is applied to the tube.

BALLONET FULLNESS INDICATING SYSTEM. The two-dial ballonet fullness indicator (8, figure 1-6) on the pilot's instrument panel indicates computed percentage values of ballonet fullness for the forward and aft ballonet. Fullness is measured by synchro-type transmitters in each ballonet and a computer amplifier on the electronics shelf aft of the sonar operator's compartment. An air temperature setting control dial on the computer must be set to correct ambient temperature at station level.

AIR-TO-HELIUM RIP TOGGLE. A red toggle overhead in the utility compartment, forward of the air system control panel, is connected to the air-to-helium rip panel. The toggle is pulled out as far as possible to unseal the air-to-helium sleeve. The panel is ripped when envelope emergencies require the addition of air to the helium compartment. After pulling the toggle, a knot should be tied in the cable to prevent the panel from blowing back into place. The sleeve is tied off when sufficient air has been added to the envelope.



1. Forward Damper Toggle
2. Close Toggle (Aft Car Valve for Forward Ballonet)
3. Close Toggle (Forward Car Valve for Aft Ballonet)
4. Open Toggle (Forward Car Valve for Aft Ballonet)
5. Open Toggle (Aft Car Valve for Forward Ballonet)
6. Aft Damper Toggle
7. Damper Toggle Hood (open position)

Figure 1-19A. Air Pressure System Control Panel (131922 and Subsequent)

AIR PRESSURE SYSTEM (131922 and Subsequent).

GENERAL. The air pressure system control panel (figure 1-19A) is a flat panel recessed into the overhead of the utility compartment. The plastic hood closes to cover only the damper toggles. The positions of the toggles are changed from the arrangement on airships 133639 and 131919 through 131921, but the function of each toggle and the hood is unchanged.

HELIUM SYSTEM.

GENERAL. The helium system consists of equipment used to increase or decrease the volume of helium in the envelope to control the static lift of the airship. The pressure of the helium which maintains the shape of the envelope is normally controlled by the air pressure system which controls ballonet inflation. The helium system is used to relieve pressure only when the maximum pressure for normal flight is reduced. Maximum normal flight pressure can be exceeded by holding helium valves closed.

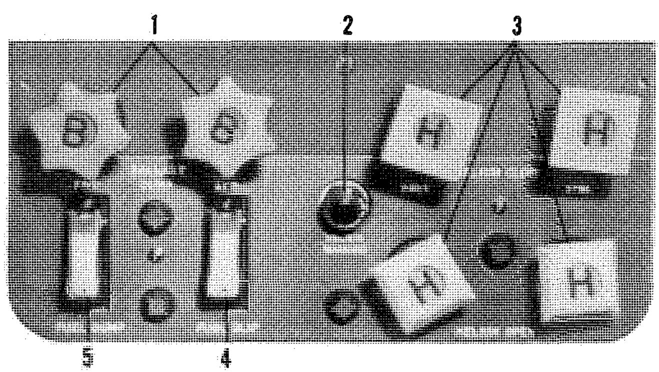
Helium is added to the envelope through inflation sleeves when the airship is on the ground. There are three sleeves on the underside of the envelope: one forward, one aft, and one over the utility compartment of the car. The sleeves can also be used to remove helium.

In flight, helium is released through three valves, two on the port side of the envelope and one on the starboard side. The valves are opened by helium pressure if the pressure reaches 3.2 inches of water and close when the helium pressure drops to 2.9 inches of water. The valves can also be opened or closed by controls at the pilot's station. When held full open at an envelope pressure of 1.5 inches of water, each valve releases approximately 160 cubic feet of helium per second so that lift is reduced by approximately 10 pounds per second. The starboard valve and one of the port valves can be opened manually.

Helium can also be released through a rip panel in the top of the envelope. The panel is ripped only to save the airship when high winds blow it from a mast or threaten to blow it from control of the crew after an emergency landing.

Helium purity, which also affects static lift of the airship, is measured by an analyzer connected to a purity test fitting. The capped end of the fitting is located above the copilot's starboard window. The analyzer is not part of the airship equipment.

HELIUM VALVE CONTROLS. Four square toggles (3, figure 1-20) on the minor controls panel of the pilot's overhead panel are the helium valve controls. The two upper toggles are closing controls, and the two lower



1. Ballast Dump Valve
2. Helium Warning Light
3. Helium Valve Toggle
4. Fuel Slip Switch
5. Fuel Dump Switch

Figure 1-20. Minor Controls Panel

toggles are opening controls. The port closing toggle is connected by cables to both port valves. Pulling on the port closing toggle closes both port valves. The port opening toggle opens only the upper valve. The two starboard toggles are connected by cables to the one starboard valve and control only that valve. The valve opening controls are used for opening the helium valves to release sufficient helium to reduce the static lift of the airship when it is too light for satisfactory flight control. The closing controls are used to close the valves when they do not seat properly after being opened. The closing controls can also be used to hold the valves closed when helium pressure exceeds the valve spring settings. A pull of approximately 20 pounds on the toggles is sufficient to hold the valves closed when flight maneuvers or ground winds cause helium pressure to exceed the pressure setting of the valves. The valves should not be held closed until helium pressure exceeds limits specified in section V.

RIP CORD. The free end of the rip cord (1, figure 3-1) is coiled and held in a button strap above the copilot's starboard window. The cord passes through a hole in the window. The window is kicked out and the cord tossed to the ground after an emergency landing so that the cord is ready for use. Less force is required to rip the panel in the envelope if the pull on the cord is directly vertical.

HELIUM WARNING LIGHT. The helium warning light (2, figure 1-20) is on the minor controls panel next to the helium valve toggles. The light is controlled by a limit switch on each of the three helium valves. The light glows red when one or more of the valves is not fully closed.

SURFACE CONTROL SYSTEM.

GENERAL. The control surfaces are arranged conventionally with horizontal elevators and vertical rudders. Manual control of the surfaces is initiated at the pilot's and copilot's stations by operation of control columns which combine rudder and elevator control functions. The elevator columns and rudder wheels at the two stations can either be interlocked to permit dual control by the pilot and copilot or separated so that the pilot has only elevator control while the copilot has rudder control. Cable assemblies transmit control movements from the elevator columns and rudder wheels through the various control system components to the control surfaces. Spring tabs on the trailing edges of the rudders and elevators aid aerodynamically in the movement of the main surfaces. An electric servo type of boost system normally supplements the manual effort exerted to move the control surfaces. An automatic pilot system, described in section IV, is installed for controlling the rudders and elevators automatically. The rudder and elevator controls can be shifted into an emergency range to reduce the effort required to move the surfaces when the boost system is inoperative. A gust lock permits locking the control system while the airship is on the ground.

All rudder and elevator input movements initiated manually or by the autopilot are applied directly or indirectly to rudder and elevator jackshafts in the car. The elevator columns and rudder wheels are connected directly to jackshaft input drums by cable assemblies. This cable linkage causes the columns and rudder wheels to follow through when the autopilot is controlling the system. Boost and autopilot servos are linked to each jackshaft by chain assemblies, so that rotation of any servo causes corresponding rotation of the jackshaft to which it is connected. Since both boost and autopilot servos are linked to a common shaft and could, under certain circumstances, operate in opposition to each other, an interlock arrangement is installed to prevent simultaneous engagement of the boost and autopilot systems. Clutches automatically disengage servo drive mechanisms to reduce friction and permit free rotation of servo sprockets when the boost and/or autopilot systems are not engaged.

When the control system is being operated manually with the boost system inoperative, elevator column movement displaces an output arm at the base of the port column; this movement is transmitted by cable directly to the elevator jackshaft input cable drum. Rotation of a rudder wheel is transmitted by a chain-cable assembly to the rudder gear box at the base of the starboard colimn and by cable from the gear box to the rudder jackshaft input cable drum. When the jackshafts are rotated the input motion is stepped up and transmitted by cables to floating pulleys in the aft car. The floating pulleys double the travel in the cables running aft to the fins to prevent envelope deflections from absorbing a large percentage of the travel without moving the surfaces. Slack absorbers take up instantaneous cable slack produced in the separate cables by gusts, envelope deflections, or sudden reversals of control movement, and tension regulators maintain tension in the cables between the car and fins. Each cable from a floating pulley runs aft to a second floating pulley at the control surface. The second floating pulley cuts the cable travel in half. Each of these aft floating pulleys is connected to a spring tab. The tab is moved when cables from the car are moved by a control input to cause the tab to move in a direction opposite to the desired main surface movement. Aerodynamic force on the deflected tab causes the main surface to move in the correct direction. If the tab moves through its full 30-degree travel before the main surface is fully deflected, any additional control movement is applied directly to the main surface to pull the surface through the remainder of its 30-degree travel.

Operation of the surface control system when the boost system is engaged is the same as when the system is operated manually, as described above, except for the manner in which control inputs are transmitted to the jackshafts. When the boost system is engaged, initial movement of a rudder wheel or elevator column is applied through an actuating spring to displace the wiper arm of a rudder or elevator boost signalling potentiometer. The electrical signal introduced into the boost system when the wiper arm is displaced causes a boost servo to operate. Servo motion is transmitted to the jackshafts through the chain assemblies connecting the servos and jackshafts. If the rudder wheel or elevator column is moved slowly and at a steady rate, the pilot need exert only sufficient force (approximately five pounds) to overcome the initial load on the potentiometer actuating spring and displace the wiper arm. If more force is applied, the potentiometer wiper arm is displaced farther, and the servo turns the jackshaft more rapidly. If excessive force is applied in an attempt to move the controls move rapidly, the potentiometer actuating spring is fully compressed, and any excess force is applied directly to the jackshaft through the cable linkage. The spring-loaded potentiometer wiper arms return to neutral position to stop the servos when no control input force is being exerted at the control column.

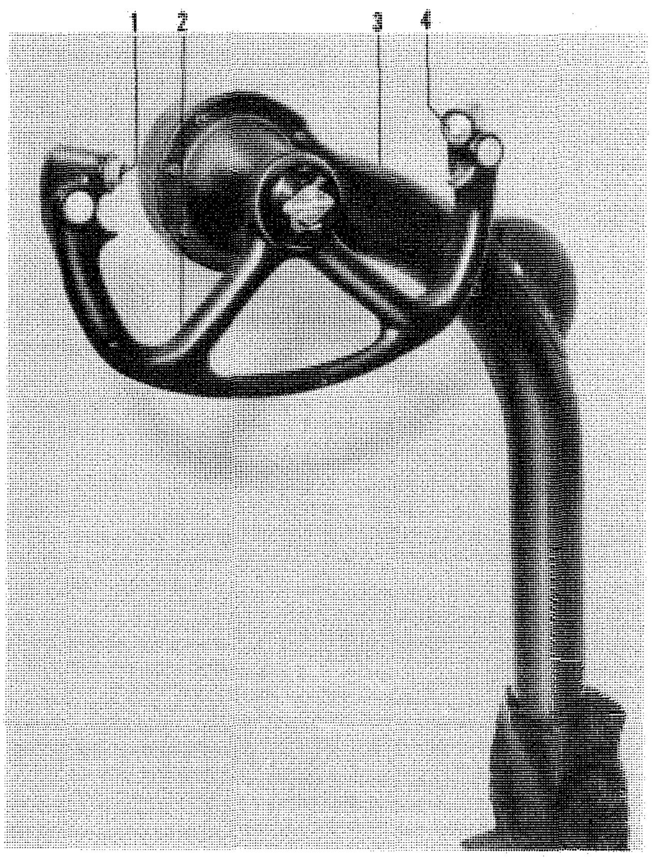
The pilot's and copilot's elevator columns and rudder wheels are normally connected together for dual control, but they can be separated at any time whether the boost or the autopilot system is engaged or whether the controls are in normal or emergency ratios. For dual control, the two elevator columns are interconnected by a rack which engages both column torque tubes, and the two rudder wheels are interconnected by a clutch at the rudder gear box on the copilot's column. When the controls are separated, the rack is pulled out of engagement with the port column torque tube and into engagement with a pair of locking jaws in car structure. This action locks the starboard column in neutral position and leaves the port column free to move independently. At the same time a clutch on the rudder gear box disengages the input cable drum for the port rudder wheel from the gear box drive shaft, and the clutch lever locks the drum in neutral position so that the port wheel cannot be turned. The dual controls can be re-engaged at any time. The elevator columns and rudder wheels should be moved to neutral position before separating or re-engaging the dual controls in order to accomplish the operation easily and to minimize wear on the control linkage.

The gust lock can be engaged to lock the control system in neutral position when the airship is on the ground. The lock can engage the jackshafts only when the jackshafts are in neutral position. The action of the tab balance springs in the main control surfaces permits up to approximately one-third of full surface deflection even though the forward control system is locked by the gust lock.

When the boost system is inoperative, the amount of manual effort required to operate the rudder and elevator controls can be reduced by shifting into emergency ratios. When the controls are shifted to emergency, the elevator column arm, which is normally a leading compound lever, becomes a simple lever. This means that a greater arc of elevator column travel is required to produce the desired amount of elevator displacement than when the controls are in normal ratios. In normal condition, full elevator displacement results from a column movement of seven inches to either side of neutral. In emergency condition, a column movement of twelve inches is required to obtain full elevator deflection. Also, when the controls are shifted to emergency a rudder clutch shifts into engagement a system of planetary gears in the rudder gear box. A rudder wheel must then be rotated 2.4 times as far to produce the same amount of rudder surface displacement. Full rudder displacement is produced by ± 86 degrees of rudder wheel rotation when the controls are in normal ratio and ± 203 degrees of rudder wheel rotation when the controls are in emergency. The controls can be shifted into emergency ratios whether the control functions are joined or separated or whether the boost or the autopilot system is engaged. The elevator controls shift to emergency ratio immediately when the handle is pulled regardless of column position, but the rudder controls shift is completed immediately only if the rudder controls are in neutral position. If the rudder wheels are out of neutral, they must be moved to a position 2.4 times as far from neutral in the same direction before the shift is completed. Until the wheels are turned to the shift position, so that a shift lever is forced into engagement by a spring, the rudder controls are turning free. Completion of the rudder control shift can be felt by the pilot due to the sharp increase in effort required to move the wheel.

When shifting from emergency back to normal ratios, the elevator shift can again be made at any column position, but the rudder wheels must be in neutral position before the shift is attempted.

ELEVATOR CONTROL COLUMNS. The elevator columns (figure 1-21), installed at the pilot's and copilot's stations, can move together or the pilot's column can move alone to control the elevator surfaces. Forward movement of the columns causes the airship to nose down and aft movement causes the ship to nose up. The small amount of play noticeable when the columns are moved with the boost system inoperative is caused by compression of the elevator potentiometer actuating spring before motion is transmitted to the elevator jack-



1. Ordnance Release Switch
2. Rudder Control Wheel
3. Elevator Control Column
4. A-12 Autopilot Release Switch

Figure 1-21. Control Column

shaft. The elevator column travel necessary to produce full elevator deflection depends upon the position of the controls in normal or in emergency ratios. Maximum column travel is limited by stops which limit the linear travel of the cables attached to the elevator horn at the bottom of the port column. Neutral position pointers mounted on car structure outboard of each column can be used as an aid in centering the control columns when the gust lock is to be engaged or when the control functions are to be separated or connected.

RUDDER CONTROL WHEELS. The rudder control wheels (figure 1-21), installed at the top of each control column, can move together or the copilot's wheel can move separately to control the rudder surfaces. Clockwise rotation of a rudder wheel causes the airship to turn to the right and counterclockwise rotation causes the ship to turn left. The play noticeable when the rudder wheels are moved while the boost system is inoperative is caused by compression of one of the two rudder potentiometer actuating springs before motion is transmitted to the rudder jackshaft. Rudder wheel travel required to produce full rudder deflection depends upon the position of the controls in normal or in emergency ratios. Travel stops limit rudder wheel maximum travel by limiting travel of the output quadrant on the rudder gear box. Each rudder wheel has an ordnance release switch (1, figure 1-21) and an A-12 autopilot release switch (4, figure 1-21) mounted in recesses at the extremities of the wheel.

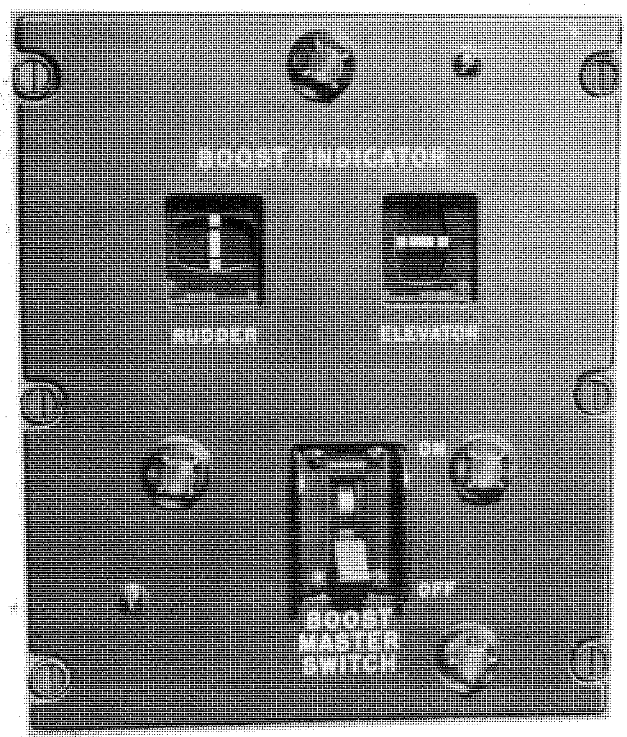


Figure 1-22. Booster Master Panel

BOOST MASTER SWITCH. The boost master switch (figure 1-22) is on the booster master panel of the pilot's overhead panel. The switch is used in conjunction with booster engage switches to start operation of the booster system. When the master switch is moved to ON, the booster control system becomes energized, the booster engage switches are unlocked, and the booster off light next to the engage switches starts flashing. The booster system is then ready to operate when the servos are engaged. If the boost master switch is moved to the OFF position, power is completely disconnected from the booster system so that system operation is stopped. The switch trips to the OFF position automatically if electrical power is not available through the system circuit breakers. If the automatic pilot is operating, the boost master switch is automatically locked in OFF so that the booster system cannot be started.

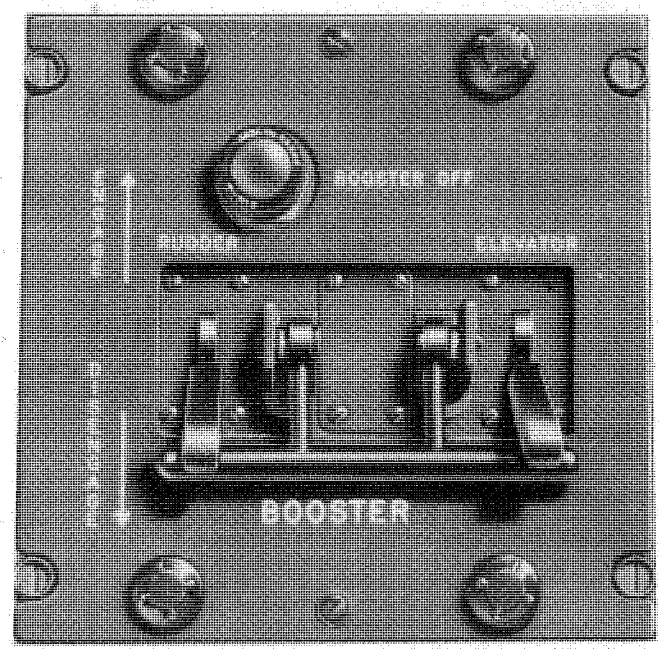
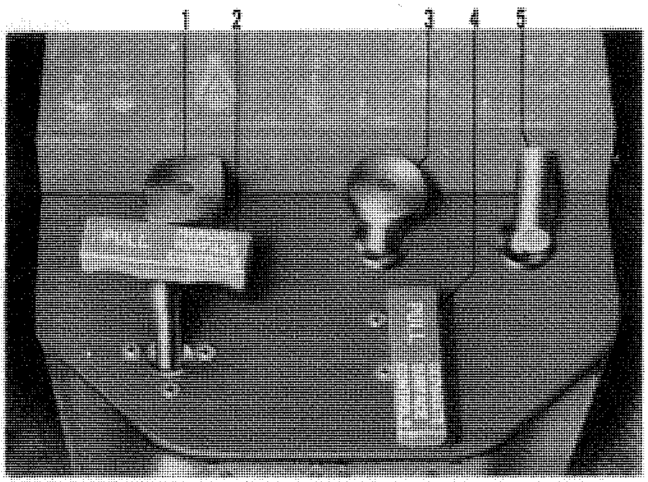


Figure 1-23. Booster Engage Panel

BOOSTER ENGAGE SWITCHES. The booster engage switches (figure 1-23) are on the booster engage panel of the pilot's overhead panel. When the switches are in ENGAGE, the booster servos are clutched so that they can drive the surface control system. The switches are moved to ENGAGE simultaneously by moving the bar below the switches. They cannot be so operated unless the boost master switch is first turned on to release the locks holding the switches in DISENGAGE position. If the boost master switch is moved to OFF either automatically or manually, the booster engage switches trip to the DISENGAGE position automatically. Either the rudder or the elevator switch can be moved to DISENGAGE individually to declutch one servo, but the switches are not normally used in this manner for flight control.

BOOSTER OFF LIGHT. The red light (figure 1-23) next to the booster engage switches is an aid in proper operation of the booster system switches. When the boost master switch is turned on, the light starts flashing and continues flashing until the engage switches are placed in ENGAGE position. If either of the engage switches is for any reason moved to DISENGAGE while the boost master switch is on, the light again starts flashing.



1. Forward Disconnect Knob
2. Manual Surface Controls Handle (Shift)
3. Long Lines Release
4. Separate Surface Controls Handle (Shift)
5. Aft Disconnect Knob

Figure 1-24. Aft Console Panel

SEPARATE SURFACE CONTROLS HANDLE. The separate surface controls handle (4, figure 1-24), located on the aft console panel, is operated to separate or join the rudder and elevator control functions. When the controls are placed in neutral position and the handle is pulled up, the controls are separated so that the pilot has only elevator control and the copilot only rudder control. When the handle is pushed down, with the controls in neutral position, the rudder and elevator functions are again joined for dual control by the pilot and copilot. The rudder wheels should be jockeyed about neutral to make certain that the operation has been completed in each case.

GUST LOCK CONTROL. The gust lock is controlled by a gust lock tape, one end of which normally rests in the gust lock tape well recess in the floor just forward of the pilot's seat, covered by a placarded gust lock access door (31, figure 1-3). The gust lock is engaged by moving the rudder and elevator controls to neutral position, lifting the gust lock access door, pulling up on the ring attached to the end of the gust lock tape, and attaching the ring to a hook in the ceiling of the pilot's compartment. It may be necessary to jockey the controls slightly about their observed neutral positions to find the actual neutral in order to engage the gust lock. The gust lock is released by unhooking the gust lock tape from the ceiling and permitting the tape to be drawn into the tape well.

MANUAL SURFACE CONTROLS HANDLE. The manual surface controls handle (2, figure 1-24), located on the aft console panel, is operated to shift the controls into normal or emergency operating ratios. When the rudder wheels are moved to neutral position and the handle is pulled up, rudder and elevator control functions are shifted immediately to emergency ratios. If the handle is pulled up when the rudder wheels are not in neutral position, the wheels must be moved to the corresponding emergency pick-up position before the rudder shift is completed. At this position, the wheel deflection is 2.4 times that at the corresponding normal position. For example, if the rudder wheels are deflected the full amount of 6 degrees to the right when the handle is pulled up, they must be turned 8.4 degrees more to the right to reach the 14.4-degree emergency position. The controls are shifted back to normal ratios by moving the rudder wheels to neutral position and pushing down on the manual surface control handle.

CAUTION

The rudder wheels must be in or near neutral position when the shift to manual or emergency ratios is begun. Do not turn the rudder wheels hard over until certain the shift has been completed.

BOOST INDICATORS. Rudder and elevator boost indicators (figure 1-22), located on the boost master panel, indicate the direction and rate at which the control surfaces are being deflected by boost servos. The indicators return to neutral position when the servos stop surface movement at any position. They do not indicate position of the surfaces. Function of these indicators is similar to that of corresponding indicators for the automatic pilot system.

WATER BALLAST SYSTEM.

The water ballast system provides 2560 pounds of jettisonable load when port and starboard water ballast tanks are filled with sea water or 2499 pounds when tanks are filled with fresh water. Each tank has a capacity of 150 gallons and is equipped with a quantity indicator and dump valve. The dump valves can jettison the total load of 2560 pounds in 55 seconds. A main fill valve in a hangar filling line and forward and aft tank fill valves in the tank fill lines are operated to control flow of water into the ballast tanks. The valves can also be operated to drain the tanks and fill lines. Ballast transfer between tanks can only be accomplished by gravity flow. To effect transfer the airship must be in trim, the forward and aft tank fill valves open, and the main fill valve closed. An electrically driven ballast pump is used to pump water from the ballast pick-up bag during in-flight reballasting. A by-pass line and relief valve are installed in the system so that part of the flow of water from the pump can recirculate to protect the pump from excessive pressures. Ballast weights and dumping rates are listed in table V in section III. The procedure for in-flight reballasting is described in section VII.

CAUTION

The carbon vanes of the ballast pump will seize if the surrounding lines are drained. Always keep pump submerged.

BALLAST PUMP SWITCH. The ballast pump switch (figure 4-38) is a two-position toggle switch on the winch operator's auxiliary panel. When in the ON position, the switch connects electrical power to operate the ballast pump.

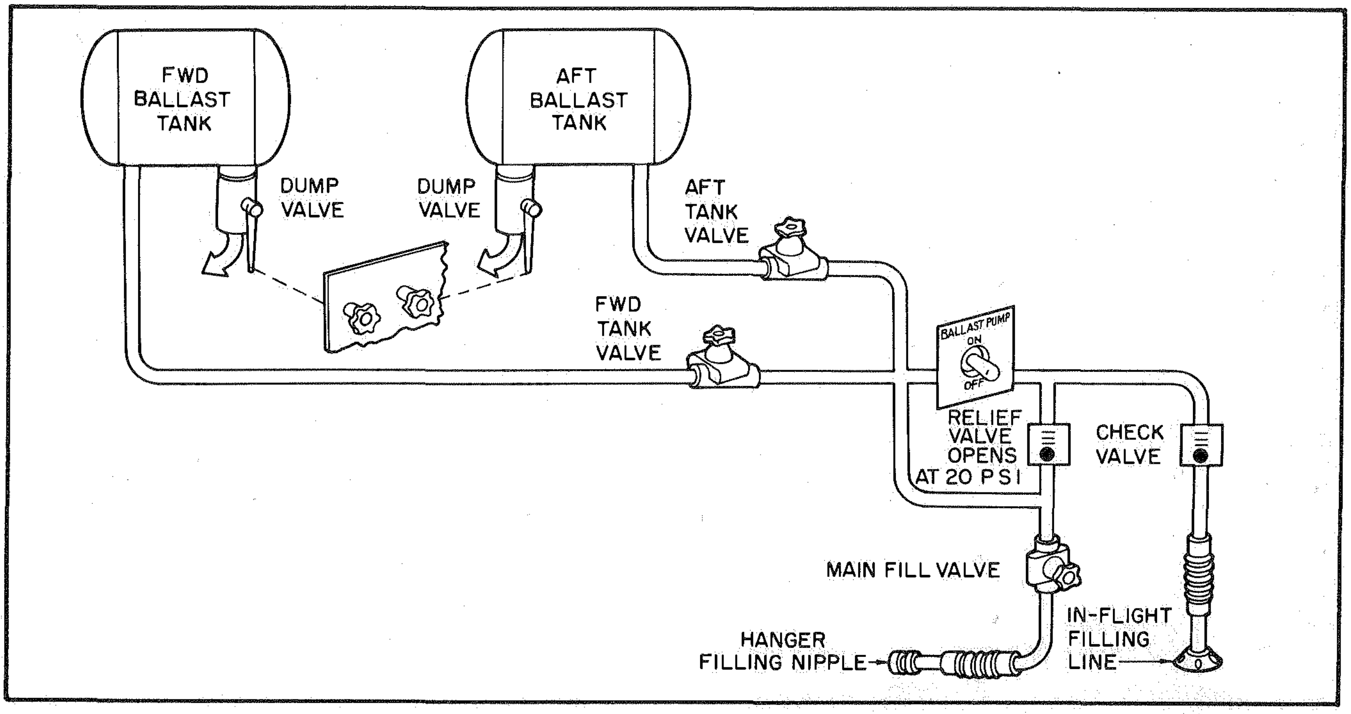


Figure 1-25. Water Ballast System Schematic

BALLAST DUMP VALVE CONTROLS. Two scalloped knobs (1, figure 1-20) on the minor controls panel are fastened to cables connected to the ballast dump valves. The port knob controls the dump valve in the forward tank and the starboard knob controls the dump valve in the aft tank. A valve remains open as long as the corresponding knob is pulled out and closes when the knob is released. If the dump valve cables are jammed or broken, either valve can be operated at the tank by pulling forward on the dump valve control arm to which the control cable is connected.

BALLAST FILLING VALVES. Three manually controlled filling valves, located on the starboard side of the stern compartment, control the flow of water in the ballast system. The main fill valve (5, figure 4-31) permits water to enter the system through the hangar filling nipple. The aft tank fill valve or upper valve (2, figure 4-31) controls flow to the aft tank, and the forward tank fill valve or lower valve (1, figure 4-31) controls flow to the forward tank.

BALLAST QUANTITY INDICATORS. A ballast quantity indicator is located on the bottom of each ballast tank. The indicators are read in pounds and are calibrated for sea water. When fresh water is used the weight of the water in the tank will be about 2-1/2 percent less than the weight shown on the indicator.

LANDING GEAR SYSTEM.

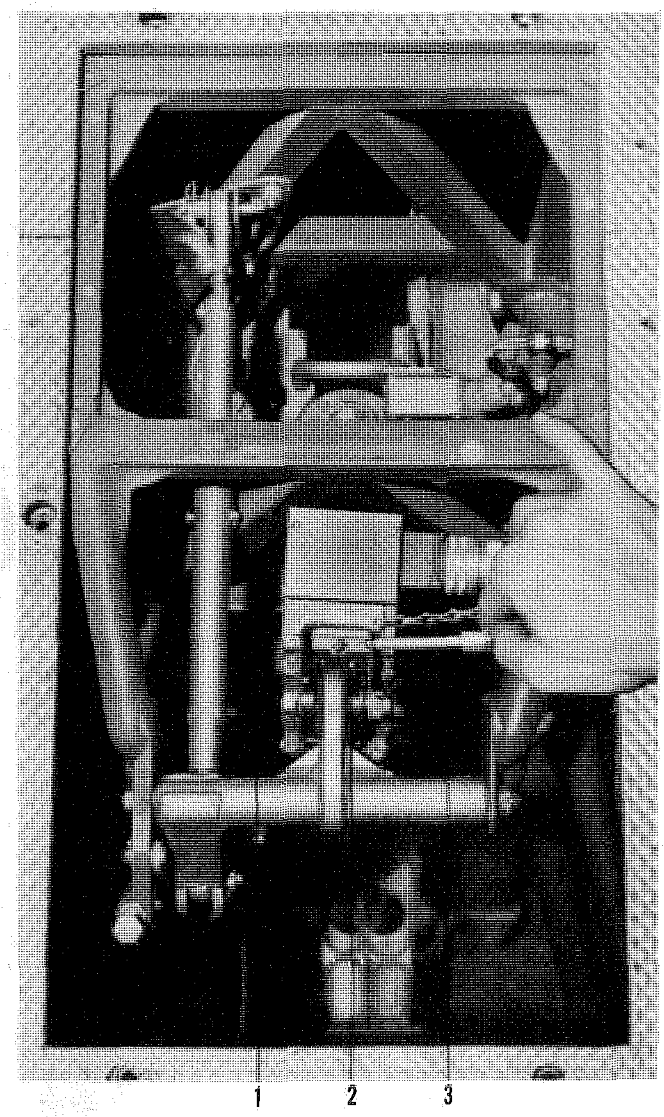
GENERAL. The landing gear system includes a single retractable gear, an electrical control system for retraction and extension, an electrical position indicator, and manual controls for emergency extension.

The gear consists of an aerol shock strut with a wheel free to swivel 360 degrees. The wheel can be locked in an athwartship position while the airship is masted out. The strut pivots on a trunnion and swings up and aft into a well in the car when retracted. A cable compresses the strut as it retracts so that the gear fits into the well space. A mechanically actuated collar pivots down over the upper strut to form a down-lock when the gear is extended. The down-lock is released by initial travel of the actuator as the gear is retracted. When the gear is fully retracted, the actuator holds it in up-lock position. To extend the gear manually, the actuator clutch is held disengaged to allow the gear to fall free; then the actuator is cranked manually until the down-lock engages.

The electrical control system controls the gear actuator, provides gear-in-motion indication, and prevents inadvertent retraction of the gear when the weight of the airship is supported by the gear. The gear actuator is controlled by a control handle and by limit switches on the gear. The gear-in-motion light in a knob on the handle is lit whenever the handle is in one position and the gear has not yet reached that position and locked. An electrically released lock prevents movement of the control handle from the DOWN position while the gear is extended if the strut is compressed by load.

LANDING GEAR CONTROL HANDLE. Gear retraction and extension are controlled by a handle (9, figure 1-6) on the pilot's instrument panel. The handle operates a switch which controls operation of the gear actuator. The handle has UP and DOWN positions corresponding to up and down positions of the gear. If the handle is in DOWN and is locked when the airship is in flight, the handle lock can be released by extending a finger through the slot in the panel above the handle. The gear-in-motion light is in the handle knob. The light can be tested by pressing the test switch adjacent to the handle. If the light is working properly it will light when the switch is pressed. The landing gear actuator extends the gear in approximately 16 seconds and retracts it in approximately eight seconds.

LANDING GEAR EMERGENCY CONTROL. When the gear cannot be extended by electrical controls, a hand crank (18, figure 4-28), stowed on a frame member near the floor on the starboard side of the utility compartment, is used to lower the gear. The gear actuator is accessible through a door in the forward utility compartment floor. After pulling the pip pin from the guard on top of the actuator, the hand crank is engaged to the end of the actuator shaft (2, figure 1-26). With the crank engaged, steady pressure applied downward on the knob of the crank releases the actuator clutch to unlock the gear. The gear falls free to the down position. Pressure on the crank is then relieved, and the crank is turned clockwise until the down-lock is positively engaged.



1. Instruction Placard
2. Actuator Shaft (Release)
3. Pip Pin

Figure 1-26. Landing Gear Emergency Release

WARNING

Hold only the knob of the hand crank when releasing the actuator clutch and hold pressure on the knob until certain that the gear has fallen all the way down. If the pressure on the crank is relieved, the actuator clutch re-engages with the gear falling. The force of the falling gear applied to the actuator could destroy the actuator gears and injure the operator by spinning the hand crank.

ATHWARTSHIP LOCK PIN. The lock pin for locking the gear in an athwartship position is furnished as ground handling equipment for the airship. It is stowed on the port entrance ladder, which is removed from the airship during flight. The pin is attached to a red streamer which warns that the pin must be removed before the airship is moved from the mast circle.

WHEEL INDICATOR. The wheel indicator (9, figure 1-6) is adjacent to the landing gear control handle on the pilot's instrument panel. The indicator shows a wheel when the gear is down and locked, the word UP when the gear is up and locked, or diagonal stripes when the gear is in motion or not fully locked. The stripes also appear when electrical power is not available to the gear control circuit. Operation of the indicator can be checked with the gear-in-motion light in the control handle.

HANDLING LINES.

GENERAL. (See figure 1-27.) The airship handling lines are a mooring pendant, two long lines, two short lines, two aft lines, four anti-roll lines (quarter lines) and a drag rope. Two quick release mechanisms are also provided so that deck lines can be used.

The mooring pendant is used to draw the airship to and hold it on a mast. The pendant is attached to the mooring cone on the nose of the airship and hangs free during flight.

For normal take-off, landing, and docking during good weather conditions, the long lines, short lines, and anti-roll lines are used. The long lines are attached at the nose of the airship and are used for directional control of the ship during landing and masting operations. The short lines are attached to the underside of the envelope aft of the nose battens and are used for directional control of the airship during unmasting and take-off. The anti-roll lines are attached to the envelope forward of the empennage and are used in docking the airship. The anti-roll and short lines hang free during flight. The long lines are drawn up along the underside of the envelope and the free ends stowed in rope boxes in the front of the car prior to take-off. These lines are released by pulling a release knob in the pilot's compartment.

During light ship handling (high landing), the long lines and drag rope are used to pull the airship down and control it until ballasted and masted. The drag rope is at-

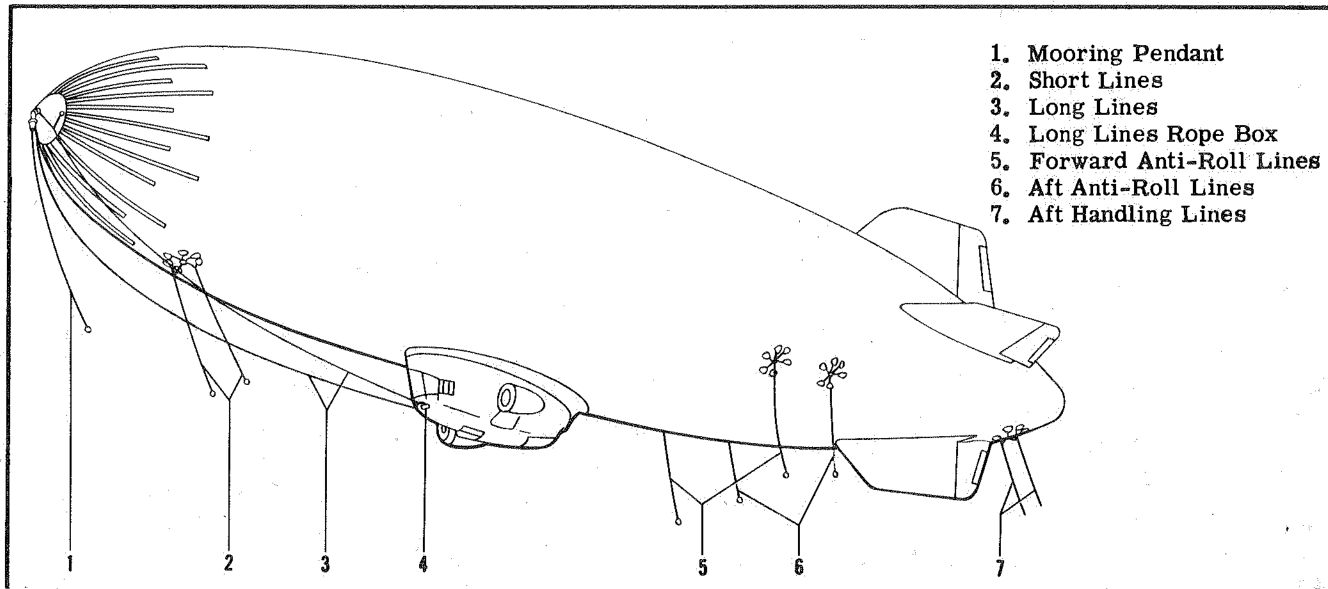


Figure 1-27. Handling Lines

tached to the coupler on the end of the winch hoist cable and is lowered by the winch. When the drag rope is in the hands of the ground party, the winch can be used to assist in landing the airship. When not in use the drag rope is coiled and stowed on a hook (6, figure 4-31) in the stern compartment.

The aft handling lines are attached to the envelope at the stern. These lines are used in combination with the anti-roll lines in docking and undocking the airship. The anti-roll lines are designed to take greater loads than the aft handling lines. The aft handling lines should be used to augment the pull exerted through the anti-roll lines during cross-wind docking when maximum loads may be applied to the handling lines. In light winds, the aft handling lines are sufficient to meet docking requirements and may be used alone, at the discretion of the ground handling officer, if the stress limitations for the aft handling lines are not exceeded. Handling line load limitations and recommended usage are discussed in section V.

The deck line quick releases are used primarily for carrier take-offs. They are controlled by the pilot to disconnect deck lines to release the airship for take-off. One release is installed on the forward hand rail at the front of the car and one is on the aft end of the car. These releases are also used as attaching points for hanger deck surge pendants.

LONG LINES RELEASE KNOB. A round knob (3, figure 1-24) in the center of the aft panel of the pilot's console is pulled up to open the long lines rope box doors. The knob is on a cable assembly connected to both of the door latches. When the knob is pulled, the latches release the doors and the coiled ends of the lines fall free.

FORWARD DISCONNECT KNOB. An oval knob (1, figure 1-24) located to port on the aft console panel, is pulled up to disconnect the forward deck line. The knob is connected to a cable attached to an engaging dog on the forward quick release mechanism. Pulling up on the knob disengages the dog from a cable fitting on the deck line.

AFT DISCONNECT KNOB. A cylindrical knob (5, figure 1-24) starboard on the aft console panel is pulled up to disconnect the aft deck line. Aft disconnect operation is the same as that of the forward disconnect.

INSTRUMENTS.

GENERAL. Instruments which are used in maintaining proper operation of a specific system are discussed in the system description. The other instruments used for flight operation are described in the following paragraphs.

PITOT-STATIC PRESSURE SYSTEM. The pitot-static tube is mounted on a tripod attached to the lower starboard side of the envelope in line with the pilot's compartment. Two pressure lines from the pitot-static tube conduct pressure to the pressure instruments. The static pressure line leads to the rate-of-climb indicator (5, figure 1-6) on the pilot's instrument panel, the rate-of-climb indicator (1, figure 4-36) on the winch operator's instrument panel, the sensitive altimeter (28, figure 1-6) on the pilot's instrument panel, the sensitive altimeter (5, figure 4-26) on the navigator's instrument panel, the airspeed indicator (7, figure 1-6) on the pilot's instrument panel and the airspeed indicator (1, figure 4-26) on the navigator's instrument panel. The static pressure line also conducts pressure to the liquid manometer (2, figure 1-3), the mechanical manometer (6, figure 1-6), and the automatic pilot amplifier. The pitot pressure line leads to the pilot's and navigator's airspeed indicators which require both static and pitot pressure.

SUPERHEAT INDICATING SYSTEM. The difference between helium temperature and ambient air temperature, referred to as superheat, is indicated on the superheat indicator (16, figure 1-6) mounted on the pilot's instrument panel. The system operates on low voltage dc obtained from a 22-1/2 volt dry cell battery located in the center console. A rheostat on the indicator compensates for battery voltage drop to permit proper calibration of the indicator. The indicator is checked for proper calibration with the selector knob in the TEST position and the push to read button pressed in to check that the indicator reads 25 degrees. To obtain a correct superheat indication, the selector knob must be turned to either port (P) or starboard (S), depending on which side of the envelope is least exposed to the sun, and the push to read button pressed in. The indicator will register the difference between the temperature of the air element on the selected side of the envelope and the temperature of the gas element within the envelope.

GYRO HORIZON INDICATOR. An electrically-driven, type H-3 gyro horizon indicator (3, figure 1-6) on the pilot's instrument panel, indicates the roll and pitch attitude of the airship relative to the natural horizon. The roll indications are of secondary importance to the pilot since he has no direct control of airship motion about the roll axis. The instrument receives 115-volt a-c power from the a-c generator.

The face of the indicator (figure 1-28) is divided into two principal parts: the gyro-stabilized background with a bank index, a warning flag, and a horizon bar; and the fixed portion of the indicator, which moves with the airship. The fixed portion includes a bezel mask with 10, 20, 30, 60, and 90-degree roll markings and a trim indicator shaped like a miniature airplane. A knob at the bottom of the indicator adjusts the position of the trim indicator. The warning flag, visible through a window in the stabilized background, signals reliable operation of the instrument when the flag is oscillating at a rate of 60 to 70 oscillations per minute. The gyro rotor starts spinning when power is supplied to the instrument, but self-erection and stabilization take approximately 10 minutes.

The horizon bar moves with the stabilized background about the roll axis, but moves independently of the background about the pitch axis. The position of the miniature airplane (trim indicator) relative to the horizon bar represents the attitude of the airship relative to the natural horizon. In flight, with the airship in flying trim, the miniature airplane should be aligned with the horizon bar by means of the adjusting knob. Once this setting is made the airship attitude is above flying trim attitude when the miniature airplane is above the horizon bar and below trim attitude when the miniature airplane is below the horizon bar. The horizon bar is free to move through a range from plus 27-degree to minus 27-degree inclination of the airship longitudinal axis relative to the natural horizon. The gyro may move outside this range, but the horizon bar will remain at the top or bottom of the indicator until the gyro moves back into the free movement range of the horizon bar. The indication of the horizon bar is accurate as soon as the gyro moves the bar away from the upper or lower stops following excessive pitch attitudes.

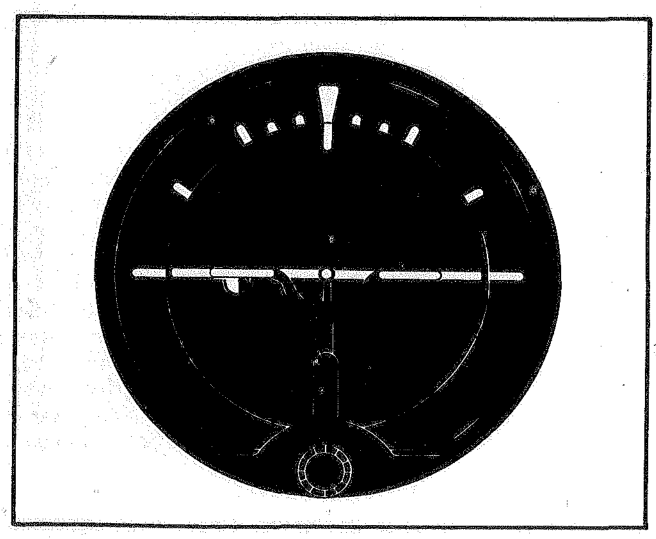


Figure 1-28. Gyro Horizon Indicator

MAGNETIC COMPASS. A standard aircraft floating compass (22, figure 1-3) indicates the heading of the airship relative to the earth's magnetic poles. The compass is mounted on the front starboard window frame of the pilot's compartment. A light controlled by the knob on the instrument case illuminates the lubber line and card.

AUTOPILOT COMPASS REPEATERS. The pilot's and copilot's autopilot compass repeaters (13 and 26, figure 1-6) on the pilot's instrument panel and the navigator's autopilot compass repeater (2, figure 4-26) on the navigator's instrument panel indicate the azimuth heading given by the autopilot gyrosyn compass control. The instruments are calibrated in two-degree increments from 0 to 360 degrees. Indexes of 0, 45, 90, and 180 degrees, located on the front bezel, are used for reference in turning or beam bracketing. The autopilot system need not be engaged for the repeaters to indicate a heading, but the A-12 filament and the autopilot circuit breakers on the pilot's circuit breaker panel must be closed.

OTHER INSTRUMENTS. Other flight instruments include a ball-type inclinometer on the port side of the center console; a free air temperature indicator (20, figure 1-6) on the pilot's instrument panel; a Wiley drift sight which can be mounted outside the copilot's window or at the starboard side of the stern compartment; eight-day clocks located on the pilot's instrument panel (22, figure 1-6), at the radio operator's station (7, figure 4-7), at the radar operator's station (11, figure 4-14), at the ECM operator's station (10, figure 4-17), at the sonar operator's station (6, figure 4-18); and an eight-day civil date indicator clock (4, figure 4-26) on the navigator's instrument panel.

EMERGENCY EQUIPMENT.

GENERAL. The emergency equipment described in the following paragraphs is used for combatting over-all airship emergencies. This equipment includes fire detecting and extinguishing systems and survival equipment. Emergency controls for operating systems and auxiliary equipment are covered either in the discussions of operating systems in this section or with the auxiliary equipment in section IV.

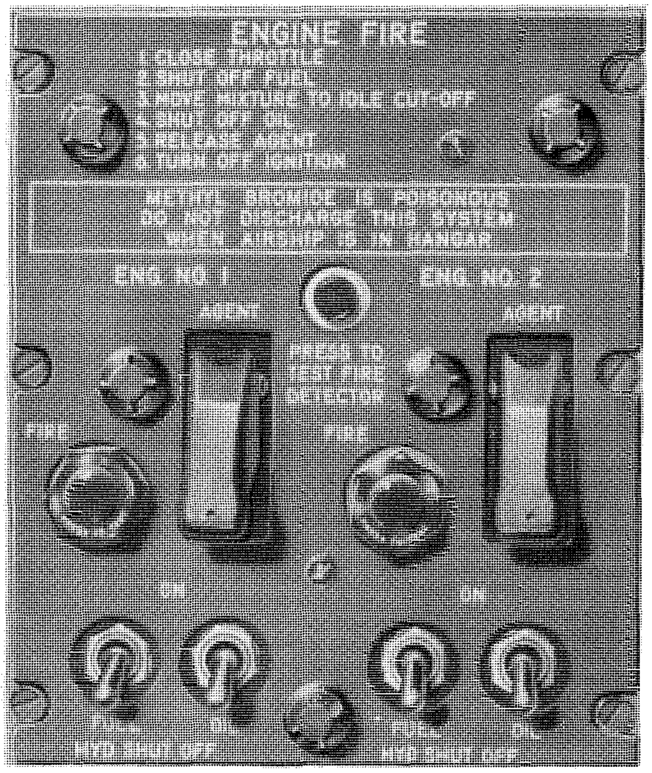


Figure 1-29. Engine Fire Control Panel

ENGINE FIRE DETECTION SYSTEM. The engine fire warning lights (figure 1-29) on the engine fire control panel and the fire master indicator (4, figure 1-6), a red light on the pilot's instrument panel, glow to indicate an engine fire or dangerously high temperature in the engine nacelles. The master indicator goes on when there is a fire in either nacelle and, at the same time, the engine no. 1 or the engine no. 2 fire warning light indicates which nacelle is affected. The fire detector elements are thermocouples located in the engine cylinder section of the nacelles, engine accessory sections, oil cooler ducts, and carburetor air ducts. Rapid changes of temperature in these areas cause the thermocouples to operate a sensitive relay controlling the warning lights. The relay can also be operated by pushing a press-to-test switch on the engine fire control panel to test the system.

NOTE

Continued operation of the propellers in reverse pitch can cause nacelle temperature to rise at a rate sufficient to trigger the fire detection system.

ENGINE FIRE EXTINGUISHING SYSTEM. The engine fire extinguishing system is a fixed, one-shot methyl bromide fire extinguisher which can be discharged into either nacelle. A single bottle in the port nacelle contains 20 pounds of liquid methyl bromide under a nitrogen charge of 400 psi. The bottle has a discharge bonnet for each nacelle connected by tubing to a discharge ring around the engine and to outlets in the oil cooler duct, carburetor air duct, and aft nacelle section. An explosive cartridge in the bonnet ruptures a sealing disc and releases the agent when the release switch is closed.

A pressure gage on the methyl bromide bottle registers the pressure within the container. A fusible safety plug with a yield point between 97.7°C (208°F) and 104.4°C (220°F) releases the contents of the bottle overboard if an overpressure condition occurs.

FIRE EXTINGUISHER AGENT SWITCHES. Two guarded agent switches (figure 1-29), one for each engine, on the fire control panel are used to detonate the explosive cartridges in the discharge bonnets. After the two shut-off switches adjacent to the illuminated fire warning light have been placed in SHUT-OFF, the guard over the agent switch is lifted and the agent switch is raised from its normal off position to completely discharge the contents of the methyl bromide bottle into the corresponding nacelle. The switch need not be held in the raised position after the cartridge has fired. The agent will be completely released in less than three seconds.

WARNING

Methyl bromide is a highly toxic compound and should not be released when the airship is in the hangar or when the handling party is in the area immediately around the nacelle.

SHUT-OFF SWITCHES. The shut-off switches (figure 1-29) on the fire control panel control shut-off valves in the fuel, oil, and hydraulic fluid lines to the nacelles. The switches must be in the ON position at all times

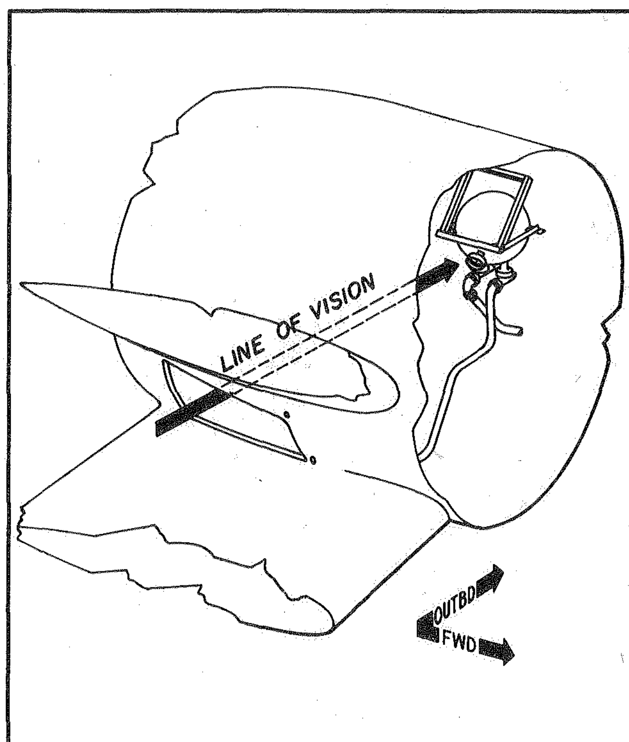


Figure 1-30. Methyl Bromide Pressure Gage

during normal operation. In case of fire in a nacelle, the shut-off switches for that nacelle are placed in the SHUT-OFF position to stop fluid flow. When the engine no. 2 fuel-hydraulic shut-off switch is placed in SHUT-OFF, hydraulic fluid supply to both nacelles is shut off. Engine no. 1 rpm should be held to a minimum to protect the engine no. 1 hydraulic pump.

CAUTION

If conditions warrant returning either fuel-hydraulic shut-off switch to the ON position, it should only be done at low engine rpm. Otherwise, the surge pressure developed by the pump may damage the drive system.

METHYL BROMIDE PRESSURE GAGE. A pressure gage on the side of the methyl bromide bottle registers the internal pressure of the bottle. Normal pressure is 400 psi. A 20 psi drop is allowed before recharging is required. The gage is visible through the inboard access door in the port nacelle (see figure 1-30). The pressure should be checked during each pre-flight exterior inspection.

GENERAL QUARTERS HORN. The general quarters horn which is located above the ECM operator's station, sounds when the general quarters switch (6, figure 1-3) on the pilot's overhead panel is placed in the ON position.

PYROTECHNIC PISTOL. The pyrotechnic pistol (1, figure 4-32) and a container holding 12 cartridges are stowed on the port bulkhead of the stern compartment above the winch operator's seat. When fired from within the car, the pistol is locked into a mount near the cartridge container and is fired horizontally through the mount tube. To open the breech for loading, the breech lock lever is pushed forward and up. After a cartridge is inserted and the breech closed, the pistol is cocked and fired by one continuous pull on the trigger. The cartridge holder with the pistol attached can be lifted and removed from the bulkhead. The pistol can be hand-fired safely.

PORTABLE FIRE EXTINGUISHERS. Two portable fire extinguishers (6, figure 3-1) are mounted in the car; one is on the port side of the stern compartment at the winch operator's station and the other at the ECM operator's station. The extinguishers are used by pointing the horn-nozzle at the base of the fire and pulling the trigger to discharge the fire extinguishing agent in the bottle. Releasing the trigger stops the release of the agent.

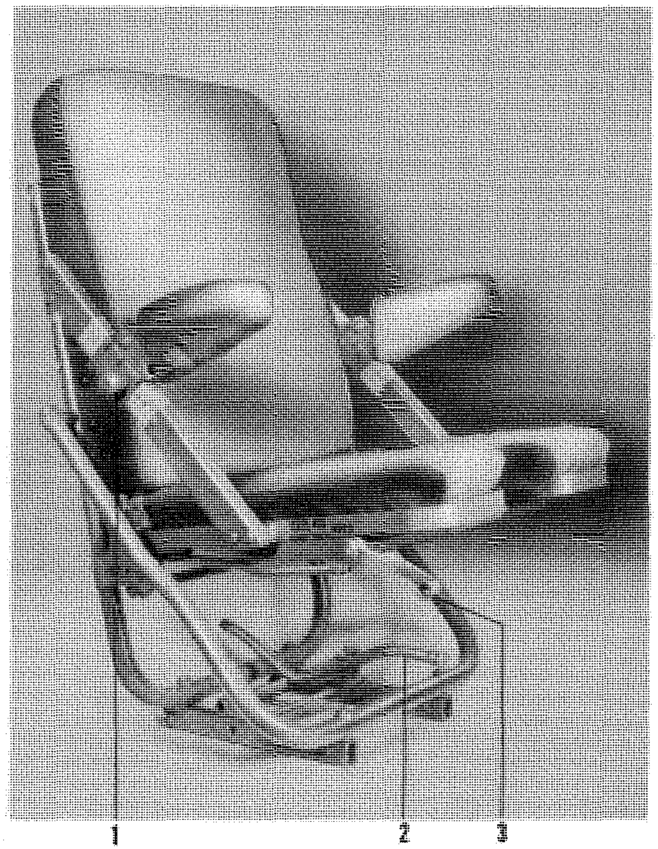
FIRST AID KIT. An aeronautical first aid kit (1, figure 4-27) is mounted on the port bulkhead of the utility compartment just forward of the outrigger access door.

LIFE RAFTS. Two four-man life rafts (4, figure 3-1) are mounted aft of the port entrance door. They are held in place by straps secured with quick release snaps. An emergency equipment container, tied to one raft, is stowed below the rafts.

EMERGENCY HATCHES. The normal escape routes for ditching are the cargo door on the starboard side of the airship and the main entrance door on the port side. Alternate exits are the refueling doors in the aft end of the car and the engine access doors on each side of the car forward of the outriggers. If crew members are trapped in the pilot's compartment or the sonar compartment, the windows should be used as emergency exits after the plastic panes are kicked out. When an emergency entrance must be cut to permit the rescue of trapped personnel following a crash landing, entry should be made in the area of the emergency exits. All compartments of the car can be reached from one or more of these locations and an entrance can be cut easily with the least danger of fuel, oil, or electrical fire.

MISCELLANEOUS CONTROLS.

PILOTS' SEATS. (See figure 1-31). Both horizontal and vertical adjustments can be made to the pilot's and copilot's seats. Horizontal adjustment is made by lifting the fore and aft adjustment lever (2) mounted under the center of the seat near the floor and sliding the seat to the desired position. The lever is then released to lock the seat in place. Vertical adjustment is made by pulling up on the vertical adjustment lever (3) mounted under the right side of the seat, then moving the seat to the desired position and releasing the lever to lock the seat in place. Each arm rest can be adjusted vertically by means of an adjustment knob (1) on each side of the chair. The arm rests can be folded against the backrest to permit easy entry to either seat.



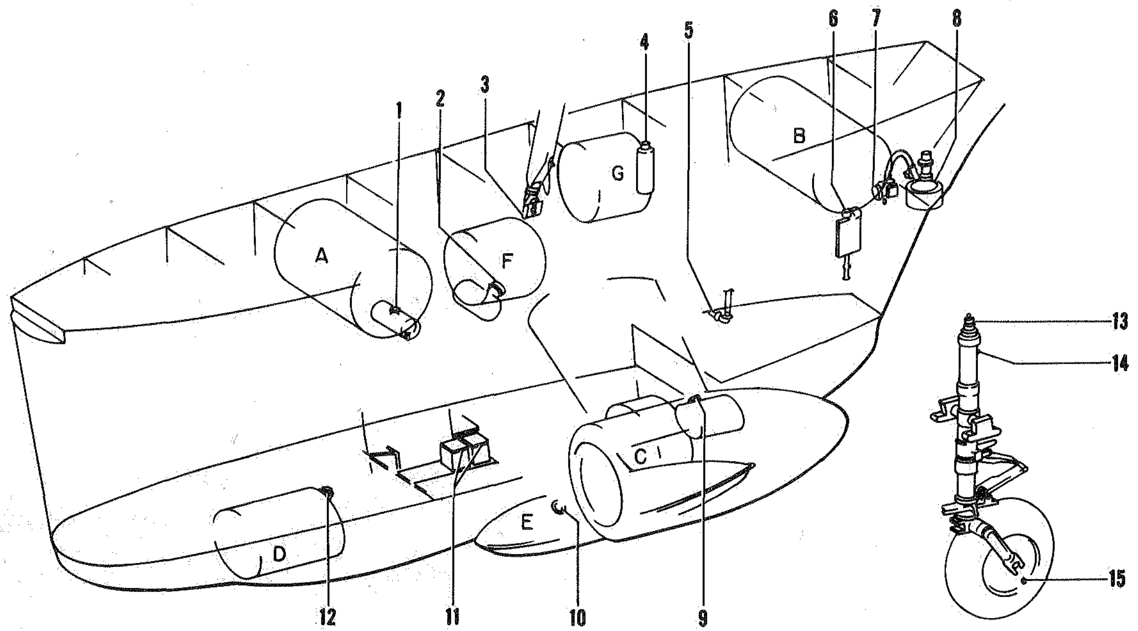
1. Arm Rest Adjustment Knob
2. Fore and Aft Adjustment Lever
3. Vertical Adjustment Lever

Figure 1-31. Pilot's Seat

AUXILIARY EQUIPMENT.

The auxiliary equipment installed in the airship is described in section IV. The systems included are as follows:

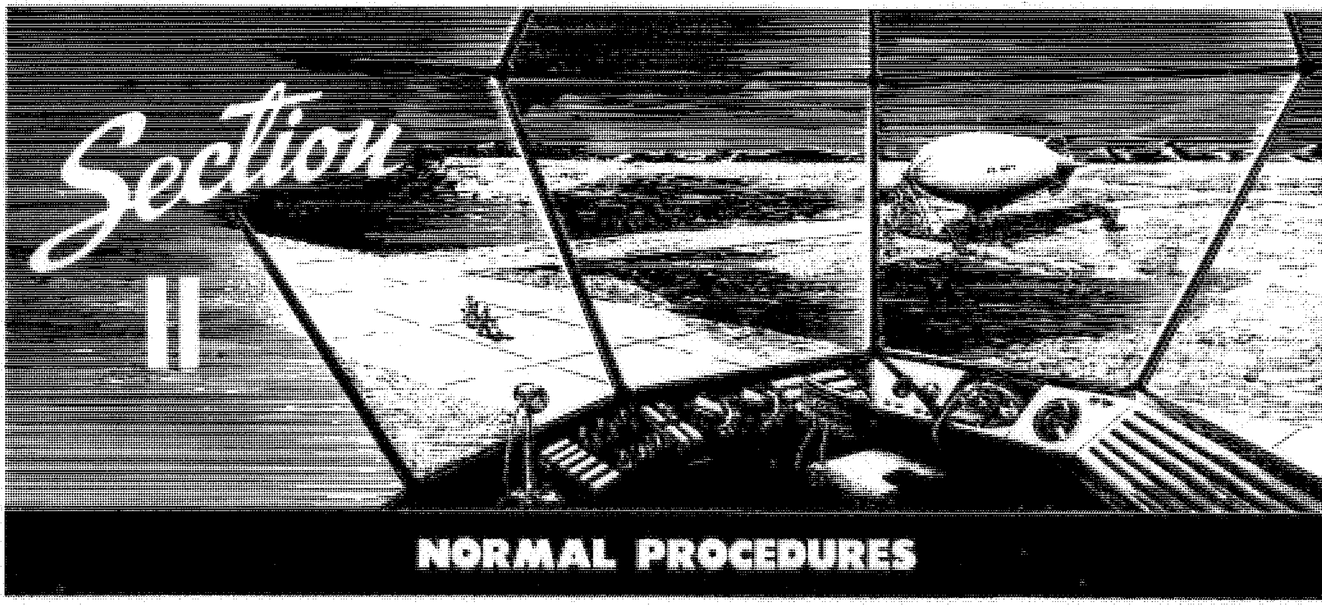
- Heating and Ventilating System
- Propeller Anti-Icing System
- Windshield De-Fogging System
- Lighting Equipment
- Automatic Pilot
- Electronics and Communication Equipment
- Navigation Equipment
- Auxiliary Power Unit
- Armament System
- Galley Equipment
- Winch System
- Inflight Refueling System
- Engine Access Provisions
- Miscellaneous Auxiliary Equipment



SERVICE POINT	SYSTEM UNIT	CAPACITY	FLUID GRADE AND SPECIFICATION
1. Filler Neck	Fresh water breaker	4.5 gallons	Drinking water
2. Filler Neck	Anti-icing tank	8.7 gallons	MIL-F-5566 or MIL-A-609
3. Helium Sleeve	Envelope	As required	Helium
4. Filler Neck	Winch reservoir	1.65 gallons	MIL-O-5606
5. Filling Line	Fwd ballast tank (F) Aft ballast tank (G)	150 gallons 150 gallons	Fresh or salt water
6. Filler Neck	Flight refueling hydraulic reservoir	1/2 pint	MIL-O-5606
7. Ground Refueling Coupling	Forward fuel tank (A)	*	
	Aft fuel tank (B)	*	MIL-F-5572, grade 91/96
8. Flight Refueling Reception Coupling	Slip tank (C)	*	
9. Filler Neck (2)	Port oil tank Starboard oil tank	22 gallons 22 gallons	MIL-L-6082, grade 1100 (summer) grade 1065 (winter)
10. Filler Neck	Fuel drop tank (E) (2 optional)	150 gallons (each)	MIL-F-5572, grade 91/96
11. Vent Caps	Batteries (2)	As required	Distilled water
12. Filler Cap	Bomb bay tank (D) (optional)	*	MIL-F-5572, grade 91/96
13. Top Air Valve	Landing gear oleo strut	5 psi	Dehydrated air
14. Side Air Valve	Landing gear oleo strut	485 psi	Dehydrated air
15. Air Valve	Landing gear tire	92 psi	Air

*Refer to Table I, NAVAER 01-195PAC-501A Supplementary Flight Handbook

Figure 1-32. Servicing Diagram



BEFORE ENTERING THE AIRSHIP.

FLIGHT RESTRICTIONS. Operating limitations imposed on the airship are described in section V.

CRUISE CONTROL. Data are included in appendix I for use by the flight crew in planning a flight. The data should be consulted to determine fuel, ballast, and ballonet fullness requirements for cruising at the proposed altitudes.

LOADING. Before take-off, determine the take-off and anticipated landing conditions of the airship. Make certain that armament and other payload is properly loaded. The Handbook of Weight and Balance Data AN 01-1B-40 shall be consulted for proper car loading and the Form F filled out. Do not exceed the gross weight limitations in section V of this handbook. Determine gross static lift of the airship by calculation or from a previously performed weigh-off. If the gross static lift is calculated, make certain helium purity, barometric pressure, temperature, and envelope fullness readings are accurate. Be sure to include humidity correction in the calculation. The loss of lift due to humidity is determined from table IV.

The effects of superheat should be considered in determining the heaviness condition for take-off and landing (refer to paragraph on weight control limitations in section V). The airship should be in trim when being towed and at take-off. Trim is affected by both car loading and ballonet fullness. Ballonet fullness is shown on the ballonet fullness indicator.

CHECK LISTS. The pilot's take-off and landing check lists (figure 2-2) are installed on the pilot's overhead panel. Detail check lists for all phases of flight preparation and operation are presented in this section under applicable paragraph headings appearing in the sequence followed in checking.

EXTERIOR INSPECTION. The "Daily Nonrigid Flight

Table IV. Loss of Lift at 100% Humidity*

TEMPERATURE (degrees F)	LOSS OF STATIC LIFT
0^{o}	.05%
20^{o}	.10%
32^{o}	.20%
50^{o}	.50%
70^{o}	1.00%
90^{o}	1.80%
100^{o}	2.50%

Inspection" sheets shall be consulted before the flight crew inspects the airship. The checks to be accomplished by the pilot before entering the airship are shown on figure 2-1. A structural mechanic and aviation machinist's mate should accompany the pilot to assist in completing the checks.

ENTRANCE. The airship main entrance door is located on the aft port side of the car.

ON ENTERING THE AIRSHIP.

INTERIOR CHECK. Normally, the flight crew boards the airship while it is at mast either in a dock or on a ramp. Immediately after entering the airship, each crew member completes the checks for which he is responsible, as defined in section VIII. The checks presented here are only those to be accomplished by the pilots to assure that the airship is prepared for flight and by the radio and radar operators in setting up the power conditions to be maintained while the airship is being towed to the mat. It is assumed that d-c power is being supplied to the airship by the APU when the airship is boarded.

* If humidity is less than 100% multiply the loss of lift by the percent of humidity.

1 NOSE

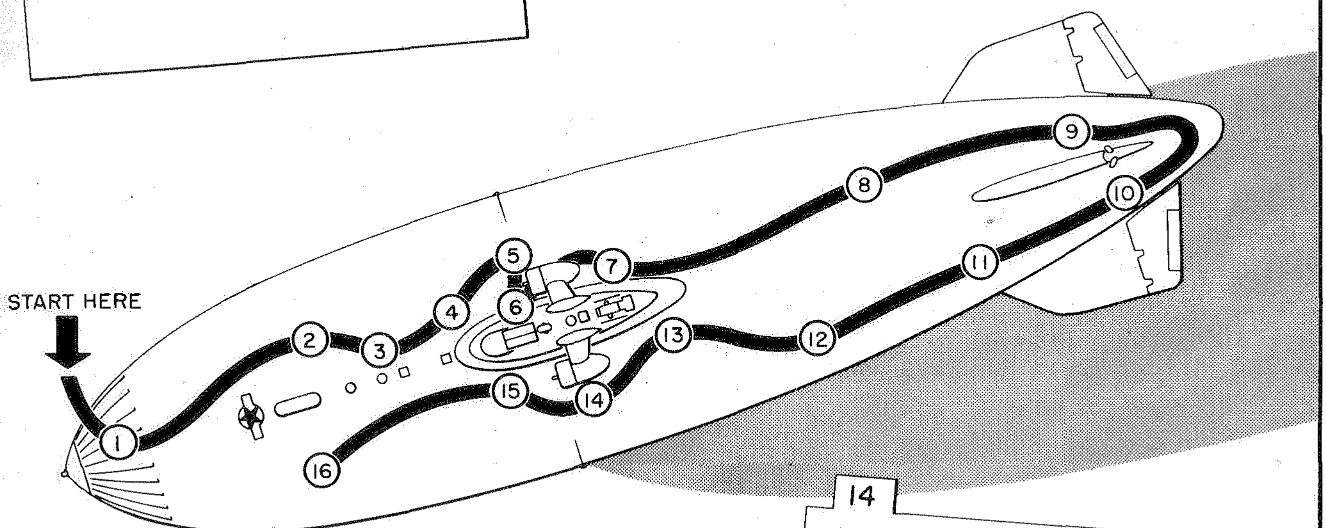
a. Battens	SECURE
b. Long Lines	SECURE
c. Short Lines	SECURE
d. Helium Sleeve Zipper	CLOSED
e. Pendant	SECURE

2 ENVELOPE (FWD AND STBD)

a. Fabric	CONDITION
b. Tapes and Patches	SECURE
c. Ballonet Manhole Zippers	CLOSED
d. Helium Valve & Controls	SECURE
e. Pitot Head	COVER REMOVED

3 ELECTRONIC EQUIPMENT

a. Antennas	SECURE
b. Fairing Zippers	CLOSED



14 PORT OUTRIGGER AND NACELLE

a. Prop Blades	CLEAN and OILED
b. Prop Cuffs	SECURE
c. Fuel, Oil, and Hyd Lines	LEAKS
d. Anti-Icing Feeder Tube	ALIGNMENT
e. Stores	SECURE
f. Drop Tank	SECURE
g. Vents	CLEAR
h. Engine Cowling	SECURE
i. Fire Extinguisher Bottle	PRESSURE

16 ENVELOPE (FORWARD AND PORT)

a. Fabric	CONDITION
b. Tapes and Patches	SECURE
c. Helium Valve & Controls	SECURE

15 CAR (FORWARD AND PORT)

a. Radome	RETRACTED
b. Bomb Bay Doors	CLOSED
c. Car Fairing Zippers	CLOSED
d. Rear View Mirror	SECURE
e. Access Doors	CLOSED

Figure 2-1. Exterior Inspection Diagram (Sheet 1 of 2)

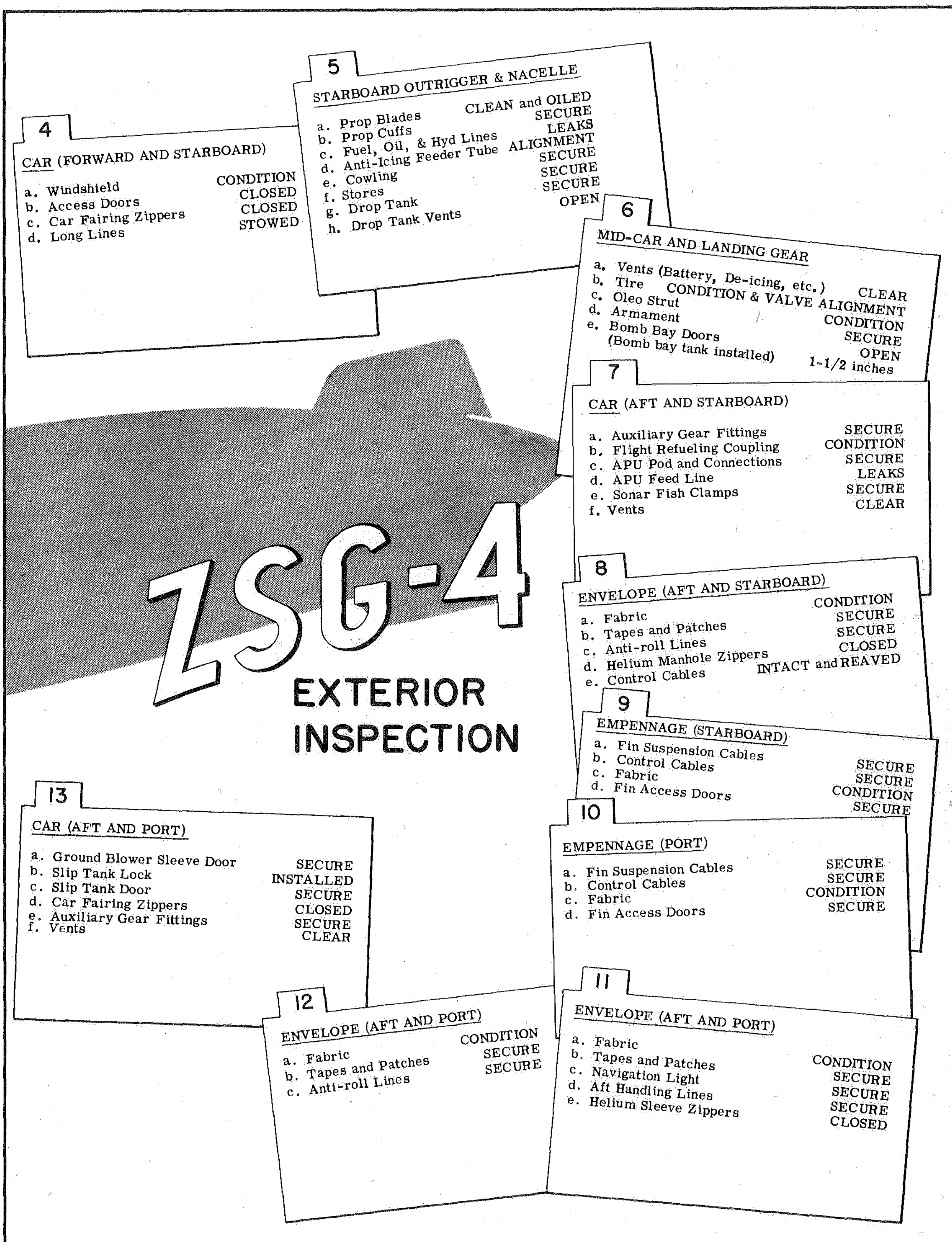


Figure 2-1. Exterior Inspection Diagram (Sheet 2 of 2)

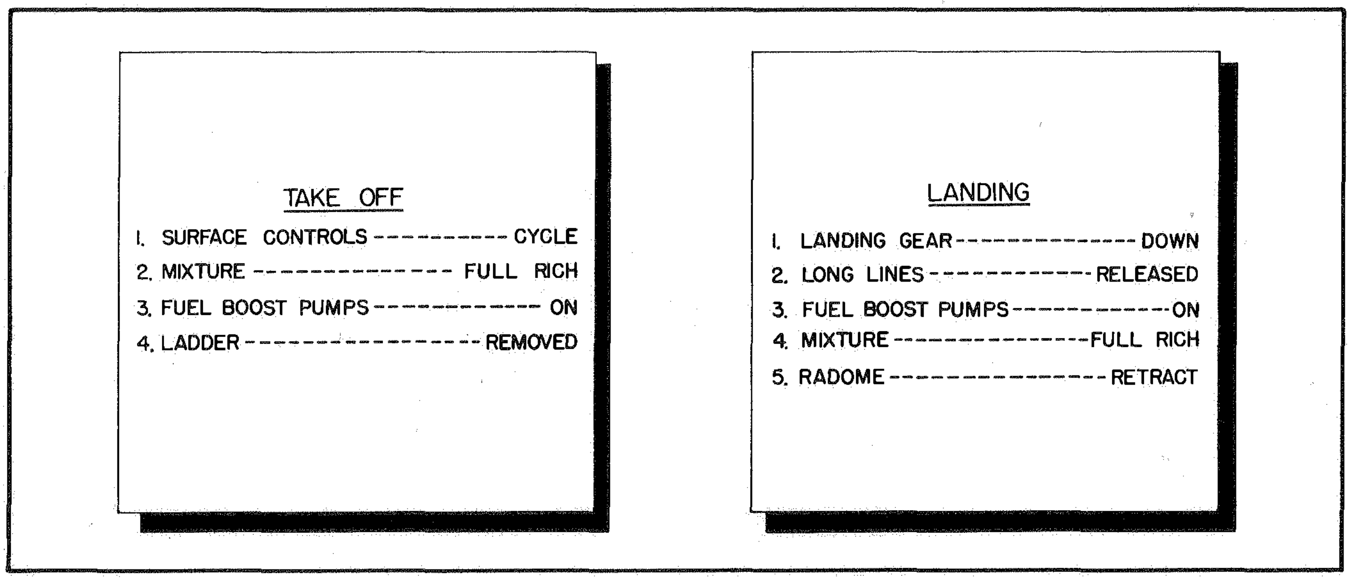


Figure 2-2. Illuminated Check Lists

PILOT'S INTERIOR CHECK.

NOTE

Before completing the checks listed below, the pilot should obtain a report from each crew member to verify that all equipment and supplies are properly stowed and that all flight equipment and systems are ready for operation. Pertinent circuit breakers should be closed.

a. Gust Lock	Engaged
b. De-Fog Switch	OFF
c. Prop De-Ice Rheostat	OFF
d. Armament Master Switch	OFF
e. Light Switches	As Required
f. Fire Detection System	Tested
g. Fuel-Hydraulic Shut-Off Switches (Fire Panel)	ON
h. Oil Shut-Off Switches (Fire Panel)	ON

CAUTION

The fuel-hydraulic and oil shut-off switches are placed in SHUT OFF position only when fighting an engine fire.

i. Fuel Dump Valve Switch Breaker	OFF
j. Helium Warning Light	Tested
k. Liquid Manometer	Zero Settings Checked
l. Rate of Climb Indicator	Set
m. Ballonet Fullness Indicator	Correct (after computer is set for temperature)
n. Altimeter	Checked and Set
o. Clock	Set
p. Superheat Indicator	Checked and Set
q. Engine Fuel Shut-Off Switches (Fuel Panel)	Shut-Off Position
r. Booster Pump Switch	OFF
s. Fuel Warning Light	Tested
t. Transfer Pump Switch	OFF
u. Throttle Override Handles	Disengaged
v. Ignition Switches	OFF
w. Blower Operating Light	Tested
x. Both Dampers	Closed
y. Blower Switch	ON
z. Blower Operating Light	Off
aa. Forward Damper	Full Open
ab. Blower Operating Light	On
ac. Forward Damper	Closed
ad. Blower Operating Light	Off
ae. Aft Damper	Full Open
af. Blower Operating Light	On
ag. Blower Switch	OFF
ah. Blower Operating Light	Off
ai. Aft Damper	Closed
aj. Air Valves	Operable

NOTE

A crew member should visually check for proper operation of both air valves as the pilot operates each of the air switches.

ak. Binoculars	Stowed

RADIO OPERATOR'S POWER CHECK.

a. Shore Power Plugged In Light	On
b. D-C Voltmeter	28 Volts
c. Battery Switch	ON
d. Battery Ammeter	Charging
e. Main D-C Generator Off Light	On
f. Main-Standby Generator Switch	OFF
g. Main D-C Generator Field Switch	NORMAL
h. No. 1 D-C Standby Generator Field Switch	NORMAL
i. No. 2 D-C Standby Generator Field Switch	NORMAL
j. Monitor Override Switch	NORMAL
k. Current Limiters	Inspect
l. Overspeed Control Circuit Breaker	Closed

RADAR OPERATOR'S POWER CHECK.

a.	Shore Power Plugged In Light	Tested
b.	Shore Power Phase Reversed Light	Tested
c.	A-C Generator-Shore Power Switch	OFF
d.	A-C Generator Off Light	Tested

NOTE

If light is on, a-c generator has been tripped. Move generator reset switch to GEN RESET and check that light goes out.

e.	Instrument Inverter Switch	OFF
f.	A-C Instrument Circuit Breaker	ON
g.	Instrument Power Off Light	ON

UNDOCKING.

Undocking and the towing of the airship to the take-off mat are primarily ground crew operations. The ground crew handles the APU pod, unlocks the landing gear, and attaches necessary handling lines as directed by the ground handling officer. The pilot is required only to maintain required helium pressure in the envelope and to operate the surface controls if necessary. Helium pressure of at least 1.5 inches of water should be maintained while the airship is being towed. The exact pressure required depends on wind and temperature.

CAUTION

All electrically-operated equipment not required during towing should be off until the engines are started and the generators operating.

BEFORE STARTING ENGINES.

Before starting the engines, obtain the proper clearance signal from the ground handling officer. His signal indicates that lines are secured, propeller areas are clear, and ground personnel are properly stationed. Before obtaining clearance, the following checks should be made:

a.	Winch Hydraulic Reservoir Fluid Quantity Indicator (Check winch operator.)	3/4 to Full
b.	Winch Hydraulic Reservoir Gas Pressure Valve (Check winch operator.)	Open
c.	Winch Hydraulic Reservoir Cylinder Pressure Indicator (Check winch operator.)	150 psi or more

d. Make sure that d-c power is connected to essential busses from battery or auxiliary power unit. (Check radio operator.)

NOTE

If batteries are used for starting, the main generator-standby generator switch should be in OFF position and the monitor override switch should be in NORMAL position. The ICS will not operate until the main generator is operating and the main generator-standby generator switch is placed in MAIN GEN. position.

e.	Constant Speed Drive Emergency Stop Button (Check radar operator.)	Pressed once to vent drive unit.

f. With throttle selector switches and prop pitch selector switches in LEVER OPER move each thrust lever and check for corresponding propeller blade angle changes.

g. Move prop selector switches to INC and DEC and check for corresponding propeller blade angle changes.

h.	Instrument Inverter Switch (Check radar operator.)	NORMAL

WARNING

If bomb bay tank is installed, the bomb bay doors should be full open before the inverter switch is placed on NORMAL. Immediately prior to take-off the doors should be closed to a 1-1/2 inch opening. Refer to the discussion of the bomb bay tank in section VII.

i.	Fire watch	Posted
j.	Propeller Lights Switch (night)	ON

STARTING ENGINES.

WARNING

Consult section III for engine fire-fighting procedure.

a.	Cowl Flap Switch	OPEN (hold 7 seconds)
b.	Oil Cooler Switch	OPEN (hold 9 seconds)
c.	Carburetor Heat Switch	COLD (hold 4 seconds)
d.	Engine Fuel Shut-Off Switch (Fuel Control Panel)	Open
e.	Emergency Feed Switch	Closed
f.	Boost Pump Switch	ON
g.	RPM Control Lever	DEC RPM
h.	Throttle Selector Switch	LEVER OPER
i.	Prop Pitch Selector Switch	LEVER OPER
j.	Thrust Lever -	Set to position approximately 1/2-inch ahead of NO THRUST to obtain 5-degree blade angle.
k.	Prop Pitch Selector Switch	Off
l.	Throttle Selector Switch	CLOSE (hold 2 seconds)

m. Open throttle by flicking selector switch three times to OPEN.

NOTE

Throttle opens fully in 1-1/2 seconds if switch is held on. Throttle should be open to 800 rpm position.

n.	Mixture Lever	Full RICH
o.	Obtain clearance from ground handling officer to "turn-up."	
p.	Starter Switch	START ENG. NO. 1 or START ENG. NO. 2

CAUTION

Turn engine six blades with starter. If unusually high compression is indicated, do not continue the start.

q.	Ignition Switch	BOTH
r.	Primer Switch	ENG. NO. 1 or ENG NO. 2

s. Adjust throttle with selector switch to obtain 700 to 800 rpm.

t. Oil Pressure Indication	Within Limits (after 30 seconds)
v. Booster Pump Switch (after both engines are started)	OFF
w. Fuel Pressure Indicators	Normal

ENGINE GROUND OPERATION.

After both engines are running and oil and fuel pressure have been checked, proceed as follows:

PILOT:

a. Open throttles with selector switches to obtain slightly more than 1000 rpm.

RADAR OPERATOR:

b. Constant Speed Drive Reset Button	Reset
c. A-C Generator - Shore Power Switch	AC GEN

NOTE

Do not attempt to start constant speed drive unit at engine speeds greater than 1100 rpm for dual-engine operation or 2000 rpm for single-engine operation. Higher starting speeds will result in overspeeding of the drive unit.

PILOT:

d. Prop Pitch Selector Switches	LEVER OPER
e. Throttle Selector Switch (one engine)	LEVER OPER

f. Check that engine rpm drops to 1000.

g. Move rpm lever ahead and check tachometer for increase.

h. Repeat steps "e," "f," and "g" for other engine.

i. Retard rpm levers and warm up engines at 1200 rpm and approximately 17-18 inches Hg manifold pressure.

GROUND TESTS.

ENGINE TESTS.

a. Oil Pressure - within normal range during all variations of power settings used for other tests.

b. Fuel Pressure - normal during all variations of power settings used for other tests.

c. Ignition - (One engine at a time)

(1) Advance rpm lever to obtain 1800 rpm.

(2) Move thrust handle to obtain manifold pressure equal to field barometric pressure.

(3) Throttle Selector Switch — Off

(4) Check rpm drop with ignition switch in L and R positions. Rpm drop should not exceed 100 and engines should operate smoothly.

(5) Throttle Selector Switch — LEVER OPER

(6) RPM Control Lever — Set for 1200 rpm

d. Cylinder Head Temperature - normal during all ground tests of engine.

e. Idle Mixture - is set full rich so it is not checked.

ENERGIZING ELECTRICAL SYSTEMS. After the engines are running and checked, the radio and radar operators can accomplish the switching and checking necessary to supply generator power to the busses. If the auxiliary power unit has been used it can be removed by the ground crew after the d-c generator is switched on. Keep electrical loads to a minimum until the generator checks are completed.

RADIO OPERATOR:

a. Main Generator - Standby Generator Switch	MAIN GEN
b. Auxiliary Power Unit (Check ground crew.)	Disconnected
c. Shore Power Plugged In Light	Off
d. Main Generator Off Light	Off
e. Main Generator Ammeter	Indicating Load
f. Voltmeter	28 volts
g. Standby Generator Ammeter	No current
h. Main Generator - Standby Generator Switch	STANDBY GEN. No. 1 and No. 2
i. Standby Generator Ammeter	Indications equal on both dials
j. Voltmeter	28 volts
k. Main Generator Off Light	On
l. Main Generator - Standby Generator Switch	MAIN GEN
m. Main Generator Off Light	Off

RADAR OPERATOR:

a. Rotate voltmeter selector switch to each position and check for 115 volts on voltmeter for each position.

b. Ammeters	Indicating Loads
c. Instrument Power Off Light	Off
d. Low Frequency Light	Off
e. Frequency Meter	400 to 405 cps

CONSTANT SPEED DRIVE TEST. The following test is made to assure that both engine-driven hydraulic pumps are operating.

a. With both engines operating at 1000 rpm and electrical loads on generators, note hydraulic pressure on gage.

b. Advance rpm lever for one engine to obtain approximately 1500 rpm and note stabilized hydraulic pressure. Pressure should be less than when checked in step "a."

c. Retard rpm lever and repeat procedure for other engine to check the other pump.

SURFACE CONTROLS AND AUTOMATIC PILOT TESTS.

a. Gust Lock	Disengaged
b. Boost Master Switch	OFF
c. Pilot Switch (Autopilot)	OFF
d. Elevator and Rudder Controls	In Neutral
e. Manual Surface Controls Handle	Pulled Up
f. Elevator and Rudder Controls	Operate Freely

NOTE

Tests may be conducted with the controls in either separate or dual control.

g. Elevator and Rudder Controls	In Neutral
h. Manual Surface Controls Handle	Pushed Down
i. Boost Master Switch	ON
j. Elevator and Rudder Boost Indicators	Centered
k. Booster Servo Engaging Switches	ENGAGE

l. Move elevator column forward and aft and rotate a rudder wheel to right and left. Controls should operate freely and to full extent with slight effort required.

m. Check with ground handling officer on direction and amount of control surface movement when each control movement is made.

n. The elevator and rudder boost indicators should indicate direction of applied boost as long as pressure is exerted on controls. Release of pressure on the controls causes the indicating lines to return to center regardless of the position of the control surfaces.

o. Elevator and Rudder Controls — In Neutral
p. Boost Master Switch — OFF
q. Turn Control Knob (Autopilot) — In Detent
r. Pilot Switch (Autopilot) — ON
s. Automatic Pilot Engaging Switches — ENGAGE
t. Rotate turn, glide, and climb control knobs in both directions and observe corresponding movements of elevator columns and rudder wheels.
u. Actuate altitude control switch to ON and check that controls do not move excessively.
v. Press autopilot release button on either pilot's or copilot's column. Pilot and altitude control switches should return to OFF, and automatic pilot engaging switches should return to DISENGAGE.

EXTERIOR LIGHTS TEST. To test the operation of the exterior lights the pilot requires the assistance of the ground crew. The ground crew signals the operation of the lights as the pilot performs each step of the test.

a. Prop Lights Switch — ON
b. Port and Starboard Propeller Lights — On
c. Landing Light Switch — EXTEND
d. Light extends from recess in car.
e. Landing Light Switch — STOP
f. Light stops before reaching fully extended position.
g. Landing Light Switch — EXTEND
h. Light moves to fully extended position.
i. Landing Light Switch — ON
j. Landing Light — On
k. Landing Light Switch — OFF
l. Landing Light — Off
m. Landing Light Switch — RETRACT
n. Landing Light retracts into recess.
o. Master Switch — OFF
p. Recognition Lights Switch — ON
q. Navigation Light Switch — ON
r. Recognition, Car Position, and Envelope Position Lights — Off
s. Master Switch — KEY
t. Car and Envelope Position Lights — Steadily Lighted
u. Key — Operate
v. Recognition Lights — Lighted when key is operated
w. Monitor Light — Lighted when key is operated
x. Master Switch — CODE
y. Car Position and Envelope Position Lights — Steadily Lighted
z. Code Selector Switch — Each position (in turn)
aa. Recognition Lights — Coded as selected
ab. Master Switch — FLASH
ac. Car Position and Recognition Lights — Flashing together
ad. Envelope Position Lights — Flashing alternately with Car Position and Recognition Lights
ae. Master Switch — STDY
af. Car Position Lights — Extinguished
ag. Envelope Position Lights — Steadily Lighted
ah. Recognition Lights — Steadily Lighted

NOTE

After exterior lights have been checked, position switches for desired operating condition.

BEFORE TAKE-OFF.

The "Daily Nonrigid Flight Inspection" sheets and the "yellow sheet" must be signed and passed to the ground handling officer.

PILOT'S CHECK LIST.

a. Crew Members — At stations
b. Engine Oil Temperature — Normal
c. Cylinder Head Temperature — Normal
d. Booster Pump Switch — ON
e. Exterior Lights — As required
f. Mixture Levers — RICH
g. Thrust Levers — NO THRUST
h. Rpm Levers — DEC
i. Carb Heat Switches — As required
j. Oil Cooler Switches — AUTO
k. Boost Master Switch — ON
l. Booster Switch — ENGAGE
m. Control Columns — Free movement
n. Entrance Ladder (Check winch operator.) — Removed
o. Doors — Closed
p. Long Lines — Stowed
q. Slip Tank (check winch operator.) — Unlocked
r. Obtain take-off clearance.

UNMASTING. During the unmasting operation, the engines should be run at 1000 rpm and the thrust lever should be placed in NO THRUST. The pilot can assist the ground crew by using reverse propeller pitch if necessary.

As the airship is released from the mast, a final check of trim should be made by noting the attitude assumed by the airship. When released from the mast, the airship is controlled by the ground crew to the extent necessary to hold the nose into the wind. Maneuvering of the airship into take-off position may be aided by employing the thrust of the propellers.

TAKE-OFF.

The take-off is made with the airship in trim and in a heavy condition. The take-off should be made from a position on the field which best utilizes the prevailing wind and where the run and subsequent take-off is not endangered by obstacles. Horizontal take-off distance required to clear a 50-foot obstacle with any specific degree of heaviness is indicated in figure A-6. Chart distances are based on the assumption that the airship is in trim and that the following take-off procedure is used.

a. Move rpm levers all the way forward to obtain 2250 engine rpm.
b. Move thrust levers forward until take-off power is obtained.

CAUTION

Engine rpm will decrease if thrust levers are advanced after 36 inches MAP is reached.

NOTE

Procedures to be followed in case of fire or engine failure during take-off are included in section III.

AFTER TAKE-OFF.

a. Landing Gear Lever	UP
b. Gear Position Indicator	UP

c. Retard rpm levers until climb rpm is reached.
d. Retard thrust levers to obtain desired airspeed.

e. Booster Pump Switch	OFF
f. Fuel Pressure Indicators	Normal
g. Slip Tank Lock Pin	Reinstalled

h. Watch carburetor air temperature carefully if carburetor heat is used during take-off and climb. The temperature may rise rapidly when engine power is increased for take-off.

CLIMB.

Normal rated power or less should be employed during the climb. The charts in appendix I can be used to determine the power settings and angle of attack required for various heaviness conditions. In determining the heaviness after take-off, the loss of superheat must be considered. Frequent changes of power setting may be required during the initial climb to compensate for the loss of superheat lift. The maximum rate of climb should not be exceeded, for if it is, envelope pressure may increase enough to cause the helium valves to open.

FLIGHT CHARACTERISTICS.

Section VI contains descriptions of the flight characteristics peculiar to the airship. Consult that section to determine airship reaction in flight.

SYSTEMS OPERATION.

Procedures for operating the more complex systems of the airship during flight are discussed in section VII. Also explained in that section are the procedures for coordinated crew operations, such as in-flight refueling.

PRE-APPROACH CHECK LIST.

The pre-approach check should be made at least five minutes from the field. The crew members report to the pilot to assure him that the necessary checks have been completed. The following checks are made:

a. Crew Members	At stations
b. Loose Equipment	Secured
c. Drag Rope	Rigged
d. Radome	Retracted
e. Armament Master Switch	OFF
f. Engine Oil Temperature	Within Limits
g. Cylinder Head Temperature	Within Limits
h. Engine Oil Pressure	Within Limits
i. Mixture Levers	RICH
j. Boost Pump Switch	ON
k. Fuel Pressure	Within Limits
l. Landing Gear Lever	DOWN
m. Landing Gear Position Indicator	Gear down
n. Pilot Switch (Autopilot)	OFF
o. RPM Levers	1500 RPM
p. Propeller Lights Switch	ON
q. Slip Tank Lock Pin	Removed

After all checks have been completed a weigh-off should be made to determine the amount of heaviness and the trim of the airship preparatory to landing.

LANDING.

The approach should be made by slowing the airship to an airspeed of 35 knots or less at a distance of two or three miles from the field. A gradual descent should be made during the approach.

An airship with a lift condition near equilibrium lands satisfactorily at an airspeed of 20 to 25 knots. The speed should be increased as necessary to sustain the dynamic forces required for landing a heavy or light airship. The speed required to prevent stalling can be determined by the action of the airship during the approach.

The airship should be brought down with the least possible nose-down attitude and should be level as the wheel touches down. With the airship heavy, as it is leveled off just above the ground the thrust levers can be retarded just enough to cause the airship to stall and drop slowly to the ground. With the airship light, the forward speed must be maintained to prevent the airship from stalling and rising.

The airship should touch down near the ground crew. The propellers can be reversed to decrease the forward momentum of the airship to assist the ground crew in seizing the lines. If the airship is light, sufficient down elevator must be applied to prevent the nose from rising during the roll and sufficient speed must be maintained so that the controls will remain effective.

WAVE-OFF.

If a wave-off is received from the ground party proceed as follows:

a. RPM Levers	Full INC (2250 RPM)

b. Move thrust levers forward as required to obtain climbing airspeed.

CAUTION

Engine rpm will decrease if thrust levers are advanced after 36 inches MAP is reached.

c. Blower Switch	OFF
d. Aft Damper Switch	CLOSE
e. Forward Damper	Intermediate Opening

AFTER LANDING.

a. Radio Altimeter Power Switch	Off
b. Booster Pump Switch	OFF
c. RPM Levers	1000 RPM
d. Thrust Lever	As needed to maintain position
e. Navigation Lights Switch (if at night)	ON
f. Exterior Lights Master switch (if at night)	STDY
g. Slip Tank Lock Pin	Reinstalled

POST-FLIGHT ENGINE CHECK. After the airship has been masted, conduct a post-flight engine check according to existing directives. Record any unsatisfactory conditions on the approved forms.

RADIO OPERATOR'S D-C POWER CHECK.

a. External D-C Power — Connected
b. Shore Power Plugged In Light — ON
c. Reduce d-c loads to capacity of external power supply.
d. Main-Standby Generator Switch — OFF
e. D-C Voltmeter — 28 Volts
f. Battery Ammeter — Charging
g. Main Generator Off Light — On

STOPPING ENGINES.

a. Thrust Lever — NO THRUST
b. RPM Lever — Full DEC
c. Cowl Flap Switch — OPEN (hold 7 seconds)
d. Oil Cooler Switch — COLD (hold 9 seconds)
e. Carb Heat Switch — COLD (hold 4 seconds)
f. Mixture Lever — IDLE CUT OFF
g. When propeller stops turning, move thrust control lever to REV.
h. Throttle Selector Switch — Off
i. Prop Pitch Selector Switch — DEC (hold 1 second)
j. Ignition Switch — Off
k. Fuel Shut-Off Switch (Fuel Control Panel) — OFF

RADIO OPERATOR AFTER ENGINES ARE STOPPED.

a. Overspeed Control Circuit Breaker — Open

RADAR OPERATOR'S A-C POWER CHECK.

a. Instrument Inverter Switch — OFF

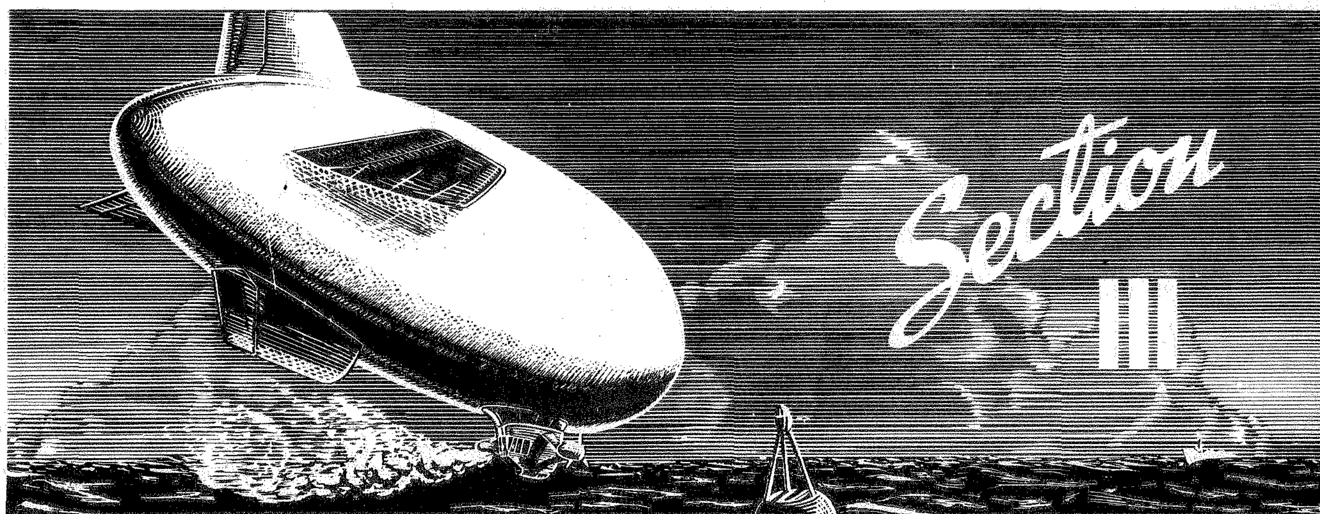
BEFORE LEAVING THE AIRSHIP.

a. Gust Lock — Locked

CAUTION

Unlessthe ship isbeing flown on the mast, the gust lock should be engaged whenever the ship is masted or maneuvered on the field.

b. Landing Light Switch — RETRACT
c. All Electrical and Radio Switches — OFF



EMERGENCY PROCEDURES

ENGINE FAILURE.

FLIGHT CHARACTERISTICS WITH ONE OR BOTH ENGINES INOPERATIVE. The airship can be flown satisfactorily on one engine if the maximum heaviness limitations stated in section V are not exceeded. After failure of one engine, the power on the other engine should be increased as required to maintain level flight. Fuel, ballast, or armament loads should be jettisoned if necessary to reduce heaviness so that the angle of attack required to maintain level flight is not excessive. Electrical loads must be reduced to a total within the capacity of operating generators. The total load that can be carried by the constant speed drive during single engine operation can be determined from information in section V. If the No. 2 engine is inoperative because of fire, only the No. 1 standby d-c generator remains operative.

If both engines fail, the airship can be flown as a free balloon. Sufficient load must be jettisoned immediately to obtain a near-equilibrium heaviness condition. Altitude can then be controlled by valving helium or jettisoning additional load until the airship can be ditched or crash landed.

PROCEDURE ON ENCOUNTERING ENGINE FAILURE. When an engine fails, a three-part procedure is followed. First, the engine must be stopped. The method used to stop the engine is the same regardless of the nature of the emergency which makes it necessary. The second part of the procedure is to shut down the engine completely after taking the steps necessary to combat the emergency condition. The third part of the procedure is to re-start the engine if the trouble has been corrected.

STOPPING THE ENGINE. If an engine is to be stopped to combat an engine fire, because the engine is malfunctioning, because of overspeeding, or as a result of any other emergency, the procedure is the following:

a. Throttle Selector Switch — CLOSE (1-1/2 seconds)
b. Mixture Control Lever — IDLE CUT-OFF

NOTE

This procedure may not bring the engine to a dead stop, but it is the quickest method for slowing the engine sufficiently to prevent spread of fire or further damage to a malfunctioning or overspeeding engine.

SHUTTING DOWN THE ENGINE. As soon as time permits after the emergency condition is remedied the engine should be shut down by operation of controls according to the following procedure.

a. Ignition Switch — OFF
b. Propeller Pitch Selector Switch — INC (FEATHER) until propeller stops
c. Cowl Flap Switch — CLOSE
d. Oil Cooler Flap Switch — CLOSE
e. Fuel Shut-Off Switch (Fuel Panel) — Closed
f. Thrust Control Lever — REV
g. RPM Control Lever — Aft

RE-STARTING THE ENGINE. The procedure for starting an engine in flight is the same as the normal starting procedure prescribed in section II.

CAUTION

Do not attempt to re-start an engine after a fire or failure unless assured that it is safe to operate the engine.

ENGINE FAILURE DURING TAKE-OFF. If an engine fails during take-off, the best procedure usually is to jettison enough load to be able to continue the take-off on one engine. Enough jettisonable load is carried to make this procedure always practicable. Table V lists the loads which can be jettisoned. The pilot should determine before take-off which of the loads are to be jettisoned in case of engine failure. By reducing the

Table V. Disposable Loads

LOAD	EQUIPMENT	WEIGHT (pounds)	RATE
Water Ballast	Forward Ballast Tank	1282	23 lb per sec
	Aft Ballast Tank	1282	23 lb per sec
Fuel	Left Drop Tank	1000	INSTANTLY
	Right Drop Tank	1000	INSTANTLY
	Slip Tank	660	INSTANTLY
	Bomb Bay Tank	1200	INSTANTLY
	Aft Tank (Dump)	1800	42 lb per sec

NOTE

Both drop tanks, together with all other loads on the bomb racks, can be released by throwing the salvo switch on the armament panel of the pilot's overhead panel. To release tanks singly, pull "MK-12 Fuel Tank Release" toggles in utility compartment.

heaviness to 2000 pounds or less immediately after the engine failure, the pilot can prepare the airship for either continued flight or an immediate landing.

ENGINE FAILURE DURING FLIGHT. In case of engine failure during flight, the general procedures to be followed are those for engine failure during take-off. Access to an engine is possible; so a fire can be extinguished or emergency repairs made if necessary by crew members. Whenever an engine must be stopped in flight, electrical power loss becomes an immediate problem. The paragraphs in this section pertaining to electrical system failures should be consulted to determine what steps are necessary when generators become inoperative.

LANDING WITH ONE ENGINE INOPERATIVE. The airship can be landed with one engine by following the normal landing procedure as long as the airship is in trim and within prescribed heaviness limitations. Trim and heaviness factors are more critical during such a landing because of loss of engine power and possible loss of the electric servo boost system for flight control.

PRACTICE MANEUVERS WITH ONE ENGINE INOPERATIVE. Either engine can be shut down to conduct practice maneuvers as long as heaviness and trim of the airship are maintained within limits. The loss of other equipment resulting from decreased electrical power output must be considered before attempting the maneuvers. If the No. 2 engine is shut down, the fuel-hydraulic shut-off switch on the fire control panel should not be operated. Operation of the switch causes the constant speed drive to cease operation.

PROPELLER FAILURE.

RUNAWAY PROPELLER. If an engine starts to overspeed, follow the procedure prescribed for engine failure in this section. Do not attempt to reduce engine rpm by operation of propeller controls. If the propeller controls do not function, efforts to reduce engine speed might be delayed until the engine is seriously damaged.

BETA CONTROL FAILURE. If propeller pitch does not change in correct relation to movements of the thrust control lever or if an engine surges, the propeller selector switch should be positioned to OFF. If surging stops, the throttle controls can be left in automatic while the propeller is controlled by the selector switch.

CAUTION

When controlling propeller blade angle with the pitch selector switch, caution must be exercised to prevent overloading the engine. An excessively high blade angle can be obtained by holding the switch too long in INC (FEATHER) position. The blade angle changes approximately 6 degrees per second while the switch is on.

PITCH CONTROL SYSTEM FAILURE. If the pitch of a propeller cannot be changed, the engine can be continued in operation if the propeller blades are in a normal forward pitch position. The propeller selector switch should then be left in OFF. The other propeller can be synchronized to the fixed pitch propeller to prevent vibration or bad control effects. The one engine should be shut down before landing so that reverse pitch control is available.

THROTTLE CONTROL SYSTEM FAILURE. If engine surging or hunting occurs and is not eliminated by moving the propeller selector switch to OFF, the throttle selector switch should also be moved to OFF. The throttle and propeller can then be controlled by the selector switches. The throttle can be controlled by the throttle override lever if the throttle selector switch fails.

FIRE.

ENGINE FIRE IN FLIGHT. An engine or nacelle fire is indicated by the fire detection system warning light on the fire panel of the pilot's overhead panel. When fire is indicated, the pilot should nose the airship down to prevent the fire from reaching the envelope if possible. Altitude should be reduced as much as possible while carrying out the procedures required to combat the fire. The power settings for the other engine must be increased as necessary to maintain airspeed and reduce altitude. When the airship is down to minimum safe altitude, crash landing or ditching can be accomplished immediately if the fire cannot be extinguished. The procedure for combatting the fire is the following:

a. Throttle Selector Switch — CLOSE (1-1/2 seconds)
b. Fuel-Hydraulic Shut-Off Switch — SHUT-OFF
c. Oil Shut-Off Switch — SHUT-OFF
d. Mixture Control Lever — IDLE CUT-OFF
e. Cowl Flap Switch — OPEN
f. Oil Cooler Flap Switch — OPEN
g. Fire Extinguisher Agent Switch — Operated
h. Ignition Switch — OFF
i. Propeller Selector Switch — INC (FEATHER) (16 seconds)

j. Order mechanic to lower access door to engine and prepare to approach nacelle with hand extinguisher.
k. Order radio and radar operators to set up emergency electrical power conditions.

CAUTION

The fire extinguisher system is a one-shot system. If fire is not extinguished or breaks out again, only hand extinguishers are available to combat it. If fire has caused any damage, no attempt should be made to re-start engine.

CAUTION

When the engine No. 2 fuel-hydraulic shut-off switch is placed on SHUT-OFF, the hydraulic fluid supply to both nacelles is shut off. Engine No. 1 rpm should be held to a minimum to protect the engine No. 1 hydraulic pump.

If conditions warrant returning either fuel-hydraulic shut-off switch to the ON position, it should be done at low engine rpm. Otherwise, surge pressures developed by the pump can damage the drive system.

ENGINE FIRE ON THE GROUND. If engine fire occurs while the airship is on the ground, the procedure for combatting the fire is the same as that followed for fire in flight except that care must be exercised in using the extinguisher agent. The methyl bromide system can be used outside if all personnel are clear of the area near the engine. Car doors and windows facing the engine should be closed.

WARNING

Never discharge methyl bromide inside a hangar. Use only CO_2 fire extinguishers for an engine fire if there is any chance of personnel being exposed to the extinguisher agent. Ventilate the area immediately after CO_2 is used.

CAR FIRE. The portable fire extinguishers located as shown in figure 3-1 can be used to extinguish a car fire. If the fire is in any equipment, such as the heater system, the equipment should be shut off immediately. Valves in fluid systems should be closed if possible to prevent feeding a fire. The airship should be nosed down and flown to minimum safe altitude to make it possible to land immediately.

ELECTRICAL FIRE. The pilot shall be notified immediately of an electrical fire. The pilot sounds the general alarm and establishes flight procedures for flying the airship without electrical power.

Unless the cause of an electrical fire is obvious and the offending system can be isolated by opening the appropriate circuit breakers, all electrical power must be shut off as quickly as possible.

RADIO OPERATOR'S D-C SHUT DOWN.

a. Battery Switch	OFF
b. Main Standby Generator Switch	OFF
c. Main D-C Generator Field Switch	OFF
d. No. 1 D-C Standby Generator Field Switch	OFF
e. No. 2 D-C Standby Generator Field Switch	OFF

RADAR OPERATOR'S A-C SHUT DOWN.

a. A-C Generator - Shore Power Switch	OFF
b. Instrument Inverter Switch	OFF

The fire can be extinguished with the hand-operated fire extinguishers stowed in the car.

RESTORING ELECTRICAL POWER AFTER A FIRE.
a. Open all circuit breakers and switch off all electrically operated equipment.
b. Restore undamaged d-c power sources by closing the battery switch, the generator field switches, and the main-standby generator switch.
c. Restore undamaged instrument inverter system by closing the instrument inverter circuit breaker, by placing the instrument inverter switch in NORMAL, and by placing the a-c instrument bus circuit breaker in ON.
d. Restore undamaged a-c generator system by closing a-c control circuit breaker and by placing the a-c generator-shore power switch in AC GEN position.
e. If the instrument inverter system was damaged, restore instrument power from undamaged generator by placing instrument inverter switch in STANDBY and the a-c instrument circuit breaker in ON.
f. Electrically operated equipment shall be restored to operation in the order of need after it has been determined that the equipment circuits are undamaged.
g. The damaged circuits can be identified by tracing wires to circuit breakers or by turning on the electrical systems one at a time.
h. As each circuit is connected to power, closely watch the ammeters for indications of excessive current demands which indicate a damaged system. A drop in the voltage indication also indicates that the system is damaged.

SMOKE ELIMINATION. Smoke can be eliminated from the car by opening the doors and windows.

ENVELOPE EMERGENCIES.

RIP IN BALLONET. A serious ballonet leak manifests itself by a change in airship trim. When it is determined that a ballonet is leaking, the damper for the bal-

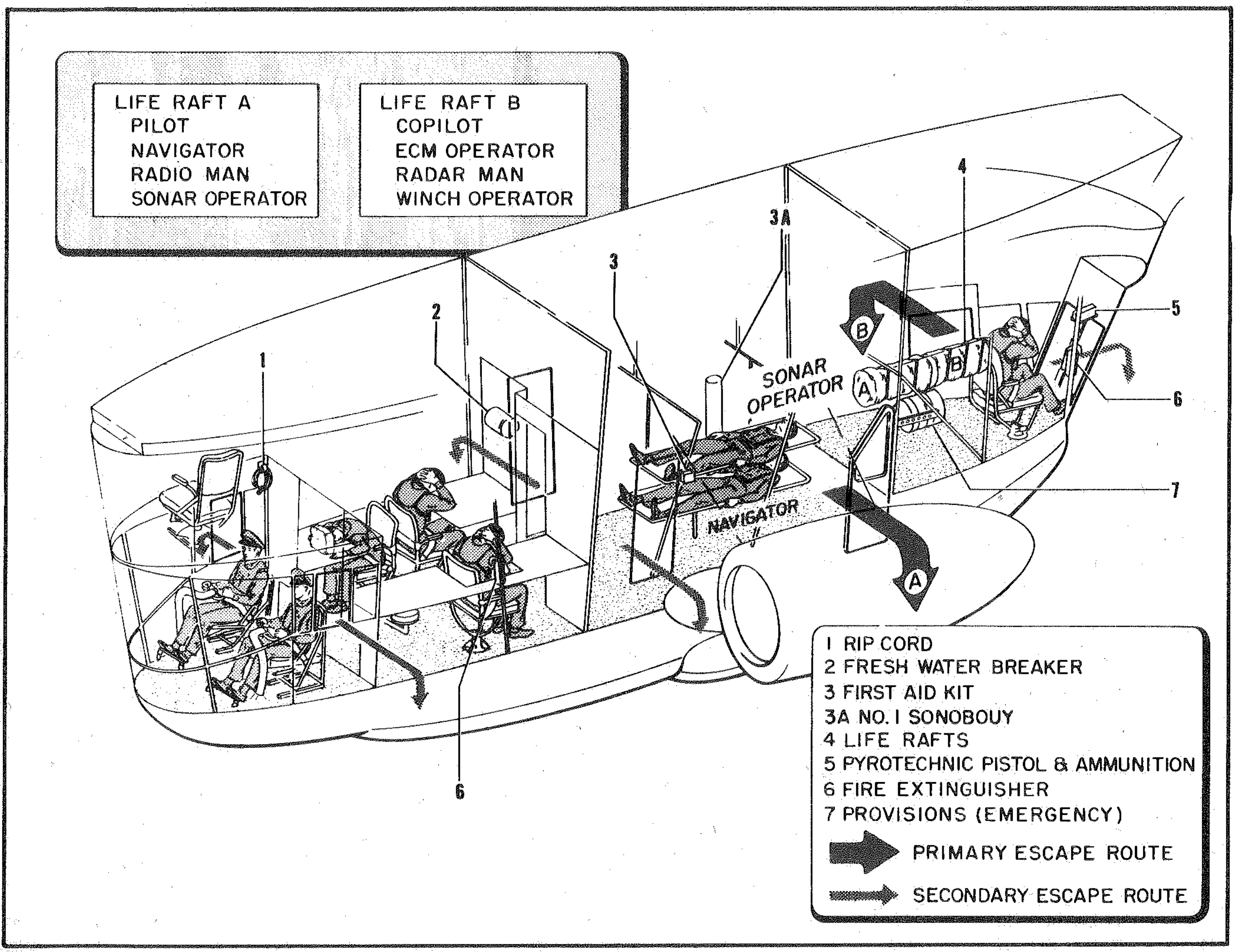


Figure 3-1. Ditching and Crash Landing Stations

lonet should be closed immediately. Air valves for both ballonets can be opened as required to regain a safe trim condition. At the same time, helium pressure is reduced by opening the valves. Helium pressure should be maintained at the minimum safe value until the airship can be landed. During descent and landing, the damper for the leaking ballonet can be opened as required to obtain a safe trim condition and adequate helium pressure for effective control of the airship.

RIP IN ENVELOPE. A leaking envelope is evidenced by an increase in ballonet fullness while the helium pressure remains constant. If a rip in the envelope is suspected fly with dampers closed, maintaining a constant altitude. Loss of pressure indicates a rip in the envelope or open helium valves.

Whenever there is reason to believe the envelope is leaking, the airship should be returned to base. Fuel and ballast loads must be jettisoned as required to maintain flight. Adequate envelope pressure should be maintained by opening the air to helium rip panel. The quantity of air passing through the ripped panel can be controlled by opening and closing the sleeve below the panel.

CAUTION

Do not attempt to maintain envelope pressure by further ballonet inflation as the ballonet might rupture if ballonet pressure exceeds helium pressure by more than 0.75 inch of water.

LANDING EMERGENCIES.

FORCED LANDING. Forced landing may be necessary as a result of fire, engine failure, bad weather, loss of helium, or depleted fuel supply. The procedure for making the landing necessarily varies according to the urgency for landing and according to what airship equipment is operative. In general, the procedure should conform as far as possible to the following:

PREPARATION.

a. Order crew to prepare for crash landing.

b. Make sure that all loose equipment is securely stowed.

c. Jettison armament stores and fuel drop tanks which might create a fire hazard if the landing is made on rough terrain.

d. Make sure that engine access doors, main door, cargo door, refueling door, and sliding windows are open.
e. If losing helium, station crew member at air to helium sleeve to open sleeve on command to maintain helium pressure.
f. If electrical power is lost, station crew members at air valve and damper controls to operate controls on command so that trim can be maintained.
g. Jettison ballast or valve helium to obtain near-equilibrium heaviness condition.
h. Order inactive crew members to assume crash landing stations as shown in figure 3-1.

LANDING PROCEDURE.
a. Follow normal landing procedure as closely as possible.
b. After touchdown, helium can be valved to increase heaviness so that the airship can be controlled more effectively.
c. If no ground handling party is available, party must be formed from crew members.
d. Valve sufficient helium to compensate for weight loss as crew members leave car.

AFTER LANDING.
a. After airship is tied down securely or in control of ground party, shut down engines.
b. If airship is not on a mast, toss rip cord to ground so that it will be accessible if moorings do not hold.
c. Secure electrical power systems.
d. Disconnect batteries if car is damaged or afire.

EMERGENCY ENTRANCE. If any cutting is necessary to gain entrance to a section of the car after crash landing, always cut through doors or windows. Cutting through other areas of the car might result in severed fluid lines or electrical wiring.

LANDING WITH GEAR RETRACTED OR DAMAGED. A flat tire or damaged or retracted gear makes a light landing necessary. The ship should be ballasted so that it is approximately 200 to 300 pounds light. Attach the drag rope to the winch cable and lower the rope before landing. Reverse the propellers at a point just over the ground party. When ground speed is reduced to zero, hold the airship in hover condition while the ground crew pulls it down with the lines.

WARNING

Make sure that proper signals are used and that the ground handling officer is aware of each maneuver before it is made. If the ground party cannot gain control of the airship, take a wave-off and make a new approach after helium is valved to reduce lightness.

After the ship is in the hands of the ground party, the emergency landing gear is attached and the ship is placed on the mast in the normal manner.

DITCHING. The procedure for ditching is the same as for forced landing except that the landing gear is retracted. If the airship is brought down in an equilibrium or slightly heavy condition, it might be kept afloat for some time by ballasting so that static lift supports the car weight. If abandoning the airship, make sure that helium valves are locked open so that the airship does not rise as crew members board rafts. If possible, the envelope should be ripped before the airship is completely abandoned. After the rafts are boarded, every effort should be exerted to lash them together. Chances of survival are better if the crew can be kept together.

Table VI lists the duties of each crew member for a ditching operation. The ditching procedure should be practiced until each crew member can perform his duties quickly and efficiently. When preparing for ditching, the prescribed procedure may have to be varied because of emergency circumstances, each as normal exits being blocked by damage or fire. The crew should be prepared for such circumstances so that panic can be avoided.

FUEL SYSTEM EMERGENCY OPERATION.

LOSS OF PRESSURE - BOTH ENGINES.
a. If feeding normally from forward tank, switch to emergency feed as shown in figure 3-2.

Selector Switch	On full tank
Forward Tank Refueling Switch	Closed Position
Emergency Feed Switch	Open Position
Transfer Pump Switch	ON
Boost Pump Switch	OFF

b. If feeding through emergency feed system, turn selector switch to another tank.

NOTE

No transfer pressure light should indicate loss of pressure if selected tank is empty.

LOSS OF PRESSURE - ONE ENGINE.
a. If feeding normally from forward tank, turn on booster pump.
b. If feeding through emergency feed system, make sure transfer pump switch is on.
c. If pressure indicator continues to indicate no pressure, shut down the engine until trouble is investigated.

CAUTION

The trouble could be a broken fuel line which is throwing fuel on the hot engine, so the fuel shut-off valve should be closed immediately. If the engine continues running smoothly while no fuel pressure is indicated, the pressure transmitter line may be broken.

BOOST PUMP FAILURE. If the boost pump is not operative, fuel can be fed through the emergency feed system as shown in figure 3-2. The transfer pump acts to some extent as a boost pump when fuel is fed through the emergency system. The switch to emergency feed is necessary only for operations which normally require that the boost pump be operated. If the boost pump fails while operating, the condition can usually be detected by a slight drop (1 to 2 psi) in fuel pressure at both engines.

TRANSFER PUMP FAILURE. If the transfer pump does not operate, fuel cannot be transferred from other tanks into the forward tank; but fuel can be fed to the engines

Table VI. Ditching Instructions

CREW MEMBER	DUTY	PROVIDE	POSITION	EXIT
PILOT	Sound ditching alarm. Check all stations ready for ditching. Winch Operator - Stern Compartment Navigator - Utility Compartment Radar Operator - Electronic Compartment Copilot - Pilot's Compartment (Crew reports in order above) Station men to operate air valve and damper controls if necessary. Complete landing checks. Land airship. Shut down engines when ready to abandon ship. Order electrical power systems secured. Attempt to keep airship afloat. Issue abandon ship order.	Binoculars	Pilot's seat with belt fastened	Main Loor (Raft A)
COPILOT	Turn on emergency IFF. Report distress by voice on guard channel. Report pilot's compartment ready for ditching. Warn crew immediately prior to contact with water. Throw out rip cord. Operate IFF destruct switch if necessary. Operate helium valves as required.	Binoculars Pyrotechnics	Copilot's seat with belt fastened.	Cargo Door (Raft B)
NAVIGATOR	Give position to radio operator. Secure equipment. Take charge of aft car operations. Assure that emergency equipment is ready for abandoning ship. Check: Rafts, Emergency Pack, Sonobuoy Extra Rations, First Aid Kit, Exposure Suits Classified Gear Report stern and utility compartments ready for ditching. Command unloading of rafts and equipment.	Navigation Kit Sextant Flashlight	Prone in bunk with feet forward.	Main Door (Raft A)
WINCH OPERATOR	Secure stern compartment equipment. Shut off heater. Open doors. Report stern compartment secure to navigator. Release slip tank if so ordered. Release drop tanks if so ordered. Operate fuel feed and transfer valves manually if ordered. Unload raft B with lanyard tied to person. Inflate raft and help load equipment.	Flashlight	Winch operator's seat turned aft.	Cargo Door (Raft B)
SONAR OPERATOR	Secure sonar compartment equipment. Report sonar compartment secure to navigator. Prepare No. 1 directional sonobuoy for unloading. Prepare first aid kit for unloading. Break out exposure suits and extra rations. Prepare other equipment as ordered by navigator. Operate air pressure system manual controls if ordered. Unload raft A with lanyard tied to person. Inflate raft and help load equipment.		Prone in bunk with feet forward.	Main Door (Raft A)
RADIOMAN	Send position and distress report. Lock down key if so ordered. Secure equipment not required. Turn off d-c power switches when ordered. Unload emergency container lashed to raft.	Flashlight	Radioman's seat turned aft.	Main Door (Raft A)
RADARMAN	Secure equipment. Report electronic compartment secure to pilot. Secure a-c power systems when ordered.	No. 1 Directional Sonobuoy	Radarman's seat	Cargo Door (Raft B)
ECM OPERATOR	Secure equipment. Operate emergency air pressure controls if so ordered. Assist in loading raft B.	First Aid Kit Water Container	ECM operator's seat	Cargo Door (Raft B)

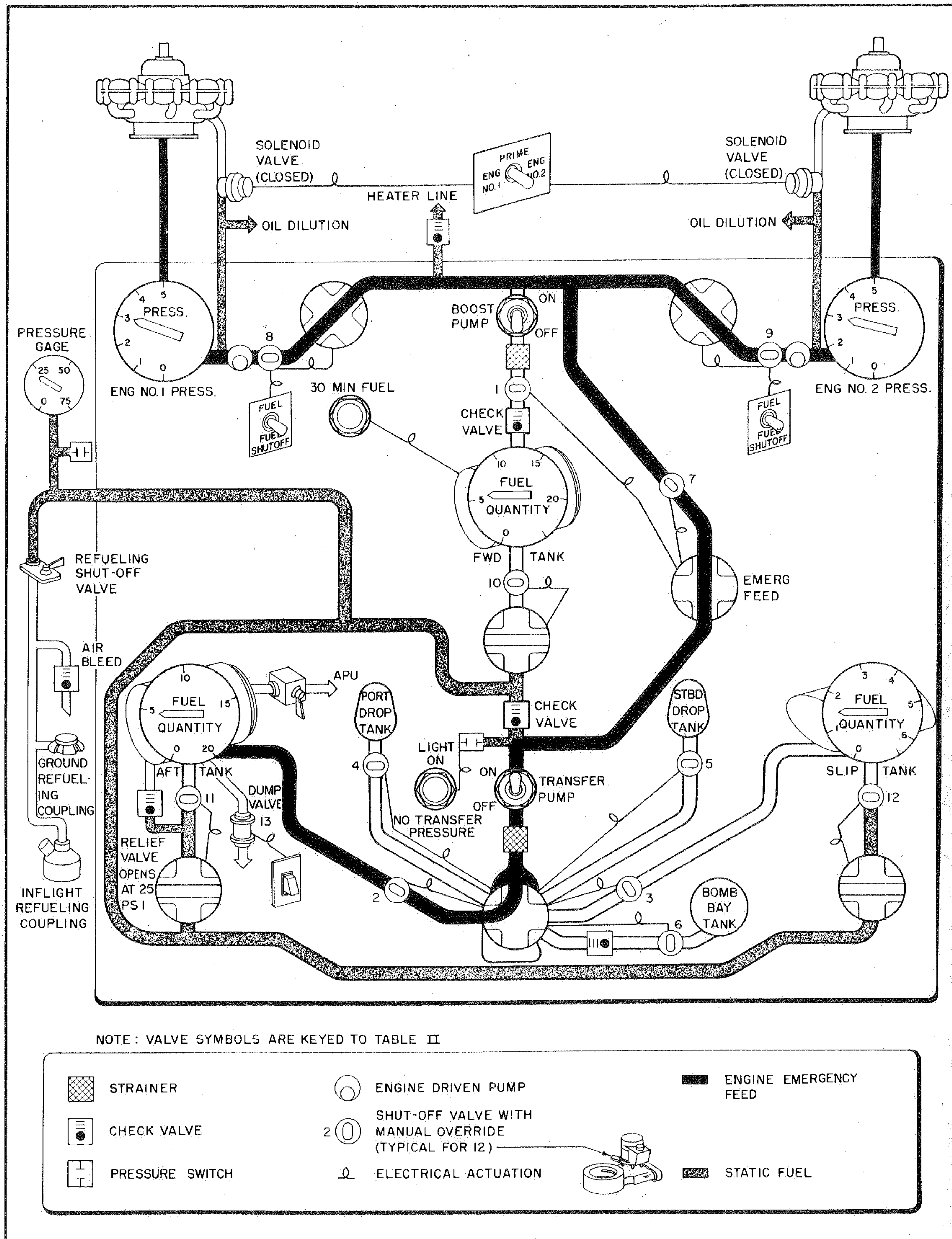


Figure 3-2. Emergency Fuel Flow Diagram

from the other tanks if flight conditions are such that adequate pressure can be maintained. If the transfer pump fails while transferring fuel, the no fuel pressure light illuminates if the pump electrical circuit is complete. If the pump stops because of electrical failure, the failure is indicated only by tank fuel quantity indications.

VAPOR LOCK. Vapor lock usually results in engine surging and accompanying fuel flow fluctuations. The vapor in engine fuel lines can be eliminated by turning on the booster pump, if feeding from the forward tank, or the transfer pump, if feeding from another tank.

VALVE CONTROL FAILURE. If any one of the valves in the fuel system cannot be operated by using electrical controls, the valve can be operated manually. A list of valve locations and instructions for manual operation is in section I.

CONSTANT SPEED DRIVE SYSTEM EMERGENCY OPERATION.

OVERSPEEDING. If the drive overspeeds, it is stopped automatically by an overspeed control. If the overspeed control does not function, the drive should be stopped by the emergency stop button when the output frequency of the a-c generator reaches 470 cps. The drive can be re-started after overspeeding by depressing the reset button momentarily. If the drive system continues to overspeed, it should be stopped until the trouble can be corrected.

OVERPRESSURE. Excessive pressure in the drive system usually occurs as a result of overloading the drive momentarily while operating only one engine or operating both engines at low rpm. If overloaded, the drive may surge in the manner described in section I. If such surging occurs or pressure in excess of 3475 psi is indicated, the drive should be stopped and reset immediately as follows:

a. Emergency Stop Button — Depressed
b. Reduce loads on drive by shutting off electrical equipment or stopping winch.

NOTE

Usually the drive can be reset after turning off the equipment which caused the momentary overload. Wait at least 45 seconds before resetting the drive.

c. Reset Button — Depressed

NOTE

The drive unit will surge if the reset button is held depressed and the overspeed condition still exists. Do not attempt to maintain drive operation by this method. If the drive does not start, reduce engine rpm and again momentarily depress the reset button. Do not attempt to reset constant speed drive at engine speeds greater than 1100 rpm for dual-engine operation or 2000 rpm for single-engine. Higher engine speeds will result in overspeeding of the drive unit.

LOSS OF SYSTEM PRESSURE. A drop in hydraulic pressure does not mean that the constant speed drive unit is malfunctioning. A reduction of winch or electrical loads causes hydraulic pressure to drop. If the drive is malfunctioning due to a loss of system pressure, the hydraulic pressure indication drops off severely (to below 500 psi), and the drive loses speed. This type of pressure drop may be caused by any of several conditions. The constant speed drive relief valve vents the hydraulic system if the drive is overloaded or overspeeds or if the emergency stop button is depressed. Pressure may also be lost because of damage to the hydraulic pump, a loss of reservoir pressure, or a leak in the hydraulic line. If the drive stops due to a loss of system pressure, the following steps should be taken:

a. Reduce engine rpm.
b. Reduce electrical and winch loads.
c. Fuel Hydraulic Shut-Off Switches — ON
d. Emergency Stop Button — Depress momentarily
e. Wait 45 seconds.
f. Reset Button — Depress momentarily

If the drive still does not operate properly, check reservoir fluid quantity and pressure, and pressure in the pressurization bottle, make sure the pressurization bottle shut-off valve is open, and check hydraulic lines for leaks.

CAUTION

If the loss of system pressure is due to the loss of reservoir fluid or pressure, operation of the constant speed drive will be erratic. However, erratic operation of the drive unit is preferable to prolonged operation of the engines with the drive unit vented. In the event of hydraulic line leaks, it is a matter of discretion whether or not constant speed drive operation should be maintained. Operation of the engines at other than low engine speeds with the constant speed drive vented will damage the hydraulic pumps.

OPERATION WITH ONE ENGINE INOPERATIVE. When one engine must be stopped for emergency reasons, loads on the constant speed drive must be reduced immediately to within the limits for single engine operation. These limits are discussed in detail in section V. If the load limits are exceeded, drive system pressure builds up until the relief valve cracks. The drive then must be reset as discussed in the preceding paragraph. If the No. 2 engine is shut down because of fire, the drive becomes inoperative because shut-off valves in the drive system are closed.

CAUTION

After operation of the No. 2 engine fuel-hydraulic shut-off switch, the No. 1 engine should be operated at rpm as low as possible. Prolonged operation of the engine at high rpm causes the drive shaft of the No. 1 engine hydraulic pump to shear.

MALFUNCTIONING. If the constant speed drive does not hold speed, operates noisily, or malfunctions in any other manner, it should be stopped by operation of the emergency stop button.

FLIGHT OPERATION AFTER CONSTANT SPEED DRIVE FAILURE. Whenever the constant speed drive fails, an extreme emergency condition exists because of the loss of electrical power. The radio operator must be prepared to set up emergency d-c power conditions immediately. Other crew members must be prepared to shut off all d-c powered equipment not required for flight control. The pilot must shift to emergency flight controls and engine controls unless d-c power can be restored immediately. If a load is on the winch when the drive fails, the winch cable must be cut unless the drive can be started.

ELECTRICAL POWER SYSTEMS EMERGENCY OPERATION.

D-C GENERATOR FAILURE. If the d-c generator or the constant speed drive fails, the radio operator should switch to emergency power conditions immediately to save the batteries. The battery switch should not be turned off unless both engines are stopped or an electrical fire occurs. The steps necessary for changing to emergency operation are the following:

a. Main Generator Emergency Field Control Switch	OFF
b. Main Generator - Standby Generator Switch	STANDBY GEN No. 1 & No. 2

NOTE

The following step is necessary if one engine is stopped because of failure or fire.

c. Standby Generator No. 1 or Standby Generator No. 2 Emergency Field Control Switch	OFF
d. Standby Generator No. 1 Off Light	Off
e. Standby Generator No. 2 Off Light	Off

f. Switch off all equipment connected to monitor busses.
g. Monitor Override Switch MONITOR OVERRIDE
h. Switch on equipment systems connected to monitor busses one at a time as required.

NOTE

Do not load one standby generator to more than 50 amperes or two to more than 90 amperes.

STANDBY GENERATOR FAILURE. If both standby generators are on when one of them fails, proceed as follows:

a. Standby Generator No. 1 or Standby Generator No. 2 Emergency Field Control Switch	OFF
b. Monitor Override Switch	NORMAL
c. Instrument Inverter Switch	STANDBY

A-C GENERATOR FAILURE. If the a-c generator fails or the constant speed drive fails, the a-c generator switch must be moved to OFF. The instrument inverter switch can be placed or left in NORMAL if sufficient d-c power is available to carry the load.

INSTRUMENT INVERTER FAILURE. If the instrument inverter fails, the instrument bus can be energized from the a-c generator by moving the instrument inverter switch to STANDBY.

OPERATION WITH REDUCED ELECTRICAL POWER. Crew members should be sufficiently familiar with the electrical distribution diagrams in section I so that equipment can be turned off quickly to reduce electrical loads when electrical power failures occur. After total loads have been reduced to within the capacity of operative generators by shutting off all but essential flight control equipment, additional equipment must not be turned on unless sufficient electrical power is available.

The blower, for example, should not be operated unless the d-c generator is operating. Changing pitch of both propellers at once imposes a 46-ampere load on the d-c system while the pitch change motors are operating; so the propeller controls should be operated only as required for effective flight control if the d-c generator is not operating. The electric servo boost system requires more current than that usually available with only standby generators operating, so the system should be used only if necessary to land the airship safely. Systems, such as the heater, which are not necessary for flight control should not be operated if the d-c generator is not operative. The foregoing examples are typical of considerations to be made for operation after electrical power failure. Care and judgment must be used in the operation of all systems so as to preserve the batteries.

SURFACE CONTROL SYSTEM EMERGENCY OPERATION.

BOOSTER FAILURE. A booster system failure is indicated by a sharp increase in the effort required to move the controls. Most failures of the electrical portions of the booster system cause the booster engage switches to trip to the DISENGAGE position and the booster off warning light to flash. The booster system should be completely disengaged in the event of malfunctioning or any failure. Cruising flight may be continued by switching on the automatic pilot. No special procedure is involved in the change of control since in normal operation the booster system is always secured before the automatic pilot can be engaged. The automatic pilot must always be disengaged before landing. The surface control system must be shifted into emergency operating range for manual operation. Separated rudder and elevator control is recommended during landing and flight in turbulent air.

SHIFTING TO MANUAL OPERATION.

a. Boost Master Switch	OFF
b. Pilot Switch (Autopilot)	OFF
c. Rudder Wheel and Control Column	Neutral (not mandatory)
d. Manual Surface Controls Handle	Pull Up
e. Rudder Wheel	Turn to engagement

NOTE

The rudder wheel turns freely until engagement. Engagement occurs when the wheel reaches a position approximately 2.4 times as far from neutral as its position when the manual surface controls handle was pulled.

SEPARATING CONTROLS.

a. Rudder Wheel and Control Column	Neutral
b. Separate Surface Controls Handle	Pull Up

NOTE

The pilot's rudder wheel and the copilot's column lock in neutral position as the separate surface controls handle is pulled. The controls are forced into exact neutral position as the handle is pulled.

RESTORING DUAL CONTROL. The controls can be connected for dual operation at any time by pushing down the separate surface controls handle while the controls are held in neutral. The rudder wheel should be jockeyed about the neutral position so that engagement of the wheels can be felt.

SHIFTING TO NORMAL OPERATION.

a. Rudder Wheel and Control Column	Neutral (not mandatory)
b. Manual Surface Controls Handle	Push Down
c. Rudder Wheel	Turn to engagement

CAUTION

The wheel must be in or near neutral position when the shift is begun and must not be turned to hard over position until the shift has been completed.

PRACTICING SURFACE CONTROL SHIFTING OPERATIONS. The various control combinations can be demonstrated or practiced without hazard. The check pilot should demonstrate each of the following combinations both with and without boost during the first familiarization flights.

a. Normal dual operation
b. Emergency dual operation
c. Emergency separated operation
d. Normal separated operation

LANDING GEAR EMERGENCY OPERATION.

GEAR FAILS TO RETRACT. If the landing gear handle cannot be moved from the DOWN position after the ship is in the air, the shock strut is stuck in a partially deflected position or the lock release circuit has failed. Proceed as follows:

a. Inspect gear through the landing gear access door. Check for structural damage or failure that would prevent safe retraction.
b. If gear is intact, release landing gear handle on pilot's instrument panel by pushing latch to starboard.

NOTE

The latch is accessible through the slot above the handle. Ease the handle up far enough to prevent the latch from returning to locked position and remove finger from the slot.

c. Place landing gear handle in UP position.

The gear should retract normally if failure is limited to the lock release circuit. If the gear fails to retract, it is possible to continue the flight with the gear in the extended position. The additional drag does not appreciably affect the performance of the airship. The preferred course of action, however, is to land immediately and correct the trouble before continuing the flight. The following checks must be executed before making any wheel landing after the gear has failed to retract:

a. Landing gear control handle in DOWN position.
b. Open landing gear access door.
c. Visually check locking collar position over upper end of shock strut.
d. If gear is not fully extended and locked, execute emergency (manual) extension procedure.

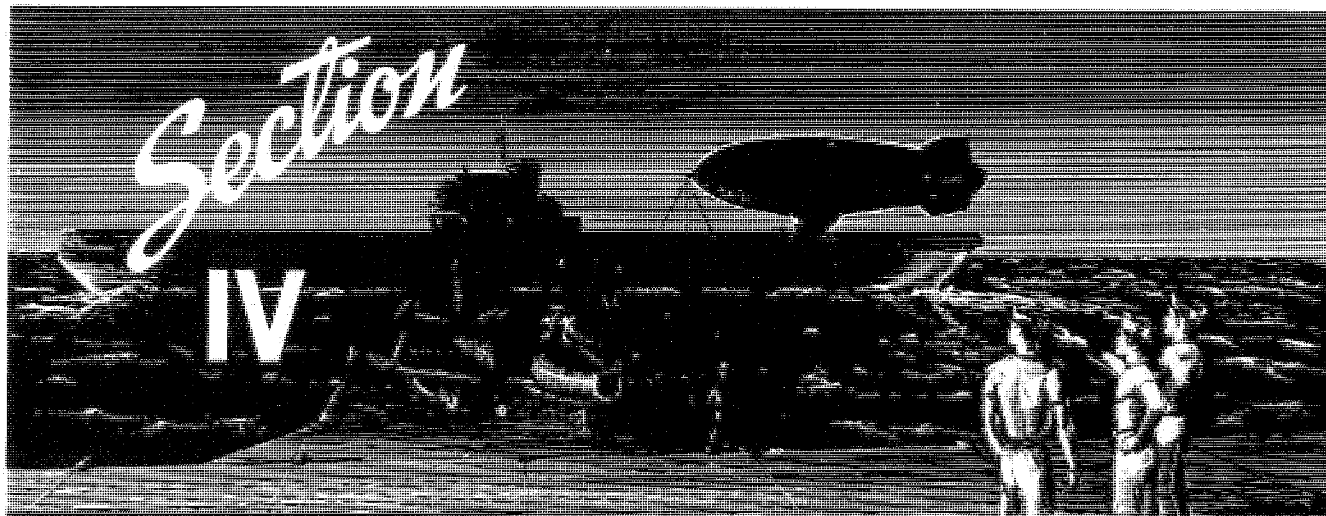
GEAR FAILS TO EXTEND. If the landing gear fails to extend when the landing gear handle is moved to DOWN position, the gear is extended manually by the following procedure (see figure 1-26):

a. Open landing gear access door.
b. Remove pip pin (3).
c. Place landing gear hand crank on actuator shaft (2) and push down to release gear for free-fall.

WARNING

Hold only the knob of the hand crank and maintain firm pressure downward on the actuator shaft until the gear stops. The force of the falling gear on the actuator could damage the actuator and injure the operator by spinning the hand crank.

d. Turn crank clockwise until the down lock is firmly seated over the upper end of the shock strut.
e. If gear does not extend and lock, follow procedure for emergency landing with damaged landing gear.



DESCRIPTION AND OPERATION OF AUXILIARY EQUIPMENT

HEATING SYSTEM.

DESCRIPTION. The car is heated by a forced draft, combustion type heater. Fuel for the heater is taken from the engine fuel feed line and pumped through a spray nozzle into the combustion chamber by a heater fuel pump. The fuel mixes with combustion air supplied by a blower and the mixture is ignited by a spark plug. The quantity of fuel sprayed into the heater is automatically regulated by controls in the fuel feed line. A mixture of fresh and recirculated air, heated by being forced by the blower through the air jacket surrounding the heater, is forced out through registers into the car.

Once put into operation, the heating system automatically operates intermittently to maintain the car temperature at the setting on a Cabinstat. If the operation of the heater, blower, or controls becomes faulty, the supply of fuel to the heater is shut off automatically. When the heater is off, the blower can be used to ventilate the car.

Seven registers admit heated or cool air into various compartments. Two registers are in the pilot's compartment, two in the utility compartment, and one each in the sonar, electronics, and stern compartments. The louvers in the registers are adjustable to regulate the amount of heated air discharged from the registers. The key stowed on the side of the heater control panel in the utility compartment is inserted into the slot on the face of the register and turned to regulate the opening.

HEATER SWITCH. When the heater switch (figure 4-1), located on the heater control panel in the utility compartment, is thrown to HEATER, it connects power to the heater fuel pump, spark plug, and automatic controls. Throwing the switch to OFF stops the heater.

BLOWER SWITCH. When thrown to BLOWER the blower switch (figure 4-1), located on the heater control panel, connects power to the blower, which supplies combustion air to the heater and forces heated air into the car. The blower may be used for ventilating the car by placing the blower switch in BLOWER with the heater switch off.

OVERRIDE SWITCH. When starting the heating system holding the override switch (figure 4-1) on the heater control panel in OVERRIDE assures a supply of fuel to the heater. When the heater is functioning properly, the switch may be released. The blower must be on before the override switch will function. This safety feature prevents starting the heater when there is no flow of air to carry away the heat.

CABINSTAT. A Cabinstat (6, figure 4-25) at the navigator's station regulates the heater to maintain a selected temperature within the car. A selector knob at the top of the Cabinstat is turned to select the temperature.

MANUAL SHUT-OFF VALVE. A manually-operated shut-off valve (9, figure 4-27), mounted in a recess in the heater housing below the utility compartment electronics shelf, is used to shut off the supply of fuel to the heater when the heater is not in use.

HEATER OPERATING LIGHT. The heater operating light (figure 4-1) on the heater control panel glows green when the heater is operating.

NO FUEL PRESSURE LIGHT. The amber no fuel pressure light (figure 4-1) on the heater control panel goes on when the pressure in the heater fuel line falls below five psi, indicating that fuel is not being supplied to the heater. After the trouble has been corrected, the override switch is held in OVERRIDE to put the heater back in operation.

STARTING HEATING SYSTEM.

a. Open manual shut-off valve in fuel supply line.
b. Throw blower switch to BLOWER.
c. Throw heater switch to HEATER.
d. Hold override switch in OVERRIDE until amber no fuel pressure light goes out.

NOTE

If the amber no fuel pressure light goes on when the heater is operating, hold the override switch

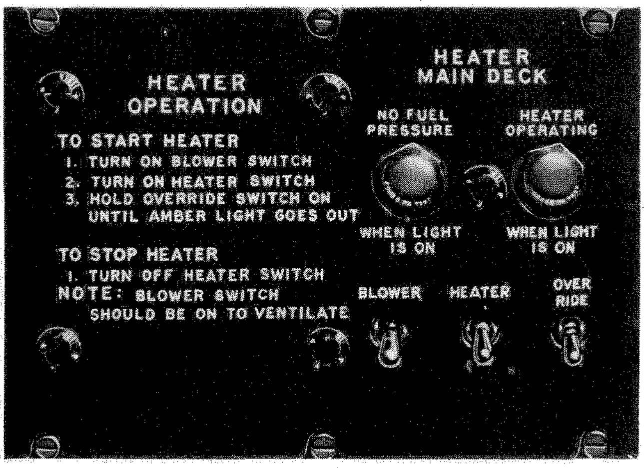


Figure 4-1. Heater Control Panel

in OVERRIDE until the light goes out. If the light goes on after the override switch has been released, throw the heater switch to OFF and investigate the trouble.

STOPPING HEATING SYSTEM.
a. Throw heater switch to OFF.
b. Throw blower switch to OFF if ventilation is not desired.

WINDSHIELD DEFOGGERS. Port and starboard de-fog blowers which direct an airflow onto the windshield are controlled by the de-fog switch on the propeller de-ice panel (figure 4-2). The switch is a three-position switch with a center OFF position. Placing the switch on HIGH directs a high volume flow onto the windshield. Placing the switch on LOW decreases the speed of the blower motors to produce a lower volume of air for defogging.

PROPELLER ANTI-ICING SYSTEM.

Anti-icing slinger rings attached to the propeller hubs distribute anti-icing fluid to the propeller blades to prevent the formation of ice. Anti-icing fluid is pumped from an 8.7-gallon tank on the starboard side of the utility compartment through lines to each nacelle. The fluid passes through a filter before being pumped out to the propellers. The speed of the electric pump is controlled by a rheostat on the prop de-icer panel. Maximum rate of flow is three gallons per hour, one and a half gallons per hour to each propeller. Refer to figure 1-32 for information on the fluid used in this system.

WARNING

The propeller anti-icing system is designed to prevent the formation of ice, not to remove ice

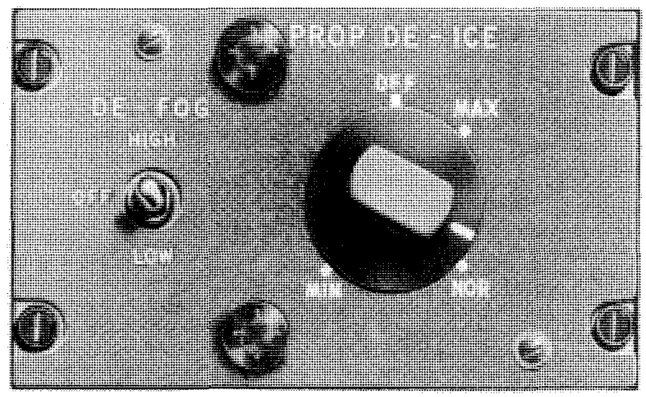


Figure 4-2. Propeller De-Ice Panel

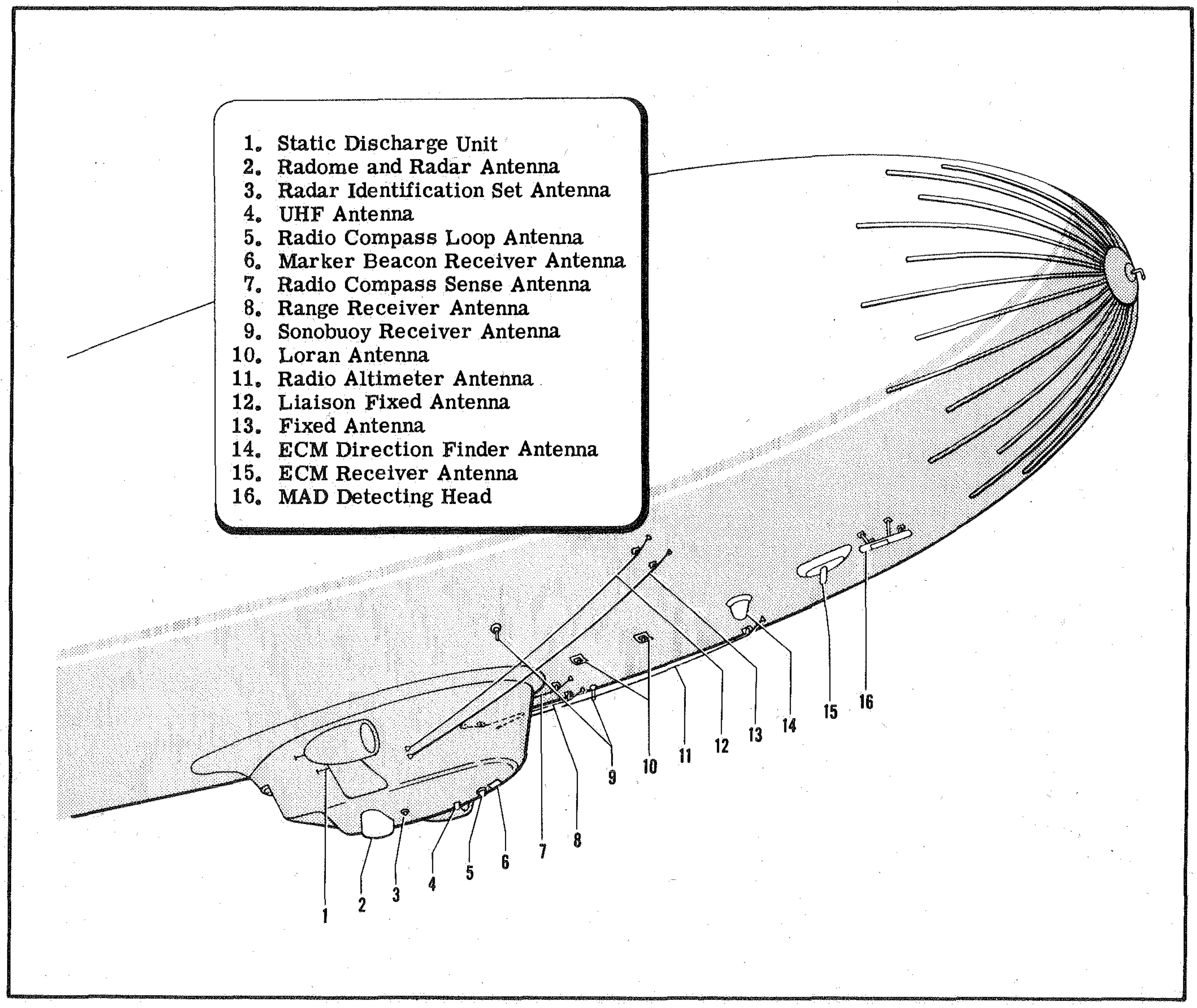


Figure 4-3. Antenna Locations

after it has formed. Turn on anti-icing system before entering icing conditions. Turn on full for about one minute to lubricate the blades, then adjust for icing conditions.

PROPELLER DE-ICE RHEOSTAT. A rheostat (figure 4-2) on the prop de-ice panel controls the rate of flow from the propeller anti-icing system pump. As the rheostat is turned clockwise from the OFF position, the MAX position is reached first, at which the pump delivers its highest rate of flow (approximately 3.0 gallons per hour). Continued clockwise rotation of the rheostat decreases the rate of flow from the pump. Graduated NOR and MIN positions are indicated on the panel. In the NOR position, the rate of flow is approximately 2.5 gallons per hour. In the MIN position, the rate of flow is approximately 0.5 gallon per hour. Other rates of flow may be selected by turning the rheostat to intermediate positions.

ANTI-ICING FLUID QUANTITY GAGE. A quantity gage (5, figure 4-28) on the side of the anti-icing fluid tank indicates the amount of fluid in the tank in one-gallon increments from one to 8.5 gallons.

COMMUNICATIONS AND ASSOCIATED ELECTRONIC EQUIPMENT.

GENERAL. The communications and associated electronic equipment is listed in table VII, and power source data is given in table III. Antenna locations are shown in figure 4-3. Only brief system descriptions and instructions for connecting power to the equipment are included here, since detailed instructions for operating electronic systems are included in other handbooks.

INTERCOMMUNICATION SYSTEM AN/AIC-7A.

DESCRIPTION. The AN/AIC-7A system provides interphone communication for the flight crew and simplified control of the UHF, liaison, navigation, and sonar equipment. The system comprises an operating assembly and ICS junction box at the radio operator's station, and a master or station control, a jack box, a headset with boom microphone, and a foot switch at each crew station. An extra foot switch and jack box are located in the utility compartment for use when releasing sonobuoys and in the stern compartment for use during in-flight refueling. An ICS call light at the sonar operator's station is controlled by sonar operator call buttons installed at each crew station.

MASTER CONTROLS. Master controls (figure 4-4) are located on the pilot's side console (1, figure 4-5) and copilot's side console (1, figure 4-6) and at the radio operator's station (10, figure 4-7) and navigator's station (18, figure 4-25). Each master control (radio and ICS panel) provides for the simplified control of the interphone, the monitoring of the UHF AN/ARC-27, liaison AN/ARC-15A, range AN/ARC-5, radio compass AN/ARN-6, marker beacon AN/ARN-12, and sonobuoy AN/ARR-26 receivers, and the transmission on the UHF AN/ARC-27 and high frequency AN/ART-13 transmitters.

The monitoring of navigation, sonobuoy, UHF, and liaison receivers is controlled by toggle switches on the panel. One or more receivers are monitored by placing the

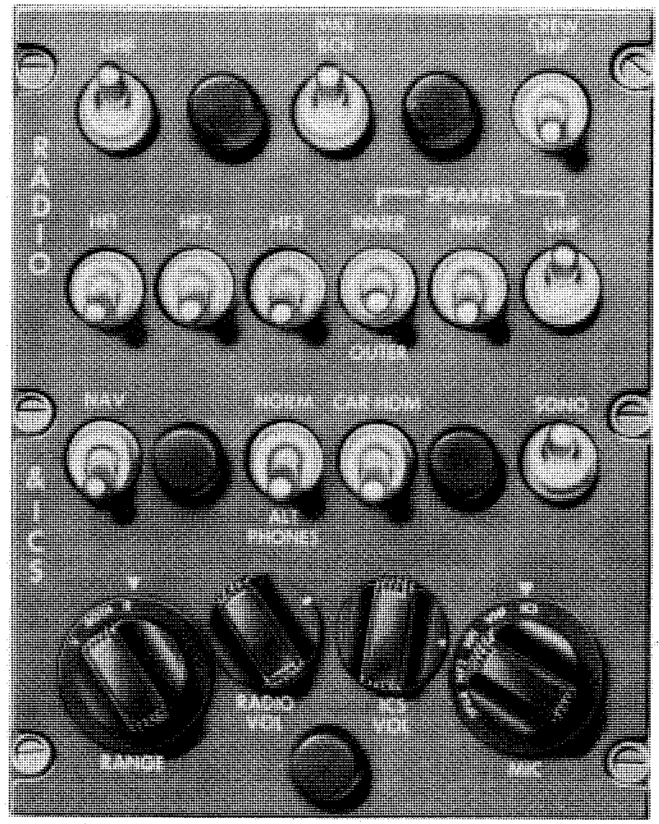


Figure 4-4. ICS Master Control Panel

toggles in the on position. The switches monitor receivers as follows:

UHF	ARC-27 UHF Transmitter-Receiver
HF-1	AN/ARR-15A No. 1 Liaison
HF-2	AN/ARR-15A No. 2 Liaison
MKR-BCN	AN/ARN-12 Marker Beacon
NAV	AN/ARC-5 Range
CAR HOM	AN/ARN-6 Radio Compass
SONO	AN/ARR-26 Sonobuoy Receivers

The HF3 and speaker switches are not used in this installation. The range filter switch controls a filter in the AN/ARC-5 receiver. When the switch is in R the filter suppresses the voice signals on the AN/ARC-5 receiver. When the switch is in V the 1020-cycle range signals on the receiver are suppressed. If the switch is placed on BOTH the filter is disconnected from the circuit. The radio volume control adjusts the volume level in the headset on any receiver selected except the marker beacon and range receivers. The AN/ARN-12 and AN/ARC-5 volume controls are on the receiver tuning units.

The PHONES toggle is an emergency switch. If this switch at any station is placed in the ALT position, the headphones at that station are connected in parallel with another control unit.

A MIC selector switch is used to transmit on the interphone, AN/ART-13, or AN/ARC-27 transmitters. The SPKR and HF2 positions are not used in this installation. The switch is placed at HF1 to transmit on the AN/ART-

Table VII. Communications and Associated Electronic Equipment

TYPE	DESIGNATION	FUNCTION	PRINCIPAL OPERATOR	RANGE	LOCATION OF CONTROLS	REMARKS
ICS system	AN/AIC-7A	Crew communication and distribution of communication signals	Entire crew		All crew stations and utility compartment	
UHF Radio Set	AN/ARC-27	Voice communications 225-400 mc	Pilot	Horizon	Navigator's station and pilot's overhead panel	I/p operation of AN/APX-6 during UHF transmission
Liaison Transmitter	AN/ART-13	Voice or CW transmission 2-18.1 mc	Radioman or Pilot	500 miles	Radio operator's station and pilot's overhead panel	Sidetone feeds through No. 2 AN/ARR-15A receiver
Liaison Receivers	AN/ARR-15A	Voice or CW receiver 1.5-18.5 mc	Radioman or Pilot	Up to 500 miles	Radio operator's station and pilot's overhead panel	
Range Receiver	AN/ARC-5	Voice or CW receiver for navigational use .19-.55 mc	Pilot	Reliable up to 100 miles	Pilot's overhead panel	
Marker Beacon Receiver	AN/ARN-12	Voice or CW receiver for navigational use 75 mc	Pilot	Up to 3 miles	Pilot's instrument panel	
Radio Compass	AN/ARN-6	ADF or MDF receiver for navigational use 100-1750 kc	Pilot	Up to 300 miles	Pilot's overhead panel	Indicators for pilot and navigator
Radio Altimeter	AN/APN-1	Absolute altimeter	Pilot	Up to 4000 feet	Pilot's console	Indicators for pilot and winch operator
Loran	AN/APN-9	Video receiver for navigational use 1700-2000 kc	Navigator	Up to 1400 miles	Navigator's station	
Radar Set	AN/APS-33F	Search and homing transmitter and receiver	Radar operator	Up to 200 miles on search	Principal controls at radar operator's station	Indicators for radar operator and navigator
Radar Identification	AN/APX-6	Identification receiver and transmitter	Copilot	Horizon	Copilot's starboard console	I/p operation of receiver during UHF transmission
ECM Receiver	AN/APR-9B	Tactical	ECM operator	Horizon	ECM operator's station	
ECM Direction Finder	AN/APA-69A	Tactical	ECM operator	Horizon	ECM operator's station	
ECM Pulse Analyzer	AN/APA-74	Tactical				Space provision only
Sonobuoy Receiver	AN/ARR-26	Tactical	Sonar operator	Up to 20 miles	Sonar operator's station	
Sonar	AN/AQS-2	Tactical				Space provision only
MAD	AN/ASQ-8	Tactical	ECM operator		ECM operator's station	

1. ICS Master Control Panel
2. Sonobuoy Operator Call Button

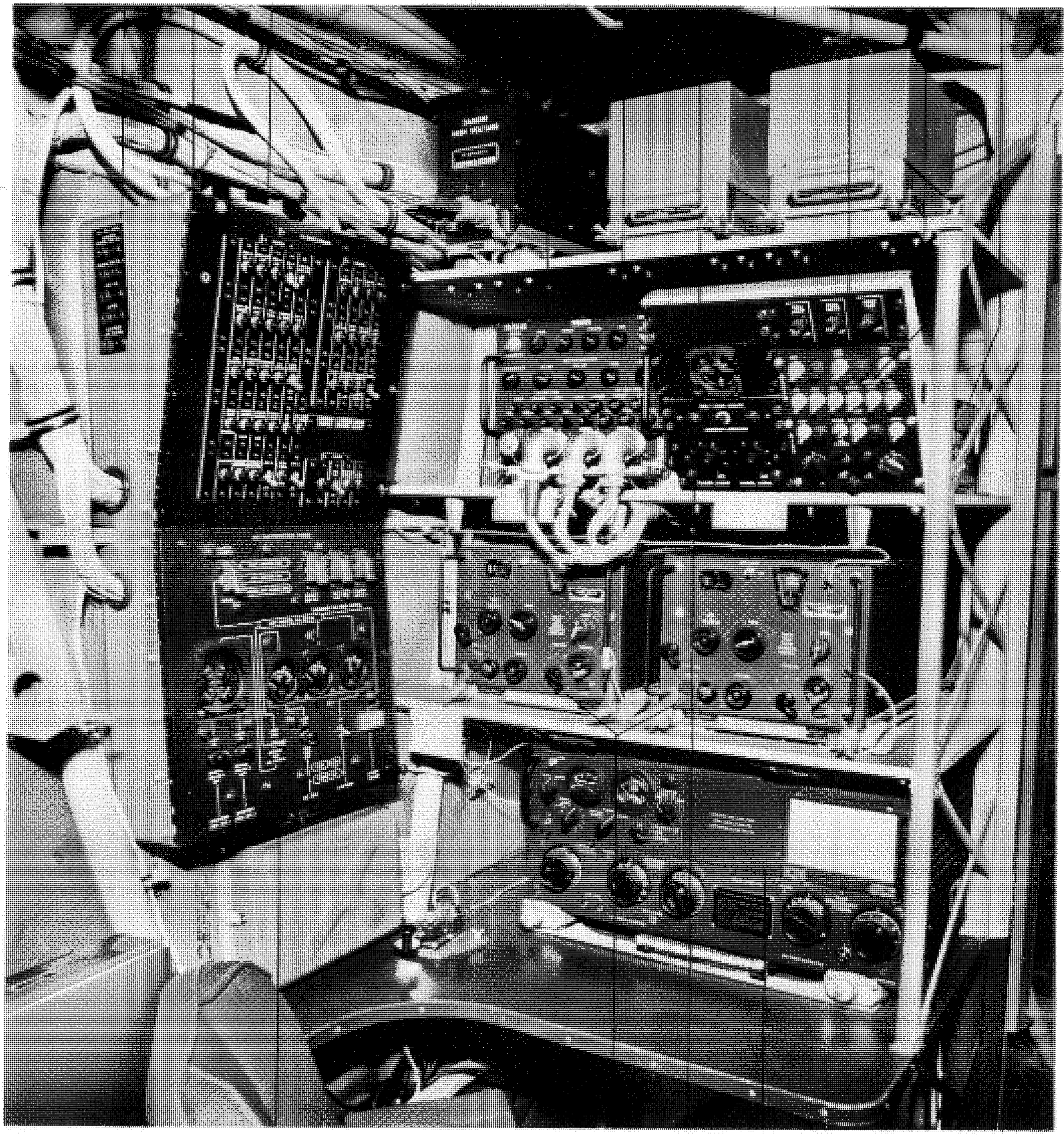
Figure 4-5. Pilot's Side Console

1. ICS Master Control Panel
2. IFF Panel
3. Sonobuoy Operator Call Button

Figure 4-6. Copilot's Side Console

13 transmitter, at VHF to transmit on the AN/ARC-27 transmitter-receiver, and at ICS to transmit on the interphone. The ICS volume control regulates the volume of incoming ICS calls. The CREW UHF is placed in the on position to transmit on UHF from a crew station which does not have a master control.

STATION CONTROLS. The intercommunication system station controls (figure 4-8) are located at the sonar operator's station (4, figure 4-18), the radar operator's station (3, figure 4-14), the ECM operator's station (6, figure 4-17), the winch operator's station (8, figure 4-32), and in the utility compartment above the sonobuoy dispenser (6, figure 4-28). Each station control is composed of a MIC selector switch, a UHF toggle switch, and a volume control. The MIC selector switch is placed on ICS to transmit on the interphone network. The selector switch is placed on RADIO to transmit on the AN/ARC-27



1. D-C Test Jacks
2. D-C Circuit Breaker Panel
3. Current Limiters
4. AN/APR-9 Power Supply
5. AN/AIC-7 Operating Assembly
6. Sonobuoy Operator Call Button
7. Clock
8. Magnetic Governor Assemblies
9. Fuse Panel
10. ICS Master Control Panel
11. Constant Speed Drive Overspeed Control
12. AN/ART-13 Transmitter
13. Light Control Panel
14. AN/ARR-15A Receivers
15. D-C Distribution Panel

Figure 4-7. Radio Operator's Station

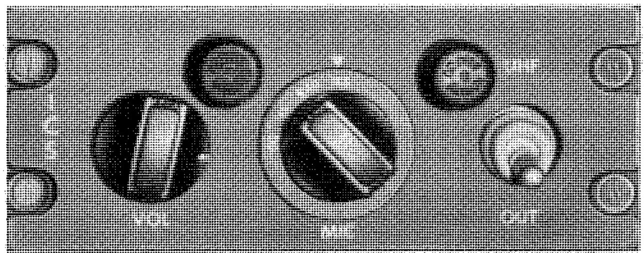


Figure 4-8. ICS Station Control Panel

(UHF) transmitter, provided a CREW UHF switch on one of the master controls is on. The IS and OS positions are not used in this installation. When UHF toggle switch is in UHF position, the AN/ARC-27 (UHF) signals are connected to the station's headphones. When the toggle is on OUT, the UHF receiver output is removed from the headphone circuit at the station. The volume control regulates the level of the incoming UHF or ICS signals.

OPERATING ASSEMBLY. The operating assembly (5, figure 4-7), located at the radio operator's station, contains all the common equipment and circuits necessary to the AN/AIC-7A system. Controls for the regulation of incoming radio level, radio level during ICS, and isolation of amplifier controls are located on the forward panel of the assembly. The assembly is pre-adjusted, but some adjustment of the volume control or emergency switching of the isolating switches may be required. Also located on the forward panel are 28-volt and 250-volt system fuses.

INCOMING RADIO LEVEL CONTROLS. The average output volume of the liaison receivers, the sonobuoy receivers and the UHF receiver is controlled by the incoming radio level controls on the forward panel of the operating assembly. The controls and the receiver affected are as follows:

TOWER MHF	AN/ARR-15A No. 1
C. W. MHF	AN/ARR-15A No. 2
UTIL MHF	(Not Used)
SONO	AN/ARR-26
TOWER VHF	AN/ARC-27

The volumes are adjusted to permit satisfactory mixing of the output from the receivers. Clockwise rotation of the controls increases the volume.

RADIO LEVEL DURING ICS CONTROLS. The controls for radio level during ICS are radio receiver volume controls for balancing receiver volume against ICS volume during interphone communication. A control is located at each station having an ICS master control panel, and the controls are identified by station. The volume level is increased by rotating the control clockwise. Radio receiver volume should override ICS volume without blocking out the ICS signal.

ISOLATION AMPLIFIER POWER SWITCHES. Two switches on the forward panel control the power supply to the operating assembly. The switches are identified "PILOT" and "C. P. - R. OP. - NAV;" each has two positions, NORMAL and ALTERNATE. When both switches are in the NORMAL position two dynamotors mounted on the rear of the operating assembly supply the isolation amplifiers. One dynamotor supplies the pilot's isolation amplifier, and the other supplies the copilot's, radio operator's, and navigator's amplifiers. If one dynamotor fails, the amplifiers involved can be switched to the functioning dynamotor by placing the appropriate switch in ALTERNATE position. This mode of operation does not overload the remaining dynamotor but does cause an unbalanced load condition and should be used only in emergencies.

STATION RECEPTACLES. Jack boxes and headset terminals are located at each crew station. If a boom microphone headset is used, the cord in connected to the terminal box. If a hand microphone is used, the mike and earphones are plugged directly into the jack box.

FOOT SWITCH. A foot switch at each crew station must be depressed to key the boom microphone.

SONAR OPERATOR CALL SYSTEM. Since the sonar operator must have his phones plugged into the sonobuoy control unit to listen to sonobuoy signals, he cannot always be a part of the ICS network. To inform the sonar operator that he is being called, a "press when calling sonobuoy-operator" switch (2, figure 4-5), located at each of the other eight control positions, causes the ICS-call light (4, figure 4-18) at the sonar operator's station to go on. The sonar operator then can connect his headset into the ICS control to rejoin the network.

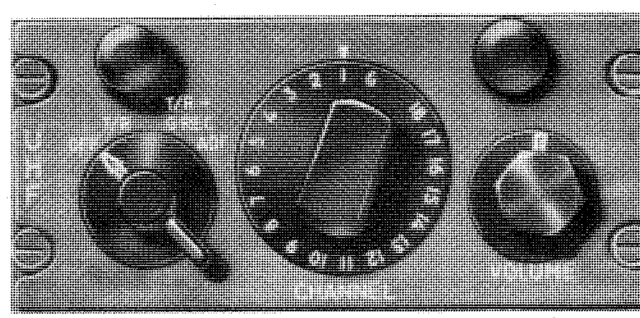


Figure 4-9. UHF Control Panel

UHF RADIO SET AN/ARC-27.

The UHF radio set comprises a transceiver mounted below the navigator's shelf, a master control on the navigator's shelf (12, figure 4-25), and a remote control panel (figure 4-9) on the pilot's overhead panel. The set is used for radio telephone communication in a frequency range of 225.0 to 399.9 megacycles on any one of 1750 frequency channels. The pilot can select any one of 18 preset frequencies or a guard channel on the remote control. The microphone input to the transmitter and the audio output from the receiver are connected to the intercommunication system. Messages can be transmitted or received at any ICS station. The transmitter can be tone modulated for an emergency signal or for direction finding. When a tone switch on the master control is in the TONE position the transmitter emits a sustained 1020 cycle-per-second tone. It is not necessary to hold a microphone button or foot switch to transmit this signal. A disabling relay switches the AN/APX-6 radar to I/P when the AN/ARC-27 transmitter is operating. The equipment is started at the master control as follows:

Local-remote switch	LOCAL
On-Off switch	ON

The set can be turned on at the pilot's remote control panel if the local-remote switch on the master control is on REMOTE. The set is then turned on by placing the pilot's switch on T/R or TR & G.REC. The ADF position is not used in this installation.

NOTE

The set requires a one-minute warm-up period.

LIAISON TRANSMITTER AN/ART-13.

The AN/ART-13 transmitter (12, figure 4-7) at the radio operator's station is used for voice, cw, and mcw transmission within a frequency range of from 2000 to 18,000 kilocycles. The primary control is at the transmitter; however, a remote control panel (figure 4-10) is located on the pilot's overhead panel. When the transmitter remote-local switch is on REMOTE an indicator light on the remote panel glows. The pilot can then select one of 10 preset frequency channels for the transmission of voice, cw, or mcw signals. The low frequency range is not operative in this installation. The microphone input to the transmitter is connected to the ICS. If the transmitter is operating, transmission can be made from any ICS station having a master control. The high voltages required for transmission are developed by a dynamotor which operates on 28-volt d-c power. When keyed for any type of transmission, the transmitter energizes relays which disable both AN/ARR-15A receivers and feed a sidetone signal through the No. 2 AN/ARR-15A receiver. In this way transmission can be monitored at the pilot's, copilot's, navigator's, and radio operator's station through the ICS. A key for cw and mcw transmission is located on the radio operator's desk. The equipment is started at the transmitter as follows:

Local-remote switch	LOCAL
Emission switch	VOICE, CW, or MCW

If the transmitter local-remote switch is on REMOTE, the transmitter can be turned on by placing the pilot's remote control switch on VOICE, CW, or MCW. The equipment is stopped at the transmitter as follows:

Local-remote switch	LOCAL
Emission switch	OFF

If the transmitter local-remote switch is on REMOTE, the set may be turned off by placing the emission switch on the pilot's remote control panel in OFF position.

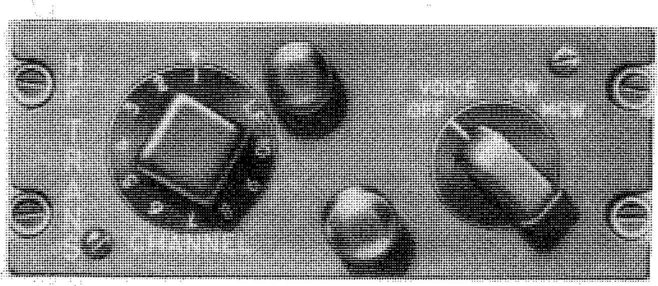


Figure 4-10. HF Transmitter Remote Control Panel

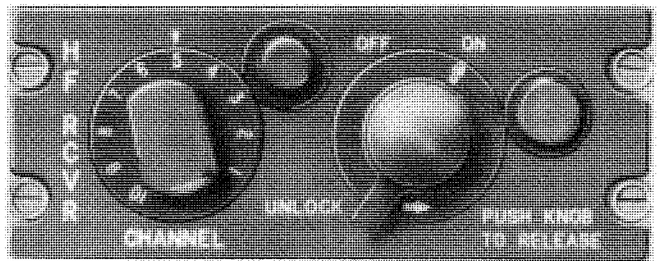


Figure 4-11. HF Receiver Remote Control Panel

LIAISON RECEIVERS AN/ARR-15A.

Two liaison receivers (14, figure 4-7) provide for preset multi-channel voice, cw, and mcw reception within a six band frequency range of 1500 to 18,500 kilocycles. The principal controls are on the receivers. However, a remote control panel (figure 4-11), located on the pilot's overhead panel, enables the pilot to turn on and select one of 10 preset channels on the No. 1 receiver. When one of the power switches is turned to ON, interlock circuits lock the other power switch in the OFF position. Either set can be monitored through the ICS at the pilot's, copilot's, navigator's or radio operator's station. When the AN/ART-13 transmitter is operating, both the No. 1 and No. 2 receivers are disabled and a sidetone signal from the AN/ART-13 is fed to the No. 2 receiver.

Either receiver can be started by rotating the ON-OFF knob on the receiver clockwise until the switch catches. The No. 1 receiver can be started also by rotating in the same manner the ON-OFF knob on the pilot's remote control panel. To stop reception push the ON-OFF switch and rotate the knob counterclockwise. The switch will snap to the OFF position.

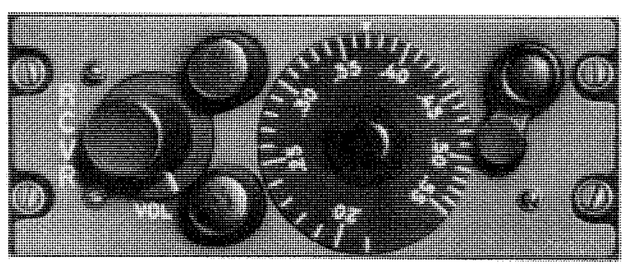


Figure 4-12. Range Receiver Control Panel

RANGE RECEIVER AN/ARC-5.

A receiver with a 190 to 550-kilocycle range is mounted on the electronics shelf aft of the sonar compartment. The receiver is controlled from a panel (figure 4-12) on the pilot's overhead panel. The receiver can be monitored at any ICS station with a master control. The necessary high voltages for receiver operation are supplied through a dynamotor mounted aft on the receiver. No power switch is provided for the receiver. The set operates when the ARC-5 circuit breaker on the main d-c circuit breaker panel is closed.

MARKER BEACON RECEIVER AN/ARN-12.

The marker beacon receiver on the electronics shelf aft of the sonar compartment signals both visibly and audibly when the airship passes over a marker beacon. The visual signal is the glow of an amber press-to-test light (10, figure 1-6) on the pilot's instrument panel. The audio signals can be monitored at each ICS station having a master control. The receiver is powered through the ARN-12 switch breaker on the main d-c circuit breaker panel. No other controls are provided.

RADIO ALTIMETER AN/APN-1.

A radio altimeter system is used to determine absolute altitude (terrain clearance) during flight. The system measures electrically the time required for a radio signal to travel to earth and back to the airship. The signal moves a pointer on the pilot's and winch operator's indicators to indicate the altitude in feet. The altimeter comprises principally a transceiver, two indicators, an altitude limit switch, and two warning lights. The transceiver is located on the port side of the sonar compartment. An indicator is located on the pilot's instrument panel (2, figure 1-6) and on the winch operator's instrument panel (2, figure 4-36). A power switch on the lower left corner of the pilot's indicator controls the electrical input to the equipment.

If the airship drops below the selected altitude, a red altimeter warning light (1, figure 1-6) on the pilot's instrument panel glows.

A knob on the upper right corner of the pilot's indicator is rotated to select either a 400-foot or a 4000-foot range of operation. The high range is not calibrated for use at altitudes below 400 feet. Under conditions of poor visibility always use the low range when operating at altitudes below 600 feet.

The power switch and range switch on the winch operator's indicator are not electrically connected to the system, but the range switch mechanically shifts the scale calibration. A green light (3, figure 4-36) on the winch operator's instrument panel glows when the pilot selects the high range indication.

A selector knob on the radio altimeter control panel (14, figure 1-3) controls the altitude limit switch. The knob, calibrated from 50 to 300 feet, is used to select a desired minimum terrain clearance.

RADIO COMPASS AN/ARN-6.

The radio compass equipment is used to take direction finding bearings on stations transmitting in the 100 to 1750 kilocycle frequency range. The equipment consists principally of a receiver and amplifier on the electronic shelf aft of the sonar operator's station. The compass control panel (figure 4-13) is on the pilot's overhead panel. The bearings received are shown on an indicator (24, figure 1-6) on the pilot's instrument panel and an indicator (3, figure 4-26) on the navigator's instrument panel. The receiver's audio signal can be monitored at any ICS station having a master control. The equipment is started by turning the function switch on the control panel to either COMP, ANT, or LOOP. The equipment

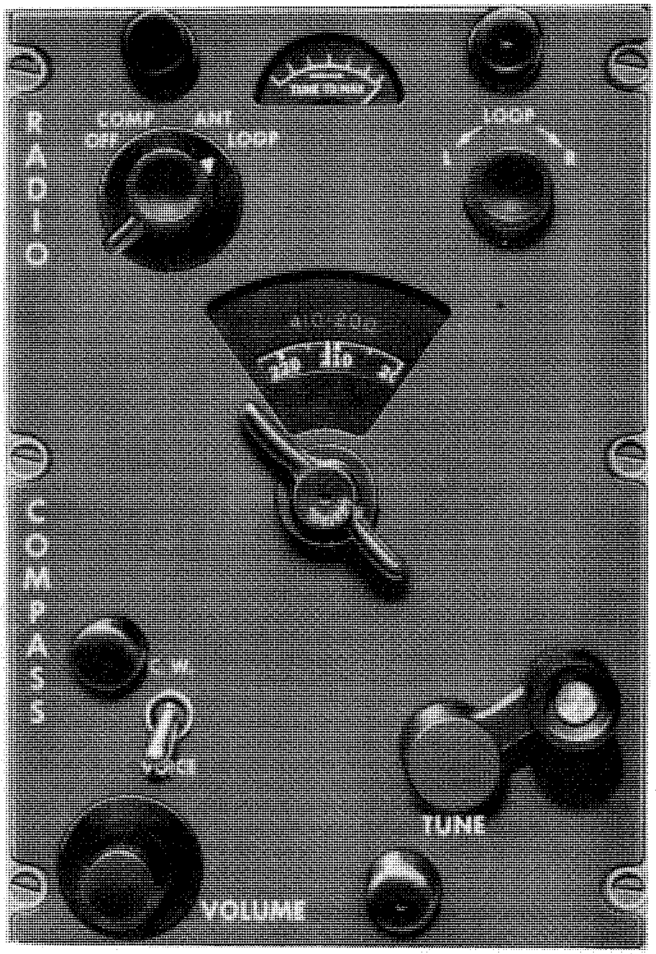


Figure 4-13. Radio Compass Control Panel

is stopped by placing the function switch in the OFF position.

LORAN AN/APN-9.

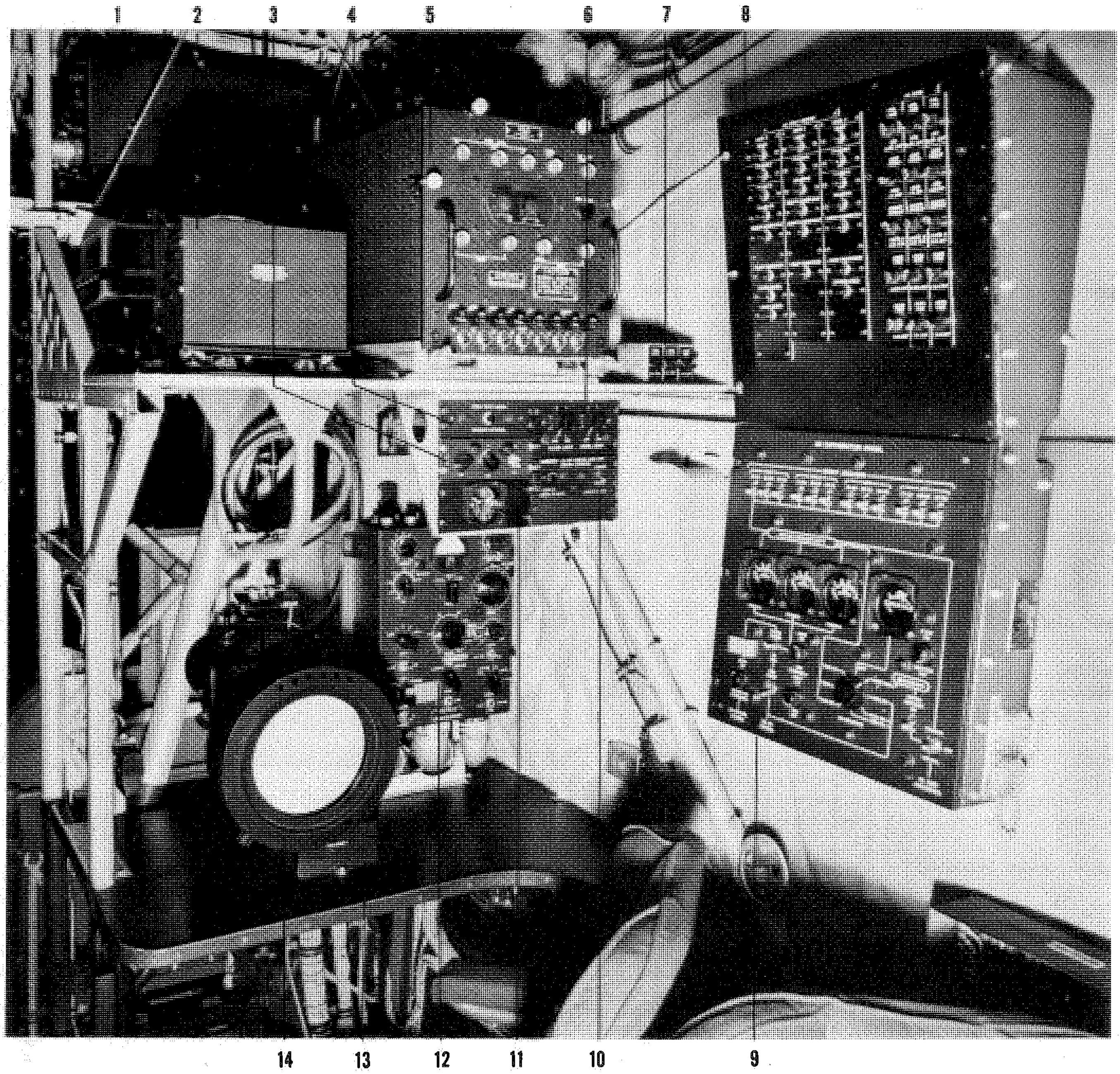
Loran is a long range navigation system used to determine the geographic location of the airship in areas where loran ground stations are operating. The receiver indicator (2, figure 4-25) and antenna matching unit (1, figure 4-25) are mounted above the navigator's shelf. The antenna matching unit should not require adjustment during normal flight operation of the loran set.

The receiver indicator is started by placing the amplitude balance and fine delay controls in the center positions and rotating the receiver gain control clockwise until the station rate counter is illuminated. Allow at least five minutes for the receiver to warm up.

To shut off the equipment turn the receiver gain control to the POWER OFF position. Check that pilot light is not illuminated and that the pattern on the indicator screen has disappeared.

RADAR SET AN/APS-33F.

DESCRIPTION. The AN/APS-33F radar system is a radio detection and ranging unit. It is used in navigation and in homing and searching operations. The equip-



1. AN/APS-33F Gyroscope Unit
2. AN/APS-33F True Bearing Amplifier
3. ICS Station Control Panel
4. Sonobuoy Operator Call Panel
5. AN/APS-33F Synchronizer
6. Light Control Panel
7. Light Fuse Panel
8. A-C Circuit Breaker Panel
9. A-C Distribution Panel
10. Radome Control Panel
11. Clock
12. AN/APS-33F Control Panel
13. AN/APS-33F Autotransformer
14. AN/APS-33F Indicator

Figure 4-14. Radar Operator's Station

ment consists principally of a transceiver, antenna, modulator, blower, and retractable radome below the deck in the utility compartment. A true bearing amplifier, synchronizer, indicator, autotransformer, radar control panel, and radome control panel are located at the radar operator's station (figure 4-14). An indicator

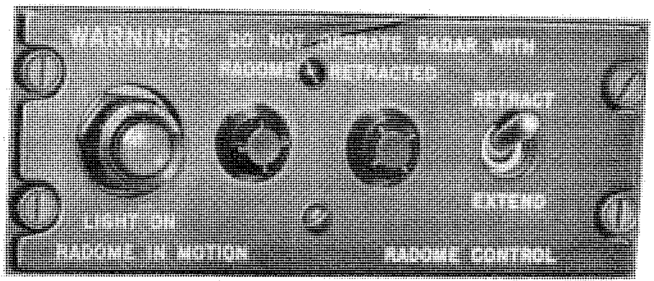


Figure 4-15. Radome Control Panel

is also located at the navigator's station (figure 4-25).

A radome retraction system extends and retracts the radome together with the enclosed AN/APS-33F transmitter-receiver, antenna, and transmitter-receiver blower. The radome is a hard, smoothly contoured enclosure in the underside of the car. A 3/8-inch diameter hole is located at the bottom of the radome for drainage. A static discharge brush rides against the outside of the radome. The radome is retracted during take-off and landing and extended during operation of the radar set. A radome in motion indicator light (figure 4-15) on the radome control panel lights when the radome is not fully extended or fully retracted. The radome control switch (figure 4-15) on the radome control panel, when placed in the RETRACT position, causes power to be connected to an actuator which retracts the radome. When placed in the EXTEND position, the radome control switch connects power to the actuator to extend the radome. A limit switch disconnects power when the radome is fully retracted or extended. The radome extends in approximately 29 seconds and retracts in 28 seconds.

RADAR SET PRE-STARTING CHECKS.

a. Radome Control Switch	EXTEND
b. Radome in Motion Light	Off
c. Radar Power Switch	OFF
d. Contrast Control	O
e. Marker Control	O
f. Delay Control	NORM
g. Slow-Fast Switch	SLOW
h. Scan Switch	OFF
i. Tilt Control	O
j. "AFC-MAN" Switch	AFC
k. Function Switch	LIN
l. Bearing Switch	REL
m. "MAG CUR" Control on Autotransformer	3/4 of total range (toward HI)
n. "MASTER BRILL" and "MKR BRILL" Controls	Full counter-clockwise
o. "BIAS" Control	Full counterclockwise (screwdriver adjustment)

STARTING RADAR SET

a. Meter Switch	LINE
b. Power Switch	STANDBY

CAUTION

Meter reading should be within the green area on the meter scale. If any other voltage is indicated, turn the power switch off immediately.

STOPPING RADAR SET.

a. Gyro Switch	CAGE
b. Power Switch	OFF

RADAR IDENTIFICATION SET AN/APX-6.

The radar identification transmitter-receiver, located on a shelf above the radar operator's station, receives interrogating signals and transmits identification signals. The set is remotely controlled from the IFF panel (figure 4-6) on the copilot's side console. When the microphone circuit of the AN/ARC-27 transmitter is actuated, the radar identification set is placed in I/P operation. The set contains a destructor which is set off when the IFF destruct switch on the control unit is operated. To start the equipment after setting up the prearranged receiver and transmitter frequencies, rotate the master control from the OFF position. To stop the equipment, return the master control to OFF.

ECM RECEIVER AN/APR-9B.

An ECM power supply, mixer amplifier, indicator, and remote control unit are located at the ECM station (figure 4-17). The receiver equipment detects and determines the frequencies of radio signals. The signals are converted to vertical deflection voltages and are then displayed visibly on the indicator. The signals can also be monitored with phones at the mixer amplifier. To start the equipment throw the power toggle switch to POWER.

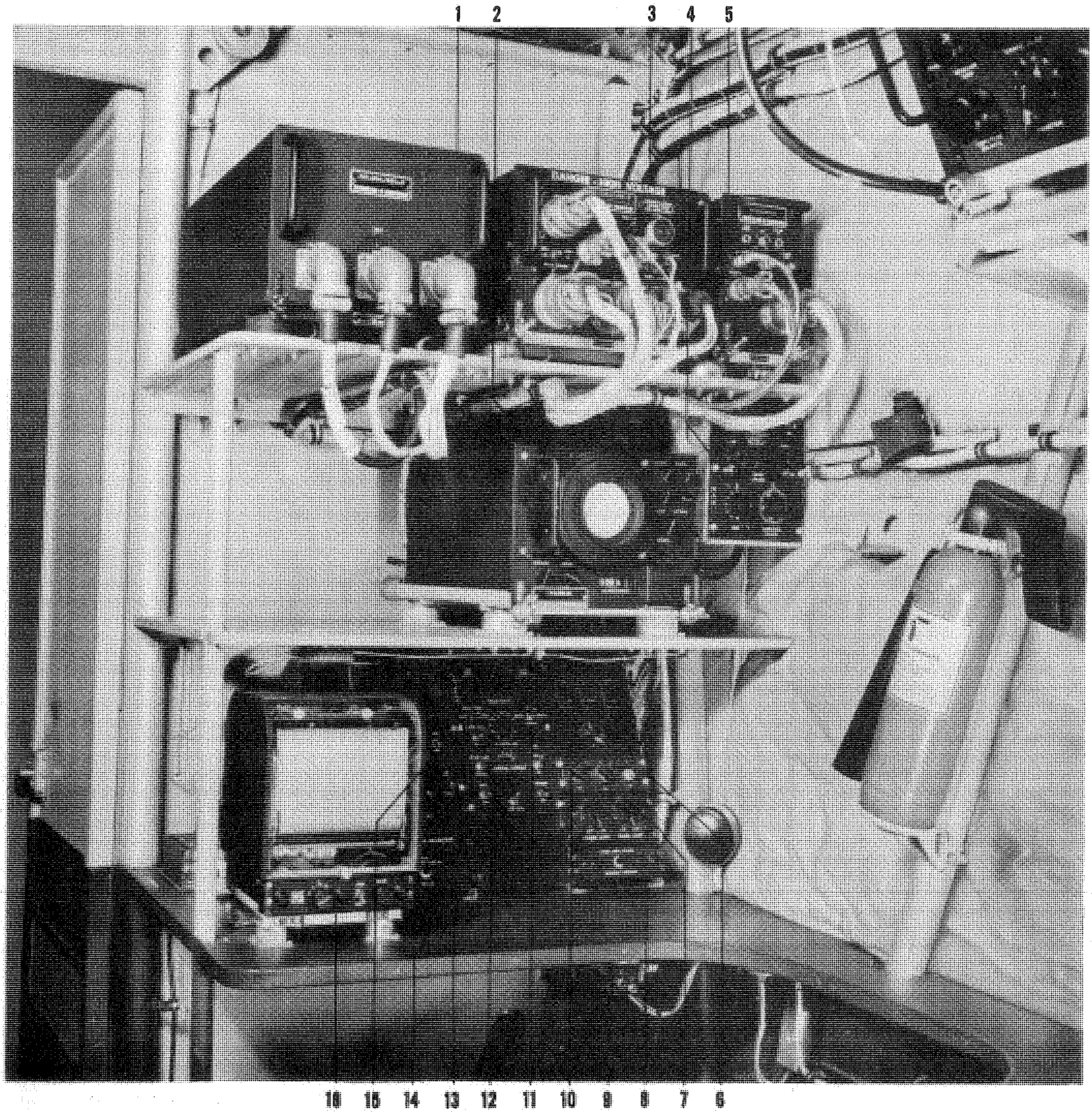
ECM DIRECTION FINDER AN/APA-69A.

The ECM direction finder is controlled by the direction finder control (15, figure 4-17). The direction finder equipment determines signal direction and presents this information visibly on the ECM indicator. The directional indication is converted to true bearing by an azimuth scale rotated around the outer rim of the cathode ray tube. This scale is driven by signals from the automatic pilot. To use the direction finder equipment, throw the power switch on the direction finder control to PWR and rotate the antenna selector switch (figure 4-16) to D. F. To stop the equipment, turn the power switch on the direction finder control to OFF.

ECM ANTENNA SWITCHING SYSTEM.

The switching system is controlled by the three-position antenna selector switch (figure 4-16) above the ECM station desk. The HOR and VERT positions select the re-

Figure 4-16. ECM Antenna Selector Panel



1. AN/ASQ-8 Amplifier
2. AN/APA-69A Indicator
3. AN/APR-9 Power Supply
4. AN/ASQ-8 Control Panel
5. AN/APR-9 Mixer Amplifier
6. ICS Station Control Panel
7. Light Control Panel
8. Sonobuoy Operator Call Panel
9. Phone Jacks
10. Clock
11. Light Fuse Panel
12. AN/APR-9B ECM Remote Control Panel
13. MAD Recorder Marker Panel
14. ECM Antenna Selector Panel
15. AN/APA-69A Direction Finder Control Panel
16. AN/ASQ-8 Recorder

Figure 4-17. ECM Operator's Station

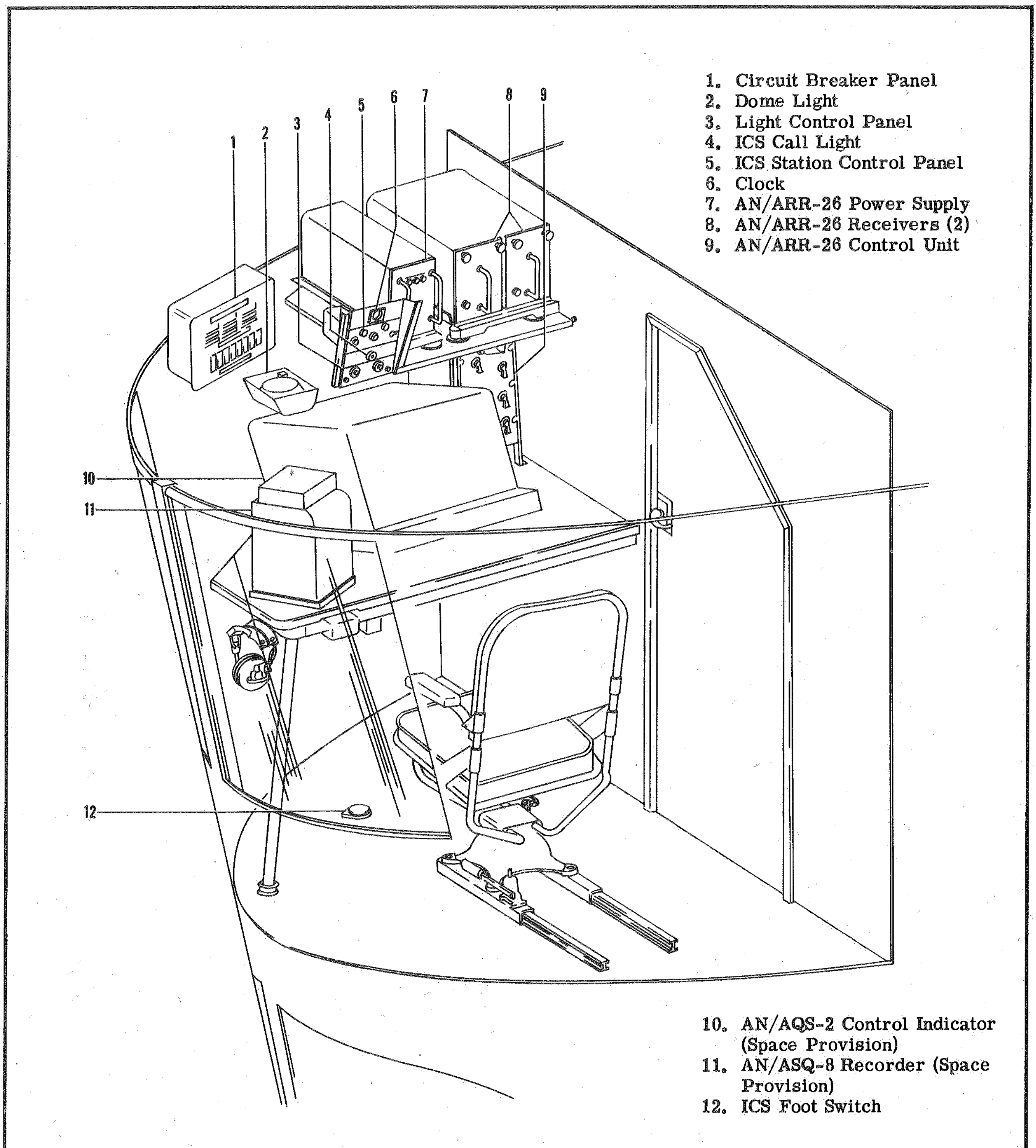


Figure 4-18. Sonar Operator's Station

ceiver antenna and the D. F. position selects the direction finder antenna. The receiver antenna consists of circular, vertical, and horizontal polarized sections. The circular sections receive signals and are connected into the receiving circuit with the antenna selector switch in either the HOR or VERT position. When a signal is received on the ECM receiver, the ECM direction finder can immediately be switched in to determine the azimuth of the signal.

ECM PULSE ANALYZER AN/APA-74.

Space and power provisions for installation of the pulse analyzer and power supply are at the ECM station.

SONOBUOY RECEIVERS AN/ARR-26.

Two sonobuoy receivers (8, figure 4-18) mounted on the top shelf of the sonar operator's station are used to receive signals from directional listening sonobuoys. The receivers are tuned to different frequencies. The audio output from each receiver is connected to the control unit (9, figure 4-18) on the top shelf of the sonar operator's station and can be connected into the ICS for monitoring by the pilot, copilot, navigator, and radio operator. When the system is connected in this manner, the sonar operator can receive ICS calls through the control unit. The sonar operator can also elect to receive the receiver signals and ICS signals through the control unit when the receiver signals are not connected to the ICS. The sonar operator must hse the ICS microphone connections to communicate with other crew members regardless of the operation of the sonobuoy receivers. A red ICS call light (4, figure 4-18) at the sonar operator's station is lighted when any crew member presses the sonobuoy operator call switch at his station. The light notifies the sonar operator that he is wanted on the ICS network.

When starting the sonobuoy receivers, be certain that the AFC switch and receiver test switch on the selected receiver are in the OFF position; then turn the power switch on receiver control to ON. To stop the equipment turn the power switch on the receiver control to the OFF position.

SONAR AN/AQS-2.

Space and power are provided for the installation of AN/AQS-2 sonar. A d-c amplifier and amplifier control may be installed in place of the AN/ARR-26 power supply and receivers (7 and 8, figure 4-18) at the sonar operator's station. Space provision is made at the sonar operator's station for a control indicator and recorder (10 and 11, figure 4-18). A sonar fish course indicator mounting (23, figure 1-6) is installed on the pilot's instrument panel. Mountings for sonar fish speed and depth indicators (5 and 6, figure 4-36) are installed on the winch operator's instrument panel. Space is provided on each side of the winch for the installation of a transmitter and power supply.

SONAR AN/AQS-2 (134019 and Subsequent).

Mounting provisions, wiring, and power sources for AN/AQS-2 sonar are installed on the airship. Provisions for the installation of the amplifier control in lieu of the AN/ARR-26 receivers and control indicator (8 and 10, figure 4-18) are located at the sonar operator's station. Provisions for mounting a recorder and d-c amplifier (1 and 5, figure 4-25A) are made at the navigator's station. Mountings for a transmitter and power supply (2A and 7A, figure 4-31) are located overhead in the stern compartment. Sonar fish depth and speed indicator mounting provisions (figure 4-18A) are located on the pilot's AN/AQS-2 indicator panel at the pilot's console. Mounting provisions for sonar fish depth, speed, and course indicators (2, 3, and 4, figure 4-25A) are located at the navigator's station. A sonar fish depth indicator mounting provision (6, figure 4-36) is located on the winch operator's instrument panel. AN/AQS-2 power sources are listed in table III.

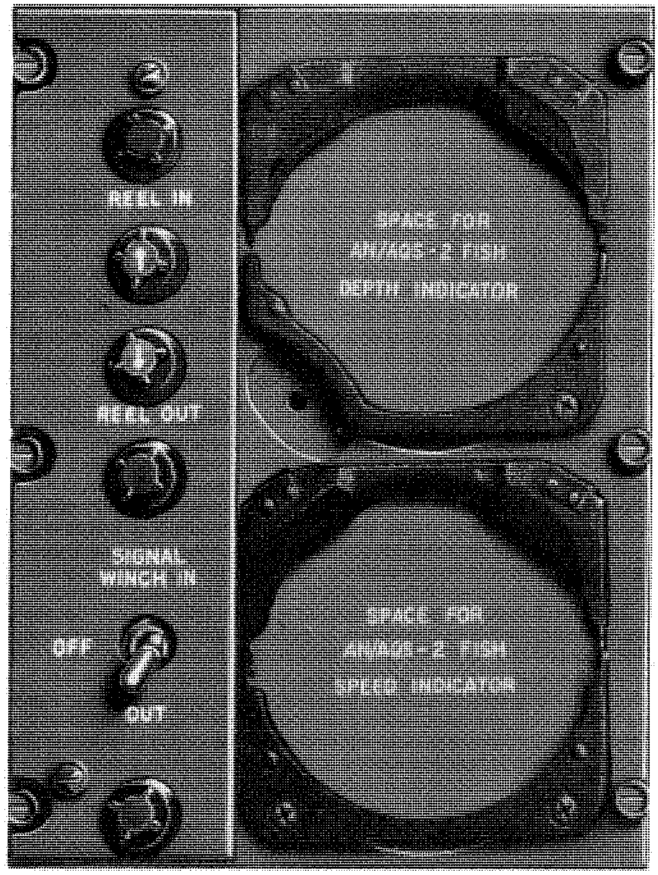


Figure 4-18A. Pilot's AN/AQS-2 Indicator Panel (134019 and Subsequent)

MAD SET AN/ASQ-8.

The AN/ASQ-8 is a magnetic detection set used in antisubmarine warfare. The detector amplifier and power supply are located on the electronics shelf aft of the sonar compartment. A primary power indicator is on the front panel of the detector amplifier, and a 300-volt d-c indicator is on the front panel of the power supply. A MAD position deviation indicator is mounted on the front of the electronic control amplifier at the ECM station.

The principal control units, a control panel (4, figure 4-17), a milliammeter recorder (16, figure 4-17), and a MAD recorder marker push button (figure 4-19) are located at the ECM operator's station. To start the equipment place the milliammeter power switch and the

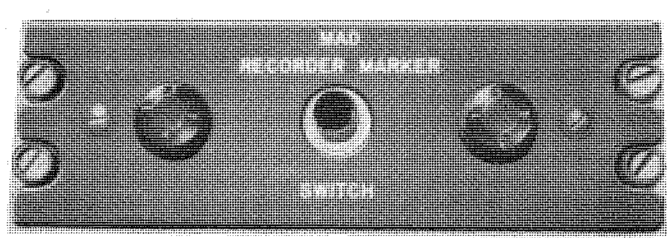


Figure 4-19. MAD Recorder Marker Panel

control panel power switch on PWR. The equipment requires a warm-up period of approximately one minute. To stop the equipment place both switches in the OFF position.

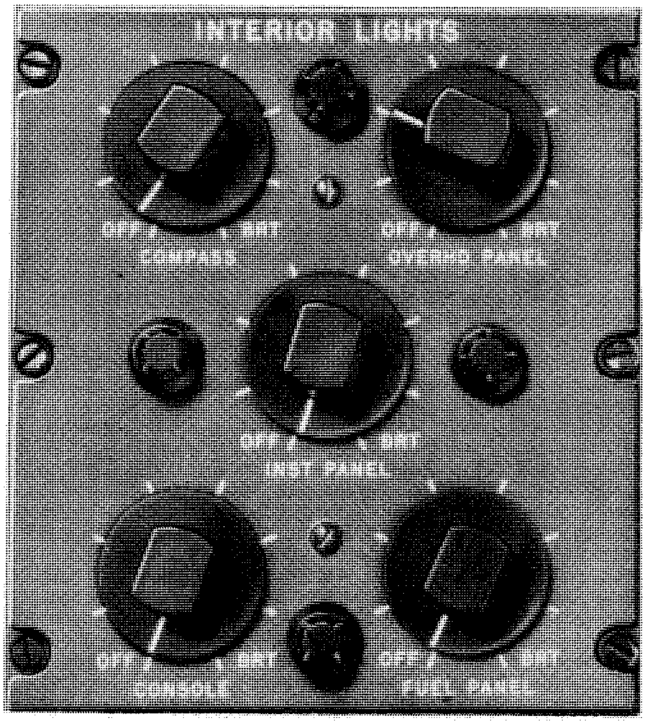


Figure 4-20. Interior Lights Panel

LIGHTING EQUIPMENT.

INTERIOR LIGHTS. The interior lights are panel lights, instrument lights, dome lights, deck lights, table lights, floodlights, a galley light, ladder lights, and bomb bay lights. These lights and their controls are listed in tables VIII through XI.

EXTERIOR LIGHTS. The exterior lights are navigation and recognition lights, propeller lights, and a landing light. The navigation lights (car and envelope position lights) and the recognition lights are listed in table XII. The navigation lights and the recognition lights may be used alone or in combination. The navigation lights can be flashed or steadily illuminated. The recognition lights can be keyed, automatically flashed in a selected code sequence, flashed in a uniform on-off cycle, or maintained in steady illumination. Selection of the mode

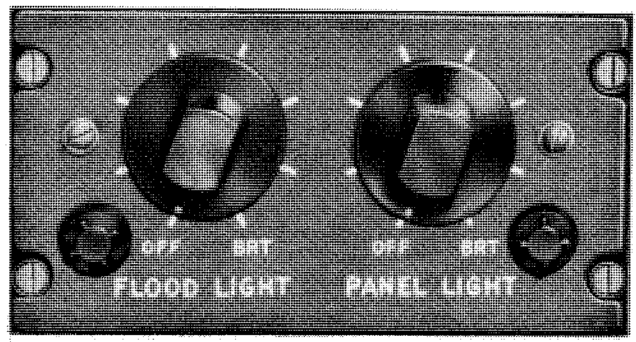


Figure 4-21. Station Light Control Panel

Table VIII. Pilot's Compartment Lighting

LIGHTS	CONTROL	FUSE or CIRCUIT BREAKER	POWER SOURCE
Pilot's Overhead Panel and Fluid Manometer Lights	Overhead panel lights switch on interior lights panel.	Forward pilot's light transformer fuse on a-c circuit breaker panel.	ASW ØB bus (115 volts a-c)
Fuel Control Panel and Instrument Lights	Fuel panel lights switch on interior lights panel.		
Pilot's Instrument Panel Lights	Instrument light switch on interior lights panel.	Aft pilot's light transformer fuse on a-c circuit breaker panel.	ASW ØB bus (115 volts a-c)
Pilot's Side Console Panel Lights			
Copilot's Side Console Panel Lights			
All Main Console Lights except Fuel Control Panel	Console light switch on interior lights panel.		
Pilot's Standby Floodlights under Pilot's Overhead Panel	Standby rheostat on pilot's overhead panel.	Emergency lights circuit breaker on pilot's circuit breaker panel.	Pilot's Essential bus (28 volts d-c)
Standby Compass Lights	Compass light switch on interior lights panel.		
Pilot's Floodlight overhead behind pilot	Rheostat and push button on floodlight.		
Copilot's Floodlight overhead behind copilot			
Map Light over Pilot's Side Console	Dome light rheostat on bulkhead behind pilot.	D-c lights circuit breaker on d-c circuit breaker panel.	ASW Monitor bus (28 volts d-c)
Dome Light overhead behind pilot			
Map Light over Copilot's Side Console			
Dome Light overhead behind copilot			
Deck Light on aft end of Pilot's Console	None.	Deck lights switch breaker on d-c circuit breaker panel.	

Table IX. Sonar Compartment Lighting

LIGHTS	CONTROL	FUSE or CIRCUIT BREAKER	POWER SOURCE
Sonar Compartment Panel and Instrument Lights	Panel lights switch on sonar operator's light control panel.	Panel lights fuse on sonar operator's circuit breaker panel. Forward pilot light transformer fuse on a-c circuit breaker panel.	ASW ØB bus (115 volts a-c)
AN/ARR-26 Control Panel Floodlight	Floodlight switch on sonar operator's light control panel.	Table lights fuse on sonar operator's circuit breaker panel. Forward pilot light fuse on a-c circuit breaker panel.	
Compartment Dome Light (red or white)	Two switches on fixture.	D-c lights circuit breaker on sonar operator's circuit breaker panel.	Sonar Monitor bus (28 volts d-c)
Sonar Compartment Floodlights (2)	Push button and rheostat on floodlight.	Upper deck floodlight circuit breaker on d-c circuit breaker panel.	ASW Essential bus (28 volts d-c)
Electronic Compartment Upper Deck Lights (2)	None.	Deck light switch breaker on d-c circuit breaker panel.	ASW Monitor bus (28 volts d-c)

Table X. Electronic Compartment Lighting

LIGHTS	CONTROL	FUSE or CIRCUIT BREAKER	POWER SOURCE
Radar Operator's Station Panel and Instrument Lights	Panel light switch on radar operator's light control panel.	Panel lights fuse on radar operator's fuse panel.	ASW light transformer fuse on a-c circuit breaker panel supplied from ASW ØB bus (115 volts a-c)
A-C Circuit Breaker Panel and Instrument Lights			
Radar Operator's Work Table Lights	Floodlight switch on radar operator's fuse panel.	Table lights fuse on radar operator's fuse panel.	
Navigator's Station Panel and Instrument Lights	Panel light switch on navigator's light control panel.	Panel lights fuse on navigator's fuse panel.	
Navigator's Table Lights (2)	Floodlight switch on navigator's light control panel.	Table lights fuse on navigator's fuse panel.	
ECM Operator's Station Panel and Instrument Lights	Panel light switch on ECM operator's light control panel.	Panel lights fuse on ECM operator's fuse panel.	
ECM Operator's Work Table Lights (3)	Floodlight switch on ECM operator's light control panel.	Table lights fuse on ECM operator's fuse panel.	
Radio Operator's Station Panel and Instrument Lights	Panel light switch on radio operator's light control panel.	Panel lights fuse on radio operator's fuse panel.	
D-C Circuit Breaker Panel and Instrument Lights			
Radio Operator's Work Table Lights (2)	Floodlight switch on radio operator's fuse panel.	Table lights fuse on radio operator's fuse panel.	
Ladder Lights (2)	None.	Deck lights switch breaker on d-c circuit breaker panel.	ASW Monitor Bus (28 volts d-c)
Radio Operator's Deck Light			
Bomb Bay Lights (2)	Bomb bay light switch on bomb bay control panel.	D-c lights circuit breaker on d-c circuit breaker panel.	
Compartment Dome Light (red or white)	Two switches on fixture.		
Navigator's Floodlight	Push button and rheostat on floodlight.	ASW emergency lights circuit breaker on d-c circuit breaker panel.	ASW Essential Bus (28 volts d-c)
Radar Operator's Floodlight			
Radio Operator's Floodlight			
ECM Operator's Floodlight			

Table XI. Utility and Stern Compartment Lighting

LIGHTS	CONTROL	FUSE or CIRCUIT BREAKER	POWER SOURCE
Utility Compartment			
Heating and Ventilating Control Panel Lights	Panel light switch on winch operator's auxiliary panel.	Aft light transformer fuse on winch operator's circuit breaker panel.	Aft ØB bus (115 volts a-c)
Sonobuoy Operator Call Panel Lights			
ICS Control Panel Lights			
Utility Compartment Dome Lights (red or white) (2)	Two switches on each fixture.	D-c lights circuit breaker on winch operator's circuit breaker panel.	Aft Monitor bus (28 volts d-c)
Galley Light	Toggle switch beside light.		
Deck Lights (7)	None.	Deck lights switch breaker on d-c circuit breaker panel.	ASW Monitor bus (28 volts d-c)
Ceiling Floodlight	Push button and rheostat on floodlight.	Aft floodlight circuit breaker on d-c circuit breaker panel.	ASW Essential bus (28 volts d-c)
Stern Compartment			
Winch Operator's Instrument Panel Lights and Instrument Lights	Panel light switch on winch operator's auxiliary panel.	Aft light transformer fuse on winch operator's circuit breaker panel.	Aft ØB bus (115 volts d-c)
Winch Operator's ICS Control Panel Lights			
Winch Operator's Auxiliary Panel Lights			
Winch Control Panel Instrument and Panel Lights	Instrument light switch on winch control panel. Panel light switch on winch operator's auxiliary panel.		
Winch Operator's Standby Floodlight	Floodlight switch on winch operator's auxiliary panel.		
Deck Light	None.	Deck light switch breaker on d-c circuit breaker panel.	ASW Monitor bus (28 volts d-c)
Winch Operator's Floodlight	Push button and rheostat on floodlight.	Aft floodlight circuit breaker on d-c circuit breaker panel.	ASW Essential bus (28 volts d-c)

of operation of these lights is made through a master switch on the exterior lights panel.

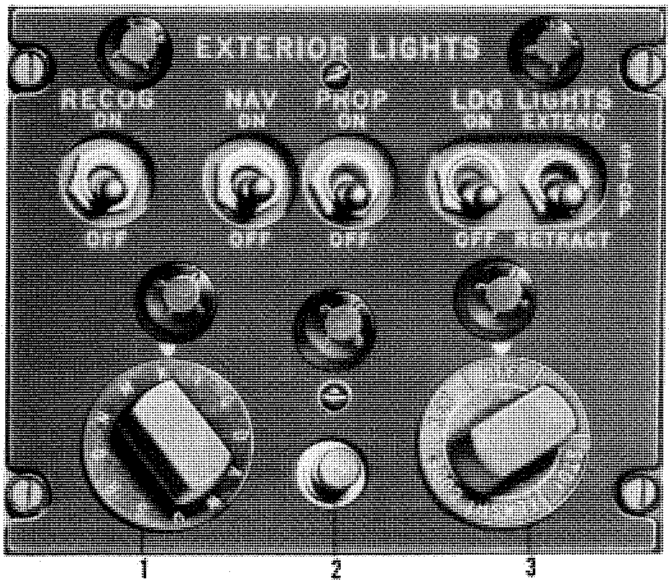
Two white lights, one on each side of the car, illuminate the propellers for ground operations at night. The lights are controlled by a switch on the exterior lights panel.

When retracted the landing light is flush with the bottom of the car below the pilot's compartment. The light pivots down and forward until the fully extended position is reached where the beam of the lamp is directed forward 15 degrees below the horizontal. The light may be stopped in any intermediate position.

NAVIGATION LIGHTS SWITCH. The navigation lights switch (figure 4-22) switches the navigation lights to control by the master switch. The navigation lights are not illuminated if the recognition light switch is in OFF.

RECOGNITION LIGHTS SWITCH. The recognition lights switch (figure 4-22) switches the recognition lights to control by the master switch. The recognition lights are not illuminated if the recognition light switch is OFF.

EXTERIOR LIGHTS MASTER SWITCH. The master switch (3, figure 4-22) on the exterior lights panel permits selection of several modes of operation for the



1. Code Selector Switch
2. Keying Switch
3. Master Switch

Figure 4-22. Exterior Lights Panel

Table XII. Navigation and Recognition Lights

LOCATION	COLOR	CIRCUIT BREAKER	BUS
Navigation Lights			
Car Position Lights			
Starboard	Green	EXT LTS & CODER on d-c circuit breaker panel	ASW Monitor
Port	Red		
Envelope Position Lights			
Bow (upper)	White	EXT LTS & CODER on d-c circuit breaker panel	ASW Monitor
Bow (lower)	White		
Starboard	Green		
Port	Red		
Stern (upper)	White		
Stern (lower)	Yellow		
Recognition Lights			
Envelope - top	White	EXTERIOR LIGHTS	ASW ØC
Envelope - bottom			
aft	White		
forward	White		

navigation and recognition lights if they are switched on. Table XIII lists the master switch positions and explains the condition of the lights during each mode of operation.

KEYING SWITCH. The keying switch (2, figure 4-22) on the exterior lights panel lights the recognition lights when the switch is pressed. The master switch must be in KEY position and the recognition lights switch must be in ON for the keying switch to function. A monitor light directly above the keying switch lights when the recognition lights are keyed by the switch.

CODE SELECTOR SWITCH. The code selector switch (1, figure 4-22) on the exterior lights panel has 12 letter positions to permit selection of the Morse code letter to be flashed by the recognition lights when the master switch is in CODE. The following letters may be selected: K, I, G, D, A, W, U, S, R, O, N, M.

PROPELLER LIGHTS SWITCH. The propeller lights switch (figure 4-22) on the exterior lights panel turns the propeller lights on or off. The propeller lights are rated for continuous operation.

LANDING LIGHT EXTEND-RETRACT SWITCH. The extend-retract switch (figure 4-22) on the exterior lights panel is a three-position switch controlling the position of the landing light. In the EXTEND position, the switch causes the light to extend until the switch is placed in STOP or until the fully extended position is reached. The RETRACT position controls retraction of the light

Table XIII. Exterior Lights Control

MASTER SWITCH POSITION	NAVIGATION LIGHTS		RECOGNITION LIGHTS
	CAR POSITION	ENVELOPE POSITION	
OFF	Off	Off	Off
KEY	Steady	Steady	Light only when keying switch is pressed.
CODE	Steady	Steady	Flash Morse code letter selected on code selector switch.
FLASH	Flash with yellow envelope stern light during off period in the flash cycling of the other lights.	Excepting the yellow envelope stern light, these lights flash together during the off period in the flash cycling of the car position and yellow envelope stern lights.	
STEADY	Off	Steady	Steady

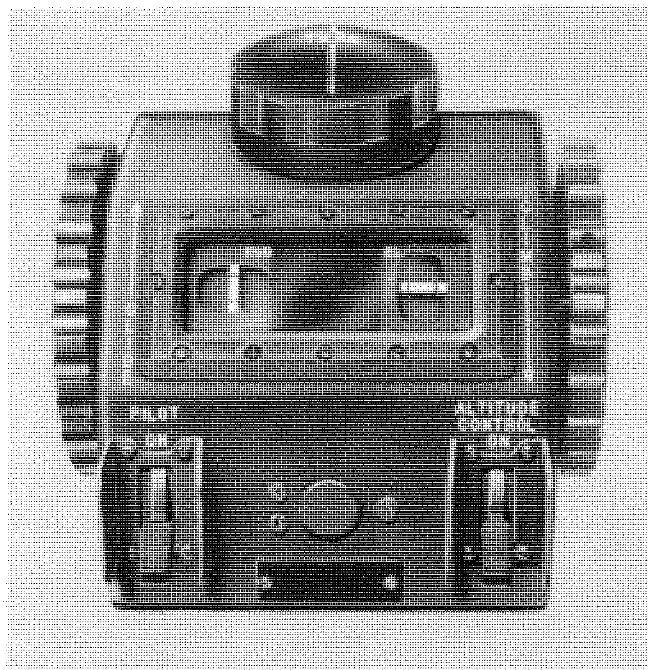


Figure 4-23. Pedestal Controller

in a similar manner. When the switch is placed in the center STOP position, the light stops moving. Limit switches prevent overtravel of the light.

LANDING LIGHT SWITCH. The two-position landing light switch (figure 4-22) on the exterior lights panel controls the lamp in the landing light. The lamp will not go on unless the landing light is extended 10 degrees or more.

AUTOMATIC PILOT.

DESCRIPTION. The automatic pilot controls the airship in flight by operating the surface control system. The automatic pilot can be operated to maintain level flight on a selected course, to change flight direction or altitude, or to maintain flight at a constant barometric pressure altitude. The automatic pilot operates the surface controls through a rudder and an elevator servo linked to the control system jackshafts.

The autopilot directional sensing elements control the pilot's, the copilot's, and the navigator's compass repeaters. The repeaters give a directional indication whether or not the autopilot is engaged. The direction sensing and amplifying components are energized whenever power is supplied through the A-12 filament and the autopilot circuit breakers on the pilot's circuit breaker panel.

PEDESTAL CONTROLLER. The pedestal controller (figure 4-23), located on the pilot's console, is the automatic pilot main control unit. The pedestal controller contains the pilot switch, the rudder and elevator trim meters, the turn knob, the altitude control switch, and the pitch control knobs.

PILOT SWITCH. The pilot switch controls the connection of electrical power to the automatic pilot equipment. The pilot switch can be thrown to ON only when the boost master switch is in OFF, the turn control knob is in detent or straight forward position, and both a-c and d-c power have been on for at least two minutes.

ALTITUDE CONTROL SWITCH. The altitude control switch is used to turn the altitude control unit on or off. The altitude control unit controls the elevator control surfaces to hold the airship at a constant barometric pressure altitude.

PITCH CONTROL KNOBS. The pitch control knobs are attached to a common shaft and control the pitch of the airship. Either knob can be rotated forward to cause the airship to nose down or rotated aft to cause the airship to nose up. The knobs are not operative when the altitude control switch is in ON.

TURN KNOB. The turn knob on top of the pedestal controller is used to control the direction of flight. The knob can be rotated in either direction from its detent position to cause the airship to turn in that direction. The turn control knob is operative only when the pilot switch is in ON and the rudder switch on the autopilot engage panel is in the ENGAGE position.

ENGAGING CONTROL. The rudder and elevator switches on the autopilot engage panel (figure 4-24) control the connection of power to the servos. The servos operate the surface control jackshafts. The switches are locked in the DISENGAGE position when the pilot switch is in OFF. When the pilot switch is in ON, the rudder and elevator switches are unlocked and can be placed in ENGAGE. When the pilot switch is thrown to OFF the switches automatically return to DISENGAGE and lock.

RELEASE SWITCHES. The two release switches (4, figure 1-21) are above the right hand grip on each rud-

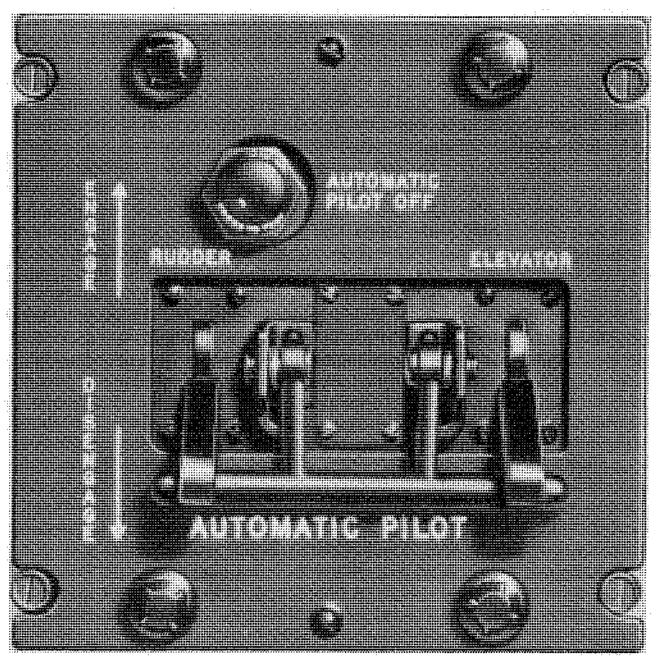
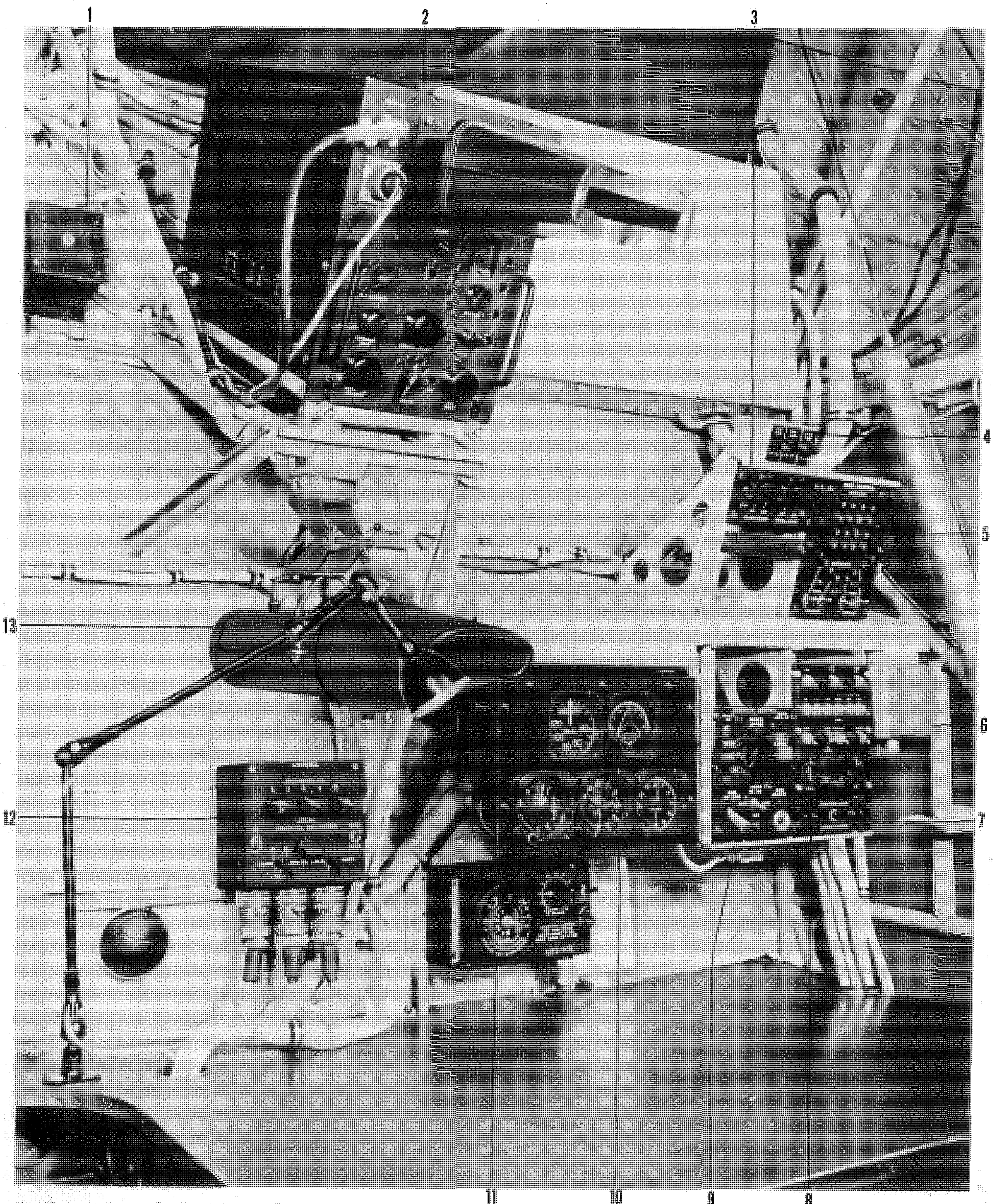
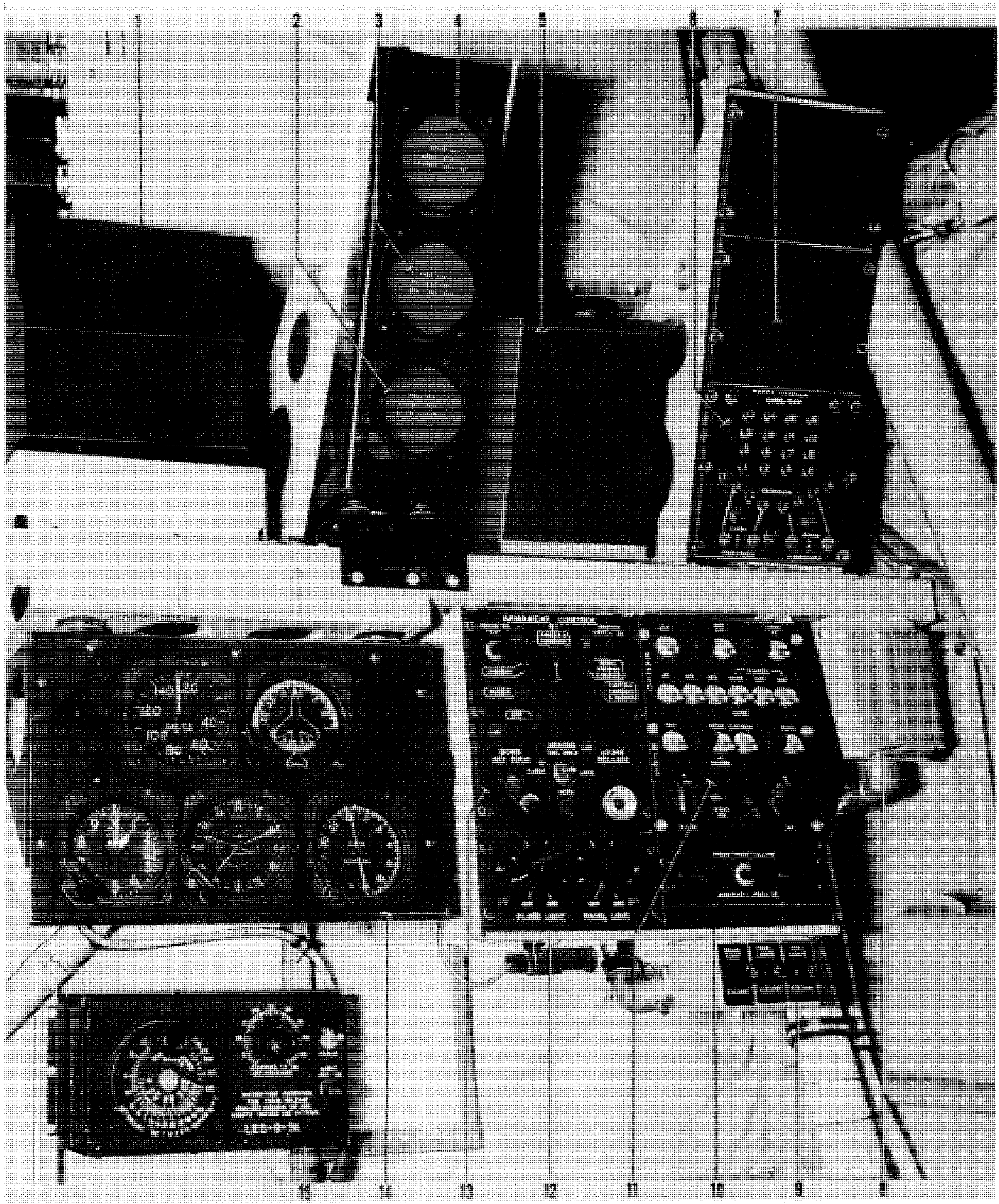


Figure 4-24. Autopilot Engage Panel



1. Loran Antenna Matching Unit
2. AN/APN-9 Receiver
3. Lighting Control Panel
4. Light Fuse Panel
5. Bomb Stations Panel
6. Cabinstat
7. Sonobuoy Operator Call Panel
8. ICS Master Control Panel
9. Armament Control Panel
10. Navigator's Instrument Panel
11. Intervalometer
12. AN/ARC-27 Master Control Panel
13. AN/APS-33F Indicator

Figure 4-25. Navigator's Station (131919 through 131926)



1. Scanning Sonar Recorder
2. Sonar Fish Depth Indicator
3. Sonar Fish Speed Indicator
4. Sonar Fish Course Indicator
5. AN/AQS-2 D-C Amplifier
6. Bomb Stations Panel
7. Torpedo Briefing Panel
8. Cabinstat
9. Light Fuse Panel
10. Sonobuoy Operator Call Panel
11. ICS Control Panel
12. Lighting Control Panel
13. Armament Control Panel
14. Navigator's Instrument Panel
15. Intervalometer

Figure 4-25A. Navigator's Instruments and Controls (134019 and Subsequent) der control wheel. The switches are operated by depressing the switch button with the thumb. Pressing either switch disconnects power to the automatic pilot so that the system is inoperable.

These switches make it possible to release automatic pilot control quickly when necessary to restore manual control of the airship. When a release switch is operated, the pilot switch, altitude control switch, and autopilot engage switches trip off automatically.

TRIM METERS. The rudder and elevator trim meters, marked RUD and EL, indicate the amount and direction of rudder and elevator correction being applied by the automatic pilot system. The trim meters should be centered before the autopilot engage switches are thrown to ENGAGE.

AUTOMATIC PILOT OFF LIGHT. An automatic pilot off light (figure 4-24) is on the autopilot engage panel. The light flashes on and off if the pilot switch is on and either or both of the autopilot engage switches are in DISENGAGE.

AUTOMATIC PILOT OPERATION. The following paragraphs describe only those procedures necessary to the operation of the automatic pilot under normal flight conditions.

ENGAGING PROCEDURE.

a. Trim airship.
b. Turn Knob — In Detent (straight forward)
c. Engage Switches — DISENGAGE
d. Booster Master Switch — OFF
e. Pilot Switch — ON
f. Engage Switches — ENGAGE

DISENGAGE PROCEDURE.

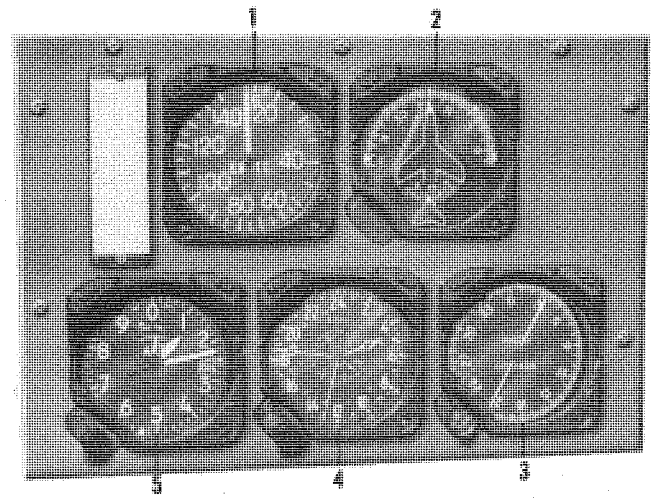
PERMANENT
Pilot Switch — OFF

TEMPORARY
Engage Switches — DISENGAGE

INSTANTANEOUS
Press autopilot release switch on either the pilot's or copilot's rudder wheel.

NAVIGATION EQUIPMENT.

The special navigation equipment consists of a drift sight and two binoculars. The drift sight can be placed on a bracket outside the copilot's window or on a bracket in the stern compartment adjacent to the flight refueling doors. The binoculars are stowed in cases strapped to support brackets on the port side of the pilot's compartment. The autopilot compass repeaters and magnetic compass are discussed in section I. No other special navigation equipment is delivered with the airship.



1. Airspeed Indicator
2. Autopilot Compass Repeater
3. Radio Compass Indicator
4. Clock
5. Sensitive Altimeter

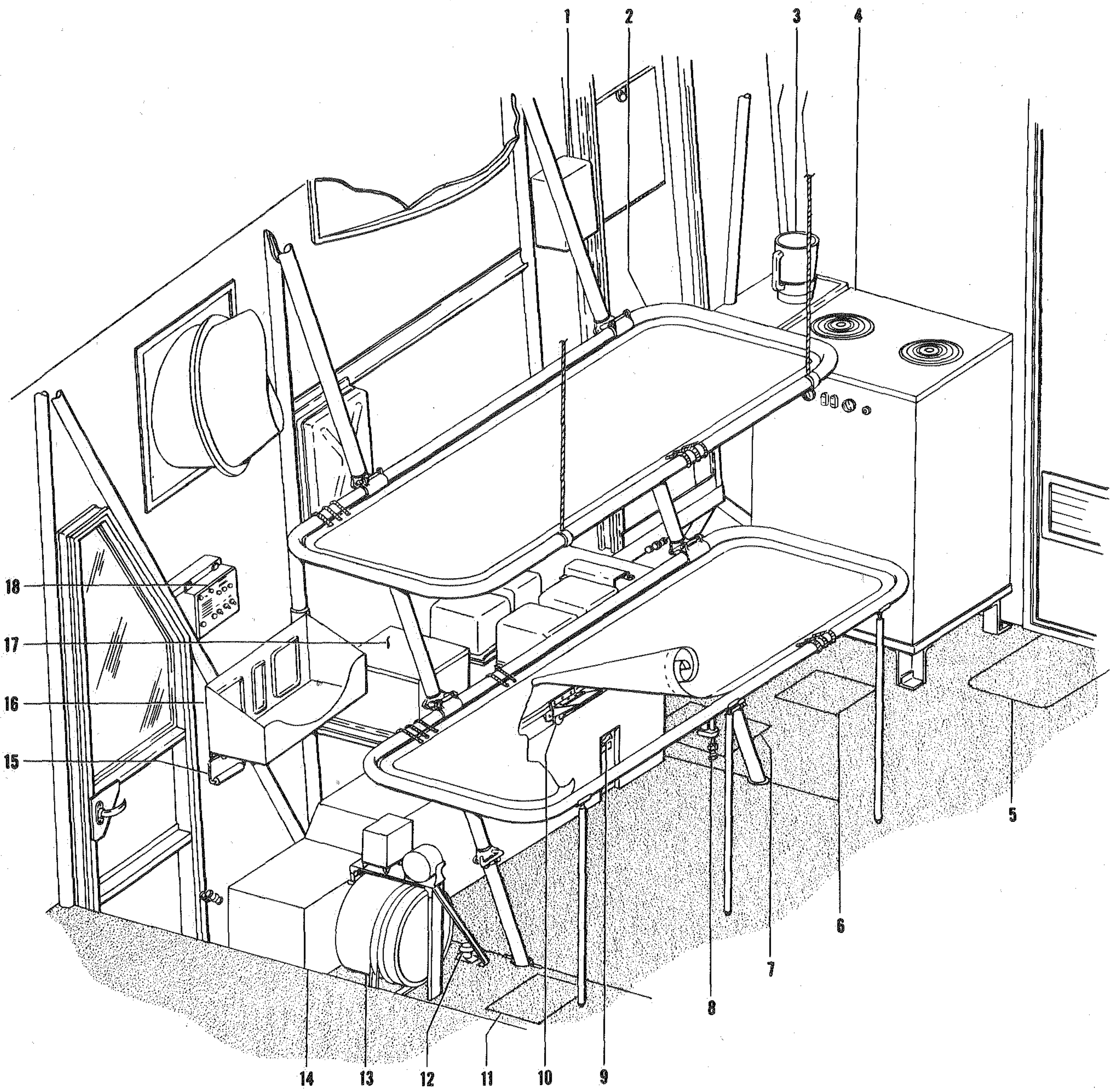
Figure 4-26. Navigator's Instrument Panel

AUXILIARY POWER UNIT.

DESCRIPTION. A portable auxiliary power unit can be used to supply d-c power to the airship main d-c bus when the airship is on the ground. The unit is mounted in a steel carrying assembly (pod) fitted with casters (figure 4-29). The entire unit weighs approximately 235 pounds. The APU can be attached to the car below the cargo door by a support assembly when the airship is on the mast.

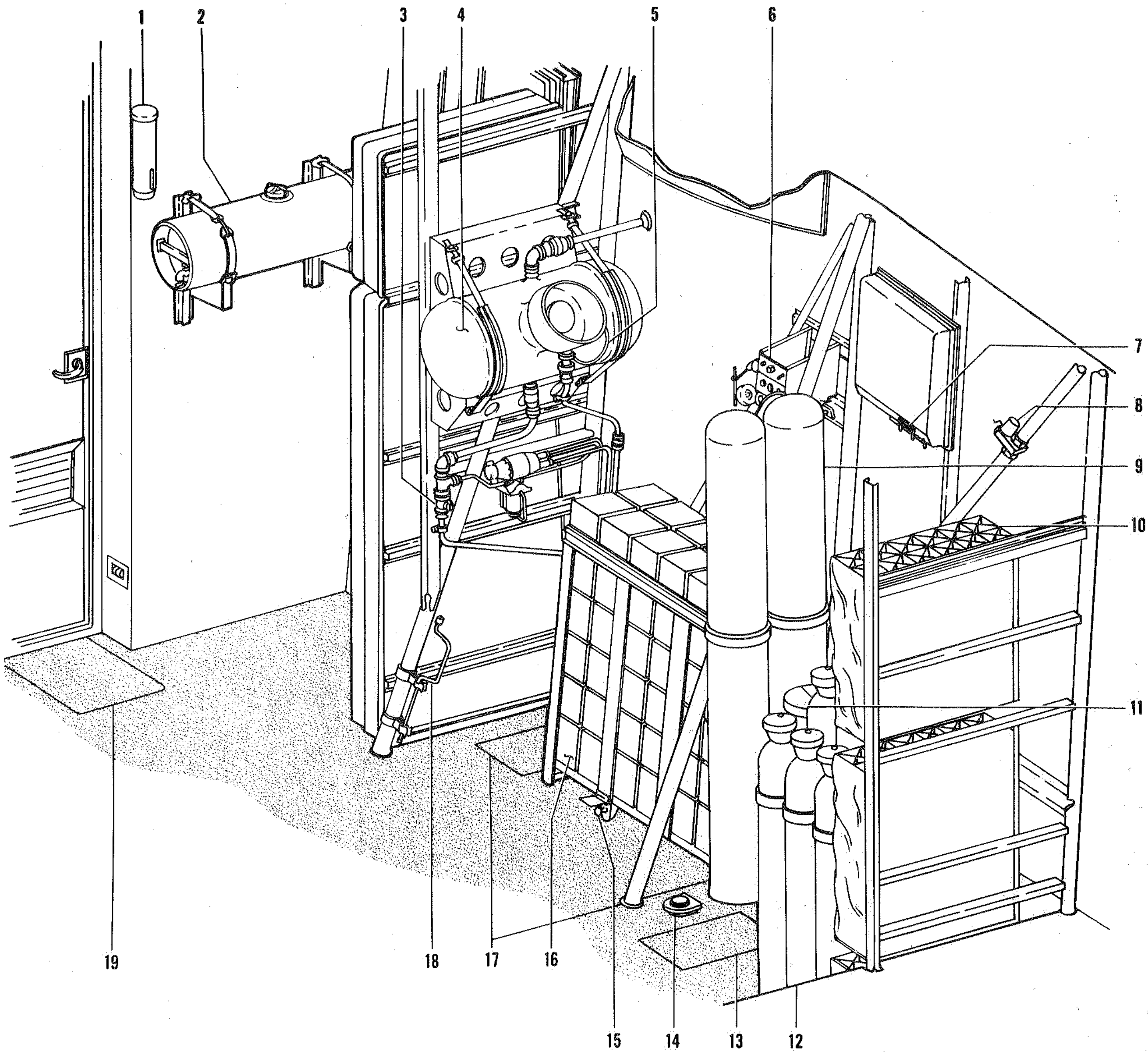
The two cylinder, four-cycle, air-cooled engine produces 10 horsepower at 3200 rpm and drives a 28.5-volt, 175-ampere, 5-kilowatt d-c generator. The APU engine can be started electrically with power from the airship main d-c essential bus or manually with a pull cord.

Fuel for operating the APU for short periods is supplied from a 2.5-gallon tank clamped to the carrying assembly. Fuel for operating the APU for extended periods is supplied from the airship fuel system. A 20-foot hose is connected to the aft fuel tank through a self-sealing quick disconnect on the starboard side at the aft end of the car. After closing the APU fuel tank shut-off valve (9, figure 4-30), a manually operated valve (10, figure 4-31) in the stern compartment is opened to permit feed through the hose. The APU uses 91/96 grade fuel, Specification MIL-F-5572.



1. First Aid Kit
2. Bunk
3. Hot Cup
4. Galley
5. Landing Gear Access Door
6. Fuel Strainer Drain Valves Access Door
7. Transfer to Fuel Feed Valve Access Door (Emergency Feed)
8. Forward Tank Fuel Valve
9. Heater Fuel Shut-Off Valve
10. MK-12 Fuel Tank Release
11. Slip Tank Transfer Valve Access Door
12. Slip Tank Release
13. Heater Fuel Control Unit
14. Heater Housing
15. Toilet Paper Rack
16. Sanitary Bag Holder
17. Electronics Shelf
18. Heater Control Panel

Figure 4-27. Utility Compartment - Port Side



1. Cup Dispenser
2. Fresh Water Tank
3. Anti-Icing Fluid Drain Valve
4. Anti-Icing Fluid Tank
5. Anti-Icing Fluid Quantity Gage
6. Sonobuoy Operator Call and ICS Station Control Panel
7. Main A-C Power Circuit Breakers
8. Aft Fuel Tank Transfer Valve
9. Directional Sonobuoy Stowage
10. Drift Signal and Dye Marker Stowage
11. Sonobuoy Chute
12. Non-Directional Sonobuoy Stowage
13. Drop Tank Transfer Valve Access Door
14. ICS Foot Switch
15. MK-12 Fuel Tank Release
16. Slick Marker Stowage
17. Engine Fuel Valves Access Door
18. Landing Gear Hand Crank
19. Landing Gear Access Door

Figure 4-28. Utility Compartment - Starboard Side

STARTING APU ELECTRICALLY. (See figure 4-30.)

a. If airship fuel system is to be used, attach APU fuel hose (1) to quick disconnect, and open APU fuel feed valve in car and fuel line shut-off valve (7) at APU.

WARNING

Be certain APU fuel tank shut-off valve (9) is closed and safetywired before connecting fuel hose to quick disconnect. The APU fuel tank can overfill if this valve is not closed.

b. If APU fuel tank is to be used do not attach APU fuel hose. Remove safety wire and open fuel tank shut-off valve (9) and fuel line shut-off valve (7) at APU.
c. Connect APU electrical connector (8) into d-c shore power receptacle and control circuit plug (10) into jack adjacent to the shore power receptacle.
d. Place throttle lever (4) in CHOKE.
e. Place ignition switch (5) in ON.
f. Close external APU control circuit breaker on d-c circuit breaker panel.
g. Check that main d-c essential bus is energized.
h. Hold start switch (3) in START until engine starts, then release switch.
i. Check oil pressure gage. If at least 30 psi is not indicated in 30 seconds, stop engine and correct trouble.
j. Place throttle lever in IDLE and warm up engine.
k. Place throttle lever and start-run switch in RUN.
l. When voltmeter indicates 28.5 volts, place generator line switch (2) in ON and load main d-c essential bus.

CAUTION

Do not operate APU with cylinder head temperature more than 254°C (490°F).

STARTING APU MANUALLY. (See figure 4-30.)

a. Follow steps "a" through "d" of electrical starting

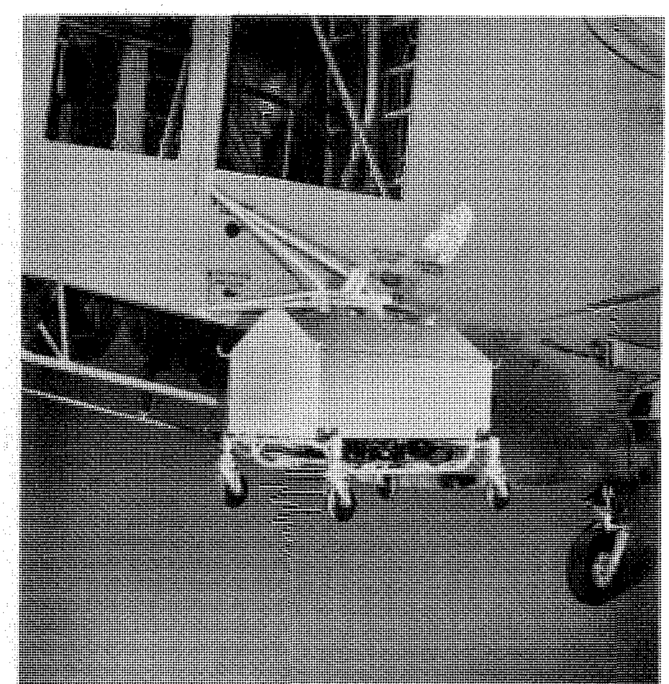
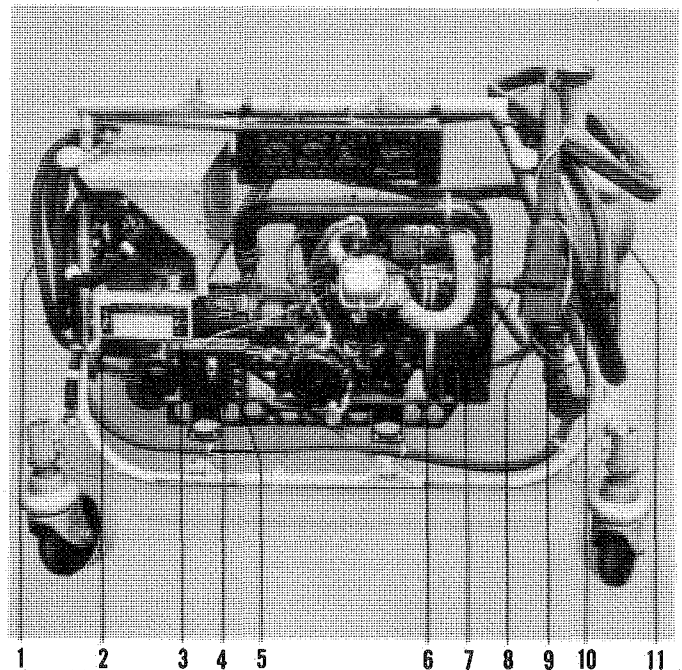


Figure 4-29. APU Pod



1. Fuel Hose
2. Generator Line Switch
3. Start Switch
4. Throttle Lever
5. Ignition Switch
6. Hand Starter Sheave
7. Fuel Line Shut-Off Valve
8. Electrical Connector
9. Fuel Tank Shut-Off Valve
10. Control Circuit Plug
11. Fuel Tank

Figure 4-30. APU Controls

procedure.

b. Wind pull cord on hand starter sheave (6).
c. Place ignition switch (5) in ON.
d. Pull sharply on pull cord handle until cord disengages from starter sheave.
e. Repeat steps "b" through "d" until engine starts. Turn ignition switch off each time before rewinding pull cord on starter sheave.
f. When engine starts, follow steps "i" through "l" of electrical starting procedure.

STOPPING APU. (See figure 4-30.)

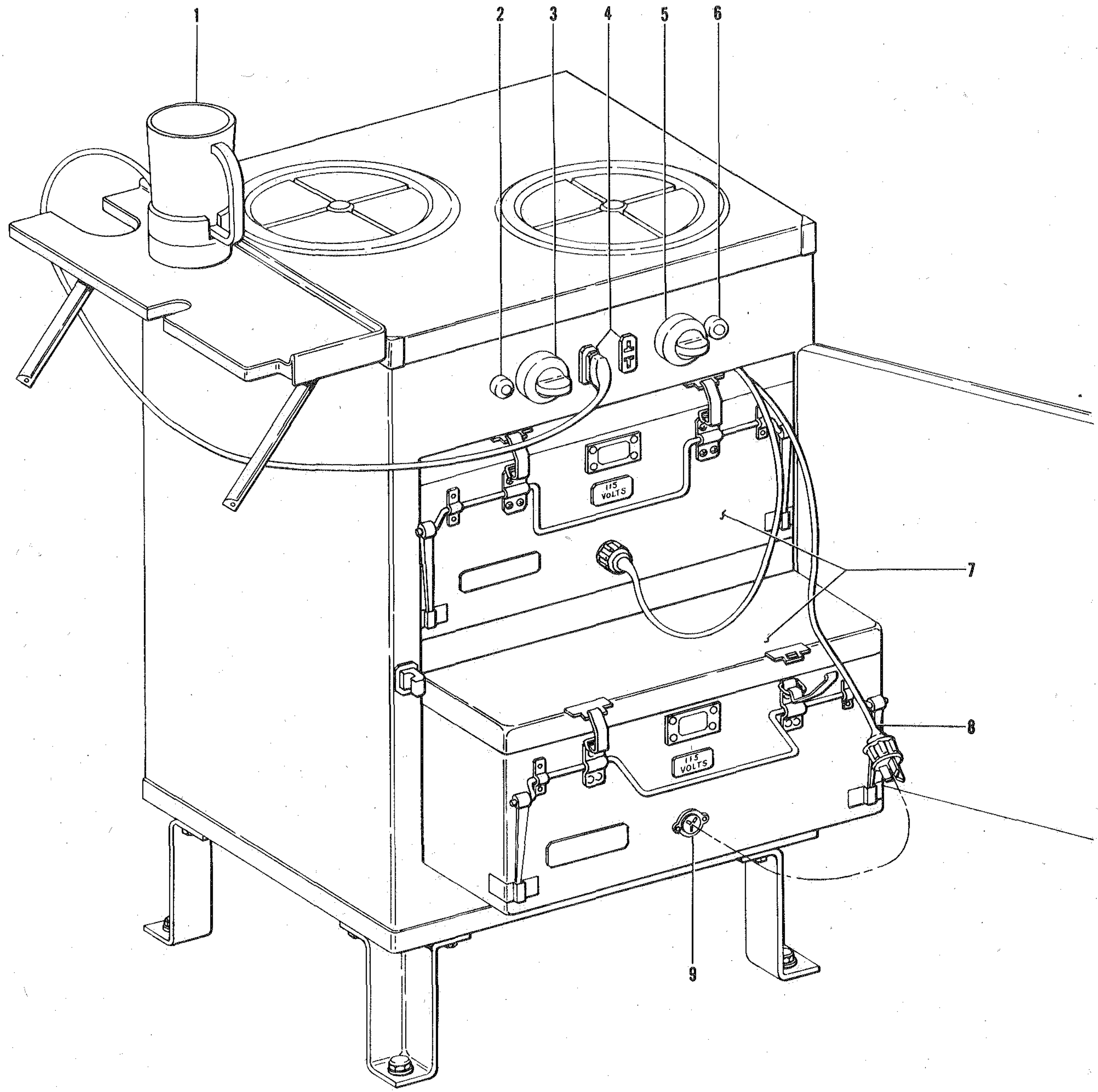
a. Remove load from main d-c essential bus.
b. Place generator line switch (2) in OFF.
c. Place throttle lever (4) in IDLE.
d. Idle engine until cylinder head temperature is below 121°C (250°F); then place ignition switch in OFF.
e. Close fuel shut-off valves.
f. While engine is warm, check APU oil supply and add oil, Specification MIL-L-6082, if required.

ARMAMENT SYSTEM.

Refer to NAVAER 01-195PAC-501A Supplementary Flight Handbook for information on the armament system.

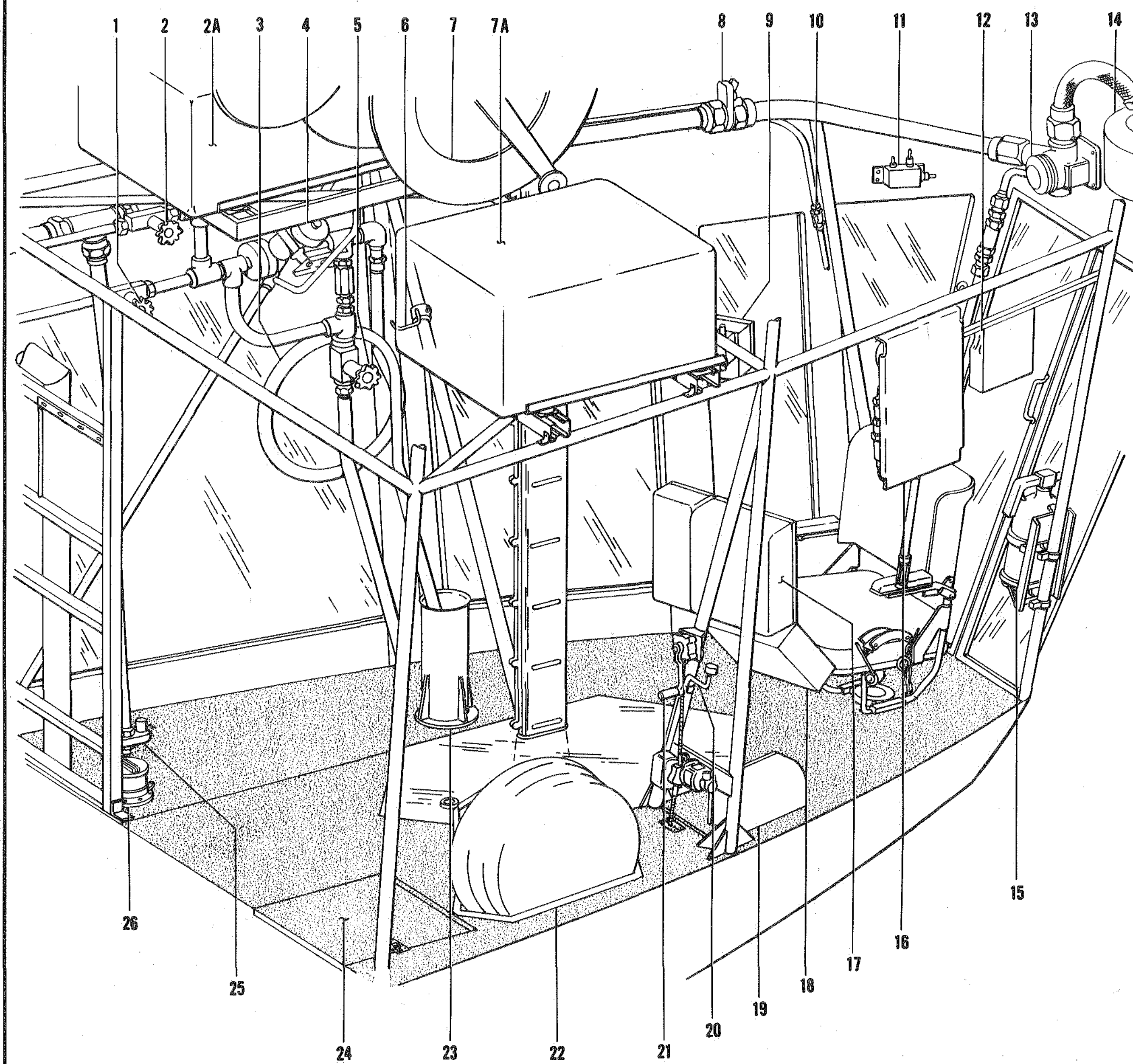
GALLEY EQUIPMENT.

The galley (figure 4-30A) includes a two-element electric range, two removable, electrically-heated food storage drawers, two utility outlets, an electric hot cup, a utility tray, and cutlery and eating utensils for 12 men.



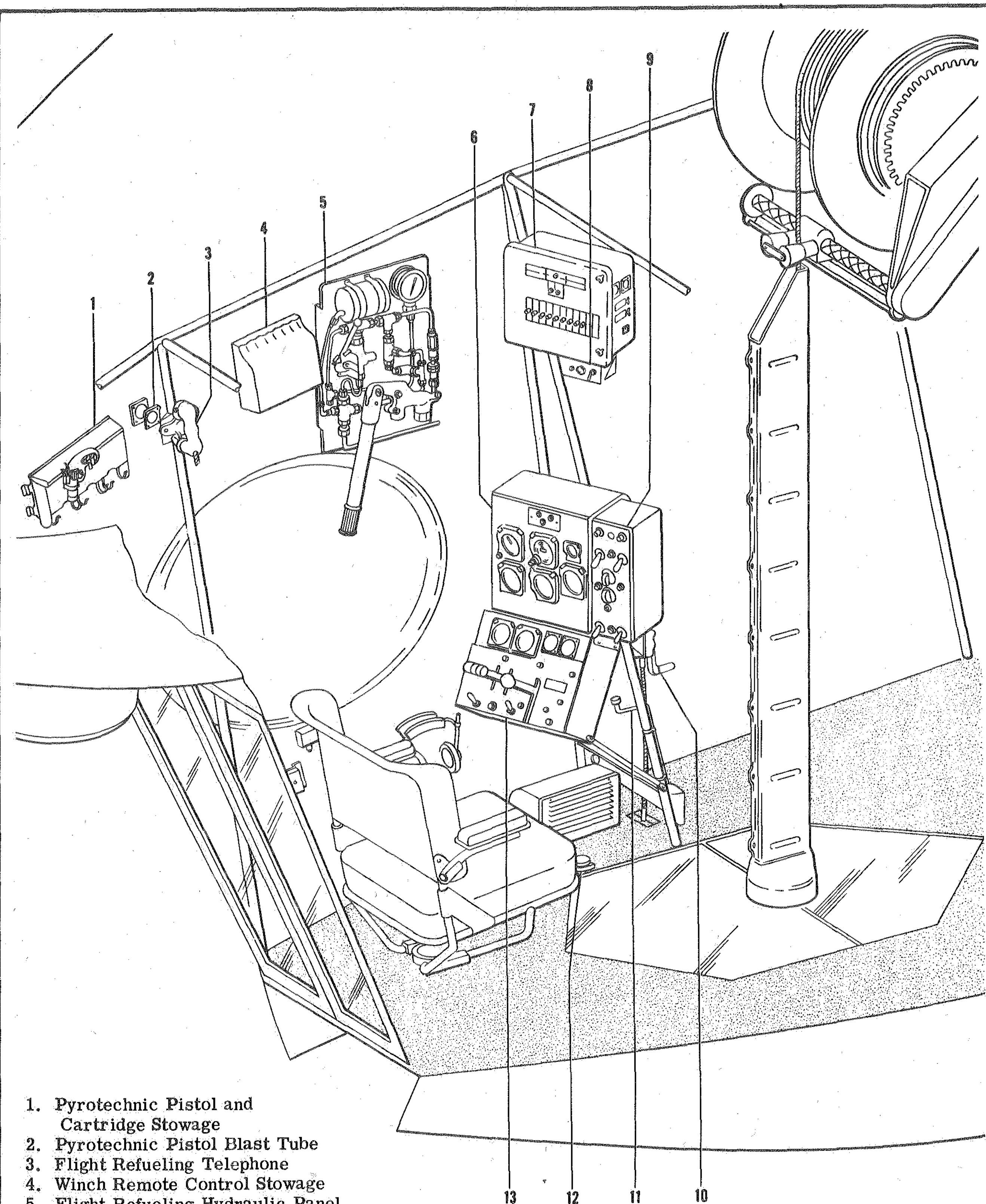
1. Hot Cup
2. Starboard Heating Element Indicator Light
3. Starboard Heating Element Switch
4. Utility Outlets
5. Port Element Switch
6. Port Element Indicator Light
7. Hot Food Storage Drawers
8. Drawer Electrical Cord
9. Drawer Electrical Receptacle

Figure 4-30A. Galley



1. Forward Ballast Tank Fill Valve
2. Aft Ballast Tank Fill Valve
2A. AN/AQS-2 Power Supply (134019 and Subsequent)
3. In-Flight Reballasting Hose
4. Ballast Pump
5. Main Ballast Fill Valve
6. Drag Rope Stowage Hook
7. Winch
7A. AN/AQS-2 Transmitter (134019 and Subsequent)
8. Winch Operator's Circuit Breaker Panel
9. Refueling Line Shut-Off Valve
10. APU Fuel Feed Valve
11. ICS Junction Box
12. Winch Remote Control Swotage
13. Ground Refueling Coupling
14. Flight Refueling Coupling
15. Fire Extinguisher
16. Flight Refueling Hydraulic Panel
17. Winch Operator's Instrument Panel
18. Winch Control Panel
19. Heater Outlet
20. Follower Pulley Hand Crank
21. Fish Clamps Hand Crank
22. Ballast Bag
23. Reballasting Hose Sump
24. Toilet Access Door
25. Slip Tank Refuel Valve
26. Marker Chute

Figure 4-31. Stern Compartment



1. Pyrotechnic Pistol and Cartridge Stowage
2. Pyrotechnic Pistol Blast Tube
3. Flight Refueling Telephone
4. Winch Remote Control Stowage
5. Flight Refueling Hydraulic Panel
6. Winch Operator's Instrument Panel
7. Winch Operator's Circuit Breaker Panel
8. ICS Station Control Panel
9. Winch Operator's Auxiliary Panel
10. Fish Clamps Hand Crank
11. Follower Pulley Hand Crank
12. ICS Foot Switch
13. Winch Control Panel

Figure 4-32. Winch Operator's Station

The switches for the range elements are on the front panel of the range. The switches have four positions: OFF, LOW, MED, and HIGH. Beside each switch is a panel light that glows when the switch is in one of the on positions and the heating element is operating.

Each hot food storage drawer inside the galley range contains four one-gallon metal containers. The temperature in each drawer is thermostatically controlled. To operate the drawer heating elements, insert the electrical plug into the receptacle at the front of the drawer.

A utility tray containing cutlery and eating utensils is located below the hot food storage drawers. The tray is accessible after the lower drawer is removed. The hot cup, which has a capacity of 37 fluid ounces, warms when plugged into the utility outlet beside the range.

WINCH.

DESCRIPTION. The two-drum winch, mounted overhead in the stern compartment, is driven hydraulically and normally is controlled electrically. The large drum carries either 0.3- or 0.7-inch multi-conductor cable and is used for sonar fish towing. The small drum, which carries 1/4-inch cable, is used for hoisting cargo, personnel, a refueling hose, or a ballast pick-up bag. The towing cable is guided by a swivel pulley below the car floor. The hoisting cable is threaded through the in-flight refueling reception coupling, and a push-pull coupler is installed on the end of the cable. The winch drums are driven through a gear box on the winch, and only one of the two drums can be operated at one time. Each drum is equipped with locking pawls and friction brakes. The brakes on both drums are released by hydraulic pressure when either drum is being driven by the winch motor. The towing drum brake is set to slip at 2500 pounds and the hoist drum brake at 2800 pounds. A level wind mechanism for each drum guides the cable so that it winds evenly on the drum. Slip rings in each drum complete electrical circuits between conductor cables and a stationary receptacle on each drum.

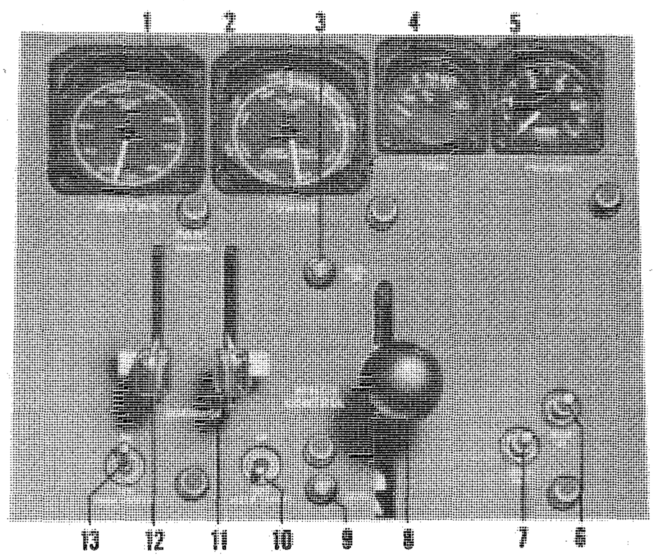
The winch hydraulic system is pressurized by a pump driven by the constant speed drive. The pump supplies a flow of fluid under high pressure to drive the winch motor. The direction and rate of flow of the fluid is controlled by a control valve, which is normally operated electrically but can be controlled manually. A shut-off valve in the system, also controlled electrically, releases pressure to actuate the friction brakes so that they release immediately when the winch starts operating. A towing vent valve, operated manually, is opened during towing to prevent a pressure build-up which might release the brakes. The winch system hydraulic reservoir serves both the winch system and the constant speed drive hydraulic system. The constant speed drive cooling system also cools the winch system pump and the fluid in the winch system. The winch reservoir is pressurized by gas from a bottle which feeds through a pressure regulator and a shut-off valve. The pressure in the reservoir must be maintained to prevent cavitation of the winch system pump and the constant speed drive system pumps.

Controls and instruments for the winch system are located on the winch, at the winch operator's station, and on the winch reservoir panel on the starboard side of the stern compartment.

LEVEL WIND DISCONNECT. A level wind disconnect is located on the starboard end of each winch drum level wind shaft. The disconnect is spring-loaded to the engaged position so that the level wind will operate with the drum to evenly space the cable on the drum as the drum rotates. If a change is necessary in the position of the level wind to align it with the cable wrapped on the drum, the level wind disconnect should be pulled and held against its spring tension while the level wind shaft is rotated. The cable feeding onto the drum should lap the preceding wrap by 1/16 inch.

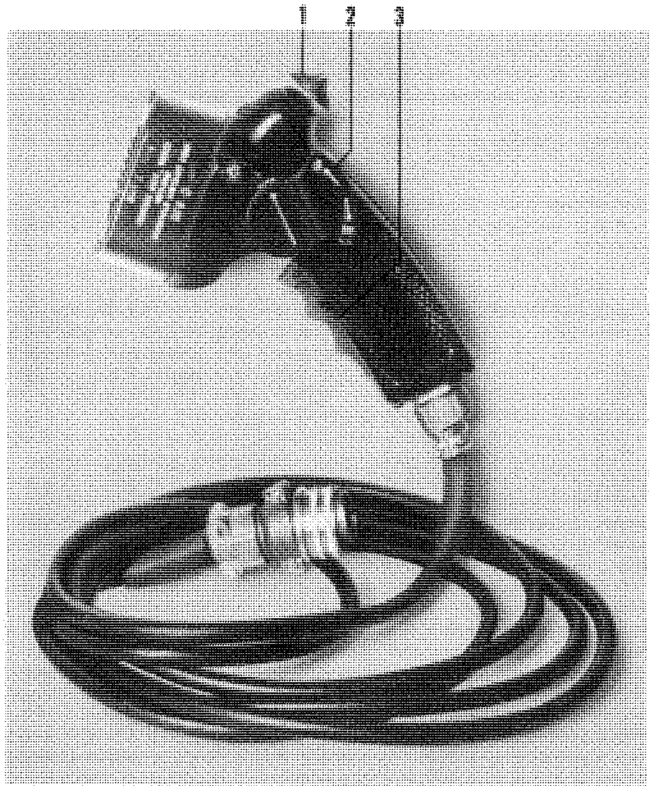
PAWL LEVERS. The two pawl levers (11 and 12, figure 4-33) are linked by a cable to gear sector pawls on the winch drums. The right lever controls the towing drum pawl and the left lever controls the hoisting drum pawl. When a lever is in the ENGAGE position, the corresponding spring-loaded pawl locks the drum. Movement of the lever is DISENGAGE causes the pawl to release.

A spring-loaded latch on each pawl lever must be raised before the lever can be moved. The pawls will ratchet with reel-in motion of the drums; however, ratcheting the pawls is not recommended. The pawl control lever for either drum should never be engaged when the load on the cable is two-blocked against the car.



1. Hoisting Cable Payout Indicator
2. Towing Cable Payout Indicator
3. Reel In Signal Light
4. Hydraulic Fluid Temperature Gage
5. Hydraulic Pressure Gage
6. Inch-In Button
7. Inch-Out Button
8. Winch Control Lever
9. Reel Out Signal Light
10. Instrument Light Switch
11. Towing Drum Pawl Control Lever
12. Hoisting Drum Pawl Control Lever
13. Main Switch

Figure 4-33. Winch Control Panel



1. Inching Switch
2. Winch Control Knob
3. Deadman Switch

Figure 4-34. Winch Remote Control

ENGAGING CONTROL HANDLES. The engaging control handles on the bottom of the winch gear box are used to engage the winch drive motor to the winch drums. Only one drum can be engaged at a time. Both handles must be moved toward the drum to be engaged. It may be necessary to momentarily depress an inching button to obtain correct gear alignment so that handles can be moved into the lock position.

WINCH CONTROL MAIN SWITCH. When placed in the ON position, the main switch (13, figure 4-33) connects 28-volt d-c power to the control circuits and temperature indicator and a-c power to the indicator circuits of the winch system. The switch is on the winch control panel.

WINCH CONTROL LEVER. The winch control lever (8, figure 4-33) is located on the winch control panel. The lever is attached to a rheostat within the control panel. As this control is moved up to its REEL IN range, electrical signals operate the control valve and close the solenoid-operated shut-off valve. The control valve operates to force fluid through the winch motor in the direction necessary to cause the pre-selected winch drum to wind in the cable. As the control is moved farther up, the control valve causes the pump to increase its output so that the winch motor speeds up and the drum winds cable more rapidly. Moving the control down into the REEL OUT range reverses the direction of fluid flow in the hydraulic system so that the engaged drum pays out cable. When the control is returned to the center neutral position, the drum stops turning and the solenoid-operated shut-off valve opens. The brakes are applied instantaneously as the system is depressurized through the open shut-off valve.

INCHING BUTTONS. The inch-in and inch-out buttons (6 and 7, figure 4-33) are precision controls to position a load at the end of the cable run. The buttons cause the same system operation as that begun by moving the winch control lever up or down, but winch speed is held to a fixed slow rate.

REMOTE CONTROL. A winch remote control (figure 4-34) is stowed in a bag above the winch operator's seat. It can be connected to the winch control system through a receptacle near the stowage bag. The deadman switch (3) is held depressed to make the control operable. The control knob (2) on the side duplicates the function of the winch control lever on the control panel. The thumb-operated inching switch is held up or down to duplicate the function of the inching buttons on the control panel.

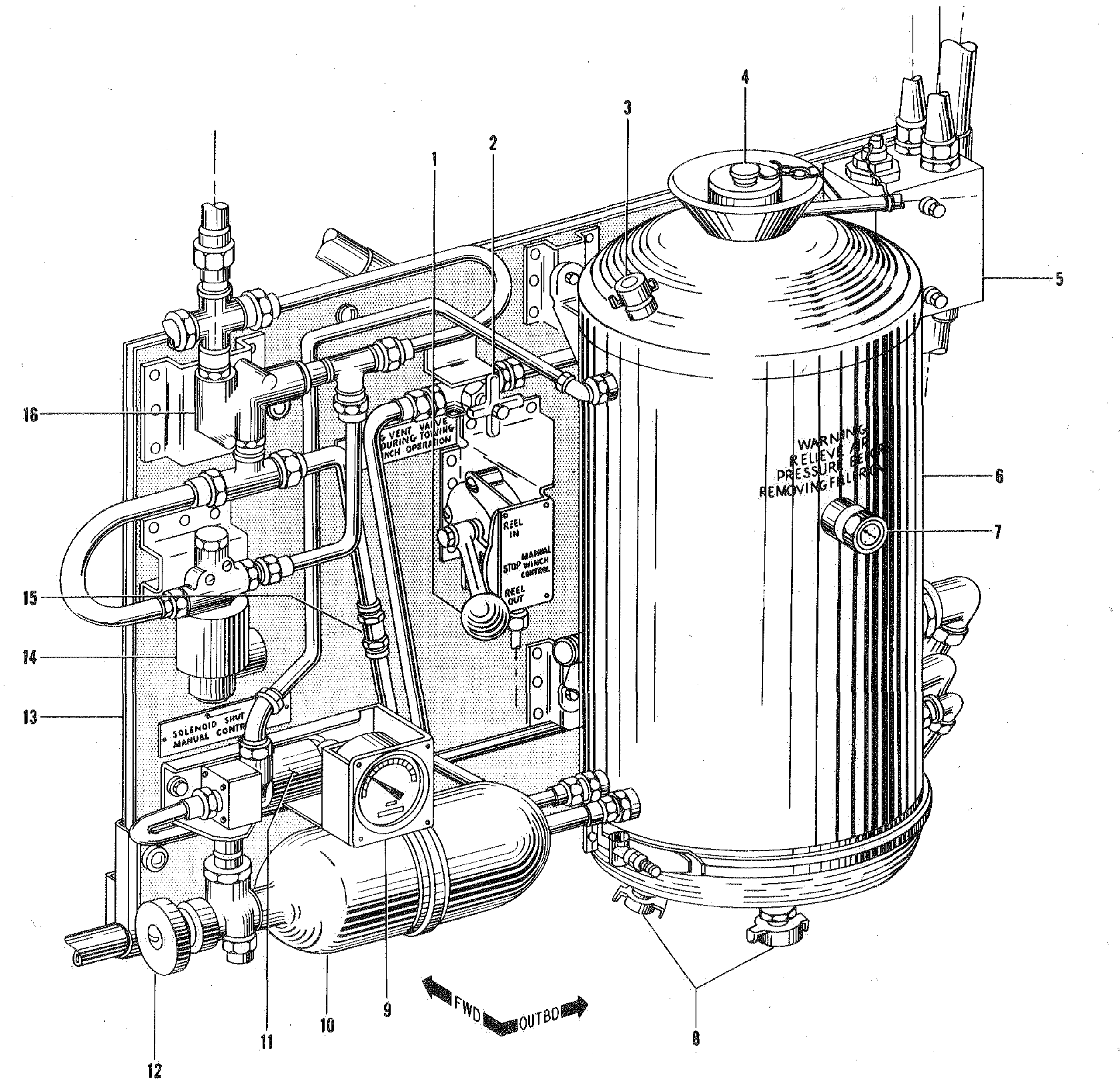
TOWING VENT VALVE. A towing vent valve (2, figure 4-35) is installed in the winch hydraulic system and is located on the winch reservoir panel. When opened the valve prevents a fluid pressure build-up in the brake release lines when surge loads are imposed on the towing drum during towing operations. The valve is closed during reel-in or reel-out operation; it is opened before the fish enters the water and closed after it is withdrawn.

MANUAL WINCH CONTROL HANDLE. A handle (1, figure 4-35) on the winch reservoir panel can be used to manually control the winch if the winch electrical control system fails. Moving the handle toward REEL IN or REEL OUT operates the winch control valve in the starboard nacelle which causes the pre-selected winch drum to rotate. Operation of the handle closes the solenoid operated shut-off valve electrically if power is available to that part of the system. If power is not available, the manual control button on the shut-off valve must be depressed to release the winch brakes.

SOLENOID SHUT-OFF VALVE MANUAL CONTROL BUTTON. The shut-off valve (14, figure 4-35) which operates to control the winch brakes is equipped with a button which can be used to close the valve. Normally the valve operates automatically when the winch control lever or manual winch control is operated, but when electrical power is not available, the valve must be controlled manually. Pushing the button causes the winch brakes to release.

GAS CYLINDER SHUT-OFF VALVE. The gas cylinder shut-off valve (12, figure 4-35) on the winch reservoir panel is opened to permit flow of gas from the bottle to the pressure regulator (11, figure 4-35). The gas is supplied to the regulator at the pressure indicated on the helium pressure indicator. The pressure is reduced to 25 ± 3 psi working pressure by the pressure regulator and directed to the fluid reservoir. The shut-off valve must be opened before either engine is started and must be left open until both engines are secured.

PAYOUT INDICATORS. The hoisting and towing indicators (1 and 2, figure 4-33) are autosyn instruments show-

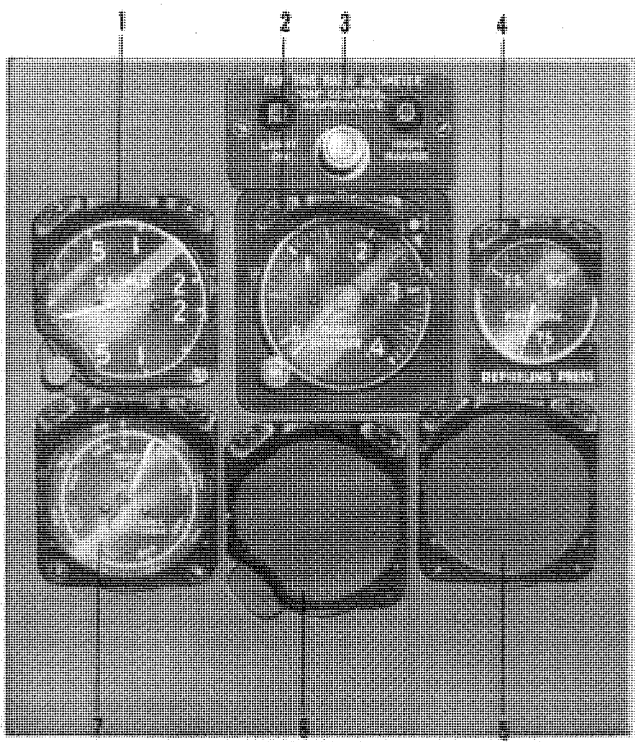


1. Manual Winch Control Handle
2. Towing Vent Valve
3. Pressure Relief Valve
4. Filler Cap
5. Relief Valve
6. Reservoir
7. Fluid Quantity Indicator
8. Drain Valves
9. Gas Cylinder Pressure Indicator
10. Gas Cylinder
11. Gas Pressure Regulator
12. Gas Cylinder Shut-Off Valve
13. Reservoir Panel
14. Solenoid Shut-Off Valve
15. Check Valve
16. By-Pass Valve

Figure 4-35. Winch Reservoir Panel

ing the amount of cable payed out from the drums. The towing indicator has two scales, one calibrated for 0.3-inch cable and the other calibrated for 0.7-inch cable. A second towing drum payout indicator (25, figure 1-6) is located on the pilot's instrument panel. Before reeling out cable, make sure that the indicating system is adjusted so that indicators read zero.

HYDRAULIC PRESSURE GAGE. The pressure gage (5, figure 4-33) registers the pressure in the winch hydraulic system. The pressure, as indicated on the gage, varies directly with the weight of the load on the cable. When the winch control is in neutral position, the brake line is vented and the indicator reading falls off to approximately zero.



1. Rate-of-Climb Indicator
2. Radio Altimeter Indicator
3. Radio Altimeter High Range Signal
4. Refueling Pressure Gage
5. AN/ASQ-2 Fish Speed Indicator
6. AN/ASQ-2 Fish Depth Indicator (131919 through 131926)
7. Cable Tension Indicator

Figure 4-36. Winch Operator's Instrument Panel

TEMPERATURE INDICATOR. The temperature indicator (4, figure 4-33) on the winch control panel registers temperature of fluid in the reservoir. Since the same reservoir is used for both the constant speed drive system and the winch system, the indicator is used to check operation of both. Fluid temperature above the normal range means that the constant speed drive cooling system is malfunctioning or that the constant speed drive system or winch system is not operating properly.

FLUID QUANTITY INDICATOR. The fluid quantity indicator (7, figure 4-35), located on the front of the reservoir on the winch reservoir panel, indicates the fluid level in the reservoir. Fluid level should be maintained between 3/4 and FULL. The engines should not be operated if fluid level is below 3/4.

GAS CYLINDER PRESSURE INDICATOR. An indicator (9, figure 4-35) on the winch reservoir panel registers pressure in the gas cylinder (10, figure 4-32). The cylinder should be replaced or recharged when pressure drops below 150 psi.

REEL-IN, REEL-OUT SIGNAL LIGHTS. The reel-in and reel-out signal lights (3 and 9, figure 4-33) on the winch control panel are not connected in this installation.

WINCH (134019 and Subsequent).

DESCRIPTION. The winch installation is identical with that on airships 131919 through 131926 except that reel-in and reel-out lights are operable.

SIGNAL LIGHT SWITCH. A three-position toggle switch (figure 4-18A) on the pilot's AN/AQS-2 indicator panel controls the operation of reel-in and reel-out signal lights. From the center OFF position the switch can be placed in the WINCH IN position to illuminate the reel-in lights, or in the OUT position to illuminate the reel-out lights.

REEL-IN, REEL-OUT LIGHTS. Reel-in and reel-out lights (3 and 9, figure 4-33) on the winch control panel are used to signal the winch operator during winch operation. The lights are controlled by the signal light switch on the pilot's AN/AQS-2 indicator panel (figure 4-18A). Reel-in and reel-out lights on the AN/AQS-2 pilot's panel operate simultaneously with the lights on the winch control panel.

NORMAL OPERATION.

BRAKE ADJUSTMENT. An adjusting nut, secured by a lock nut, is installed on one end of each brake band. Tightening the adjusting nut with an offset box-end wrench tightens the brake band and increases the setting at which the brake will slip. Loosening the adjusting nut loosens the band and decreases the setting at which slippage occurs. The brake slippage protects the winch and airship against surge loads encountered in towing and hoisting operations. An indicator on top of each brake cylinder indicates in pounds the cable load which will cause the brake to slip. Normally the hoisting drum brake is set to slip at 2800 pounds and the towing drum brake is set for 2500 pounds.

USE OF PUSH-PULL COUPLER. The push-pull coupler is threaded on a swaged terminal at the free end of the winch hoisting cable and secured with a lock nut. The coupler consists of six spring-loaded fingers in a sliding housing. When the housing is pushed toward the cable, the fingers spread apart to grasp the ball fitting on the refueling hose, ballast bag, or sandbag adapter. The housing is then pushed forward toward the ball fitting and locks the fingers around the ball. The coupler and lock nut must be removed from the terminal to allow the cable to be removed from the refueling reception coupling. When the coupler is to be re-installed, the lock nut is screwed on the terminal first, then the coupler; then the lock nut is tightened down against the coupler. When the winch is used for ballast pick-up, the coupler should be checked for security each time a ballast lift is made. Rotation and oscillation of the bag can cause the coupler to loosen from the swaged terminal.

USE OF SANDBAG ADAPTER. A sandbag adapter coupled to the hoisting cable is used as a weight when the cable is lowered and is used to stow the cable when it is secured. When the cable is being secured the adapter is seated snugly into the in-flight refueling reception coupling by means of the inching button.

OPERATING PROCEDURE. The winch is normally operated by the controls on the winch control panel or the remote control handle in the stern compartment. The following operating procedures apply to basic operation of the winch. Use of the winch for specific operations such as fish towing or refueling is explained in section VII. With the winch in secured condition, the operator should make the following checks before operating the winch.

With the winch main switch OFF, check the following:
a. Winch speed control handle in neutral position.
b. Hoisting drum and towing drum pawl control levers in ENGAGED position and pawls engaged to drums.
c. Reservoir fluid level indicator registering between 3/4 and FULL.
d. Gas pressure indicator registering above 150 psi and pressurization shut-off valve open.
e. Towing vent valve closed.
f. Hoisting drum brakes set at 2800 pounds and towing drum brakes set at 2500 pounds.
g. Constant speed drive operating with normal load.

Place the winch main switch in ON and check as follows:
h. Hydraulic fluid temperature indicator registering in normal range.
i. Hoisting and towing cable payout indicators on winch control panel and pilot's instrument panel registering zero.
j. On airships 134019 and subsequent, reel-in and reel-out lights operative when signal light switch on pilot's AN/AQS-2 indicator panel is operated.

After the checks have been made, the winch is operated as follows:
a. With the main switch on, engage selected drum to motor by shifting engaging control handles toward drum.

CAUTION

Handles must be shifted slowly to avoid damage to gears in case motor is rotating slightly. If gears do not mesh, press inch-out button momentarily.

b. Raise latch on pawl control lever and move lever to DISENGAGE position.

WARNING

Never disengage pawl of drum which is not engaged to motor. Brakes on both drums release simultaneously when speed control handle is moved from neutral. The drum not being used will spool out if pawl is disengaged when a load is attached.

c. Move speed control handle toward REEL OUT. Winch speed is directly proportional to amount of handle movement from center neutral position.
d. Stop winch reel-out by returning speed control handle to neutral.
e. Reel in winch by moving speed control handle toward REEL IN. If a slow, steady reeling speed is desired, the inching buttons may be used instead of the control handle. The control handle must be in neutral when the inching buttons are used.

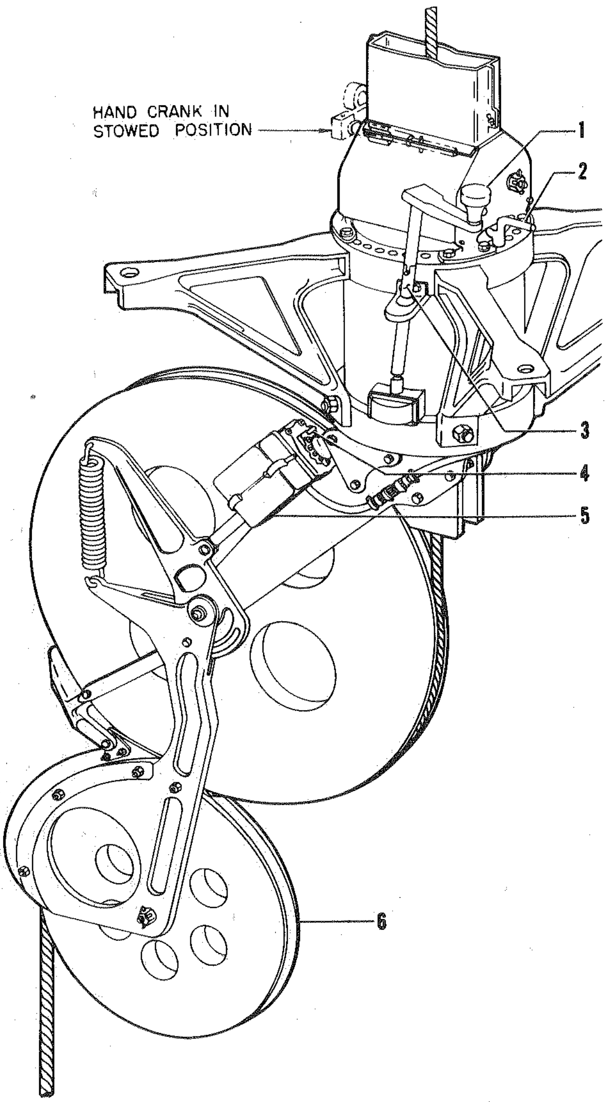
NOTE

The pawl control lever should be on DISENGAGE while the drum is reeling in. If the pawl is inadvertently left engaged and the load is two-blocked against the car, the pawl block must be loosened to back off the load.

f. Secure winch by reeling in last few feet of cable by means of the inching button and carefully two-block load against car; then inch drum out slightly, engage pawl, and move main switch to OFF.

WINCH EMERGENCY OPERATION.

If the electrical circuit between the speed control handle and the hydraulic control valve fails, the valve is controlled manually by the winch manual control handle. Manual operation of the valve completes an electrical circuit to the solenoid-operated shut-off valve, closing the shut-off valve and releasing the brakes. If the shut-off valve circuit also fails, the shut-off valve must be closed manually when the control valve is manually operated. The shut-off valve is closed by pushing in on the manual control button.



1. Swivel Pulley Hand Crank
2. Lock Handle
3. Swivel Pulley Hand Crank and Drive Shaft
4. Actuator Manual Override Shaft
5. Electric Actuator
6. Follower Pulley

Figure 4-37. Swivel Pulley

SWIVEL PULLEY.

DESCRIPTION. (See figure 4-37.) The swivel pulley, located in the sonar fish well, guides the towing cable and protects the car structure from damage as the cable strain shifts during towing operations. The pulley rotates to compensate for any difference between the sonar fish course and the airship heading. A follower pulley mounted below the swivel pulley keeps the swivel pulley aligned with the towing cable. A dial on top of the pulley housing indicates in degrees the pulley deviation from the car longitudinal centerline. The pulley is stowed in the 180° position and secured by a lock handle. The pulley is normally extended and retracted by an electric actuator which is not connected to power unless the pulley is in the 180° position. The pulley can also be extended or retracted manually. A hand crank is engaged in gearing on the pulley housing to swing the swivel pulley in azimuth.

SWIVEL PULLEY SWITCH. The swivel pulley switch (figure 4-38) on the winch operator's auxiliary panel electrically controls the swivel pulley actuator. If the pulley is in the 180° position, placing the switch on TOWING connects power to the actuator to drive the follower pulley to the towing position. Placing the switch on STOWED connects power to drive the follower pulley to the stowed position. Wiper contacts on the pulley fork and housing break the electrical circuit when the pulley is out of the 180° position.

FOLLOWER PULLEY HAND CRANK. An emergency hand crank (20, figure 4-31) stowed on the port side of the stern compartment is used to extend or retract the follower pulley mechanically. The crank is engaged on an override shaft (4, figure 4-37) on top of the actuator. The crank is rotated clockwise to retract the follower pulley to the stowed position and counterclockwise to extend the pulley to the towing position. The override shaft is accessible after a transparent floor panel is raised.

SWIVEL PULLEY HAND CRANK. A hand crank (1, figure 4-37) stowed on the cable guide is used to swing the swivel pulley in azimuth. The crank engages in a socket connected to gearing in the pulley housing. The crank is pushed down and rotated to align the pulley.

SWIVEL PULLEY LOCK HANDLE. A lock handle (2, figure 4-37) on the pulley housing secures the pulley in the stowed position. The lock engages a slot in the indicator dial when the pulley is in the 180° position. The lock is released by lifting up and turning the handle

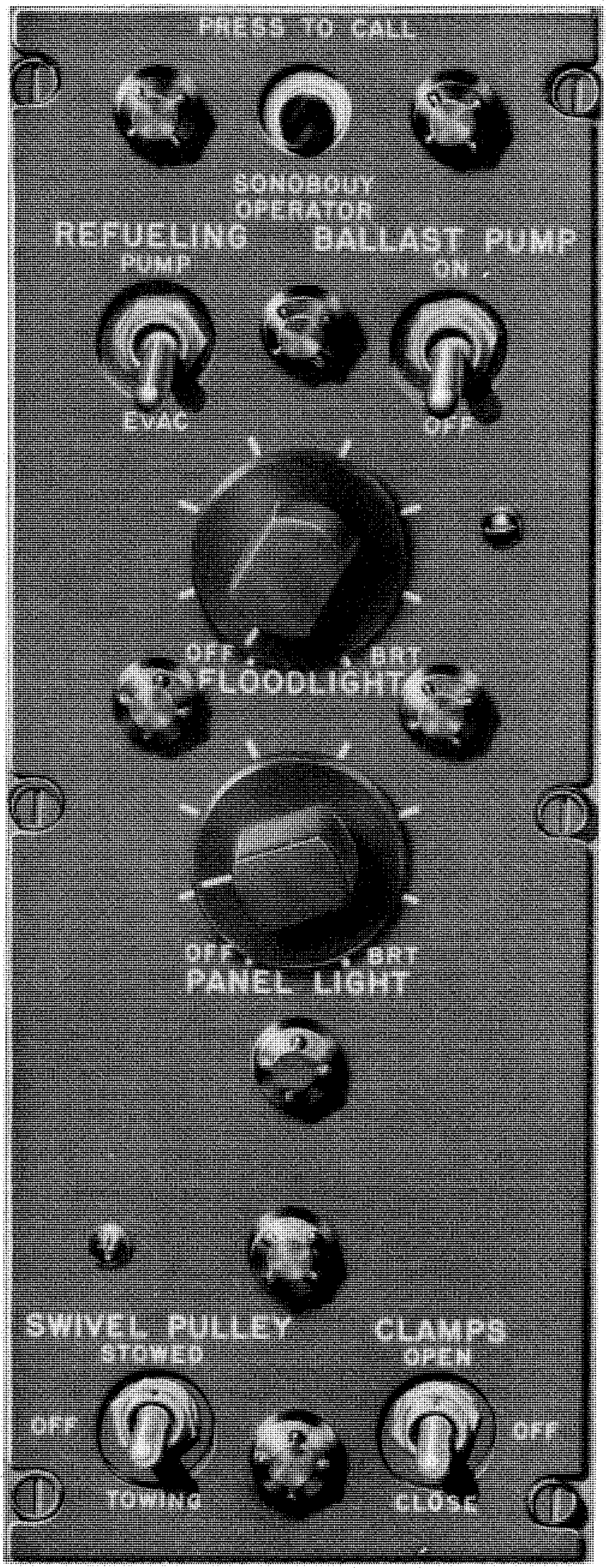


Figure 4-38. Winch Operator's Auxiliary Panel

counterclockwise to the athwartship position. A needle on the handle provides an index point for the indicator dial when the handle is in the unlocked position. The pulley is secured in the 180° position by turning the handle clockwise and releasing so that the lock engages the slot in the indicator dial.

SONAR FISH CLAMPS.

DESCRIPTION. Two clamps are mounted beneath the stern compartment deck to secure the stowed sonar fish. The clamps are opened or closed by a flexible linkage driven by an electric actuator mounted forward of the winch operator's panel. The clamps can be operated manually by turning the hand crank above the actuator.

FISH CLAMPS SWITCH. A two-position clamps switch (figure 4-38) on the winch operator's auxiliary panel controls the actuator which moves the fish clamps into the open and close positions. When the switch is placed in the OPEN position, the clamps open to the fully extended position. When the switch is returned tothe CLOSE position, the clamps close approximately half-way. When the sonar fish is two-blocked against the fish clamp stops it depresses a limit switch in one of the stops, and the actuator then operates to fully close the clamps.

FISH CLAMPS HAND CRANK. A hand crank (10, figure 4-32) is used to open or close the fish clamps manually. The crank is spring-loaded and must be pushed in to engage the gearing. The crank is turned clockwise to close and counterclockwise to open the fish clamps. Approximately 250 turns are required to drive the fish clamps from full open to full close.

IN-FLIGHT REFUELING SYSTEM.

DESCRIPTION. The equipment required for in-flight refueling consists of a reception coupling for connecting the hose, a hydraulic system for controlling the coupling, an electrical control system for controlling the pump at the surface vessel, a sound-powered phone system for communication with the surface vessel, a manual shut-off valve in the airship refuel line, and a refueling pressure gage.

The reception coupling contains hydraulically controlled toggle arms which hold a hose in the coupling. The arms release if the load exceeds 1250 pounds. A hydraulically-controlled flap valve in the coupling is opened to permit fuel to flow into the airship refueling line. A relief valve in the coupling dumps fuel overboard if the fuel pressure at the coupling exceeds 60 psi. The toggle arms and flap valve are controlled by a hydraulic system which is pressurized by manual pumping. The major components of the hydraulic system are on a panel (figure 4-39) at the winch operator's station.

Some of the components of the control system for the refueling pump on the surface vessel are on the surface vessel and some on the airship. The control circuit is completed by plugging a cable from the surface vessel into a receptacle on the aft car and closing the circuit with a refueling switch on the winch operator's auxiliary panel. When the circuit is complete, a signal lights on the surface vessel to indicate that the airship is ready to take on fuel. The circuit is opened by the refueling switch or by a pressure switch actuated when pressure in the airship refuel line reaches 32 psi. When the circuit is opened, a valve at the surface vessel is re-positioned so that the pump evacuates the refueling hose. If the refueling hose should pull loose from the reception coupling, the plug for the control system will pull free from the receptacle because the electrical cable is attached to the hose. The control circuit is thus opened and the pump evacuates the hose.

The sound-powered phone system is connected when the cable brought up with the refueling hose is plugged into the receptacle on the car. The airship phone (3, figure 4-32) is installed on the port side of the car, aft of the winch operator's station.

HYDRAULIC CONTROL HANDLE. A hydraulic control handle (2, figure 4-39) on the hydraulic control panel controls the engagement of the refueling hose by the reception coupling. When the handle is placed in ENGAGE, hydraulic pressure developed by a hand pump on the panel first actuates toggle arms in the coupling to clamp the hose and then opens a flap valve to permit fuel flow through the coupling. Moving the handle to RELEASE relieves the hydraulic pressure so that the flap valve closes and the hose is released.

CAUTION

Do not pressurize the refueling hydraulic system in flight unless the refueling nozzle is seated in the reception coupling. Trapped fuel spilled from the coupling will be sucked into the car.

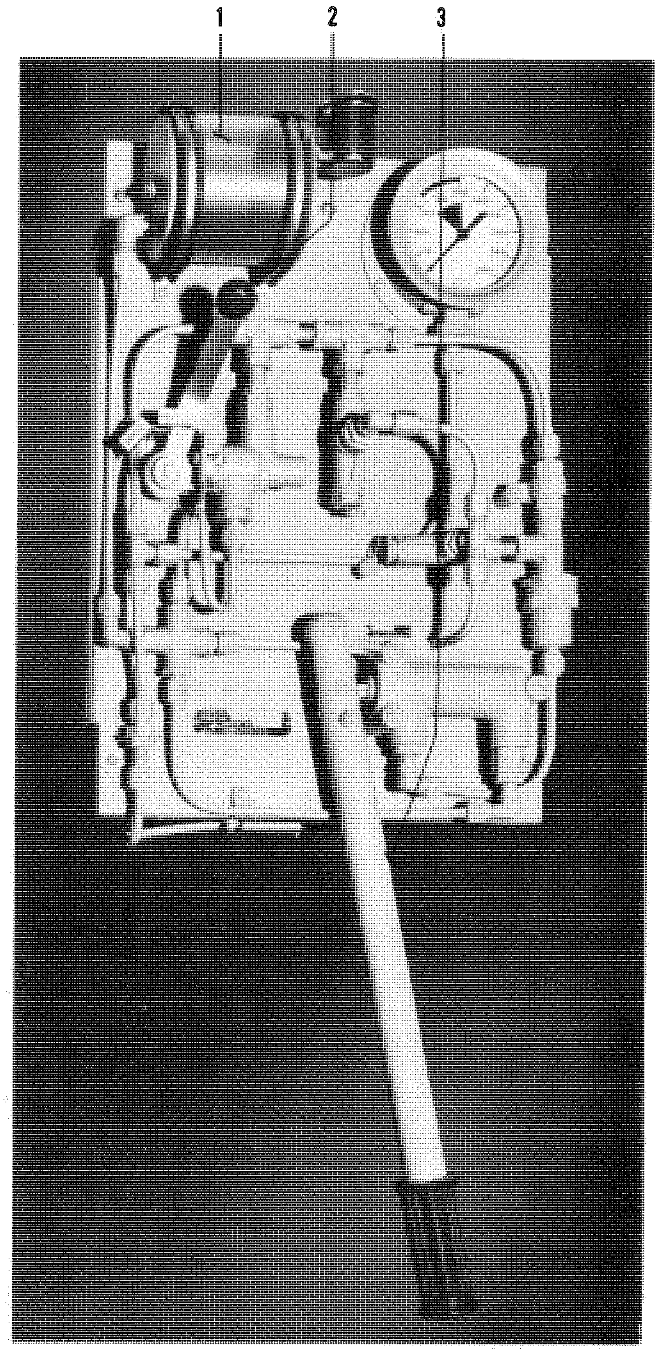
HYDRAULIC PUMP. The hydraulic pump (3, figure 4-39) on the refueling hydraulic panel is manually operated to pressurize the reception coupling hydraulic system. Reciprocating the pump handle raises the system pressure when the control handle is in ENGAGE. A gage on the panel indicates system pressure.

REFUELING SWITCH. The refueling switch (figure 4-38) is on the winch operator's auxiliary panel. After the refueling hose is connected the switch is placed in PUMP to start flow of fuel through the hose to the airship. The switch is placed in EVAC to cause the pump to evacuate the hose.

REFUELING LINE SHUT-OFF VALVE. A manually operated shut-off valve (9, figure 4-31) is installed in the refuel line forward of the ground refueling coupling. The valve must be open when refueling through either the flight or ground refueling coupling.

REFUELING PRESSURE GAGE. The refueling pressure gage (4, figure 4-36) is on the winch operator's instrument panel. The gage registers pressure in the aft section of the refueling line. Maximum pressure is 32 psi; and if the gage indicates higher pressure during refueling, the refueling switch should be thrown to EVAC.

NORMAL OPERATION. The in-flight refueling procedure involves the operation not only of refueling equipment but also of the winch, fuel system, ballast system, and airship flight controls. The step-by-step procedure for re-



1. Reservoir
2. Control Handle
3. Pump

Figure 4-39. Flight Refueling Hydraulic Panel

fueling is in section VII. Some general instructions applicable to refueling equipment are the following:

a. Before moving the hydraulic control handle to ENGAGE and operating the pump to actuate the reception coupling toggle arms and valves, always make sure that the hose nozzle is properly seated against the coupling seal. If this is not done the nozzle may be damaged or fuel lost.

b. When the airship is refueled on the ground, the refueling reception coupling should be actuated after the operation to drain trapped fuel from the aft section of the refueling line. If the fuel is not drained, it will be released when the coupling is actuated in flight and may be sucked into the car through open doors.

EMERGENCY OPERATION. The flap valve automatically closes if the fuel hose pulls loose from the reception coupling. To insure that the flap valve is closed, the hydraulic control handle should be moved to RELEASE. The reception coupling toggles release the hose if the load is greater than 1250 pounds. The push-pull coupler shear pin shears at 1600 pounds. If the push-pull coupler does not break away when the coupling releases the hose, the winch should be reeled out to prevent breaking the hose. In an emergency the winch cable can be cut.

WARNING

This procedure is hazardous since the winch cable may lash when the load is released.

ENGINE ACCESS PROVISIONS.

DESCRIPTION. Whether the airship is on the ground or in flight the engines are easily accessible from within the car. An outrigger access door on each side of the car swings down aft of the propeller arc to form a catwalk to the nacelle. The cowl side panels on the nacelle open out to form work platforms. Handholds and steps on the nacelle permit a crew member to crawl over the top of the nacelle to the outboard work platform. A safety harness worn by a crew member can be rigged on either side of the car to save the man if he should fall from the catwalk or nacelle. The propeller must be stopped before the catwalk is used as it is possible for the crew member to fall or reach into the propeller arc. If the engine fire extinguisher fails to smother a fire in flight, a hand fire extinguisher can be discharged through the cowl flap openings on the inboard side of the nacelles, which can be reached from the catwalk. A small fire extinguisher door is located on the outboard side of each nacelle for use when an engine fire occurs on the ground.

OUTRIGGER ACCESS DOORS. An outrigger access door is located on each side of the forward end of the utility compartment. Each door is hinged at the bottom to swing down to form a catwalk. A tie-rod on each side of the door supports the outboard end when the door is in the horizontal position. The upper portion of the door contains a small window and a dog on each side to latch the door in the closed position.

OUTRIGGER SAFETY HARNESS. The outrigger safety harness installation consists of a safety belt, a safety line, a pulley, port and starboard tension straps and pulley brackets, and a harness stowage rack. The stowage rack is mounted on the port utility compartment wall aft of the outrigger door. When the harness is stowed the line is coiled on a rack with a pulley and a pip pin stowed in the center of the rack. The safety belt is attached to a hook at the top of the rack.

The safety line attaches to tension straps anchored to the car structure. A pulley bracket located above each outrigger door is accessible after the removal of a panel secured with two quick disconnect fasteners.

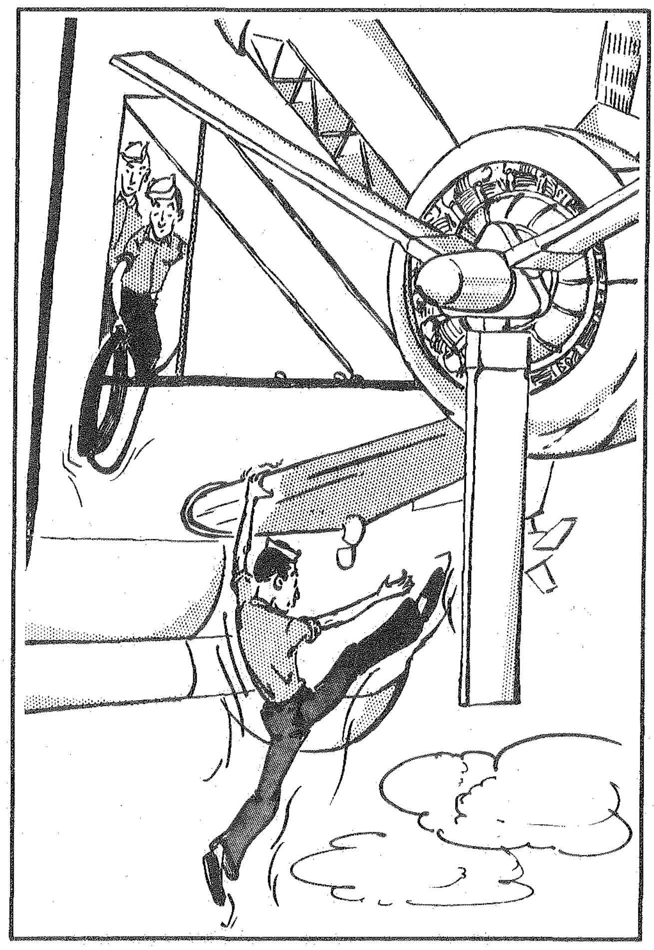
RIGGING SAFETY HARNESS.

a. Remove panel over pulley bracket above outrigger access door.

b. Open outrigger access door.

c. Remove safety line from rack and pass free end out through pulley bracket.

d. Remove pip pin and pulley from stowage rack and install in pulley bracket. Safety line must pass over top of pulley.



e. Attach safety belt to line and strap safety belt around crew member.

f. A second crew member should stand by at the outrigger access door to tend the safety line.

WARNING

Do not step through access door if the engine is running or propeller is windmilling.

COWL SIDE PANELS. The cowl side panel on each side of the engine nacelles is hinged at the top and bottom so that the panel can be raised or lowered to gain access to the engine. For access to the engine from the outrigger access door catwalk, the cowl side panel is always lowered to form a platform for the crew member to stand on. The cowl flap screw jack is connected to the flap in the side panel by a quick disconnect which must be disconnected before the panel is lowered. A cable and a support arm on the sides of the panel support the outer end when it is lowered.

OPENING COWL SIDE PANEL.

a. Open cowl flaps.

b. Reach through cowl flap opening in side panel and disconnect screw jack quick disconnect.

c. Unlatch side panel top hinges.

d. Lower side panel until support arm is fully extended.

e. Remove lock pin from stowage fitting on upper support arm and insert in lock holes adjacent to support arm center pivot.

NACELLE HANDHOLDS AND STEPS. Two handles attached to the top of the engine cowling are used as handholds by a crew member standing on a work platform or crawling over the top of the nacelle. Two step doors are located on the outboard side of the nacelle aft of the cowl side panel. These doors push in to form steps. The outboard cowl side panel can be opened by a man standing on these steps steadying himself by using the handles.

MISCELLANEOUS EQUIPMENT.

PILOT'S COMPARTMENT. The pilot's compartment contains foot rests and ash receivers forward of the pilot's and copilot's seats, and Vent-O-Pane and sliding windows.

SONAR COMPARTMENT. Observation windows forward, a movable seat, a sonar operator's table, and an ash receiver are installed in the sonar compartment. A compartment door is installed in the aft bulkhead. The sonar operator's seat can be revolved when a release lever below the front of the seat is operated. The seat also can slide port and starboard on tracks when a release lever on the back of the seat is operated.

ELECTRONICS COMPARTMENT. A blackout curtain, which slides in a track over the entrance to the pilot's compartment, and a hinged door in the aft compartment bulkhead can be closed to seal off the electronics compartment. Ash receivers are installed at all electronics compartment crew stations. The navigator's stool is hinged to the forward leg of the navigator's table. The stool can be stowed under the table when not in use. Swivel seats are installed at the other crew stations. Each seat can be revolved when a release lever below the seat is operated. A ladder leading to the sonar compartment is built into the inboard end of the radar operator's table and equipment racks.

UTILITY COMPARTMENT. The main entrance door leads into the utility compartment, which contains a fresh water breaker, a cup dispenser, two crew bunks, disposable sanitary bag holder, and a toilet paper holder. There are no blackout provisions for the utility compartment.

MAIN ENTRANCE DOOR. The main entrance door, with a glass panel, is on the port side of the utility compartment. The door is latched on the aft side and can be opened from inside or outside the car. A catch on the trailing edge of the port outrigger secures the door in the open position. Two pins on the main entrance ladder, which is provided as ground equipment for the airship, fit into holes in the deck at the main entrance.

FRESH WATER BREAKER. A 4-1/2 gallon cylindrical tank is strapped to the starboard side of the forward bulkhead in the utility compartment. A spring-lock filler cap is on top of the tank. Water is drawn through a valve on the inboard side of the tank. A cup dispenser is mounted on the bulkhead above the tank.

CREW BUNKS. Two removable bunks are mounted on the port side of the utility compartment. The bunks are hinged on the outboard side and fold against the side of the compartment for stowage when not in use. The lower bunk is raised for use and three folding legs lock in slide mountings on the deck to support the inboard side. The upper bunk is supported by cables on the inboard side when it is lowered for use.

STERN COMPARTMENT. A relief tube and a disposable bag toilet are located forward in the stern compartment. Three windows and a cargo door are located on the starboard side of the compartment. Refueling doors are located at the aft end of the car. A window, winch operator's seat, and an observation dome are located on the starboard side. There are no blackout provisions for the stern compartment.

SANITARY FACILITIES. A relief tube is stowed in a bracket attached to the car structure on the port side of the stern compartment. A disposable bag toilet is covered by a hinged floor panel beside the relief tube. Disposable bags and toilet paper holders are forward of the main entrance door in the utility compartment.

STARBOARD CARGO DOOR. The cargo door in the stern compartment is latched on the aft side. The door can be opened from inside or outside the car. When the door is full open a striker on the door engages a spring catch through the car skin. The catch is released from inside the car.

REFUELING DOORS. The two refueling doors open aft and hinge port and starboard in the stern compartment. Top and bottom latches on the port door engage the car structure to lock the doors in the closed position. The port door must be opened first and closed last. A folding spring-lock check holds each door in the open position. The check is released by tapping the center hinge.

WINCH OPERATOR'S SEAT. A swivel-type winch operator's seat is mounted in the stern compartment. The seat can be revolved when a release lever at the base of the seat is operated.

SECTION V

OPERATING LIMITATIONS

Refer to the Supplementary Flight Handbook, NAVAER 01-195PAC-501A, for information on the operating limitations of the airship.

SECTION VI

FLIGHT CHARACTERISTICS

The airship has no unique flight characteristics. Surface control operation is discussed in section VII.

ENGINES.

SPARK PLUG FOULING. Spark plug fouling may occur during ground operation with the engines idling or during flight if the thrust control levers are allowed to remain in the approximate NO THRUST position even for a relatively short interval. The flat blade angle of the propeller causes a decrease of engine BMEP, which results in incomplete combustion of the fuel-air charge. When idling an engine with the propeller at the low thrust blade angle, frequent run-ups should be made to prevent spark plug fouling.

USE OF PREHEAT CARBURETOR AIR. The engines' float-type carburetors are susceptible to icing even in clear air at nearly closed throttle positions. Carburetor preheat should be used when flying in any conditions conducive to ice formation. When it is necessary to use heat intermittently to remove ice formation, the constant use of heat to prevent icing will improve engine performance in most respects. Under carburetor icing conditions preheat should be used in most instances during takeoff and during approach and landing. The carburetor air temperature indicator on the pilot's instrument panel shows the temperature of the air as it enters the carburetor. Since in this installation air temperature is sensed as air enters the carburetor, the operating range for the carburetor air temperature is higher than in installations where the temperature, known as carburetor mixture temperature, is sensed "downstream" of the carburetor. Table XIV is a summary of recommended temperatures to be used as a guide in setting preheat.

DETONATION. Continuous or frequent detonation will result in damage to an engine; in extreme cases it can result in complete engine failure. A rapid increase in the indicated cylinder head temperature is the pilot's only warning of detonation. Six factors contribute to the tendency of an engine to detonate: (1) excessive manifold pressure, (2) insufficient cooling, (3) lean fuel-air mixtures, (4) excessive carburetor air temperatures, (5) faulty ignition system, and (6) fuel of low octane. If cylinder head temperature rises sharply, possibly indicating detonation, the pilot can (1) reduce power, (2) open the cowl flaps, (3) enrich the fuel-air mixture, and (4) reduce carburetor air temperature. Detonation most frequently occurs when the use of preheat is followed by an increase in the power setting. The temperature of the exhaust manifold, the primary source of carburetor preheat, rises with an increase in power setting, causing a corresponding rise in carburetor air temperature. Whenever the power setting is increased while preheat is being used the carburetor temperature indicator should be checked to insure that carburetor air temperatures stay within operating limits.

Table XIV. Carburetor Air Temperature (°C)

CONDITION	MIN*	RECOMMENDED OPERATING RANGE	MAX
Icing	+25	+32 to +38	+38
Cold Weather Cruise		+10 to +32	+32
Cold Weather Take-Off (O. A. T. Below 0°C)		+10 to +32	+32
Letdown	+20	+20 to +32	+32

*Use full preheat when the minimum temperature cannot be obtained.

POWER CONTROL. The application of thrust control (Beta system) has reversed the fundamental relationships of engine power control. Instead of controlling the power output of the engine directly, as in throttle control of manifold pressure, and governing the propeller blade angle to absorb the power and maintain constant rpm, the Beta system controls the load on the engine through thrust lever control of blade angle and governs the throttle setting to control power output of the engine and maintain constant rpm. In more concise terms, normal operation with the Beta system is a fixed pitch-variable throttle operation as opposed to the more conventional fixed throttle-variable pitch operation. Direct electrical control of the throttle is available for use when the governing action of the system is not required. The throttle override levers are mechanical controls for emergency use only.

NORMAL THROTTLE OPERATION. Each engine throttle is normally controlled electrically, either automatically by operation of the throttle governor or manually by operation of the throttle selector switch.

Automatic control of the engine throttle is engaged by placing the propeller selector switch and the throttle selector switch in the LEVER OPER position. Any engine speed between 1000 and 2250 rpm can then be selected by operation of the rpm control lever. The carburetor actuator, controlled by the throttle governor, maintains a constant engine rpm regardless of the propeller pitch setting. Automatic control of the throttle actuator is used for all normal flight operations except starting or shutting down the engine.

The throttle actuator is manually controlled by placing the throttle selector switch in the momentary OPEN or CLOSE position. The actuator cycles the throttle from open to close in approximately 1-1/2 seconds. Each engine idles at 800 rpm when the propeller is at take-off pitch (+12 degrees) and the throttle actuator is in the full close position. From this setting idling speed varies inversely with the blade angle.

Engine overspeeding, which can occur when control of the throttle actuators is changed from manual to automatic, may be prevented by the following procedure:

a. Place prop selector switch in the center off position.
b. Adjust engine speed for 1000 to 1050 rpm with the throttle selector switch.
c. Set the rpm control lever in full DEC RPM position.
d. Place throttle selector switch in LEVER OPER.
e. Place propeller selector switch in LEVER OPER.

EMERGENCY THROTTLE OPERATION. In the event of electrical power or throttle actuator failure, the throttles are controlled manually by operation of the override levers. These levers are normally left in the full closed position and should not be engaged except in an emergency. The override is engaged by raising the levers until the override engages when lever position matches the throttle position. With the override engaged, approximately 40 to 50 pounds pressure must be applied to overcome actuator friction and change the throttle setting. The override is disengaged by pulling a spring-loaded pin at the carburetor while the override lever is bottomed. The disengaging procedure is difficult and hazardous in flight since the pin must be disengaged in the nacelle.

CAUTION

Never operate throttles electrically with the override engaged. The actuators are not designed to carry the load imposed by the override.

PROPELLER OPERATION.

Propeller blade angle is controlled by operation of the thrust lever or the propeller pitch selector switch. Thrust lever control is used when the Beta system is operating. The propeller selector switch and the throttle selector switch must be in the LEVER OPER position for the related thrust lever to be operative. The position of the thrust lever determines the blade angle within the range between plus 29.4 degrees (full FWD position) and minus 6.7 degrees (full REV position). Some degrees of power lag must be anticipated when the Beta system is operative. If thrust levers are advanced to increase manifold pressure, stop the lever when MAP is indicated as 2 inches less than the desired pressure. The manifold pressure increases approximately 2 inches after the thrust lever stops. At take-off engine speed (2250 rpm) advance thrust levers to obtain a manifold pressure of 36 inches Hg. Further advance will cause engine rpm to decrease, since full available throttle is reached before maximum blade angle setting. Full engine take-off power is not obtainable with the Beta control system.

There is no specific hover blade angle when the Beta control system is operating. Any blade angle can be selected to produce the desired hover condition. The maximum allowable rpm (refer to section V) should not be exceeded in the hover condition. A no thrust condition is attainable throughout the entire range of engine speeds.

Blade angle control by momentary operation of the prop pitch selector switch permits the selection of any blade angle between feather (+89.4 degrees) and full reverse (-8.7 degrees). This is the only method for feathering a propeller.

OIL SYSTEM MANAGEMENT.

The flap thermostat in each oil cooling system is set to maintain oil temperature between 71°C (160°F) and 77°C (170°F) when the oil cooler switches are in the AUTO position. If either flap thermostat fails, hold the switch in OPEN or CLOSE long enough to place the oil cooler flap in the position required to maintain oil temperature within the limits marked on the indicator.

FUEL SYSTEM.

NORMAL FEED. Under normal flight conditions fuel is fed from the forward tank to both engines. The forward tank is replenished by automatic transfer as follows:

a. Turn selector switch to tank from which fuel is to be transferred.
b. Turn forward tank refueling valve switch to the open position.
c. Turn emergency feed switch to the closed position.
d. Place transfer pump switch in ON.

The transfer pump control system starts the transfer pump when fuel in the forward tank drops to 600 pounds. Fuel is transferred from the selected tank to the forward tank; when the forward tank holds 900 pounds of fuel, the transfer pump stops until the level again drops to 600 pounds. This automatic replenishment of the forward tank is continuous as long as the transfer pump switch is left at ON. During automatic transfer, the no transfer pressure warning light does on when the tank from which fuel is being transferred is empty. The selector switch must then be turned to a tank containing fuel.

FUEL TRANSFER. (See figure 7-1.) Fuel can be transferred from any tank except the forward tank. Automatic transfer into the forward tank is described as part of the normal feed condition. Fuel is transferred into the aft or slip tank by the following procedure:

a. Select tank from which to draw fuel.
b. Transfer Pump Switch ON
c. Emergency Feed Switch Open

CAUTION

The fuel being transferred is also supplying the engines. Check engine fuel pressure gages after switching to emergency feed.

d. Open refueling valve to tank receiving fuel.
e. Close refueling valve when tank is full or transfer is completed.

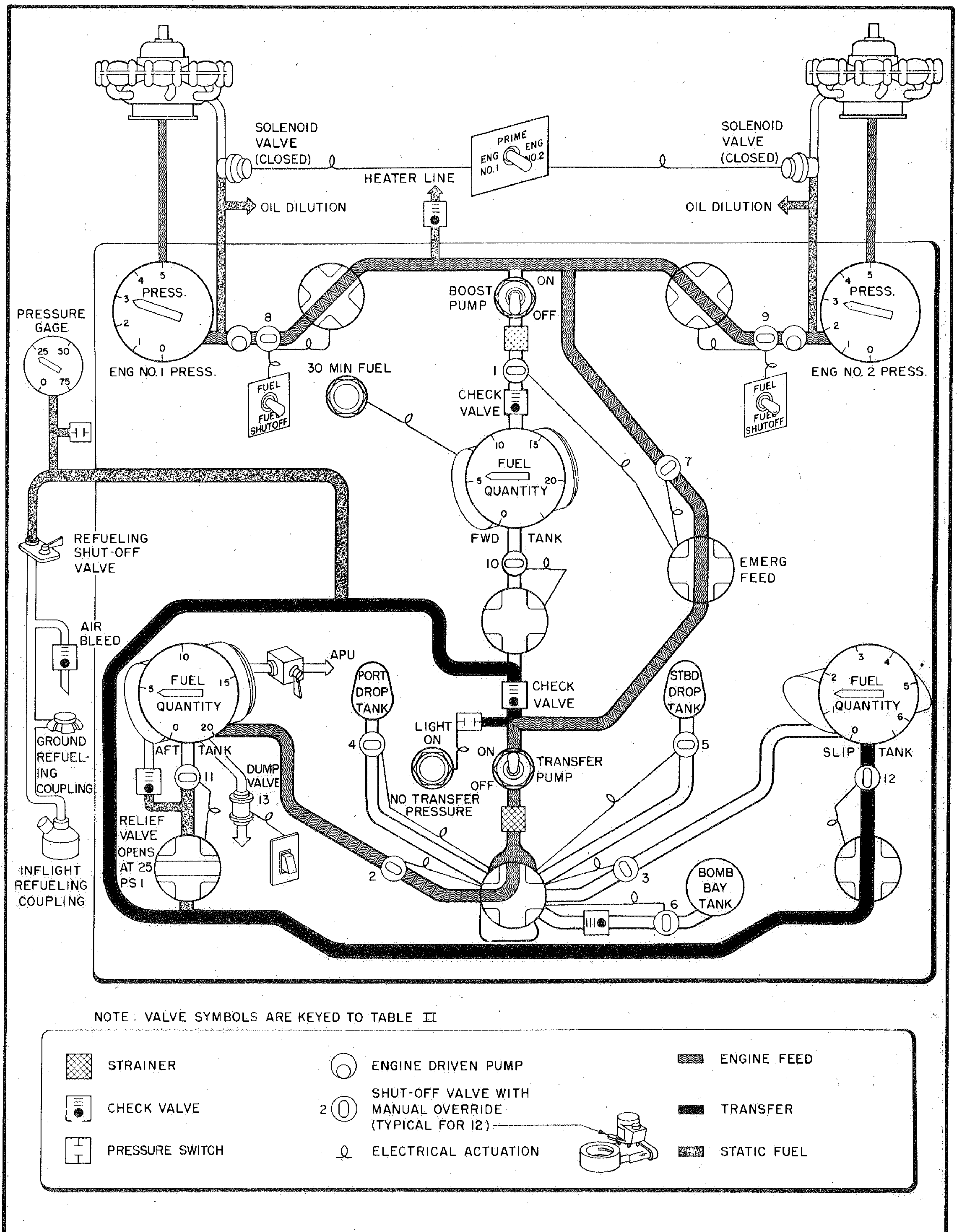


Figure 7-1. Fuel Flow Diagram - Transfer

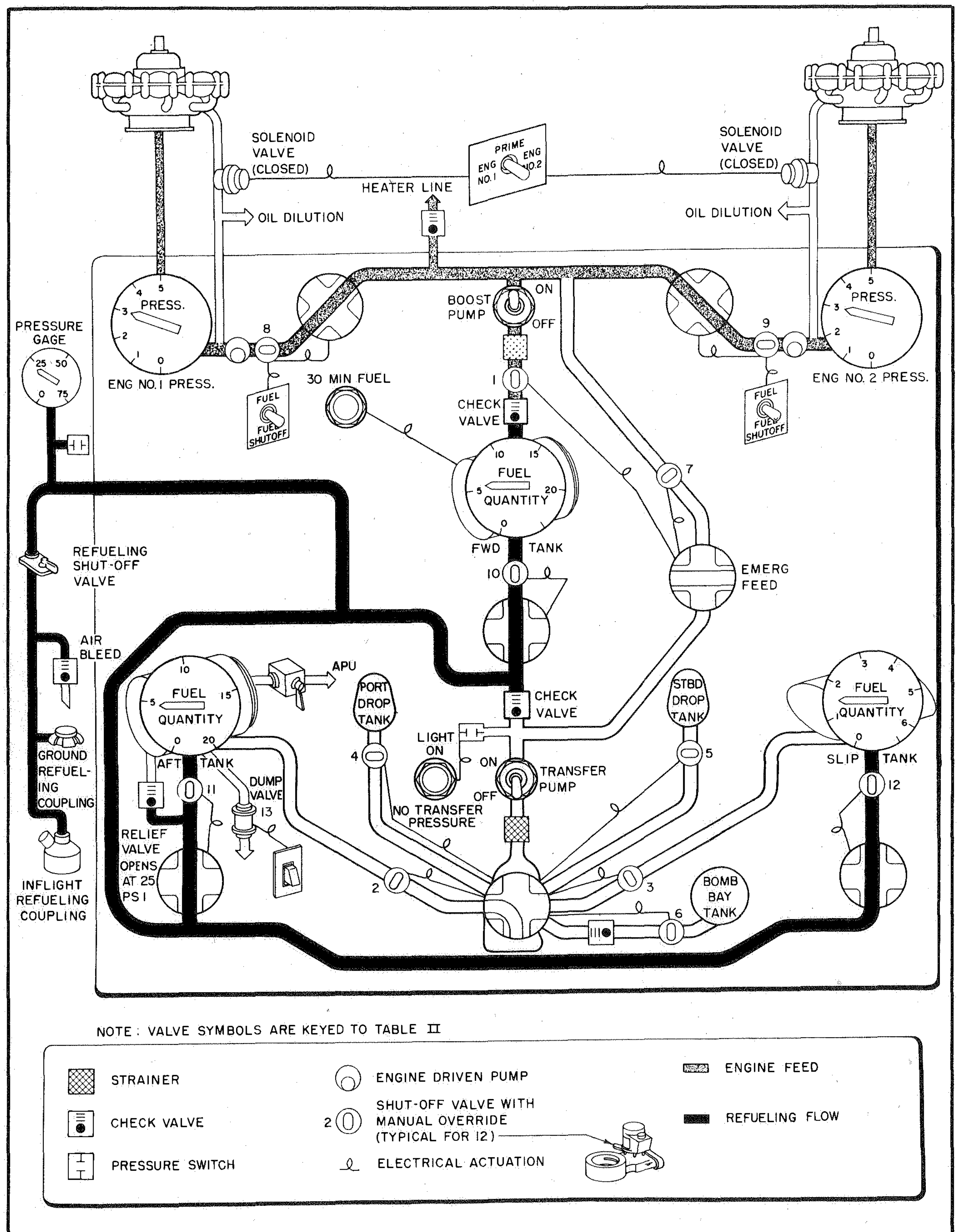


Figure 7-2. Fuel Flow Diagram - Refueling

f. Emergency Feed Switch .... Closed

NOTE

Normal engine feed from forward tank is resumed when emergency feed is shut off.

USE OF FUEL BOOSTER PUMP. The booster pump should be operated during take-off and landing and when an engine is started. Booster pressure should also be used whenever an engine-driven pump is not maintaining the steady feed pressure required for safe flight.

BOMB BAY TANK. When the bomb bay tank is installed, the bomb bay door should be open approximately 1-1/2 inches to provide adequate ventilation of the bomb bay. Since intermediate positions of the bomb bay doors cannot be maintained when the electrical control system is energized, the bomb bay control circuit breaker on the d-c circuit breaker panel must be opened. The doors are then opened manually.

WARNING

Bomb bay doors should be full open if the instrument inverter is operated during ground operation.

RELEASE OF JETTISONABLE FUEL TANKS. The procedures for jettisoning the drop tanks and bomb bay tanks are discussed with the armament system in section IV.

IN-FLIGHT REFUELING.

PREPARATION. Engine fuel feed and tank refueling flow are shown in figure 7-2. Flight refueling requires the coordinated effort of the flight crew. Directly concerned in the operation are the pilot, a refueling officer, and the winch operator. The pilot plans the operation and briefs the refueling officer, who supervises the stern crew during refueling. The pilot must consider the heaviness condition of the airship before and after refueling and the wind velocity over the deck of the refueling vessel to determine the necessary airspeed and the trim and power changes required to maintain constant altitude. Figure A-5 can be used to select the angle of attack and power settings required for various conditions of heaviness. Before refueling, the pilot must take note of the operating limitations established in section V for flight refueling operations. He should plan fuel distribution so that trim can be maintained. During refueling the pilot controls the flow of fuel into the tanks, dumps ballast to maintain a satisfactory condition of heaviness, and controls the airship so as to maintain level flight and a fixed position relative to the surface vessel. Power changes, as slight and as smoothly applied as possible, should be made only when necessary.

The winch operator controls the winch operation with the winch remote control handle, aligns and secures the refueling hose in the coupling, and operates the refueling line manual shut-off valve. The hoisting drum brake should be set at 2800 pounds. Both the refueling officer and winch operator should wear headsets with boom microphones. The refueling officer's headset is plugged into the winch operator's ICS terminal. The winch operator's headset is plugged into the refueling ICS terminal beside the flight refueling doors. The winch operator should wear a safety harness with the harness line secured to car structure in the stern compartment.

During the refueling procedure all crew members are alerted and all non-essential electrical and electronic equipment is shut down. No smoking is permitted. The car should be sealed off as tightly as possible and the blower secured. If fumes are present the car may be ventilated after the refueling is completed. The heater blower should not be used in ridding the car of explosive fumes.

FLIGHT REFUELING PROCEDURE.

PILOT	REFUELING OFFICER	WINCH OPERATOR
1. Level off to maintain constant position relative to surface vessel.		
		2. Open refueling doors (safety bar secured across door opening).
		3. Lower hoisting cable to surface vessel.
	4. Notify pilot when refueling hose is attached to cable.	
		5. Operate winch to haul up hose.
6. Make trim adjustment to compensate for weight of hose. Dump approximately 300 pounds of ballast as hose is hauled up.		
		7. Inch hose into reception coupling.
	8. Make certain hose nozzle is correctly seated in coupling.	
		9. Place control handle on flight refueling hydraulic panel in ENGAGE and actuate hand pump until indicator shows 850 psi. Minimum pressure of 750 psi must be maintained while hose is clamped in coupling.

PILOT	REFUELING OFFICER	WINCH OPERATOR
		10. Inch out cable approximately two inches. Pawl should not be engaged on hoist drum.
		11. Plug circuit leads hoisted with hose into phone jack.
	12. Check wind speed over deck of surface craft and inform pilot.	
13. Adjust power setting to maintain fixed position relative to surface vessel.		
		14. Close flight refueling doors and refueling line manual shut-off valve.
15. Close tank refueling switches.		
	16. Inform surface vessel that testing for line pressure is to begin. Place refueling switch in PUMP. Pressure as shown on refueling pressure indicator should rise to 32 psi. Inform pilot of maximum pressure. Then evacuate line.	
17. Place boost pump switch ON.		
18. Open forward tank refueling valve.		
	19. Notify surface craft that refueling operation is to begin. Then place refueling switch on PUMP.	
		20. Stand by with portable fire extinguisher.
21. Watch forward tank quantity indicator and discharge ballast at approximately the same rate that fuel is taken aboard.		
22. When forward tank is full, repeat steps 18 and 21 for the slip and aft tanks in that order. The aft tank is filled last so that sufficient space is available to take the discharge of the aft tank relief valve in the event of refueling pressure surges.		
	23. Watch refueling pressure gage and place refueling switch in EVAC if pressure exceeds 32 psi.	
24. When tanks are filled close tank refueling valve and order refueling officer to stop the refueling operation.		
	25. Place refueling switch in EVAC. Inform surface craft that refueling is completed.	
		26. Close manual shut-off valve; open refueling doors.
		27. Inch up slack in hoist cable.
		28. Disconnect control circuit from phone jack.
		29. Place control handle on flight refueling hydraulic panel in RELEASE.
		30. Operate winch to lower hose to surface vessel.
	31. Notify pilot when hose is disconnected.	
		32. Reel in winch cable.
33. Trim airship.		

CONSTANT SPEED DRIVE SYSTEM.

The pressure in the gas cylinder on the winch reservoir panel must be checked before each flight. The cylinder must be replaced when the pressure indicated is less than 150 psi. Before the engines are started, the gas cylinder shut-off valve is opened to pressurize the reservoir and insure an adequate supply of fluid to the constant speed drive unit and the hydraulic pumps. Cavitation of the pumps, caused by an inadequate fluid supply, will damage the pumps. Cavitation of the pumps is also caused by operating the engines at high rpm with the drive unit vented. If the engines must be run with the drive unit vented or the reservoir depressurized, engine rpm should be kept as low as possible to prolong pump life. If a pump is run until it fails, the pump drive shaft shears when the pump seizes. Engine operation is not affected by hydraulic pump failure but electrical power generation is greatly reduced. Procedure for resetting the constant speed drive is given in section III. The gas cylinder shut-off valve is closed and the winch reservoir depressurized after the engines are stopped.

ELECTRICAL SYSTEMS MANAGEMENT.

GENERAL. The a-c generator, the instrument inverter, and the main d-c generator normally supply the entire electrical system during flight. Since both the main d-c and the a-c generator are driven by the constant speed drive, normal operation of the electrical systems is dependent upon proper functioning of the drive unit. Under normal load conditions, the generators are driven at a constant speed; however, a large increase in electrical load at low speed requires an increase in engine rpm. Figure 5-3 covers the maximum electrical loads at various engine speeds during single and dual engine operation.

As the drive unit is loaded the hydraulic pressure increases until the red-line limit is exceeded as the overload point is reached. This overload may be a combination of electrical load and winch hydraulic load, but the effect is the loss of electrical power generation regardless of what causes the drive to be overloaded. Use the hydraulic pressure indicator to gage the load on the constant speed drive unit and increase engine rpm whenever the pressure approaches the red-line limit. Anticipate the addition of large loads and increase engine rpm in advance to insure that electrical generation will continue.

LOSS OF MAIN D-C GENERATOR. If the main d-c generator or constant speed drive fails, the two standby generators must be switched on to supply the main and essential d-c busses. Connected in parallel the two 50-ampere standby generators are rated at 90 amperes, 30 percent of the maximum electrical load carried by the main d-c generator. The two 24-volt batteries have a combined life of 48 ampere hours (see figure 7-3).

The load on the electrical system must be held to a minimum when operating on the standby generators or the batteries. The monitor busses are automatically disconnected from the electrical system when the main d-c generator is disconnected. These busses are energized from the standby generators or the batteries by placing the monitor override switch in OVERRIDE.

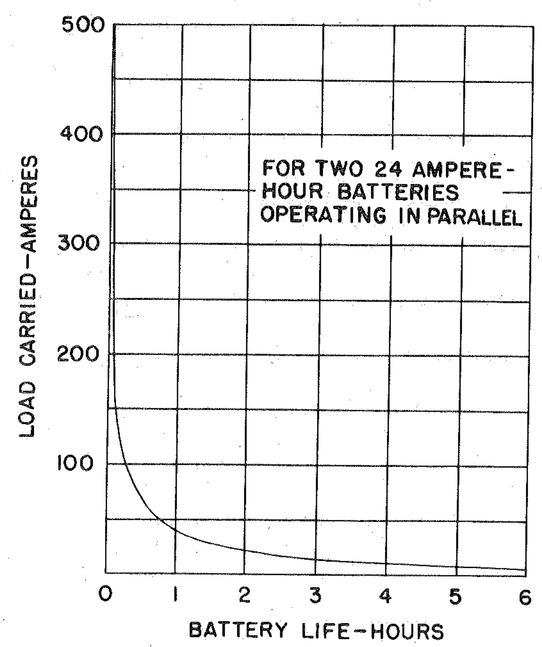


Figure 7-3. Battery Life Chart

Serious overloading will result unless every non-essential circuit breaker on the monitor busses is manually opened before the monitor is overridden.

INSTRUMENT INVERTER FAILURE. The instrument inverter can be operated when the d-c essential bus is energized. If the inverter fails or the d-c essential bus is not energized, phase A power from the a-c generator is connected to the instrument bus by placing the inverter switch in STANDBY.

RESETTING A-C GENERATOR. When the generator off light comes on to signal a generator fault trip, the a-c generator reset switch should be held in RESET momentarily. If the light is not extinguished and the ammeters do not indicate a generator load the main a-c power circuit breakers should be checked immediately. The main circuit breakers that have tripped should be reset and the generator reset switch again placed in RESET momentarily to restore generator operation.

SURFACE CONTROL SYSTEM.

GENERAL. The surface controls may be separated or shifted to manual operation at any time without regard to booster engagement or automatic pilot operation. The simultaneous operation of the boosters and the automatic pilot is prevented by an interlock circuit. Automatic pilot control of the rudder alone is not practical since manual operation of the elevator is required with the boosters off. The advantages of partial control by the automatic pilot are offset by the extra effort required to operate the elevator. The automatic pilot should be used on both elevator and rudder or the booster system should be engaged and the pilot and copilot alternate at the controls.

Normally the surface controls are moved by the electrical boost system and spring tabs. The pilot has very little control "feel" while this boost system is operating. The initial tendency to overcontrol will disappear as the pilot develops a lighter touch on the controls. Caution should be used in determining longitudinal trim of the airship. More attention should be given to control column position than to the force required to hold the column in position or to move it.

If the boosters fail, emergency (manual) control utilizes spring tabs on all control surfaces to allow the pilot to fly the ship without exceeding the following control loads:

Maximum pilot effort required to hold maximum deflection: Rudder - 75 pounds
Elevator - 80 pounds
Maximum pilot effort required to return control to neutral: Rudder - 68 pounds
Elevator - 35 pounds

ENGAGING BOOSTER SYSTEM.

Pilot Switch (Autopilot Pedestal Controller)	OFF
Elevator Columns and Rudder Wheels	Approximately neutral position
Manual Surface Control Handle	Down
Boost Master Switch	ON
Booster Engage Switches	ENGAGE

DISENGAGING BOOSTER SYSTEM. The elevator and rudder servos can be disengaged separately by placing the booster engage switches on DISENGAGE. An electrical interlock automatically trips both engage switches when the boost master switch is placed in the OFF position.

SEPARATING SURFACE CONTROLS.

Elevator Columns and Rudder Wheels	Approximately neutral position
Separate Surface Control Handle	Up

RESTORING DUAL SURFACE CONTROL

Elevator Columns and Rudder Wheels	Approximately neutral position
Separate Surface Control Handle	Down

ENGAGING MANUAL SURFACE CONTROL. The manual surface control handle is pulled up to engage emergency operating ratios for operation of the surface controls.

The elevator shift occurs immediately; however, the rudder wheel shift does not occur until the wheel reaches the position required to effect the same degree of rudder displacement in the emergency range. Rudder wheel displacement in the normal range from neutral to hard over is 86 degrees and in the emergency range, 203 degrees. The shift into emergency range can be made with the controls in any position, but the shift from emergency to normal should not be made with the controls hard over.

ENGAGING AUTOPILOT. The procedure for engaging the autopilot is discussed in section IV.

USE OF GUST LOCK. The gust lock should be locked when the airship is moored or on the mast, except as necessary to operate the controls.

BALLAST SYSTEM.

GENERAL. The ballast system provides a variable and jettisonable load and is used to control the trim and heaviness condition of the airship. As fuel is used, water ballast can be picked up to compensate for the weight of the fuel consumed, thus keeping the airship heaviness near equilibrium. A gravity flow between the two ballast tanks equalizes the water level in the tanks when the airship is in trim and the tank shut-off valves are open with the main fill valve closed.

IN-FLIGHT REBALLASTING.

PREPARATION. In-flight reballasting requires the coordinated effort of several crew members; the pilot, the winch operator, and a reballasting officer. The pilot is responsible for the planning and execution of the reballasting operation. Before reballasting he determines the heaviness condition of the airship and the anticipated heaviness after reballasting. The reballasting officer directs the operation from the utility and stern compartments and keeps the pilot informed about the progress of the reballasting. The winch operator operates the winch, the reballasting pump, and the tank and main fill valves. Intercommunication is of prime importance during the reballasting operation. The winch operator uses the refueling station ICS terminal, and the reballasting officer uses the utility compartment terminal. The winch operator should wear a safety harness with the safety line secured to car structure. The pilot can determine angle of attack and the power setting required for various heaviness conditions from figure A-5.

REBALLASTING PROCEDURE.

PILOT	REBALLASTING OFFICER	WINCH OPERATOR
		1. Check out winch (refer to section IV). 2. Lower hoist cable, with sandbag attached, approximately 10 feet. 3. Open refueling doors, secure safety bar, and pull sandbag into car.

PILOT	REBALLASTING OFFICER	WINCH OPERATOR
		4. Uncouple sandbag and attach ballast bag to push-pull coupler.
	5. Make certain lock nut on coupler is secure; loose nut can result in loss of coupler and bag.	
		6. Ease bag and cable overboard.
	7. Notify pilot that winch operator is ready to lower bag.	
	If airship is heavy:	
8. Trim airship to attitude of approximately 11 degrees nose-up while holding full up elevator at zero ground speed.		
		9. Reel out 300 feet of cable.
	10. Notify pilot of bag position.	
11. Head into wind and reduce airspeed. Allow airship to settle slowly and bag to settle into water.		
	12. Notify pilot when bag is full.	
13. Apply thrust gradually.		14. Simultaneously with step 13, rapidly reel in hoist cable until bag clears water.
15. If bag drags across water, slow airship until winch operator lifts bag clear of the water.		
	If airship is light:	
8. Trim to an attitude of five degrees nose-up holding full up elevator at zero ground speed.		
		9. Reel out 100 feet of cable with bag attached.
10. Fly airship down to altitude of 150 feet, using minimum airspeed. 11. Apply reverse thrust and notify winch operator.		
		12. Quickly lower bag into the water.
	13. Notify pilot when bag is full.	
		14. Reel in hoist cable.
15. Simultaneously with step 14 apply forward thrust.		
		16. If bag swings during hoisting slow or stop winch to reduce pendulum effect of load. Stabilize winch cable with gloved hand.
	17. Notify pilot when ballast bag is hoisted to refueling doors.	
18. Adjust trim and power as necessary.		
		19. Place in-flight reballasting hose in ballast bag. 20. Open aft or forward tank valves (as instructed by pilot) and place reballasting pump switch ON.
	21. Observe ballast indicators and notify winch operator and pilot when sufficient ballast is aboard.	
		22. Close valves when operation is complete and place ballast pump switch OFF. Never operate pump dry as carbon vanes may seize. Cut off pump before water in bag is depleted.

PILOT	REBALLASTING OFFICER	WINCH OPERATOR
		23. If water remains in bag, dump same amount from one of the tanks; then pump water from bag into tank.
	24. Notify pilot when reballasting is complete.	
		25. Pull ballast bag aboard; disconnect bag and coupling. 26. Replace sandbag on cable and inch cable with sandbag to refueling coupling. 27. Close refueling doors and stow ballast bag.

SONAR FISH TOWING.

Towing speed, fish depth, airship altitude, and tow cable length are related. Any variation of one affects the others. For a given cable length, higher speed requires lower airship altitude because of smaller cable angles. Higher airship altitude and deeper fish depth are attainable only at lower towing speed. The faired cable must be submerged at least ten feet at all towing speeds. The fish tends to yaw if the fairing breaks water, resulting in greater towing loads and possible damage to the fairing. Excessive depth also results in greater towing loads. The greatest structural loads imposed in towing are produced when the fish bounces on the surface, especially in rough water. The fish should be immersed and withdrawn at near zero ground speeds.

The winch is not normally operated during towing. However, limited operation of the winch is allowable at ground speeds not exceeding 18 to 19 knots. For the towing operation the winch brake should be set to slip at 2500 pounds. The limitations for sonar fish towing are discussed in section V. The following general limitations should be strictly observed:

a. Maximum ground speed should not exceed 43 knots during steady towing.
b. Fish depths should not exceed 55 feet at maximum towing speeds.
c. Maximum towing altitude at maximum speed is 100 feet when fish depth is 55 feet and 1000 feet of cable is reeled out.
d. The winch should not be operated when towing at speeds over 18 to 19 knots.

FISH TOWING PROCEDURE.

PILOT	WINCH OPERATOR
1. Make necessary trim and power adjustments for desired fish depth, towing speed, and airship altitude as determined from towing characteristics chart. 2. Establish communication with winch and sonar operators. 3. Instruct operator to lower fish until faired cable is clear of swivel pulley.	
	4. Check out winch as described in section IV and place winch main switch in ON. 5. Shift engaging control handles to engage towing drum with winch motor. 6. Move towing drum pawl control lever to DISENGAGE. 7. Depress inch-in button momentarily to remove slack from towing cable. 8. Actuate fish clamps switch to OPEN. 9. Reel out winch until faired cable clears swivel pulley. 10. Check that swivel pulley is locked in 180° position. 11. Place swivel pulley switch on TOWING to lower and engage follower pulley. 12. Disengage lock handle. 13. Rotate swivel pulley to 0° trail position. Do not engage lock handle. 14. Report to pilot that fish is ready to be lowered.
15. Reduce ground speed to 19 knots or less. Maintain altitude greater than desired towing altitude to ensure that fish does not enter water during reel-out.	

PILOT

16. Instruct winch operator to reel out required length of cable.

18. Reduce altitude slowly to immerse fish and maintain required towing altitude throughout towing operation. Adjust airspeed as required.

20. Reduce ground speed to 19 knots or less when towing is completed.
21. Increase altitude until fish is clear of water.
22. Instruct winch operator to retrieve fish.

WINCH OPERATOR

17. Reel out required length of cable and then open towing vent valve. Report to pilot.

CAUTION

Towing vent valve must never be closed while fish is in water. It is opened before fish hits water and closed after fish is retrieved.

19. During towing operations while fish is in water:
Keep towing vent valve open.
Keep tongs open.
Keep towing drum pawl disengaged.
Observe reservoir quantity and temperature and helium bottle pressure.
Observe cable angle.
Observe winch for pay-out caused by brake slippage.
Report above checks to pilot.

23. Close towing vent valve and reel in unfaired cable.
24. Rotate swivel pulley to 180° position and engage lock handle.
25. Place swivel pulley switch in STOWED.
26. Reel in faired cable until fish approaches clamps.
27. Reduce speed and inch fish against cradle stops.
28. Place fish clamp switch on CLOSE.
29. Momentarily depress inch-out button to reduce tension on towing cable.
30. Move towing drum pawl control lever to ENGAGE.
31. Place winch main switch in OFF.

CREW DUTIES

AIRSHIP COMMANDER.

The airship commander is responsible for the airship and the accomplishment of the mission. He directs the preparation of the watch list and assures that each crew member is properly informed and carries out his assigned duties. He checks the airworthiness of the airship by consulting the airship post-flight servicing inspection sheet and noting the weigh-off data. An exterior "walk-around" inspection of the airship is executed following weather and mission briefing of the flight crew. The airship commander normally rotates watches as pilot, copilot, and navigator with the other two aviators in the flight crew.

PILOT.

The pilot is responsible for flying the airship. The final checks on the condition of the airship for flight are the interior inspection made by the pilot immediately after boarding the airship and the system ground check, which is executed after the engines are operating. The pilot is responsible for submitting a completed airship pre-flight inspection sheet to the command pilot prior to take-off. The normal duties of the pilot are outlined in section II and his emergency duties are listed in section III.

He must obtain reports from each crew member that all necessary checks have been completed before he executes any operation such as take-off or landing. The pilot assigns any crew duties not covered by specific checks as the need arises. The functions of command pilot and pilot usually are combined unless an extra pilot is assigned to the flight crew.

COPILOT.

The copilot assists the pilot in flying the airship. He is also required to make the checks in the following paragraphs in addition to those outlined and discussed in sections II and III.

ON ENTERING CAR.

a. Correction Cards	In Holders
b. Radio and ICS Controls	OFF
c. Binoculars	Properly stowed
d. Rip Cord	Properly coiled and stowed
e. IFF Controls	OFF
f. Pilot's Circuit Breaker Panel	Required circuit breakers closed

BEFORE TAKE-OFF.

a. Radio and ICS	Operable
b. Pilot's Compartment Interior Lights	Operable
c. Altimeter	Set
d. Clock	Set

BEFORE APPROACH.

a. IFF Controls	OFF

NAVIGATOR.

In addition to his primary navigation duties, the navigator is responsible for operation and control of the armament equipment. He also serves as refueling officer and reballasting officer during flight refueling and reballasting operations. The checks which the navigator is required to make at specific times are included in the following paragraphs.

ON ENTERING CAR.

a. Navigation Equipment and Supplies	Available
b. Armament Control Switches	OFF
c. Correction Cards	In holders
d. All Navigation and Tactical Electronic Equipment Power Switches	OFF
e. Sonobuoys	Properly stowed (Record serial and channel numbers.)
f. Night Drift Signals	Properly stowed
g. Fluorescent Dye Markers	Properly stowed

h. Slick Markers	Properly stowed
i. Bomb Bay Door Handcrank	Positioned properly

BEFORE TAKE-OFF.

a. Electronic Equipment	Operable
b. Armament System	Checked
c. Lights	Operable
d. Altimeter	Set
e. Clocks	Checked against navigator's chronometer
f. Heater Cabinstat Control	Set (if heating system required)

BEFORE APPROACH.

a. Electronic Equipment Power Switches	OFF
b. Armament Control Switches	OFF

RADAR OPERATOR.

In addition to his primary responsibility, which is to check out the radar equipment before flight and operate the equipment during flight, the radar operator must check and operate the a-c power controls. In flight the radar operator is responsible for checking the a-c instruments and indicator lights to assure that the a-c system is functioning properly.

The checks which the radar operator is required to make at specific times, other than those outlined and discussed in sections II and III, are as follows:

ON ENTERING CAR.

a. Radar Equipment	OFF
b. A-C Circuit Breaker Panel	Required circuit breakers closed.
c. Spare Tubes and Lamps	Properly stowed

BEFORE TAKE-OFF.

a. ICS	Operable
b. Lights	Operable
c. Clock	Set
d. Radome	Extended
e. Radar Equipment	Checked
f. Radome	Retracted

BEFORE APPROACH.

a. Radar Equipment	OFF
b. Radome	Retracted

BEFORE LEAVING AIRSHIP.

a. A-C Electrical System	Secured

ECM OPERATOR.

The ECM operator is responsible for operation of the equipment at the ECM station. Before take-off he checks all equipment at the station to assure that the equipment is operable. Before landing he makes certain that all equipment is secured.

When the ECM equipment is not being used the operator may be required to alternate watches with either the radio operator or the radar operator. The checks which the ECM operator is required to make are the following:

ON ENTERING CAR.

a. First Aid Kit	Properly stowed
b. Outrigger Safety Harness	Properly stowed
c. Port Engine Access Door	Secured
d. Cooking Facilities	Available and Properly stowed
e. Air System Control Panel	Hood lowered
f. Portable Fire Extinguisher at ECM station	Checked and Properly stowed
g. Electronic Equipment	OFF

BEFORE TAKE-OFF.

a. Lights	Operable
b. ICS	Operable
c. Clock	Set
d. Electronic Equipment	Operable

BEFORE APPROACH.

a. Electronic Equipment	OFF

RADIO OPERATOR.

In addition to his primary responsibility, which is to check out the radio equipment prior to flight and operate the equipment during flight, the radio operator must operate and check the d-c power controls. In flight the radio operator is responsible for checking the d-c instruments and indicator lights to assure that the d-c system is functioning properly. The checks which the radio operator is required to make at specific times, other than those outlined and discussed in sections II and III, are as follows:

ON ENTERING CAR.

a. Electronic Equipment	OFF
b. D-C Circuit Breaker Panel	Required circuit breakers closed
c. Current Limiters	Check and replace if necessary

BEFORE TAKE-OFF.

a. Lights	Operable
b. Radio and ICS	Operable
c. Electronic Equipment	Operable
d. Clock	Set

BEFORE APPROACH.

a. Electronic Equipment	OFF

BEFORE LEAVING AIRSHIP.

a. D-C Electrical System	Secured
b. Overspeed Control Circuit Breaker	Open

WINCH OPERATOR (MECHANIC).

The winch operator is responsible for the operation of the equipment in the stern compartment. This includes the winch and associated equipment, in-flight refueling equipment, and the water ballast equipment. The winch operator also is responsible for any emergency repairs to engines or other mechanical equipment.

The checks which the winch operator is required to make at specific times are listed below.

ON ENTERING CAR.

a. Sanitary Facilities	Available and Properly stowed

b. Emergency Equipment Container	Properly stowed
c. Mark 4 Life Rafts	Properly stowed
d. Ballast Pick-Up Bag	Properly stowed
e. Refueling Phone	Properly stowed
f. Winch Remote Control Handle	Properly stowed
g. Aft Portable Fire Extinguisher	Checked and Properly stowed
h. Refueling Doors	Closed
i. Refueling Doors Safety Bar	In place
j. Cargo Door	Closed
k. Cargo Door Safety Bar	In place
l. Scupper Hose	Properly stowed
m. Winch Hydraulic Reservoir	Full
n. Pressurization Bottle Shut-Off Valve	Open
o. Pyrotechnic Pistol and Ammunition	Properly stowed
p. Fish Clamps Hand Crank	Positioned properly
q. Swivel Pulley and Follower Pulley Hand Cranks	Properly stowed
r. Winch Operators Circuit Breaker Panel	Required circuit breakers closed
s. Engine Tools	Available
t. Spare Hydraulic Fluid	Properly stowed
u. Drag Rope	Properly stowed
v. Flight Refueling Shut Off Valve	Closed
w. Flight Refueling Hydraulic Reservoir	Full

BEFORE TAKE OFF.

a. Lights	Operable
b. ICS	Operable
c. Heating System	Operable
d. Register Adjustment Key	Properly stowed
e. Entrance Ladder	Removed
f. Entrance Door	Closed
g. Entrance Door Safety Bar	In place

SONAR OPERATOR.

The sonar operator is responsible for operation of the electronic equipment at the sonar operator's station. Before take-off he checks all equipment at the station to assure that it is operable. Before landing he makes certain that all equipment is secured. The sonar operator is also responsible for any emergency rigging, such as repairs to fabric, cable system, or car structure. When neither sonar nor sonobuoy equipment is being used the operator may be required to alternate watches with either the radio operator or the radar operator. The checks which the sonar operator is required to make at specific times are the following.

ON ENTERING CAR.

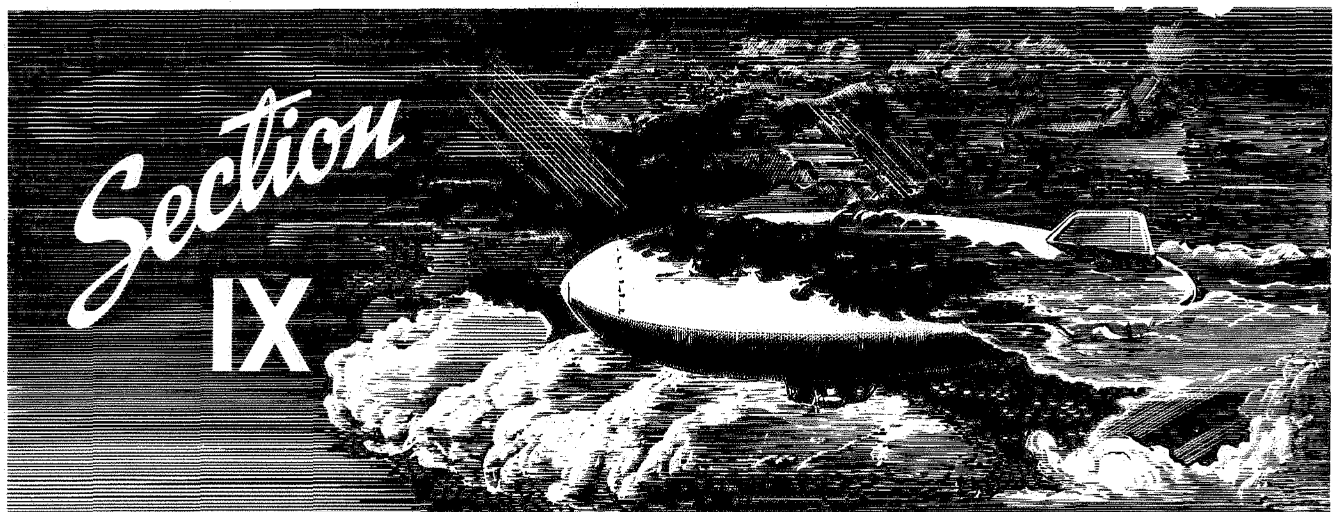
a. Main A-C Power Breakers	Closed
b. Utility Compartment ICS Controls	OFF
c. Anti-Icing Fluid Tank	Full
d. Starboard Engine Access Door	Secured
e. Drinking Cup Dispenser	Full
f. Fresh Water Tank	Full
g. Spare Manometer Fluid	Properly stowed
h. Landing Gear Emergency Hand Crank	Properly stowed
i. Life Jackets	Properly stowed
j. Circuit Breaker Panel	Required circuit breakers closed
k. Electronic Equipment	OFF

BEFORE TAKE-OFF.

a. Lights	Operable
b. Clock	Set
c. ICS	Operable
d. Electronic Equipment	Operable

BEFORE APPROACH.

a. Electronic Equipment	OFF



ALL-WEATHER OPERATION

INTRODUCTION.

This section includes all weather procedures which either replace or supplement the normal flight procedures discussed in section II. Normal flight procedures are repeated here only when necessary for clarity or emphasis. Flight in all weather conditions requires a high degree of pilot proficiency as well as conscientious flight planning. Good airmanship is of prime importance. Information and data available on all weather flight is limited, and the information presented in this section will be amended and supplemented as required in future revisions of the handbook.

INSTRUMENT FLIGHT PROCEDURES.

GENERAL. The airship is well adapted to instrument flight. Dual control of the rudders and elevators frees the copilot of control operation and permits him to use his full time for operation of the power controls and communications and auxiliary systems while the pilot flies the airship by the instruments. Electronic aids to navigation which supply information directly to the pilot are the range receiver, the marker beacon receiver, the radio altimeter, and the radio compass. Loran and radar also function as electronic navigational aids. The instruments available for determining airship position and altitude are the sensitive altimeter, the autopilot repeater compass, the gyro horizon indicator, the magnetic compass, the rate of climb indicator, and the inclinometer.

BEFORE ENTERING AIRSHIP.
Complete the normal exterior inspection described in section II.

ON ENTERING THE AIRSHIP.
a. Complete the normal interior checks and start the engines.
b. Erect gyro horizon indicator and align miniature airplane with horizon bar.
c. Check autopilot and autopilot repeater compass for slaving and heading.

d. UHF	Check primary channels
e. Rate of Climb Indicator	Set pointer on zero
f. Marker Beacon and Radio Altimeter	Test warning lights
g. Radio Compass	Check operation on all positions
h. ICS	Check operation
i. AN/ART-13 Transmitter and AN/ARR-25 Receivers	Check operation
j. Radio Altimeter	Check operation
k. Loran and Radar	Check operation
l. Propeller Anti-Icing	Check fluid level and operation
m. Boost Master Switch	ON
n. Booster Engage Switches	ENGAGE

UNMASTING. Follow normal procedures described in section II. Propeller and navigation lights should be turned on.

TAKE-OFF. Take-off by instruments or with low visibility is accomplished by following normal take-off procedures. The ground crew aligns the airship on the runway. The pilot must know the length of the runway and be aware of any obstacles within the pattern. All instruments should be rechecked immediately before take-off. Airship attitude and heading should be referenced to the gyro horizon indicator, the compasses, and the inclinometers. During the take-off run and transition to flight the airship attitude must not exceed 10 degrees nose-up or the lower rudder will drag. Full take-off power should be applied smoothly and maintained until the airship is clear. Then power settings are reduced to normal.

CLIMB. The climb should be made at the normal rate with the forward damper open. Normal operating procedures for climb as covered in section II are fully applicable under instrument flight conditions.

CRUISE. Cruise power settings are established by consideration of the distance to be travelled and the fuel consumption data in appendix I. Pilot fatigue can be greatly reduced by engaging the autopilot. With the autopilot engaged, deviations from heading can be corrected by operation of the climb and turn knobs on the pedestal controller. In an emergency the autopilot can be released by pressing the release button on either the pilot's or copilot's control wheel.

DESCENT. Descent on instruments is made with normal cruising power. Maintain descent primarily with reference to the altimeter, rate of climb indicator, and gyro horizon indicator. Before letting down through a cloud or fog layer, carburetor heat should be increased to prevent icing, and windshield defoggers should be turned on HIGH.

INSTRUMENT APPROACH. The airship responds rapidly to control changes at an airspeed of 50 knots. This airspeed reduces the drifting effect of the wind. The airship should be well trimmed and all pre-approach procedures carried out before initiating the approach. Minimum safe altitudes should be requested to minimize the altitude control factor during the approach procedures. The weigh-off should be conducted after visual contact is made with the airport.

RADIO RANGE LETDOWN. Contact the radio range station and request clearance for radio range letdown, preferably at minimum altitudes.

WARNING

Do not assume that the radio range station personnel are familiar with the operating limitations of airships, especially if the facility does not normally serve LTA.

Drift angles of 25 to 30 degrees or greater may be necessary if strong winds prevail. The rapidity of change from on-course to off-course signals is a good index of wind velocity. Advise tower when visual contact is made with the ground and conduct pre-landing checks and weigh-off.

NIGHT FLYING.

The techniques and problems of night flying are similar to those of instrument flying. The pilot should allow a safety margin on his normal operating procedures and control the airship primarily by reference to the instruments. All lighting circuits should be checked prior to take-off. Panel and instrument lights are turned on bright at dusk and then dimmed as soon as the pilot's night vision is adjusted. Illumination in the pilot's compartment should be kept at the lowest level at which the instruments are visible to the pilot. If floodlights and compartment lights are used they should be red shielded, as one flash of white light can seriously impair night vision. Glare from the electronics compartment can be eliminated by drawing the blackout curtain. The windshield should be kept spotless. Propeller clearance lights should be turned on before undocking and should be left on until the ship is clear of the ground. Climb should be established at a standard rate and maintained until a minimum safe altitude is attained.

The propeller light should be turned on before an approach is made. The landing light should be used during the approach but extinguished before landing so as not to blind the ground crew. The landing light is rated for continuous ground operation and can be used to assist ground handling, but the beam must be kept low.

ICE, SNOW AND RAIN.

Ice and snow should be avoided when possible by altering course and seeking a more favorable altitude. Ice and snow can result in loss of control. The only available remedy is to operate controls through complete cycles to prevent freezing of control surfaces. Ice and rain can increase the weight of the airship considerably. Snow does not add appreciably to the weight of the airship at cruising speeds or higher. It will in some cases adhere to the horizontal surfaces and to the aft end of the envelope, affecting trim. If the airship slows down for a landing, the snow sticks and very quickly makes the airship heavier. As much as 1000 to 1500 pounds of snow can be picked up in a very short time at low speeds.

Ice is the most dangerous form of precipitation. Clear heavy ice, such as encountered in turbulent air at near freezing temperatures, will add a great amount of weight to the airship. Flight should not be attempted if there is a possibility of clear ice.

WARNING

When icing is encountered in flight, change altitude immediately to seek a level free of icing.

Rime ice is not so great a hazard as clear ice. Rime is usually encountered in smooth air of high moisture content and near freezing temperatures. Stratus clouds produce this type of icing. Rime does not add appreciably to the weight of the airship unless exposure to the condition is prolonged. The propeller anti-icing protects against the loss of power caused by the weight of accumulated ice on the propeller blades. Anti-icing should be used to prevent the accumulation of ice since the fluid probably will not remove ice already formed. Carburetor heat should be used as explained in section VII to prevent carburetor icing.

FLIGHT IN TURBULENCE AND THUNDERSTORMS.

If possible, fly around thunderstorms and clouds with extreme vertical development; otherwise, attempt to fly under the bad weather. As a last resort, if terrain conditions will not permit flying under the turbulence, select the brightest spot in the turbulence to fly through. Maintain an altitude between 300 and 400 feet above the surface when flying through the turbulent regions.

The airship should be rigged for possible crash landing or ditching. Disengage the autopilot and rig the surface control system for separated control with the boosters engaged. Station a crew member at all helium and air valve manual controls. Reduce electrical loads and turn the volume down on radio equipment. If turbulence is encountered at night, turn up instrument lights, turn on floodlights and white compartment lights, and remove the red shields from compartment floodlights to accustom the eyes to brighter light, thus lessening chances of being blinded by flashes of lightning. Do not lower the landing gear as it will decrease the aerodynamic efficiency of the airship. Devote full attention to flying the airship. Concentrate on maintaining attitude, but apply minimum elevator control. The airspeed indicator and the other pitot static instruments are not reliable in turbulent air. Try to avoid extreme envelope pressures. When passing through storm areas, rain, hail, and turbulence can be expected. Proper ballasting is necessary during this period to prevent the airship from becoming excessively heavy. Skillful operation of the surface controls is required to prevent unnecessary pitching and rolling and to hold the airship on course. Reduce power as much as possible to avoid excessive strain on the envelope and suspension cables. If the airship is excessively light, helium should be valved, since a slightly heavy airship is more easily controlled in turbulent air.

COLD WEATHER PROCEDURES.

GENERAL. In cold weather operation, most difficulties encountered in flight are caused by icing. Flight in the type of weather which causes icing should be avoided if possible. Other problems encountered in cold weather can generally be alleviated by following proper procedures before and after flight. Engines can be kept operable by following correct shut-down procedures, using oil dilution, preheat, and the correct grade of oil. Instruments and other equipment can be prepared for flight by heating the car interior with an external heater or with the car heater before take-off. Some electronics equipment requires a longer warm-up period and special operating procedure during cold weather. Publications on the equipment should be consulted for instructions on cold weather operation.

Grade 1100 lubricating oil should be used in the engines for ground starting at temperatures down to 2°C (35°F). If lower temperatures are anticipated or if it is necessary to use oil dilution, grade 1065 oil should be used. When using grade 1065 oil, inlet temperature should be maintained between 65°C and 75°C during engine operation to ensure proper lubrication and to prevent the accumulation of moisture and volatile products. If it is not possible to hold the temperature within this range, oil pressure should be maintained within the operating range. Continued engine operation is not recommended if inlet temperatures cannot be kept above 60°C. Grade 1065 oil generally requires preheat at temperatures below minus 18°C (0°F).

The procedures in the following paragraphs should be followed in addition to normal checks when operating in cold weather.

BEFORE ENTERING AIRSHIP.

a. Windshield and empennage dry and free from ice, snow, and frost.

CAUTION

Chipping or scraping of ice can damage airship.

b. Engine and nacelle covers in place. Do not remove covers until just before starting.

c. Preheat engines if necessary. Preheating is required if the temperature is below -18°C (0°F) even if oil is diluted. Preheat is not complete until oil flows from the oil tank sump drain and the propeller can be pulled through by one man.

CAUTION

In extremely cold weather oil may congeal behind the piston rings and prevent the rings from compressing to conform with cylinder bore taper. If the engine is started with pistons frozen, damage may result. Continue preheat until the engine can be pulled through.

d. Landing gear free from ice and dirt. Check particularly the limit switches and the down-lock mechanism.

e. Tire and strut properly inflated.

f. Battery fluid level up and specific gravity, corrected for temperature, between 1.275 and 1.30 as shown on the hydrometer. If reading is below 1.240 replace battery.

g. Oil and fuel tank sump drains, vent lines, and engine breather lines free from ice and condensates.

h. Remove pitot tube cover.

ON ENTERING AIRSHIP.

a. Determine that heat has generally been applied to the car and locally to instruments, communication and electronic equipment.

b. Check the operation of all instruments that will function without engine operation. Operate car heating system.

CAUTION

If an external power source is not available, do not check instruments or car heater. Save battery power for starting the engines.

c. Operate all fuel valve switches and check valve operation.

d. Check all helium valves, car air valves, and dampers, using manual toggles.

e. Check ballast tanks for anti-freeze and crack both dump valves momentarily.

f. Have engine or nacelle covers removed.

STARTING ENGINES. Use normal procedures for starting engines except as noted below.

a. If a battery start must be made, depress constant speed drive emergency stop button and check that electrical load is reduced.

CAUTION

The engine should be run for only a short period and engine speed should be held below 1000 rpm when the constant speed drive is not operating.

b. Place main-standby generator switch on STANDBY.

c. Either engine can be started first. Try to start the engine on the first attempt. Ice is likely to form on the spark plug points in a few seconds if the engine fires and quits. If the engine does not start after two or three tries, examine the front spark plugs for ice. If ice is present the front plugs should be removed and heated to dry the points.

d. Do not crank engine continuously for more than

30 seconds. Allow starter to cool for at least one minute after the first attempt and at least five minutes after each subsequent attempt.

e. Do not prime engine until propeller has started rotating. Intermittent priming should be used only until engine is operating smoothly.

CAUTION

Overpriming is dangerous and can result in engine fires or scored cylinders.

f. If oil pressure does not register after 30 seconds of operation, hold oil dilution switch for two minutes. If oil pressure still does not register, shut down engine and investigate trouble.

NOTE

Oil pressures may be abnormally high immediately after starting. This condition is allowable; but as the temperature increases, pressure should drop to the normal range. Do not increase engine rpm until pressure is normal.

g. Cowl flaps should be opened as required to maintain normal cylinder head temperature.

h. Oil cooler flap should be closed until oil temperature reaches 60°C. If the oil cooler switch is placed on AUTO, the thermostat will keep the flap closed until this temperature is reached.

i. When engines are firing regularly apply carburetor heat as required to maintain carburetor air temperature at 40°C.

j. As soon as engines are running smoothly, increase engine rpm to between 1200 and 1400 rpm, reset constant speed drive, and place main-standby generator switch on MAIN GEN.

ENGINE WARM-UP AND GROUND TESTS. During engine warm-up, oil pressure and temperature should be watched closely. If oil pressure is high, additional dilution should not be attempted; warm-up should be continued until pressure is in the normal range. When oil temperature reaches 60°C place oil cooler switch on AUTO unless oil has been diluted. If oil is diluted allow temperature to rise considerably above 60°C. After a layover of several days during which the engine has been started and the oil diluted several times it is advisable to run the engines at normal temperatures for 30 minutes before take-off. Check the oil level before take-off as it may be reduced by the evaporation of gasoline. The ground run should burn out any excess fuel in the oil after dilution. The excess fuel could cause oil to blow through the breathers or oil pressure to drop during take-off with high power.

As oil temperatures and pressures permit, the throttles should be advanced slowly until engines are operating at 1200 to 1400 rpm. Maintain this rate until warm-up is complete. Use carburetor heat as required to assist in fuel vaporization and to prevent back-firing. After the engine is warmed up, engine operation should be satisfactory if the carburetor heat switches are left in COLD. Further application of carburetor heat is dependent upon icing conditions. Maintain carburetor air temperature above 32°C. If oil temperature fluctuates or drops when rpm is increased, reduce rpm and continue warm-up until oil temperature responds to high engine rpm. Place throttle selector switch and propeller selector switch in LEVER OPER and cycle thrust control lever to check propeller operation. Cycle surface controls and have ground handling officer observe control response. Check instruments operating off the pitot-static system to assure that ice is not obstructing tubing.

BEFORE TAKE-OFF. If icing conditions prevail, carburetor air temperature should be kept high enough to prevent induction system icing. The cowl flaps should be opened as required to maintain normal cylinder head temperatures. Check all instruments for proper functioning. Adjust car heater Cabinstat and start heater. Start de-fog blowers.

AFTER TAKE-OFF. As soon as cruise altitude is reached after taking off from a snow or slush-covered field, operate the landing gear through three complete cycles to prevent the gear from freezing in the up position. Use propeller anti-icing as required to prevent propeller icing.

DURING FLIGHT. Cylinder head temperatures must be maintained high enough to prevent erratic engine operation. No specific minimum temperature can be recommended. The required minimum temperature varies with mixture strength which varies with power settings. Cylinder head temperatures high enough for satisfactory engine operation at any power setting should be obtainable by operation of the engine cowl flaps. If high cylinder head temperatures cannot be maintained at low cruising speeds, power settings should be increased. When cruising under severe icing conditions, use at least 75 percent normal rated power with mixture controls in RICH.

LANDING. No special landing procedures are required for cold weather landings. Rich mixture settings should be used to prevent erratic engine operation. Carburetor heat should not be used unless actual icing conditions exist. If carburetor heat has been applied, do not return to the use of cold air for approach or landing under icing conditions.

OIL DILUTION. Oil dilution is used when the airship is masted outside for prolonged periods in low ambient temperatures. If a temperature of -18°C (0°F) or below is anticipated before the engines are restarted, oil dilution will probable be required as part of the procedure for shutting down the engines. The oil system is designed for dilution with the oil tank approximately one-quarter full (5.5 gallons). If necessary the engines should be stopped and the oil drained to this level before dilution is started. If it is necessary to service the oil tank, approximately one-half the dilution period should be run before servicing. Then add the required oil and complete the dilution. Oil dilution has a desludging effect which results in sludge deposits on the engine oil strainer. The pilot should be certain that the maintenance crew checks the oil strainers after each flight, following dilution. If sludge deposits are found after the first flight, the oil should be changed and the filters cleaned. It is not necessary to change the oil after subsequent flights unless large deposits of sludge are clogging the strainers. An oil dilution period of 2 minutes and 20 seconds is required for 10 percent dilution when the oil tank is one-quarter full.

CAUTION

Oil dilution is extremely hazardous if attempted with high temperature. Do not dilute if oil temperatures are above 50°C. Oil diluted more than 15 percent is highly volatile.

SHUTTING DOWN ENGINES USING OIL DILUTION. The procedure for shutting down the engines is as follows:
a. Open oil dilution manual shut-off valves in nacelles.
b. Idle engines until oil temperature drops to 40°C.
c. Run engines at 1000 rpm during dilution. Maintain oil temperature below 50°C and oil pressure above 15 psi.
d. Post fire watch at engines.
e. Hold dilution switch for period required for desired dilution.
f. Move mixture control to IDLE CUT-OFF. Hold dilution switch until engine stops.
g. Turn ignition switch to OFF.
h. Close oil dilution manual shut-off valve. If in an area where oil dilution is not frequently required, safetywire shut-off valve closed.

BEFORE LEAVING AIRSHIP. The following steps should be taken to protect the airship in below freezing temperatures.
a. Protect ballast system against freezing by the use of heaters, anti-freeze, or draining.

CAUTION

The ballast pump must be submerged at all times to prevent seizure of the carbon pump vanes. If possible, fill pump with an anti-freeze solution. Anti-freeze MIL-E-5559 is recommended for protection of the pump and ballast system.

b. Drain fresh water breaker.
c. Heat batteries or remove to warm shelter.
d. Heat car either by an external heat source or by operation of the car heater if shore power is available.
e. Seal all car openings to keep out blowing snow.
f. Cover engines, nacelles, pitot tube, and windshield.
g. Cover limit switches on landing gear and apply a thin film of hydraulic fluid to exposed surfaces on landing gear strut.

DESERT OR TROPIC OPERATION.

GENERAL. Primary damage to airship structure in tropic climates is from moisture and heat. The airship fabrics and cordage have been treated with fungicide to protect them from fungus attack. Signs of fungus growth on any equipment indicate that fungus protection has been destroyed. Report any suspected fungus attack to base maintenance. Moisture causes corrosion of metal surfaces that have lost their protective coatings. Scratches and worn areas should be restored with protective coating similar to the original protection. Blowing dust and sand are primary hazards of desert operation and all traces of such abrasives must be removed from vital surfaces before each flight.

BEFORE ENTERING AIRSHIP.
a. Inspect oleo strut and tire for cleanliness and proper inflation.
b. Use a cloth moistened with hydraulic fluid to wipe the oleo strut free of dust and sand.
c. Operate movable surfaces and inspect cables, pulleys, and hinges for dust, sand, and corrosion.
d. Remove all covers and seals, including pitot covers.

ON ENTERING AIRSHIP.
a. Inspect and clean engine breathers, vent tubes, and sump drains.
b. Inspect and clean carburetor air induction system and oil cooler duct.
c. Where humidity is high, warm instruments with external source of heat until all moisture is eliminated.
d. Conduct warm-up and ground tests in minimum time.

TAKE-OFF.
a. Avoid taking off where other aircraft have raised dust and sand clouds.
b. In excessive heat, longer take-off runs are necessary than in ordinary temperatures.
c. Reduce take-off power as quickly as possible to avoid overheating engines. Use full cooling air flow.
d. Carburetor heat should not be used.

LANDING.
a. A heavy airship sinks faster in excessive heat than in moderate temperature.
b. Use maximum engine cooling immediately upon landing and keep engine ground operation to a minimum.

BEFORE LEAVING AIRSHIP.
a. As soon as engines have cooled, cover engines and close cowl flaps.
b. Install pitot covers and protect propellers, oleo struts and other exposed mechanisms.
c. Close all doors and hatches tightly.

NOTE

If blowing sand is not a hazard, allow air circulation through car.

d. Cover plastic windshields where driving sand is a hazard.
e. Where practicable, cover all ducts and openings if blowing sand is a hazard.
f. See that airship is moored securely.

CAUTION

Do not top off fuel tanks as expansion will cause overflow through vents.

APPENDIX I

OPERATING DATA

Refer to NAVAER 01-195PAC-501A, Supplementary Flight Handbook for data on operating the airship.

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NAVY-Copifyer Lithograph Corporation-Cleveland-1000