Extracts From CAP 479 (Cont'd)

70.27 SWITCHES (cont'd)

(4) Ignition switches shall be installed so that they are readily accessible and not liable to be inadvertently operated. In metallic aircraft the ignition switches shall be grounded through the mounting, and in non-metallic aircraft the ignition switches shall be grounded by a wire, or wires, to the engine mount(s).

70.28 RELAYS

Hermetically sealed relays should be used if available. Other relays shall be mounted so that contacts can be inspected without having to remove them or other equipment. Relays having exposed contacts shall not be located in compartments where fuel or combustible vapor is likely to be present, or where the armature might inadvertently be disturbed.

70.29 RESISTORS

Resistors shall be installed so that the heat dissipated will not harm or interfere with the operation of other equipment.

INTERIOR LIGHTING

70.30 FLOOD LIGHTING

Red flood lighting shall be installed in all aircrew compartments of all aircraft. In certain aircraft white flood lighting may also be required in the lower part of the pilot's compartment for use by day at high altitudes.

70.31 ANCILLARY LIGHTING

Ancillary amber lighting shall be installed in the pilot's(s') and navigator's compartments for map reading. Desks and tables at all aircrew stations shall be lighted by one or more flexibly mounted light. The number of ancillary lights shall be kept to the minimum necessary for adequate illumination.

70.32 INSTALLATION

The intensity of all lights in aircrew compartments shall be controlled by conveniently located rheostat switches. Interior lights shall be arranged so as to avoid direct and reflected glare.

Extracts From CAP 479 (Cont'd)

70.33 INSTRUMENT LIGHTING

Instruments shall be illuminated by shielded red light. The intensity of illumination shall be controlled by conveniently located rheostat switches.

70.34 CONSOLE LIGHTING

Consoles shall be illuminated by plastic plate type red lighting.

EXTERIOR LIGHTING

70.41 EXTERIOR LIGHT ASSEMBLIES

(1) Aeroplanes shall be provided with the following exterior light assemblies:

(a) navigation lights;

(b) fuselage lights;

(c) taxi lights (when specified);

(d) landing lights; and

(e) other exterior lights required by the RCAF Aircraft Specification.

(2) The installation of additional exterior light assemblies for any specific purpose shall be subject to approval by the RCAF.

70.42 GLARE

Exterior lights shall be installed or shielded as to prevent direct or reflected glare.

70.43 CONTROLS

(1) All exterior light controls shall be operable by the pilot.

(2) Separate controls shall be provided for each exterior light assembly, except the navigation and fuselage light assemblies.

(3) Controls for navigation and fuselage lights shall provide for selection of either steady or flashing operation. The control shall be a single switch having three positions, viz: "Flash" - "Off" - "Steady".

Extracts From CAP 479 (Cont'd)

70.44 NAVIGATION LIGHTS

(1) Colour. Navigation lights shall consist of:

(a) red and green wing tip lights; and

(b) red and white tail lights.

(2) Installation. Navigation lights shall be installed as follows:

(a) one red light on the port wing tip;

(b) one green light on the starboard wing tip; and

(c) one red and one white light at the extreme tail. Where practicable, the tail lights shall be installed in a vertical plane, the red light above the white light. If this is not practicable, they shall be installed in a horizontal plane, the red light to port of the white light. The distance between the center of the tail lights shall not exceed 6 inches.

(3) Intensity. The intensity of navigation lights shall be as follows:

(a) wing tip lights shall be 24 candle power; and

(b) tail lights shall each be 21 candle power.

(4) Visibility. Each wing tip navigation light shall be visible from all positions within an angle of 90 degrees above and below the horizontal, and from directly forward through an angle of 110 degrees measured horizontally outward from a line parallel to the longitudinal axis of the aeroplane. Where practicable, provisions should be made for visually checking operation of the wing tip lights. Tail lights shall be visible from all positions within an angle of 90 degrees above and below the horizontal, from directly astern through an angle of 90 degrees to port and starboard.

(5) Operation. The navigation and fuselage lights shall normally operate on a flashing sequence, in two circuits, alternately operating:

(a) wing tip lights and white tail light on one circuit; and

(b) fuselage lights and red tail light on the other circuit.

Extracts From CAP 479 (Cont'd)

70.44 NAVIGATION LIGHTS (cont'd)

(5) (cont'd)

One circuit shall be ON while the other is OFF. Each circuit shall flash at a rate of approximately 40 cycles per minute. Provision shall also be made for continuous operation of both circuits together when selected by the pilot.

70.46 TAXI LIGHTS

(1) Colour. Taxi lights shall be white, with clear cover glass.

(2) Installation. Taxi lights shall be installed if required by the RCAF Aircraft Specification. Taxi lights may be mounted on the fixed portion of the landing gear or on the wing. On aeroplanes equipped with nosewheels, the taxi light(s) shall, if practicable, be installed on the nose wheel assembly, so that the light will turn with the wheels. The width of the taxi light beam shall be approximately 30 degrees and the depth of the beam shall be approximately 5 degrees.

(3) Power. Taxi lights shall be 150 watts.

(4) Visibility. The taxi light(s) shall be installed so as to afford the pilot the maximum visibility for manoeuvering on the ground. Unless otherwise specified, the taxi lights shall be installed so that, with the aeroplane on level ground in normal taxiing position, the center of the beam strikes the ground at a point 250 feet ahead of the pilot's windscreen. This point shall be the point nearest the longitudinal axis of the aeroplane that is visible to the pilot at that distance.

70.47 LANDING LIGHTS

(1) Colour. Landing lights shall be white, with clear cover glass.

(2) Installation. Where practicable, landing lights shall be installed on the wing.

(3) Power. If one light only is provided it shall be 600 watts. If two lights are provided they shall each be 250 watts.

(4) Visibility. The landing light(s) shall be installed so as to afford the pilot the maximum visibility for landing.

Extracts from CAP 479 (Cont'd)

ACCESSORIES

70.51 TRANSFORMERS

Wherever practicable, transformers shall not be installed in locations having high ambient temperatures. Sufficient space shall be provided around transformers to permit free circulation of air for cooling. Transformers shall not be installed below lines containing inflammable fluids.

70.53 MOTORS

(1) Wherever practicable, motors shall not be installed in locations having high ambient temperatures. Sufficient space shall be provided around motors for inspection and servicing, and to permit free circulation of cooling air. Motors shall be installed and provided to prevent the entrance of water or other foreign matter and so that a minimum hazard exists due to leakage of combustible vapours or fluids. Motors should not be installed below lines containing inflammable fluids.

(2) A good electrical contact between the motor frame and the aircraft structure, through the motor mounting, shall be ensured for internally grounded motors. If the motors frame is not mounted on a structure that will provide a good ground, suitable bonding jumpers shall be installed.

(3) Care shall be exercised to mount the motor in line with the driven equipment. The mounting shall be sufficiently rigid to prevent relative motion between the motor and the driven equipment.

INSTALLATIONS

70.61 MOUNTING

All electrical equipment shall be mounted so as not to be inadvertently actuated by inertia forces or other causes.

70.62 CLEARANCE

Clearance shall be provided in accordance with the installation clearance drawing for the equipment. If an installation clearance drawing is not available, the space provided shall be not less than the dimensions shown on the maximum envelope drawing for the equipment together with adequate additional clearance to allow for maintenance and proper ventilation. Adequate spacing shall be provided for shock mounted units.

Extracts From CAP 479 (Cont'd)

70.63 MAINTENANCE

Adequate provision shall be made for ease of maintenance, including installation, removal, and adjustment and inspection in place.

70.64 PROTECTION

Protection shall be provided against moisture, water leakage, condensation, excessive heat, combustible vapours and fluids, and physical damage.

70.65 COMPASS DEVIATIONS

Electrical wiring and equipment shall be installed so as not to cause excessive compass deviations.

70.66 VIBRATION

Electrical equipment shall be installed so that it will not be subject to vibrations exceeding the limits specified in the applicable equipment specification.

70.67 MOUNTING SCREWS

Machine screws or bolts shall be used for mounting electrical equipment. Self-tapping screws shall not be used for mounting electrical equipment or for making electrical connections.

70.68 DAMAGE

Electrical shall be installed so as not to cause damage to or be damaged by other equipment, wiring, or plumbing.

70.69 SAFETYING

Electrical equipment shall be properly secured by means of safety wire, cotter pins (split pins), locknuts, or other approved means.

70.691 VENTILATION

Adequate ventilation shall be provided. Electrical equipment shall be installed in such a manner that the operating temperature range of the equipment will not be exceeded under normal operating conditions.

70.692 FIRE PREVENTION

Particular care shall be exercised to insure that electrical equipment is not installed in such a manner as to constitute a fire hazard.

Extracts From CAP 479 (Cont'd)

70.693 GROUND RETURN

Equipment that incorporates a ground terminal shall be grounded by the shortest practicable lead to the nearest suitable metallic ground. Equipment that does not incorporate a ground terminal and that is internally grounded shall be grounded by the shortest practicable lead if adequate contact to metallic ground cannot be made or maintained without corrosion occurring at the mounts of the equipment.

70.694 Static Ground

Provision shall be made for the discharge of accumulated charges of static electricity by automatically bringing the aircraft to ground potential on landing.

70.695 FUEL NOZZLE GROUNDING RECEPTACLES

Fuel nozzle grounding receptacles shall be installed adjacent to all fuel tank inlets.

EXTRACTS FROM USAF - ARDCM 80-1

6. BODY

6.104 GENERAL ILLUMINATION

All crew compartments and crew passageways shall be generally illuminated on walls, ceilings, and floor. Electrical installations shall be in accordance with paragraph 10.1, Electrical Systems; Reference paragraph 23.16, Warning Sign.

6.17 LIGHTNING PROTECTION

6.170 GENERAL

Lightning protection is required on aircraft so that a lightning discharge current may be carried between any two points on the aircraft without risk of damaging flight controls, destroying part of the aircraft structure, such as plastic antenna housing, canopies, or electrically isolated conductors, and without injuring personnel.

All metal aircraft are inherently well protected from lightning damage, and rarely, if ever, suffer disabling damage from lightning strokes. Bonding of control surfaces, flaps, etc., in accordance with Specification MIL-B-5087 will provide adequate protection for the airframe.

6.171 STROKE GUIDANCE DEVICES

All external electrically isolated conducting objects, except antennas, which protrude above the aircraft surface, must have a bonding jumper or suitable stroke guidance device to the aircraft skin or structure to prevent serious structural damage to the aircraft in the event of a lightning strike.

6.512 SIGNAL LIGHTS AND ALARM BELLS

Signal lights and an alarm bell shall be installed in accordance with Specification MIL-L-6503.

6A.01 AIRCREW CONTROLS - GENERAL

6A-011 DIRECTION OF MOTION

All controls shall be so designed that the actuation thereof forward, upward or clockwise shall result in increased performance of the component or the aircraft. All controls shall be so designed that the actuation

Extracts From USAF - ARDCM 80-1 (Cont'd)

6A-011 DIRECTION OF MOTION (Cont'd)

thereof aft, downward or counterclockwise shall decrease the performance of the component or the aircraft.

On overhead switch panels, where the panel is divided into two or more flat sections, having different angles with respect to the horizontal, the average angle of the combined panels shall determine the direction of motion for all switches as follows:

(a) If this average angle is greater than 45 degrees with respect to the horizontal, all switches shall actuate upward for increased performance.

(b) If the average angle is less than 45 degrees from the horizontal, all switches shall actuate forward for increased performance.

All controls of a variable nature induced by a rotary motion shall move clockwise from the "OFF" Position, through the "LOW" or "DIM" to "HIGH" or "BRIGHT". This direction of control motion shall be established with reference to the operator, not the aircraft.

6A.13 EMERGENCY CONTROLS

6A.131 FIRE EXTINGUISHING CONTROLS AND WARNING INDICATORS

(a) Location and Actuation - The fire fighting controls shall be located on an emergency panel accessible to the pilot's throttle hand.

The controls shall consist of a single fire emergency control for each engine for critical area, and one agent discharge switch. The control may be either electrical or a combination of electrical and mechanical and shall include a handle incorporating the fire warning light. The control motion, which shall be pulled for "ON" shall perform all necessary fire extinguishing operations except the discharge of the agent. Actuation of the agent discharge switch shall release agent to the area selected by the fire emergency control.

Extracts From USAF - ARDCM 80-1 (Cont'd)

6A.131 FIRE EXTINGUISHING CONTROLS AND WARNING INDICATORS (Cont'd)

(b) Control Knob Shape and Fire and Overheat Warning Lights - The fire extinguishing controls shall be "T" shaped and shall be fabricated of clear translucent plastic and shall incorporate a red warning light. If overheat warning lights are to be installed, they shall be incorporated into the fire warning light by the use of an interrupted circuit. The indication for an overheat condition will be an interrupted signal from the fire warning light. The indication for fire shall be a steady signal. The light colour shall be red and one light shall be used for each power plant or critical area. When no fire extinguishing controls are incorporated, as in single engine aircraft, the fire warning light shall be located in the upper right hand portion of the instrument panel. Aircraft which have the controls at the flight engineer's position shall have a master fire warning light on the pilot's panel.

6A.16 ELECTRICAL CONTROLS

6A.161 LIGHT AND MISCELLANEOUS SWITCHES

(a) Light Switches - (General Requirements) - In single or tandem pilot aircraft, all light switches except landing light switches shall be located on the right side of the cockpit in a light panel. The grouping of the switches and rheostat within the panel shall be as functional as possible. In side by side pilot aircraft, the lighting panel shall be on the overhead switch panel in number 4 position on Figure 6A-2.

The actuating motion of the light switches shall comply with the requirements set forth in paragraph 6A.011, Direction of Motion.

(b) Landing Light Switches - The landing light switch(s) shall be adjacent to the power control or landing gear control lever. The actuation of landing light switches shall be up or forward for "ON" and down or aft for "OFF".

(c) Miscellaneous Switches - All switches other than light and landing light switches shall be of the "centre-off" position type for easy determination of switch position.

Extracts From USAF - ARDCM 80-1 (Cont'd)

6A.162 ELECTRICAL POWER CONTROLS

This panel will include the battery, generator, primer(s), starter(s), inverter(s) and oil dilution controls.

In single or tandem pilot installation the subject switches shall be grouped together on the right side forward. In side by side pilot aircraft the subject switches shall be grouped on the overhead panel, the number 3 position in Figure 6A-2.

6A.163 CIRCUIT BREAKERS

In single or tandem pilot aircraft, the circuit breakers shall be located forward on the inboard face of the right console. In side by side pilot aircraft, the circuit breakers shall be on the overhead panel, the number 5 position in Figure 6A-2. The circuit breakers will be grouped functionally with the most critical circuit breakers in the most accessible position. In aircraft where available cockpit space for circuit breakers is limited, only those circuit breakers essential to safety of flight will be located in a position accessible and readable to the pilot. Circuit breakers not essential to the safety of flight may be placed in the cockpit in such positions as not to occupy space considered more essential for operating controls.

6A.17 INSTRUMENT ARRANGEMENT AND LIGHTING

6A.171 LIGHTING

Except for instrument lighting the cockpit lighting for all aircraft shall be in accordance with Specification MIL-L-6503. Instrument lighting shall be designed and installed in accordance with Specification MIL-L-5667. All switch, radio, and auxiliary control panels shall be lighted by plastic plate edge lighted panels as specified in Specification MIL-P-7788.

The cockpit lighting controls which shall be located as specified in paragraph 6A.161, Light and Miscellaneous Switches, shall consist of the following:

(a) A single rheostat for control of the light intensity within each basic flight instrument panel.

(b) A single rheostat for control of the light intensity within the engine - instrument and auxiliary control panels (radio, switch panels etc.).

Extracts From USAF - ARDCM 80-1 (Cont'd)

6A.171 LIGHTING (Cont'd)

(c) A single rheostat for control of all type A-11 red flood lights at each station.

(d) A single dimming control and a selector switch for red and white cockpit utility lighting if applicable.

6A.172 WARNING LIGHTS, CAUTION INDICATORS AND ON - OFF INDICATORS

(a) Warning Lights - Warning lights are defined as those lights which serve as an attention-getting device to alert the operator to some existing dangerous condition requiring immediate action. They will be red in colour. Normally the only lights falling into this category will be the oxygen and emergency fire warning lights. Warning lights should not be used for denoting minor or routine deviations from normal operations, nor should they be used for indicating malfunctions which require attention but not necessarily immediate action. Warning lights should indicate immediately the nature of the hazardous condition, to facilitate necessary action. An identification label or placard shall appear immediately adjacent to the warning light except when word warning panels are provided. In either case the identification shall be plainly legible under day or night conditions. The fire warning lights shall be located on an emergency panel accessible to the pilot's throttle hand. The oxygen warning lights will be located in the upper right hand portion of the instrument panel in single and tandem pilot aircraft.

(b) Caution Indicators - Caution indicators are defined as those indicators which serve to alert the operator to an impending dangerous condition requiring attention, but not necessarily immediate action. Caution indicators should not be used to denote minor or routine deviations from normal operating conditions. The caution indicator system shall consist of a master indicator light and an indicator panel. The master light shall be red in colour and shall be labeled or placarded "Master Caution", the legend to be clearly legible under day or night conditions. It shall be located high

Extracts From USAF - ARDCM 80-1 (Cont'd)

6A.172 WARNING LIGHTS, CAUTION INDICATORS AND ON - OFF INDICATORS (Cont'd)

(b) (Cont'd)

on the right hand side of the instrument panel in single or tandem pilot aircraft, and high in the centre of the instrument panel in side-by-side pilot aircraft.

The caution indicator panel will consist of appropriate words or abbreviations, to signify the conditions of caution, provided on a plastic panel in accordance with MIL-P-7788. Each condition specified on the panel will be provided with a suitable lighting fixture to identify the legend in red at night. The same or an auxiliary fixture(s) in the centre of and/or adjacent to the legend shall provide a suitable visual indication, red in colour, in daylight. An example of a suitable daylight indication is a direct view of the lamp filament through a clear identification red filter. The caution panel shall be located on the right side forward in single and tandem pilot aircraft, and on the centre console immediately aft of the power quadrant in side-by-side pilot aircraft. The actuation of the caution system shall be as follows:

(1) When a malfunction occurs, the master light and the appropriate light(s) on the caution panel will be activated.

(2) The master light will be manually reset to indicate another malfunction by the actuation of a switch located on or adjacent to the caution indicating panel.

(3) The appropriate light(s) on the caution panel will continue to indicate a caution condition until the malfunction is corrected.

(4) A test circuit shall be incorporated for testing the lamp filaments.

(c) On-Off Indicators - On-off indicators are defined as those indicators in which the "ON" position denotes a satisfactory or normal operating condition. In general, the absence of an indication

Extracts From USAF - ARDCM 80-1 (Cont'd)

6A.172 WARNING LIGHTS, CAUTION INDICATORS AND ON - OFF INDICATORS (Cont'd)

(c) (Cont'd)

serves the same purpose, and this principle should be adhered to if at all practicable. In such cases where it is necessary to denote a normal or satisfactory condition by an indication, a mechanical or electro mechanical indicator should be used. This type of indicator should be located as near to the display or control to which it is related as is possible.

(d) General - The number of warning lights, caution, and on-off indicators shall be kept to an absolute minimum. In no case shall warning or indicator lights be located directly within or above the basic flight instrument group. A dimming circuit shall be provided for all warning lights and caution lights. This dimming circuit will provide for manual selection of either a bright or a dim level of light intensity wherever the flight instrument light circuit is energized; the dimming circuit shall be "reset to bright" automatically wherever the flight instrument light circuit is de-energized. The method of dimming shall be subject to the approval of Wright Air Development Centre.

7.6 LANDING GEAR RETRACTING MECHANISMS

7.61 DESIGN REQUIREMENTS

7.611-K SAFETY SWITCHES

Leakproof, sealed units using Air Force approved low travel switches (Specification MIL-S-6743) shall be installed on all main landing gear in such a manner that the initial compression motion of the shock absorber actuates the switch. The purpose of these switches is to prevent retraction of the landing gear while the airplane is on the ground. They shall be wired in series with each other and shall be capable of being adjusted to operate at 1/2 inch plus 1/4 inch minus 0 inch from the shock strut fully extended position. These shall serve to operate a continuous duty-type solenoid for unlocking the landing gear control lever.

Extracts From USAF - ARDCM 80-1 (Cont'd)

7.61 DESIGN REQUIREMENTS (Cont'd)

7.630-B SEQUENCE VALVES

If the sequence valves are operated electrically, the control switches shall be ruggedly constructed and be of a type which will not freeze because of condensed moisture or water. They shall be mounted on rigid supports and not subjected to malfunctioning caused by normal structure deflections or jamming caused by foreign matter. It shall be possible to extend the gear by the emergency means in the event of failure of the electrical circuit.

9.41 LANDING GEAR CONTROLS

9.410 MOVEMENT

The landing gear control lever shall be installed with a solenoid released locking device which functions to preclude motion of the control lever from "down" to the "up" position when on the ground. The solenoid will be operated by the closing of safety switches, Ref. para. 7.611-K, Safety Switches.

For hydraulic or pneumatic retracting systems where the landing gear lever operates selector valves electrically by means of a conventional control circuit, a separate "contact" (multiple-pole switch) will be closed for each selector valve energized. For electrical retracting systems where the landing gear control lever operates electric motors by means of a conventional control circuit a separate "contact" (Multiple-pole switch) will be closed for each electric motor energized.

The solenoid shall be of the "continuous duty" type.

9.522 IGNITION CONTROL SYSTEMS

In turbojet and turboprop aircraft, the master switch shall be located adjacent to its respective power control.

Since the ignition system is designed for intermittent duty, it must be limited to a maximum of 3 minutes operation each attempted start. On single

Extracts From USAF - ARDCM 80-1 (Cont'd)

9.522 IGNITION CONTROL SYSTEMS (Cont'd)

or twin engine aircraft this shall be accomplished by using an approved time delay switch or by some automatic means such as a tie-in with other systems. On aircraft with more than two engines a momentary on-switch is acceptable if it can be operated conveniently by flight personnel.

It shall be possible to crank the engine without energizing the ignition system until a safe cranking speed is obtained. A safe cranking speed is defined as that speed at which no damaging flashback may occur.

Single and twin engine aircraft shall utilize ignition systems with dual circuitry, each circuit being separately fused. The dual circuitry shall extend back to the power source. This arrangement is not mandatory on aircraft having more than two engines.

10.1 ELECTRICAL SYSTEM

The types and characteristics of aircraft electrical systems shall conform to Specification MIL-E-7894. In selecting one or more of these systems for an airplane, careful consideration shall be given to such factors as reliability of operation, simplicity, light weight, vulnerability, and ease of installation, operation and maintenance. The designer shall submit to Headquarters, Wright Air Development Center, sufficient data on the chosen system or systems to permit an evaluation relative to the applicability to that particular airplane. The general requirements for the installation of electrical equipment in aircraft, as set forth in Specification MIL-E-7080, MIL-E-7563 and MIL-E-7614, shall be complied with where applicable. Certain important requirements called for in the above three specifications are listed in the following paragraphs for the convenience of the designer, together with other requirements.

All electrical equipment and components subject to high acceleration forces will be mounted so as not to be inadvertently actuated by the application of acceleration forces.

The power requirements for all Air Force airborne equipment may be found in Air Force Specification Bulletin No. 89.

Extracts From USAF - ARDCM 80-1 (Cont'd)

10.10 POWER SOURCES

10.100 GENERATORS

Generators are identified by Air Force type designations and are listed together with their power ratings in the U.S. Air Force Status of Equipment Book. Generators shall be installed in accordance with the applicable requirements of Specification MIL-E-7080, MIL-E-7563 and MIL-E-7614.

10.101 STORAGE BATTERIES

Batteries shall conform to applicable specifications referenced in United States Air Force Specification Bulletin No. 59. Battery installations shall conform to the requirements of Specification MIL-E-7080 and shall not be located so as to be affected by excessive heat.

Batteries shall be installed at a point which will not impose hazardous conditions to maintenance personnel, aircraft and batteries, when servicing, testing, and replacement operations are performed. The installation shall be easily accessible and will not require the use of specially designed ground handling equipment for servicing, testing, and/or battery replacement. They shall be securely anchored in place. If a nonshielded battery is specified, a container made of acid-resistant material shall be provided. Battery access doors, located on the outside of the aircraft, shall be plainly marked "BATTERY" in red letters no less than 3/4 inch high.

10.102 ACCESSORY POWER PLANTS

Accessory power plants shall be selected from those listed in the USAF Specification Bulletin No. 59.

10.103 EXTERNAL POWER RECEPTACLE

An external power receptacle shall be installed in the aircraft in accordance with the requirements of Specifications MIL-E-7080, MIL-E-7563 and MIL-E-7614. The installation shall, in addition, conform to the following:

Extracts From USAF - ARDCM 80-1 (Cont'd)

10.103 EXTERNAL POWER RECEPTACLE (Cont'd)

(a) The receptacle shall not be located in the propeller blast or adjacent to the jet blast. A spring-loaded hinged access door shall be installed over the external power receptacle(s) so that the door will open against the slip stream and will close unaided after withdrawal of the power cable.

(c) The receptacle(s) shall be located and connected to the bus system so that the voltage drop between the receptacle(s) and the starter terminal will not exceed 2 volts.

(d) The receptacle(s) shall be located to permit the maximum practical spacing between the external power plant(s) and any fuel system servicing openings or vents, from which fuel spillage may occur during refueling, defueling and engine starting etc.

10.11 POWER APPLICATIONS

10.110 MOTORS

Direct current motors shall conform to Specification AN-M-40 and alternating current motors shall conform to Specification 32590. Motors shall be installed in accordance with Specifications MIL-E-7080, MIL-E-7563, and MIL-E-7614.

10.111 STARTERS

Starters shall be as specified in the aircraft type or model specification.

10.112 LIGHTING

Lighting equipment shall be installed in accordance with Specification MIL-L-6503.

Landing lights shall not be located in front of wing fuel cells, unless no other suitable location is available. This will minimize the fire hazard during crash landings.

Extracts From USAF - ARDCM 80-1 (Cont'd)

10.113 HEATERS

Design and installation data pertaining to electrical heater units shall be submitted to Headquarters, Wright Air Development Center, for approval.

10.114 ACTUATORS

Electro-mechanical actuators shall conform to specification MIL-A-8064.

10.12 CIRCUIT ACCESSORIES

Requirements relating to switches, rheostats, voltage regulators, relays, circuit breakers, fuses, and other circuit accessories, are set forth in Specifications MIL-E-7080, MIL-E-7563 and MIL-E-7614. Fuses when used, shall be quickly accessible, and spare fuses shall be provided.

10.13 WIRING

The wire sizes shall conform to existing Air Force-Navy requirements. Wiring shall be installed in accordance with Specification MIL-W-5088.

Electrical connections and wiring shall be adequately protected from damage or short circuit caused by movement of personnel, cargo, or equipment. Extreme care shall be taken to insure that all bare conductors, connections, terminals, or other exposed current carrying parts are adequately protected against short circuits caused by loose or foreign objects. This protection may be provided by means of suitable covering, by installing in junction boxes, by locating in such manner that additional protection is not required, or by other means acceptable to WADC. Installations having dielectric strength equivalent to that described in Specification MIL-C-3162 will be acceptable.

Lightly insulated high tension or radio wires shall clear all parts normally at ground potential by at least 3/4 inch.

10.14 BONDING

All metallic parts of the aircraft and its equipment and accessories shall be bonded in compliance with Specification MIL-B-5087.

Extracts From USAF - ARDCM 80-1 (Cont'd)

10.15 DUPLICATE POWER SOURCES

Any combination of engines which will maintain the aircraft in the air shall drive generators of sufficient capacity to operate electrically actuated services normally necessary to permit continued flight and landing.

10.16 ELECTRICAL EQUIPMENT

Electrical equipment shall comply with the requirements of Specification 32466.

11.2 FIRE ELIMINATION SYSTEMS

11.20 FIRE EXTINGUISHER SYSTEM

Fire-extinguishing systems shall be installed on all multi engine aircraft and may be specified for experimental single-engine aircraft where the complexity of the engine installations, the inclusion of new and untried features or the general importance of the project warrants the additional protection for the aircraft.

Fire-extinguishing systems shall be installed and tested in accordance with Specification MIL-E-5352.

11.21 FIRE-DETECTION SYSTEM

Fire-detection systems shall be installed in all multi engine aircraft and in single-engine aircraft that have the engine behind the pilot or submerged in such a way that the pilot would not be readily aware of engine fire. The fire detection systems shall normally be in accordance with Specification MIL-D-7253. In instances where an overheat - detector system is used in lieu of the fire-detection system, it shall be in accordance with Specification MIL-D-8114.

11.22 OVERHEAT-DETECTOR SYSTEM

An overheat-detector system shall be installed in all turbo-jet, turbo-prop, and rocket-type aircraft in accordance with Specification MIL-D-8114. The overheat-detector system shall be installed unless it can be demonstrated that primary structure cannot be overheated by either normal or abnormal engine operation.

Extracts From USAF - ARDCM 80-1 (Cont'd)

11.3 ICE-ELIMINATION SYSTEMS

All Air Force Aircraft with the exception of gliders, trainers, liaison and rotary wing aircraft will be equipped with complete anti-icing systems.

13.615 Isolation of Electrical and Oxygen Equipment from Combustible Materials and Fuel Tanks. Electrical Equipment and fuel should be isolated to prevent ignition of the fuel by arcing of broken electrical and fuel lines resulting from battle damage, accidental breaking, or normal arcing.

Oxygen equipment should be isolated from hydraulic fluid, oil, and fuel lines and tanks to reduce the chances of severe explosion of fire due to battle damage. Sparks formed as the metal is ruptured by the flak or shell fragment, and the hot fragments themselves have caused fires when the damage allowed combustible fluid to escape. It is highly desirable to isolate electrical and oxygen equipment from combustible fluids and reasonable weight penalties to accomplish this are justified. An example of isolating the fuel and electrical equipment from each other is an electric fuel valve installation in which the valve is flange mounted on a bulkhead with all electrical equipment on one side of the bulkhead and the fuel valve and fuel lines on the opposite side of the bulkhead. Fuel, oil, and hydraulic lines and equipment shall never be located in a position where leaking fluid will come in contact with electrical equipment through either the effect of gravity, air flow, or battle damage, and hydraulic lines will be routed below electrical equipment and wires wherever they cross paths, pursuant to Specification MIL-E-7563.

Most electrical equipment, such as standard switches, relays, and motors (with the exception of inverters, electric motor-driven hydraulic pumps, and open relays), are explosion proof. Inverters, electric motor driven hydraulic pumps, and open type relays or other non-explosion-proof equipment should be located away from any vicinity likely to be contaminated with fuel vapor as a result of a fuel leak due to poor maintenance or battle dammage. If this equipment is located in such an area it shall be isolated

Extracts From USAF - ARDCM 80-1 (Cont'd)

13.615 (Cont'd)

from that area by a metal inclosure which renders it explosion proof. This inclosure should be vented to the atmosphere in such a manner that fuel vapor from the interior of the aircraft will not come in contact with the brushes, commutator, open contacts, etc., at any time including when the electrical equipment is not operating or when the aircraft is at rest on the ground. Cooling air from an inverter or electric motor should not be exhausted to the interior of the aircraft. If a fuel leak forms an explosive mixture both inside the aircraft and near the commutator, while the aircraft is at rest, and if any sparking occurs when the equipment is first started, it is highly probable that an explosion will occur which will flash back into the aircraft. As a further precaution to prevent explosions, a small explosion proof blower should be installed in these inclosures. These blowers should be started before the main electrical equipment to remove all explosive vapors from the inclosures. If ram pressure is used to ventilate the inclosures in flight, the blowers could be turned off.

Explosion proof equipment is equipment which will not explode a combustible atmosphere in which the equipment is operating under all environmental conditions as defined in its model specification.

13.618 FIRE DETECTING AND EXTINGUISHING

The general findings of the various fire tests show that a serious nacelle fire can reach maximum intensity in 30 seconds for a two-zone cowl and 15 seconds for a single-zone cowl. To be of any value, a fire detector should be capable of detecting a fire in 3 seconds or less.

It is seen from the above paragraph that a very few seconds elapse between the time that the fire-warning light indicates an engine fire and the time that the fire drill must be completed. It is evident that the cockpit, controls, and fire-extinguishing equipment must be arranged so that the drill can be performed automatically and at great speed.

Extracts From USAF - ARDCM 80-1 (Cont'd)

13.717 MISCELLANEOUS DESIGN REQUIREMENTS

(d) Electrical Bonding - In all vibration - isolating and vibration absorbing mountings, adequate provision shall be made for compliance with the electrical bonding requirements of Specification MIL-B-5087.

15.200 POWER PLANT ELECTRICAL EQUIPMENT

Electrical equipment used throughout the power plant and throughout the aircraft in connection with the power plant shall be designed in accordance with Specification 32466. All equipment in the power plant installation or in compartments containing combustible fluids or combustible vapors shall be explosion - proof.

15.52 GENERAL DESIGN REQUIREMENTS

15.524 ELECTRICAL WIRING

All wiring in the aircraft constituting part of of the control system shall conform to Specification MIL-W-5088. When required, control equipment shall be positively grounded with an external metal strap in accordance with Specification MIL-B-5087.

16.623 ICE PROTECTION

The entrance to the air induction system shall be protected against ice formation and build-up. This is considered necessary because of the severe power losses associated with relatively small disturbances to engine air flow.

In addition, all airframe parts in the air induction system, such as engine accessory covers or air duct valves, subject to collection of ice shall be protected. The meteorological design conditions shall conform to Specification MIL-E-5007.

When an ice accretion meter is not furnished with the engine, an ice detecting device shall be installed in the air inlet duct and connected to a suitable indicator light. Cyclic operation of the indicator light will furnish the pilot with an indication of the rate of ice formation.

Extracts From USAF - ARDCM 80-1 (Cont'd)

19.4 MISCELLANEOUS INSTRUMENTS

19.411 CAPACITANCE

This type fuel quantity gage consists of one or more tank units (electro static capacitors) all capacitance measuring circuit and equipment incident thereto, and an indicator. The tank units are located in the fuel tank so that, as fuel replaces air as their dielectric, their total capacitance will vary according to the quantity of fuel in the tank. The tank units are characterized such that all linear relationship exists between the electrical capacitance of the tank units and the volume of fuel sensed. The tank unit capacitance is measured by the circuit and is registered by the indicator. The indicator is calibrated in pounds since a correlation exists between the dielectric constant and density of aircraft fuels. The electrical and physical properties of fuels conforming to Specification MIL-F-5624 which are normally used in jet engine aircraft, vary such that excessive errors are introduced in the gage. Therefore, the gage when used in jet aircraft must be compensated to minimize the errors thus introduced. For jet aircraft applications the gage shall incorporate dielectric constant compensation and shall conform to Specification MIL-G-7818.

19.412 Installation and Calibration - The installation and calibration of any fuel quantity gage shall be engineered so that the inherent accuracy of the gage system shall be utilized to the best possible advantage. The installation and calibration of fuel-quantity gages shall be in accordance with Specification MIL-G-7940. The fuel quantity gages shall be calibrated in pound units.

21.365 TRANSIENT VOLTAGES

Circuits for all electrically primed ordnance such as rockets, electrically primed ammunition, seat ejection charges, explosive volts, etc., shall be adequately protected as required to prevent inadvertent ignition of the primers by transient induced EMF. Protection may include the use of shielded wire (or coaxial cable), firing leads properly routed to achieve separation from other cabling and/or grounded through a safety relay located as close to the ordnance item as possible.

APPENDIX 2

PARTS TO AVROCAN SPECIFICATIONS

PARTS TO AVROCAN SPECIFICATIONS

SECRET

UNIT	MANUFACTURER	MFG. DWG. OR PART NO.	AVROCAN SPEC.	SPEC. OR SPEC. DWG.	CO. STD. DWG.
Battery 15 AH	Saft	22023	E209	7-1152-11	-
Flasher - Position Lights	Lucas-Rotax	Dev. 5001	E224	-	CS-F-106
Wing Tip Lights	Grimes(Aviation)	D8020 D7067 SK538	E229	-	1&2 CS-L-129
Fin Tip Lights	Soderberg	S1124A S1124-4A	E229	7-1183-11 & 12	-
Switch (Fire Ext) Push Button	Hetherington	A3084R-BX	E287	-	CS-S-155
Inertia Switch	M-H	-	E290	-	CS-S-150
Instrument Transformer	Can. Atlas Trans	-	E291	7-1152-31	-
Rotary Switch (Refuel)	C-H	7262K11	E295	-	CS-S-149
Power Failure Detector	Can. Diaphlex	-	E296	7-1156-11	-
Transformer - Variable Voltage	Can. Atlas Trans	-	E352	-	CS-T-134
Control Box - Master Warning	M.J. Johnson	W 1000	E376	7-1152-12	-
Switch (Relight)	Hetherington	C 1006	-	MIL-S-6743	CS-S-151
Switch S.P.D.T. (3 Posn."On")	M-H	311TS1-13	-	MIL-S-6745	CS-S-154
Switch Limit. Canopy Act.	M-H	-	-	MIL-S-6743	CS-S-152
Actuator (Limit Switch)	M-H	JE5	-	MIL-S-6744	CS-A-105
Relay 2 PDT 10 Amp	Leach(Leonard)	-	-	MIL-A6106A Type 1 Class B	CS-R-122
Fuse	Burndy(Northern Elect.)	-	E240	-	CS-F-107
Fuse Holder	Burndy(Northern Elect.)	-	E241	-	CS-F-108
Connector-Lanyard Release Starting Control & Intercom.	Garrett Corp. Wiggins	9500 A5V 9500 A6V	E307	-	CS-C-142
Indicator Light	Marco	-	-	MIL-I-3661	CS-I-108

UNIT	MANUFACTURER	MFG. DWG. OR PART NO.	AVROCAN SPEC.	SPEC. OR SPEC. DWG.	CAN. STD. DWG.
Relay 50 AMP SPDT Class A	Can. Diaphlex	650 - 4063	-	MIL-R-6106A	CS-R-128
External Supply Receipt & Cover	Albert & J.M. Anderson Mfg. (Powerlite)	-	E-345	-	CS-R-127
Relay - Time Delay	Rogers-Majestic	M6412	E-285	-	CS-R-126
Switch 3 Pos. Slide	M-H	X11618	-	MIL-S-6743 MIL-S-6744	CS-S-153
Plug - External Power Lanyard Release	Albert & J.M. Anderson Mfg.	R67 with Springs	E-345	-	CS-P-123
Switch (Mom Contact) Jettison	Hetherington (Leonard Elect)	-	-	MIL-S-6743	CS-S-156
Indicator Light (Miniature)	Dialite	-	E-318	-	CS-I-107
Connector, Panel - Dual	Cannon	-	E-394		CS-C-145 CS-C-146
Connector, Panel	Cannon	-	E-394		CS-C-143 CS-C-144
Panel - Landing Gear Control	M.J. Johnson	-	E-279	7-1152-8	
Indicator - Warning - Dual	Korry	204 BPRL 204 BPAL	-	MIL-I-3661	CS-I-109
Alternator 208/120V A.C. 400 cycle	Lucas Rotax	60601	E-202	7-1125-11	
Control Unit & Transformer Rectifier	Lucas Rotax	60349	E-202	7-1156-12	
Relay - Differential Current Protection	Lucas Rotax	-	E-360		CS-R-123
Light - Indicator Case Grounded	Hetherington (Leonard Elect)	L2000G	E-268		CS-L-132

APPENDIX 3

A REVIEW OF THE ENGINEERING DECISIONS ON BATTERY SELECTION FOR THE CF-105 AIRCRAFT AND THE EFFECT OF A POSSIBLE MODIFICATION

A REVIEW OF THE ENGINEERING DECISIONS ON BATTERY SELECTION FOR THE CF-105 AIRCRAFT AND THE EFFECT OF A POSSIBLE MODIFICATION

1. INTRODUCTION

A nickel cadmium battery was selected for the CF-105 aircraft. This selection was largely based on the reduction of weight and the ease of maintenance that a nickel cadmium battery would provide over the more commonly used lead acid battery. Recently, the selection of this type of battery has been queried by the RCAF in letters Ref. No. S-1038-105-8 (ACE-1) and 1038-CF105-80 (AMTS/DIE ENG). The objections raised to the present installation appear to be:

(a) that the battery has been incompletely evaluated and qualified by the U.S. Navy, and

(b) that the batteries of this type are prone to self destruction at aircraft operating temperatures.

It was also pointed out that a quick disconnect type of battery connector was desired. Accordingly, this review of the present situation is presented so that the full details of the present installation may be known, and further, that the details of those changes that would be necessary should a decision be made to adopt a lead acid alternative battery.

2. THE QUALIFICATION AND RELIABILITY OF NICKEL CADMIUM BATTERIES

2.1 QUALIFICATION STATUS

A nickel cadmium battery of this type has been electrically qualified as indicated in a letter dated 7th, December 1955 Ref. AER-EL-501/67, Department of the Navy Bureau of Aeronautics, Washington 25, D.C. A copy of this letter has been sent to Mr. D.M. Fraser, 1070 Birchmount Rd., Toronto 16, Ontario, and its contents state that the battery meets the electrical qualification test requirements of MIL-B-8565. However, full qualification is contingent upon the completion of the specified life test and the elimination of two difficulties which are:

(a) a mounting structure failure, and

(b) a connector malfunction.

2.2 SERVICE USE

This type of battery has given 200 hours of trouble free operation in a CF-100 MK.4 aircraft and it is understood that aircraft companies in France, England, and in the United States have reported good performance and reliability of similar units.

2.2.1 SERVICE DIFFICULTIES

There are no known records of the so called "vicious cycle" that have not been associated with overcharging of the battery. However, it may be noted that this problem also exists with the lead acid type of battery but in that case the temperature rise on overcharge is not as high as in the nickel cadmium type. The higher temperature rise of the latter is due to the low internal resistance which makes possible its superior high discharge rate characteristics.

3. BATTERY SELECTION

A 15 ampere-hour battery is required for the CF-105 aircraft. The nearest standard size is the AN 3151, a 24 A.H. lead acid type battery for which a dimensionally equivalent nickel cadmium type of 22 ampere hours capacity is available. However, the use of the 22 ampere hour battery would entail a weight penalty of 10 to 12 lbs. over the 15 A.H. nickel cadmium battery presently selected, and a still greater weight penalty would have to be taken should the lead acid type be selected.

4. NICKEL CADMIUM BATTERY TEMPERATURES

4.1 GENERAL

The early model of the nickel cadmium battery required a wiring connection to the generator controls to control the voltage at the battery terminals. Later, this arrangement was modified and a thermocouple was incorporated in an outer battery cell to control a relay which isolated the battery from its charging circuits when overcharging caused the outer reference cell to reach 135°F, which is equivalent to an inner cell temperature of 160°F.

4.2 CHARACTERISTICS OF THE BATTERY TEMPERATURE RISE

Battery temperature does not start to rise until the battery reaches 100% of full charge as is shown by a temperature rise versus % overcharge curve (Fig. 1) furnished by the battery manufacturer. This curve indicates a rapid temperature rise if a high charging rate is maintained after the battery comes up to full charge.

However, this temperature rise may be prevented by:

(a) completing the final charging of the battery at a low rate, or

(b) by charging at a voltage which is less than the full charge voltage of the battery.

5. ANTICIPATED TEMPERATURES OF THE NICKEL CADMIUM BATTERY AS INSTALLED IN THE CF-105

5.1 ELECTRICALLY INDUCED TEMPERATURE

As the no-load full charge battery voltage is 29 volts and the aircraft charging voltage is 27.5 ± 1 volt, there appears to be no danger of overcharging and consequently overheating the battery.

5.2 AMBIENT TEMPERATURE

The battery is installed in a compartment whose ambient temperature is controlled by the air conditioning system to 160°F. However, to take full advantage of the nickel cadmium batteries' characteristics it was decided to provide a special cooling facility to maintain the battery itself at 80°F.

6. TERMINALS

Nut type terminals were selected because no quick disconnect type existed for the 15 a.h. battery and maintenance requirements did not appear to demand its development. In this regard it was noted that the maintenance problems connected with the use of nickel cadmium batteries appeared to be far less than

6. TERMINALS (Continued)

those associated with the lead acid type, and for this reason the nickel cadmium battery did not appear to require removal as frequently as the other type. In particular, the lead acid battery was frequently removed for servicing for any one of the following conditions:

(a) exposure of the aircraft to low temperatures often required replacement of a cold battery with a warm one, especially when an electrical starter was used.

(b) routine inspecting involving cleaning and corrosion prevention due to spillage, leakage and spraying of the electrolyte.

(c) routine specific gravity adjustment of the electrolyte, entailing bench checking.

(d) on some aircraft installations, the battery must be disconnected to disable the canopy ejection mechanism when the aircraft is hangared.

The nickel cadmium battery installation as proposed for the CF-105 aircraft will not require battery removal for any of the above reasons. This aid to ease of maintenance of the aircraft is brought about through the following characteristics of the nickel cadmium battery and its installation.

(a) the low temperature characteristics of the nickel cadmium battery are superior to those of the lead acid type and in addition, the fact that it is not used for starting completely eliminates the necessity of replacing it in cold weather. (The a.h. efficiency of the nickel cadmium battery is approximately 30% at -40°F, while that of the lead acid battery is only 17% at -20°F. (Reference - Defence Research Chemical Laboratories Report No. 180 of project No. D52-54-80-08).

(b) the battery is a sealed unit and so requires no electrolyte maintenance.

(c) the canopy and seat ejection mechanisms of the CF-105 aircraft are not electrically operated.

7. THE EFFECT OF MODIFYING THE PRESENT INSTALLATION TO RECEIVE A LEAD ACID TYPE BATTERY

Provisions could be made to install either an AN 3151 battery or its dimensionally equivalent 22 a.h. nickel cadmium battery at the expense of the following changes:

(a) a larger sealed compartment would have to be provided,

(b) the aircraft's primary structure would have to be modified to accommodate the larger compartment,

(c) corrosion protection would have to be provided for the compartment and all areas within 12 inches of the battery,

(d) equipment and wiring would have to be moved from the battery area into other already congested equipment space,

(e) space allowance would have to be provided to cater for the maintenance of the lead acid type battery, i.e., measuring and refilling electrolyte, removing caps, etc.

(f) the battery compartment would have to be vented according to AND 10441.

8. THE INCORPORATION OF A QUICK DISCONNECT CONNECTOR

The battery mounting is such that a quick disconnect connector could be installed (with alterations to the existing battery) at a weight penalty of over one pound. However, in view of the small amount of maintenance required on this battery, it would appear that it would not be economical to take the necessary weight penalty for the small convenience for which it would provide.

9. RECOMMENDATION

It is recommended that the present installation remain unchanged, as from the foregoing paragraphs it would appear that the present installation provides the lightest and most compact installation, and in addition provides performance and maintenance advantages over other installations investigated.

SAFT BATTERY - VOLTABLOC VO.15 EFFICIENCY STUDY

1. EMERGENCY D.C. BUS FLIGHT LOADING

SERVICE	AMPS	
External Tank Jettison	1.35	Momentary
U/C Indication	.09	Cont.
Fire Detection	1.00	Cont.
Canopy Seal	1.00	Cont.
Speed Brake Act.	.60	Cont.
Master Warning Box	1.35	Cont.
Emergency Cockpit Lts.	.60	Cont.
Turn & Bank Ind.	.20	Cont.
Ignition (Relight)	7.00	30 Secs. Max.
A.R.C. 34 U.H.F.	14.00	Cont.
A.I.C. -10 Intercomm.	2.90	Cont.
	31.09	

Momentary & Short Duration 8.35

Continuous 21.74

2. EFFECT OF TEMPERATURE ON TIME OF OPERATION IN FLIGHT

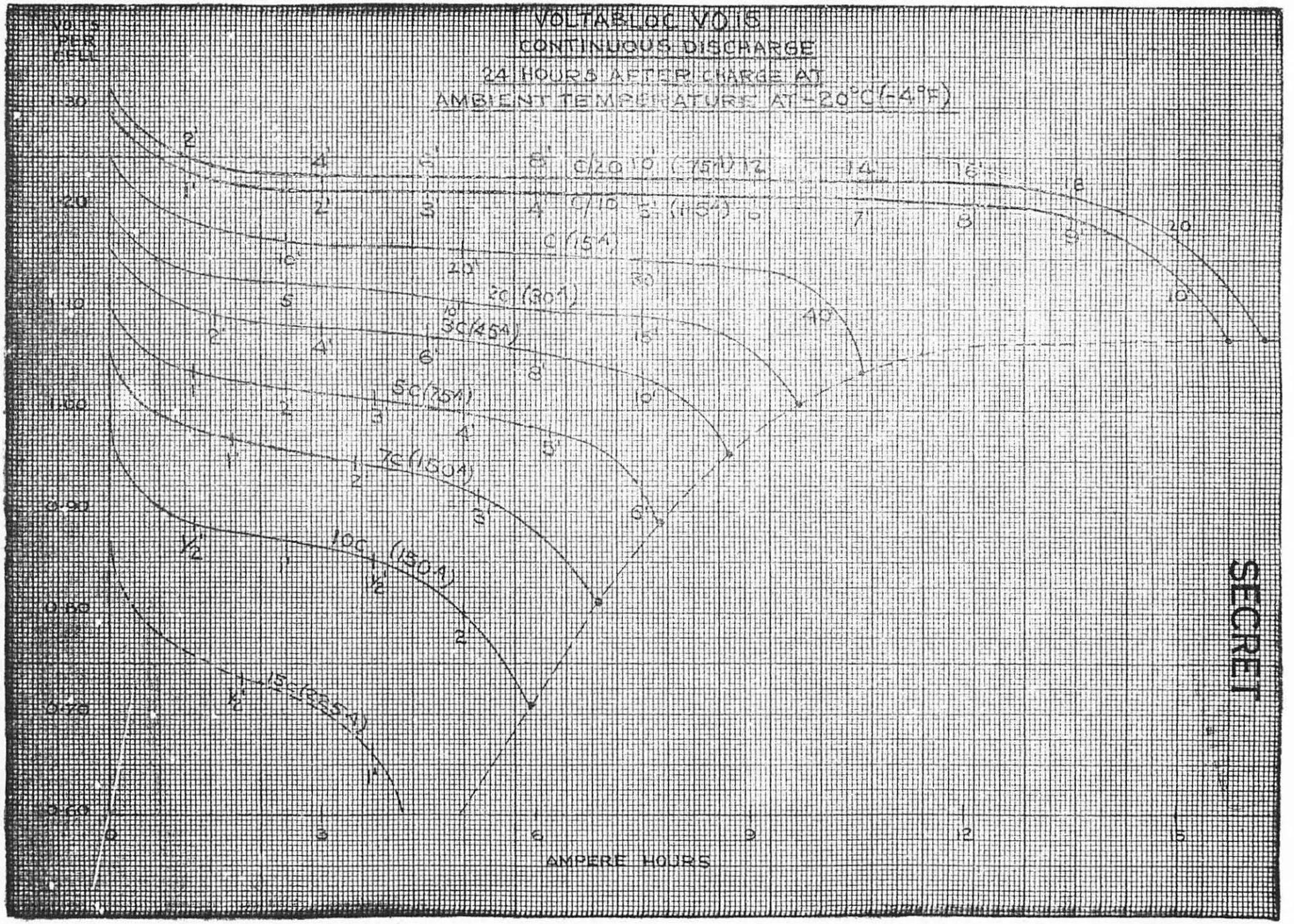
Calculating on the basis of a 22 Amp continuous Load.

AMPS	TEMPERATURE	MINUTES OF OPERATION
22	+68°F	48
22	+32°F	38½
22	- 4°F	29-3/4
22	-40°F	18½

3. MISCELLANEOUS LOADINGS

SERVICE	AMPS	
Canopy Act & Control	16.8	8 Sec.
Fire Extinguishing	8.0	MOM
L/P Cocks (Close (2)	12.8	1 Sec.
I.F.F. Crash	40.0	MOM

The above services are not normally used in flight emergency.


VOLTABLOC VO15
CONTINUOUS DISCHARGE
24 HOURS AFTER CHARGE AT
AMBIENT TEMPERATURES AT -20°C (-4°F)
VOLTS PER CELL
1·30
1·20
1·10
1·00
0·90
0·80
0·70
0·60
C/20 10' (75A) 12
C/10 5' (154)
C (154)
2C (308A)
3C (454A)
5C (754A)
7C (1504A)
10C (1504A)
15C (2254A)
AMPERE HOURS
0
3
6
9
12
15
SECRET

VOLTS PER CELL
1.30
1.20
1.10
1.00
0.90
0.80
0.70
0.60
0
3
6
9
12
15
AMPERE HOURS
CONTINUOUS DISCHARGE
½
1
1½
2
2½
3
3½
4
4½
5
6
7
8
9
10
11
12
13
14
15
16
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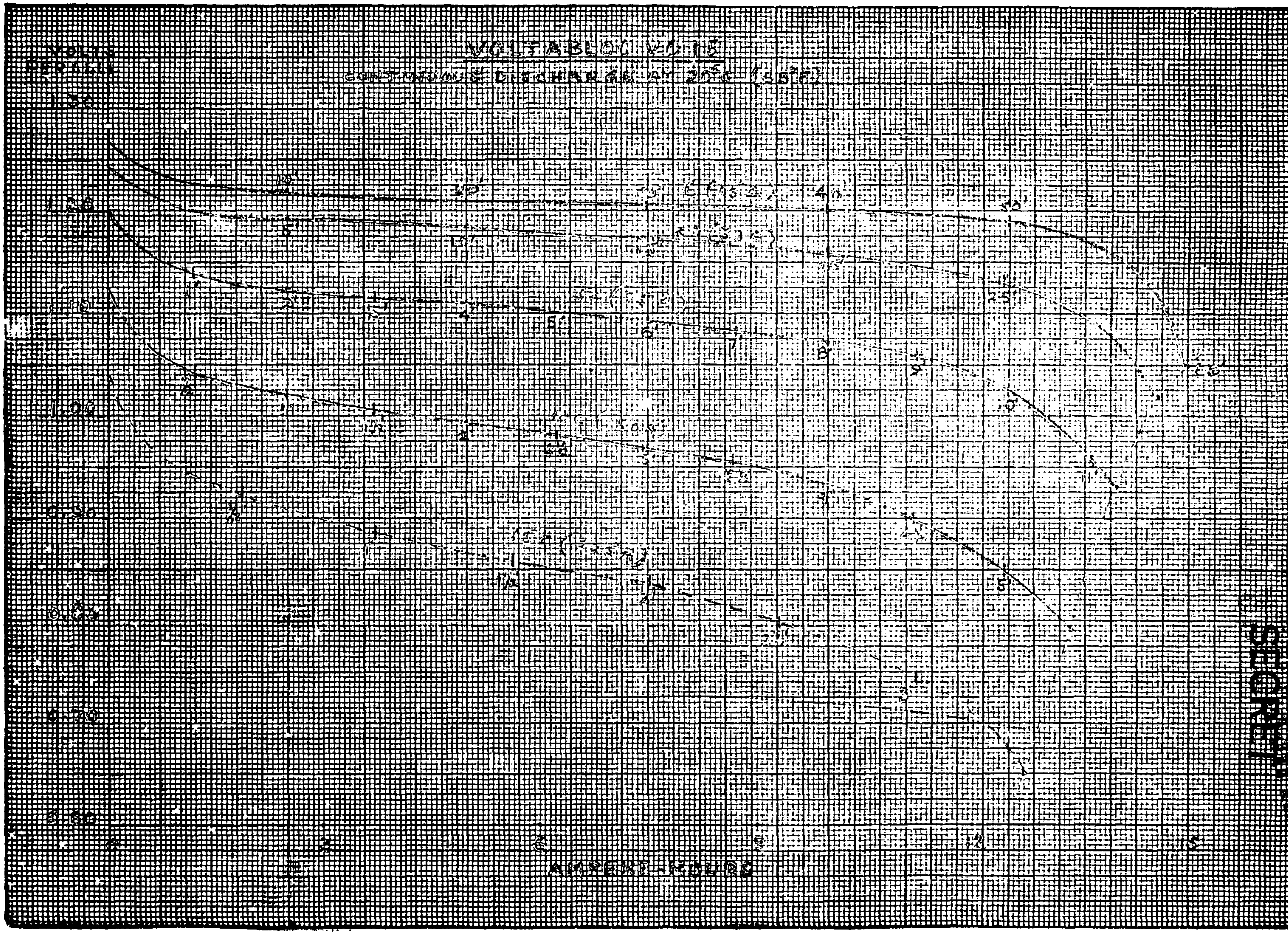
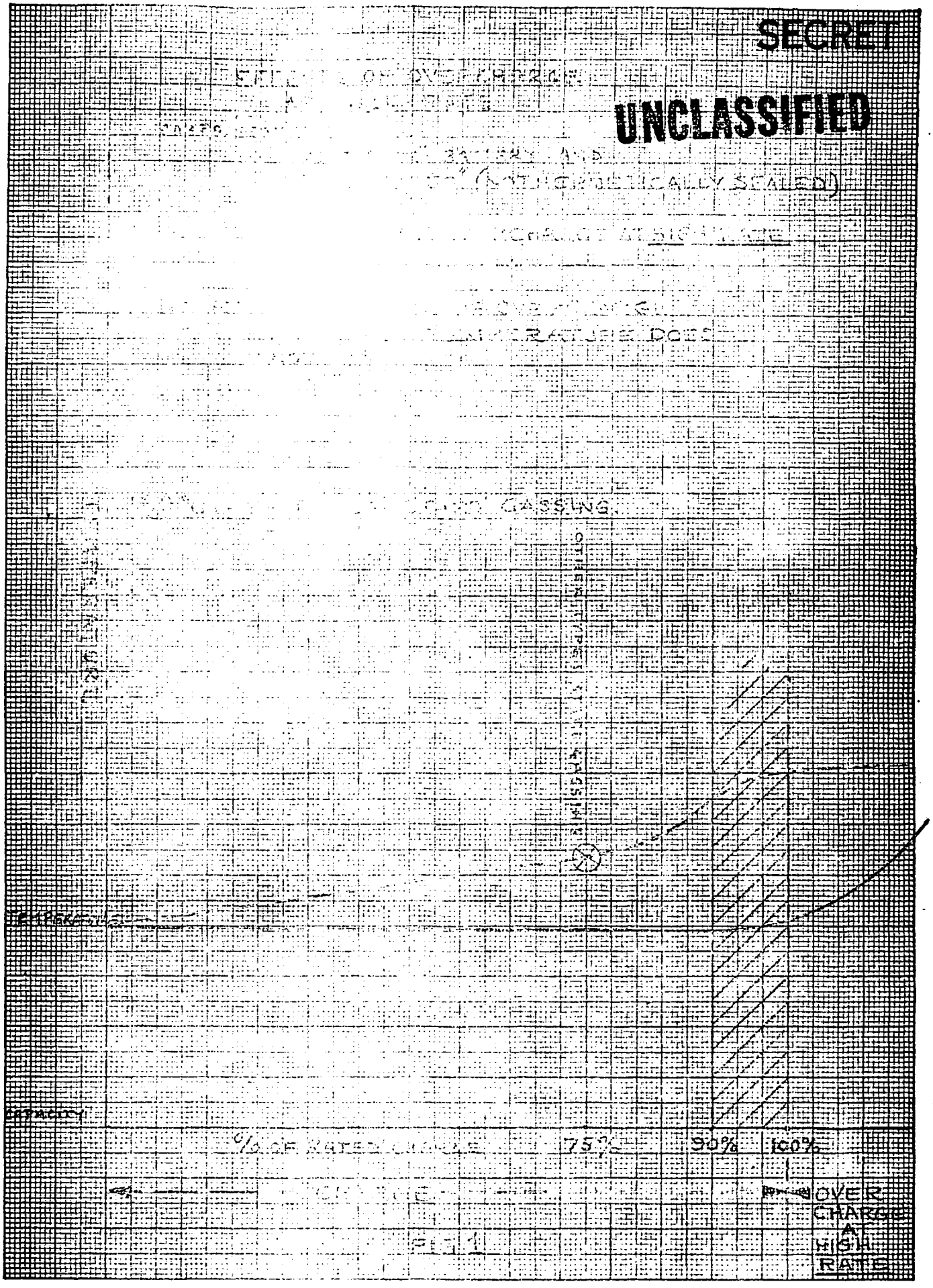

VOLTABLOC VO 15
CONTINUOUS DISCHARGE AT 20°C
VOLTS PER CELL
1.30
1.00
0.60
AMPERE HOURS
3
6
9
12
15

SECRET

VOLTAGE VOLTS
CONSTANT CURRENT DISCHARGE SHOWS RATED CHARGE
AMBIENT TEMPERATURE 77° F
VOLTS PER CELL
1.30
1.20
1.10
1.00
0.90
0.80
0.70
0.60
0
3
6
9
12
AMPERE HOURS
5BC20

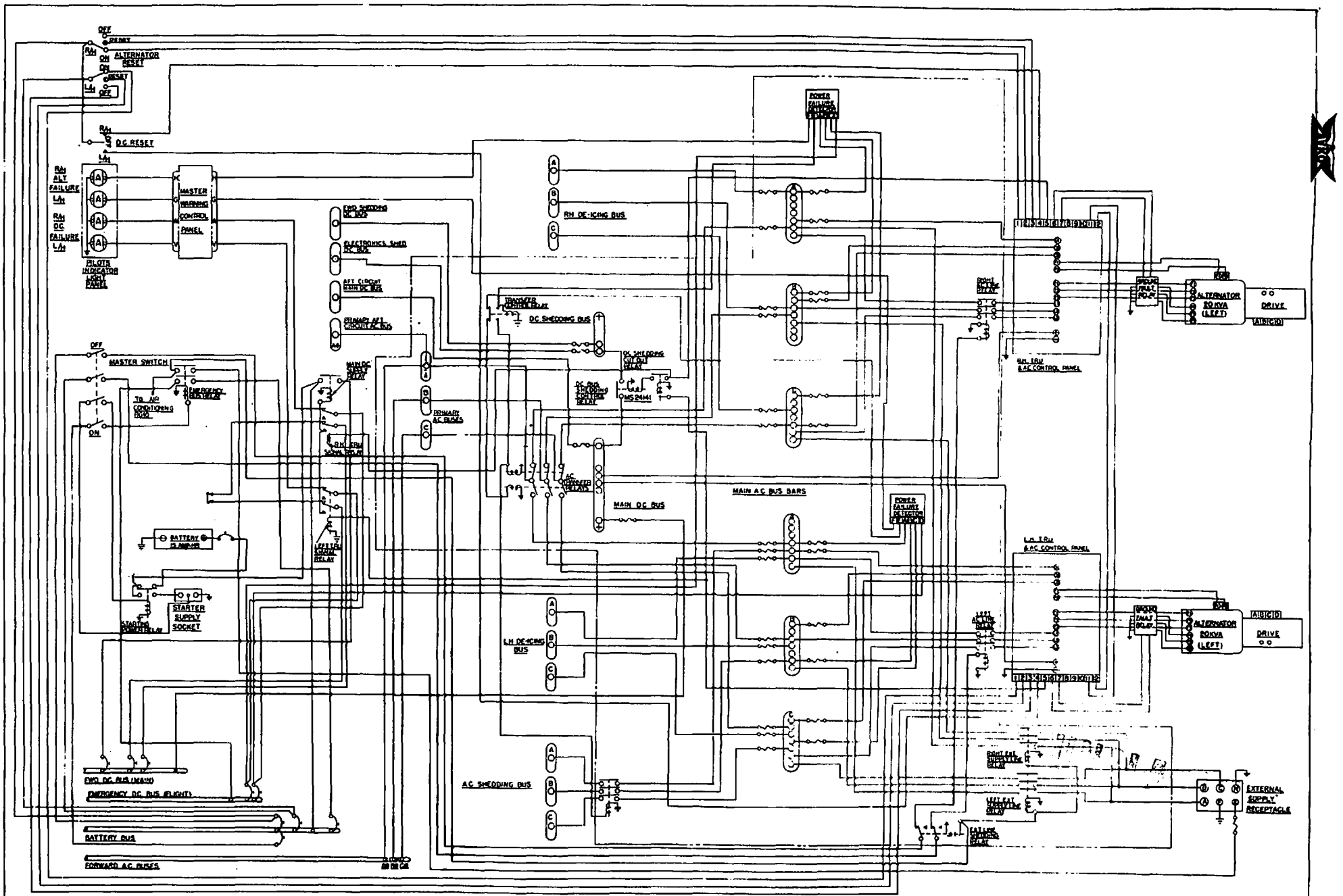
SECRET

UNCLASSIFIED



AVRO AIRCRAFT

INDEX OF ILLUSTRATIONS



ALTERNATOR & TRANSFORMER RECTIFIER SYSTEM

FIG. 1

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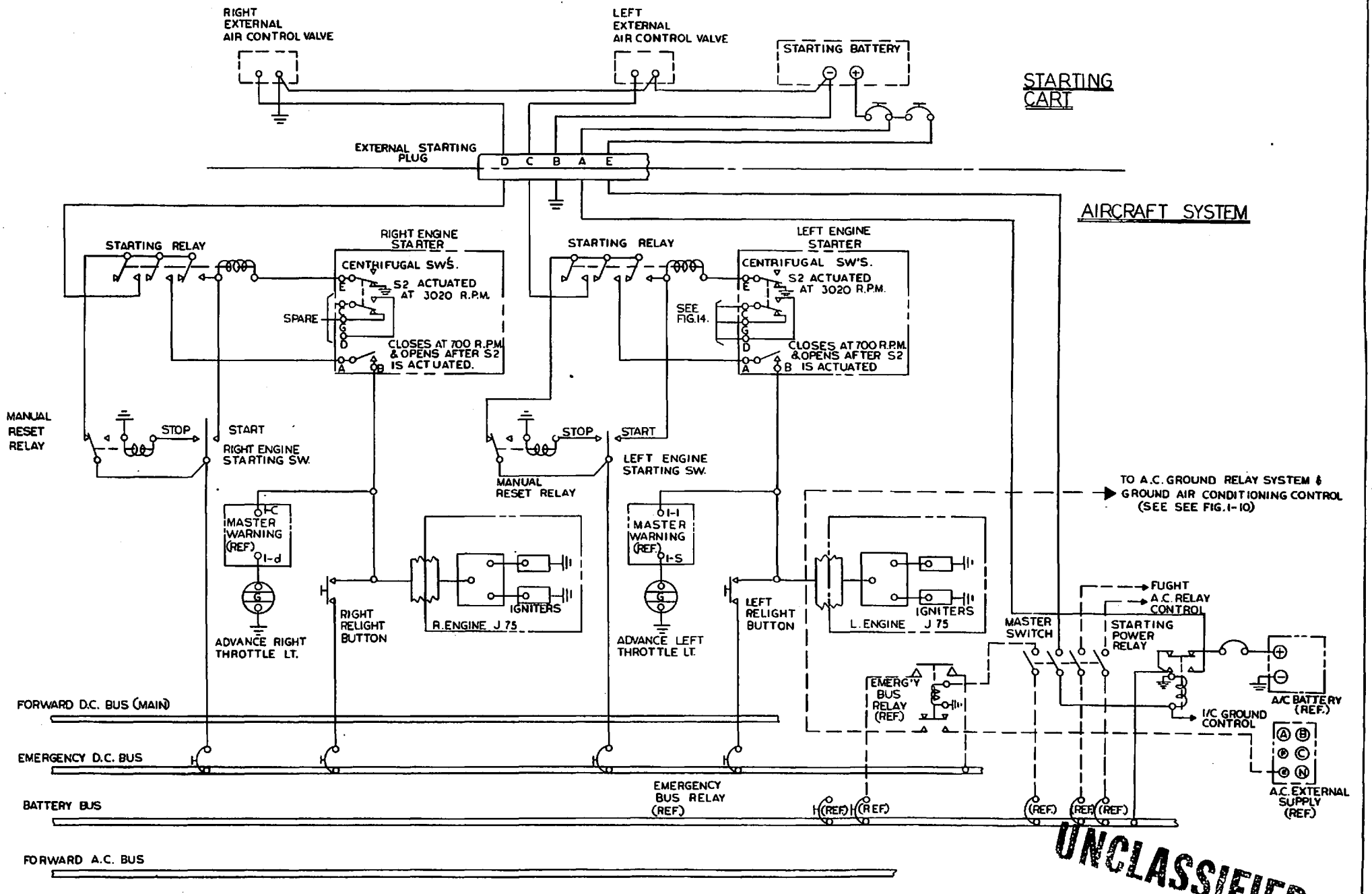

STARTING & IGNITION

FIG.2.

UNCLASSIFIED

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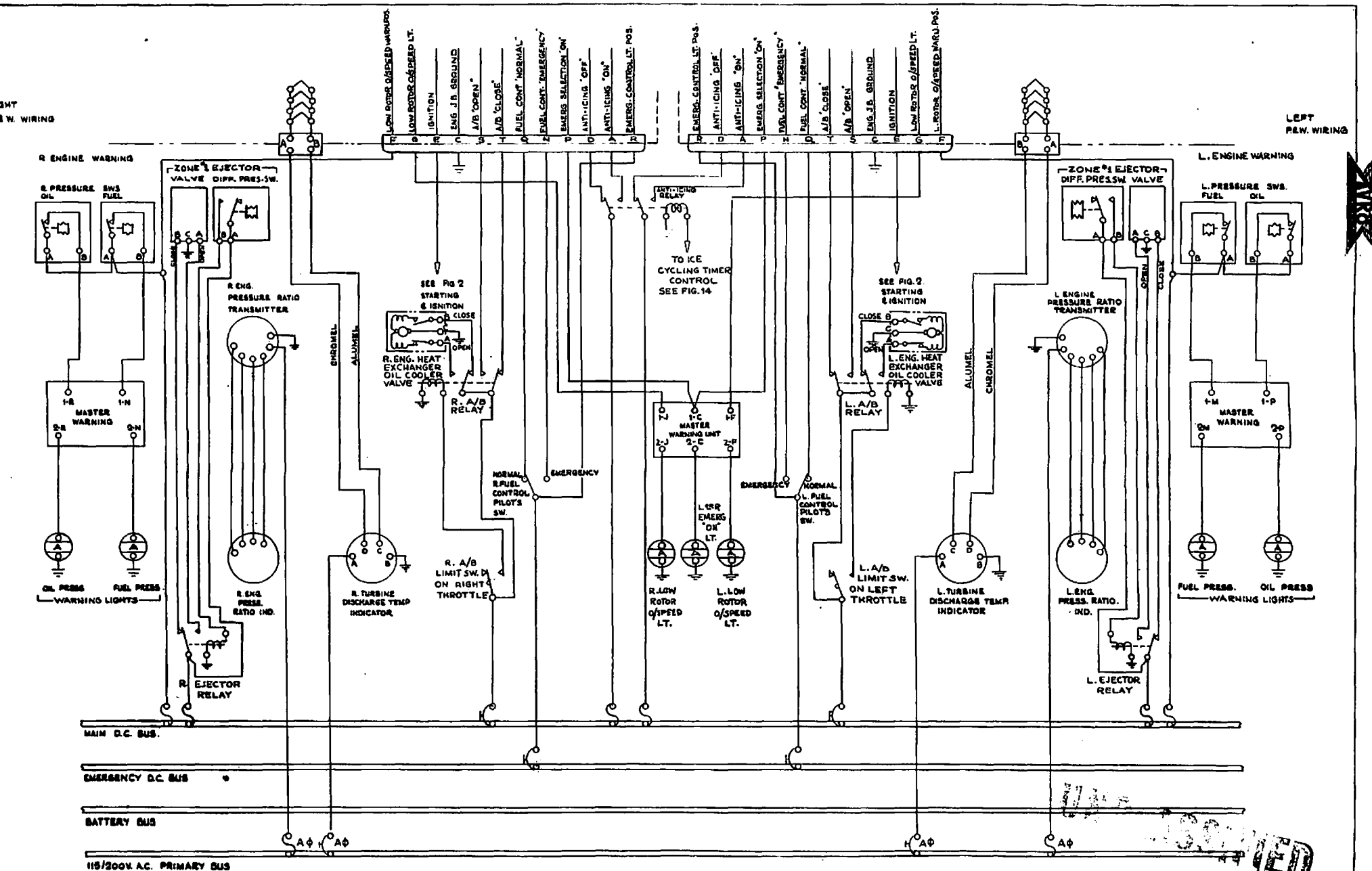

ENGINE SERVICES

FIG. 3

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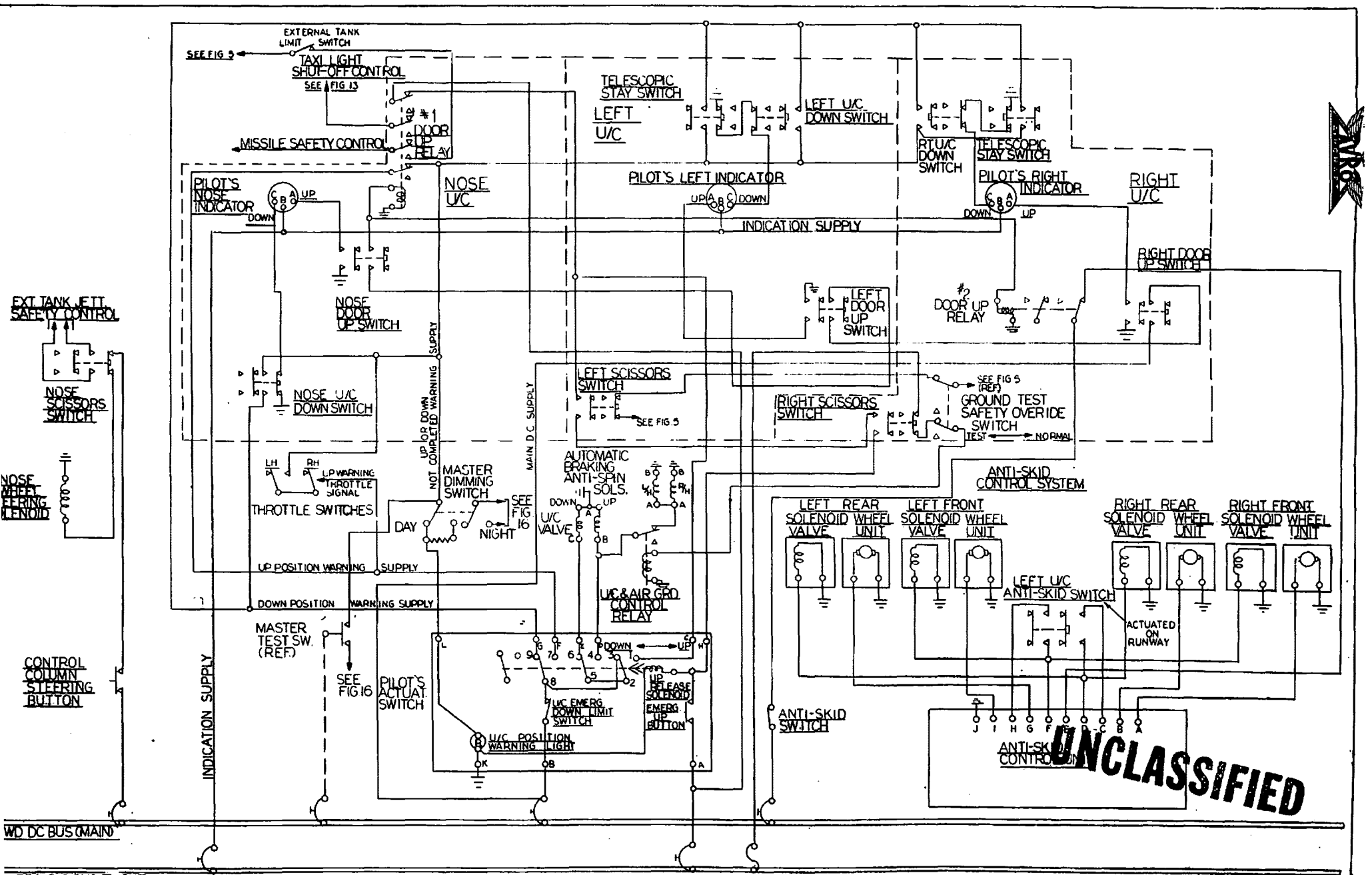

UNCLASSIFIED

LANDING GEAR ACTUATION & INDICATION

FIG. 4.

SECRET

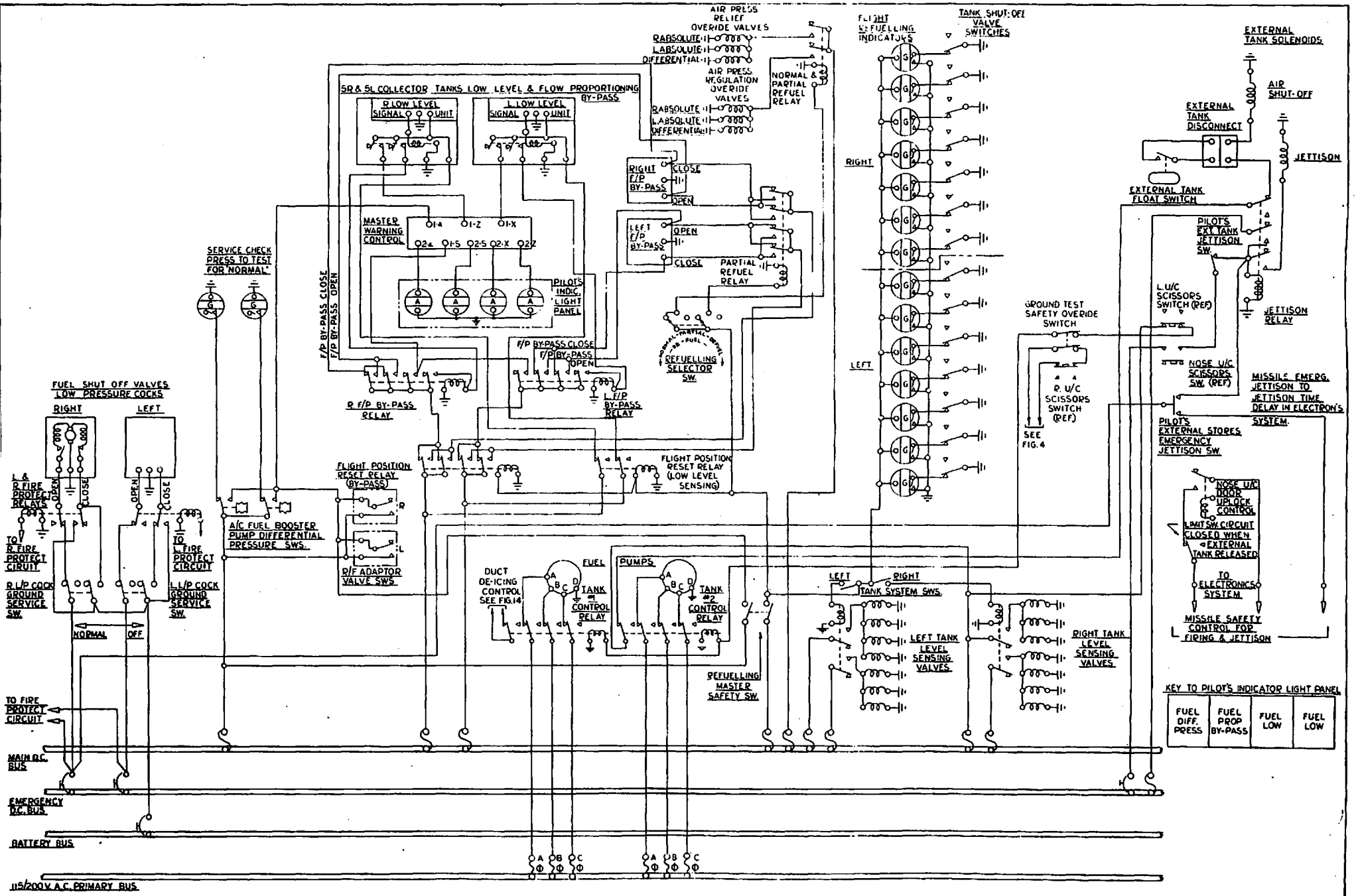

FIG. 5 FUEL SYSTEM

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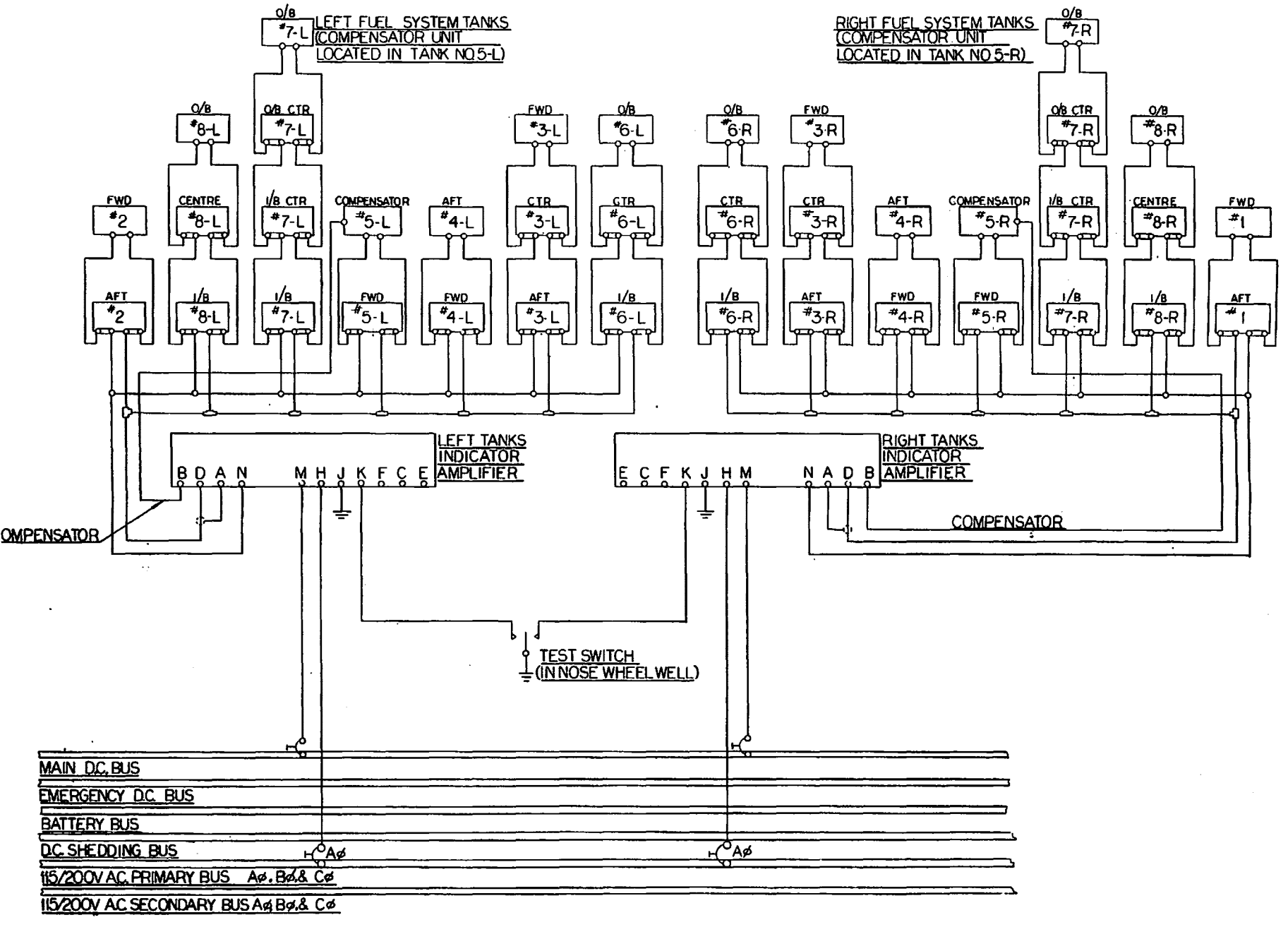

FUEL CAPACITANCE INDICATION

FIG. 6

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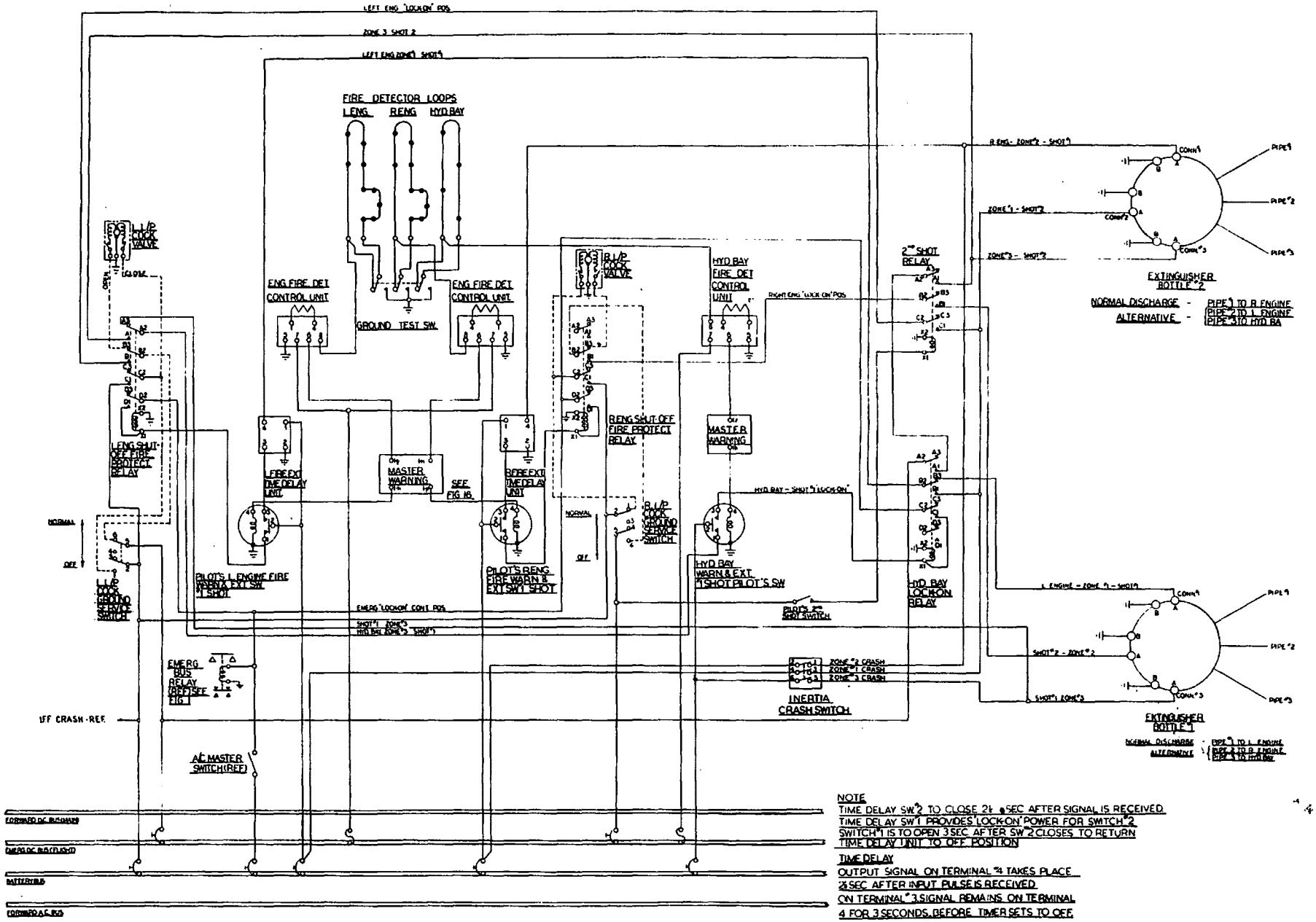
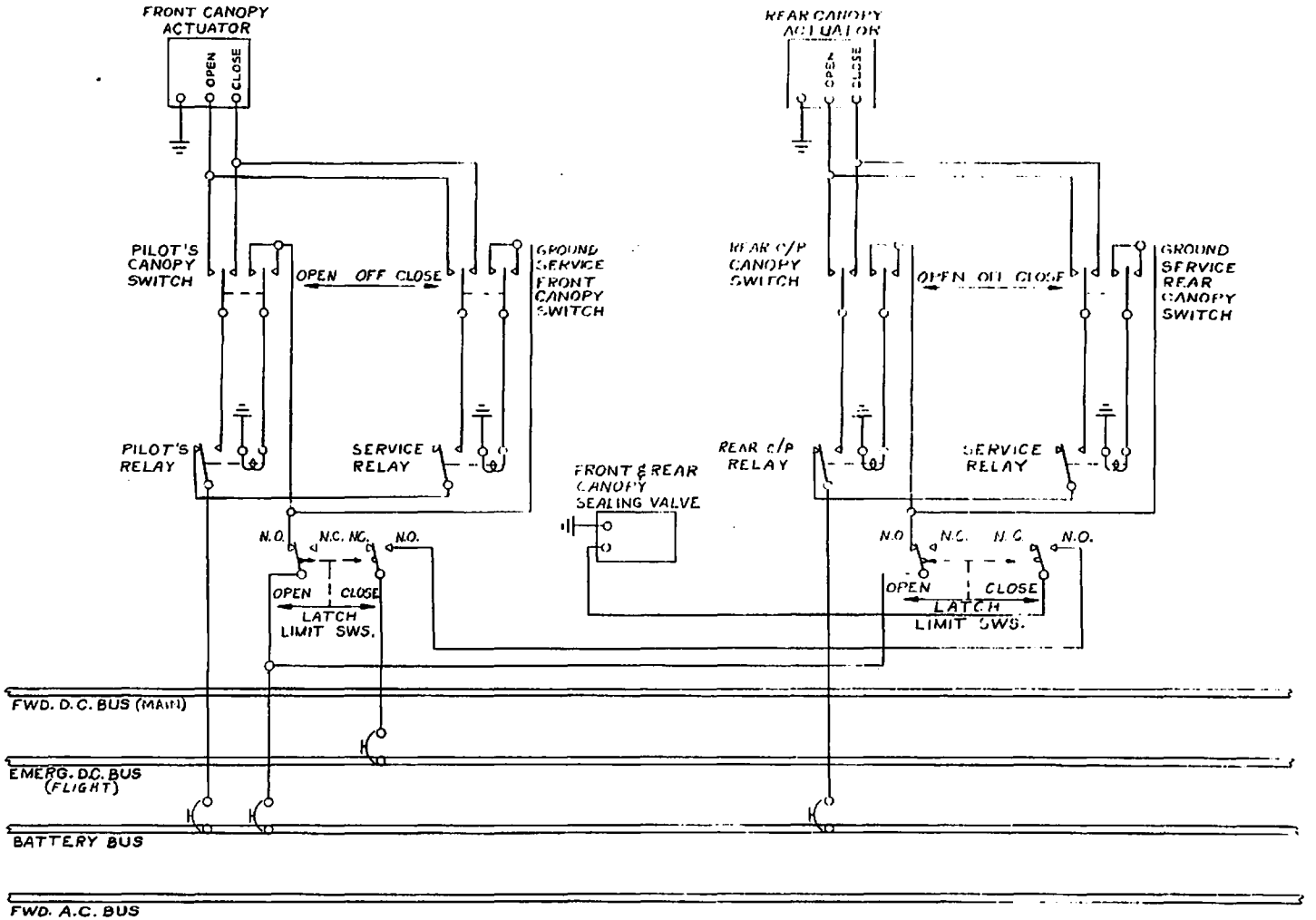


NOTE
TIME DELAY SW 2 TO CLOSE 2½ SEC AFTER SIGNAL IS RECEIVED
TIME DELAY SW 1 PROVIDES 'LOCK-ON' POWER FOR SWITCH 2
SWITCH 1 IS TO OPEN 3 SEC AFTER SW 2 CLOSES TO RETURN
TIME DELAY UNIT TO OFF POSITION

TIME DELAY
OUTPUT SIGNAL ON TERMINAL 4 TAKES PLACE
2½ SEC AFTER INPUT PULSE IS RECEIVED
ON TERMINAL 3 SIGNAL REMAINS ON TERMINAL
4 FOR 3 SECONDS, BEFORE TIMER SETS TO OFF

FIRE PROTECTION SYSTEM
FIG 7

SECRET



CANOPY ACTUATION

FIG. 8

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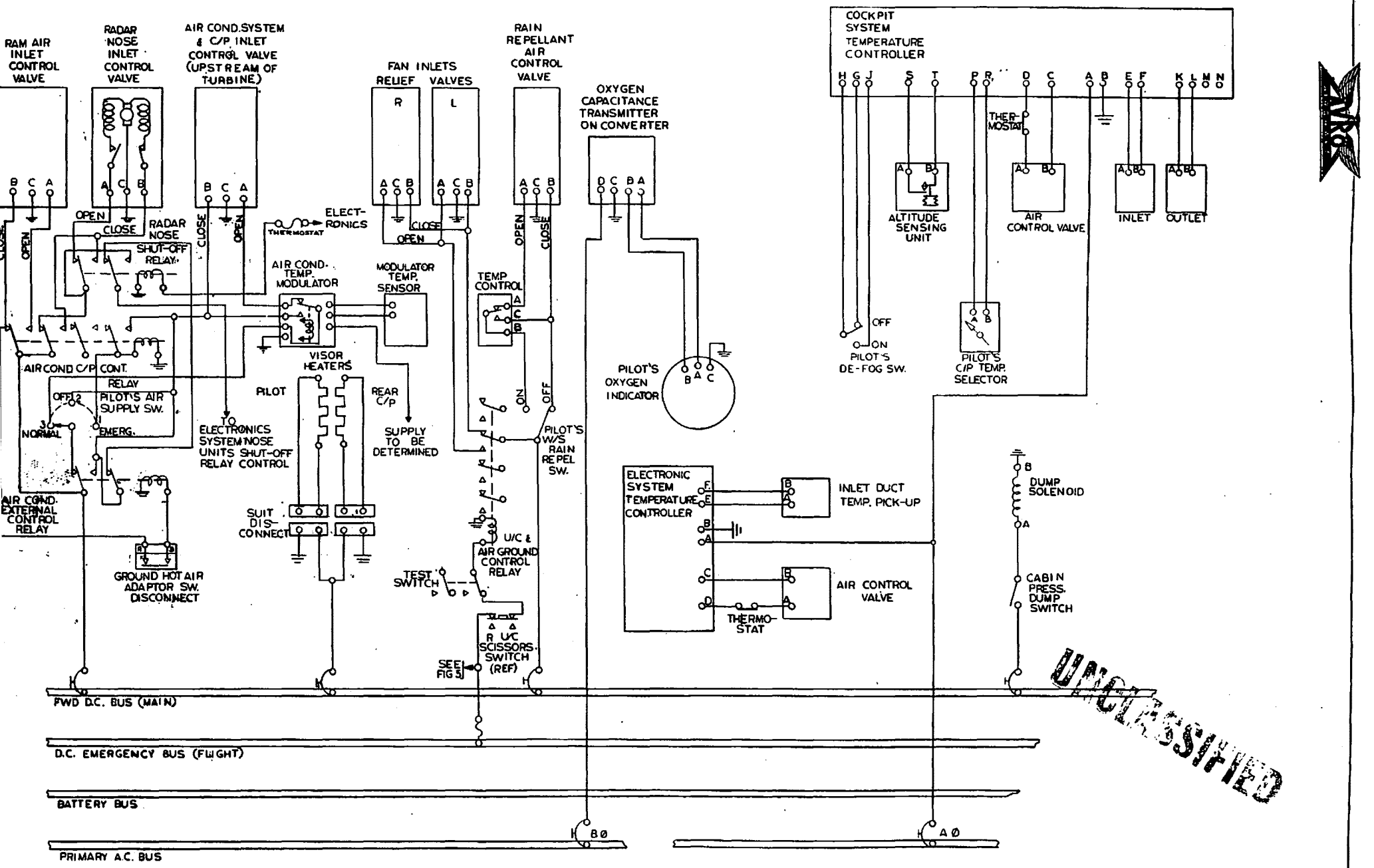

FIG.10

AIR CONDITIONING

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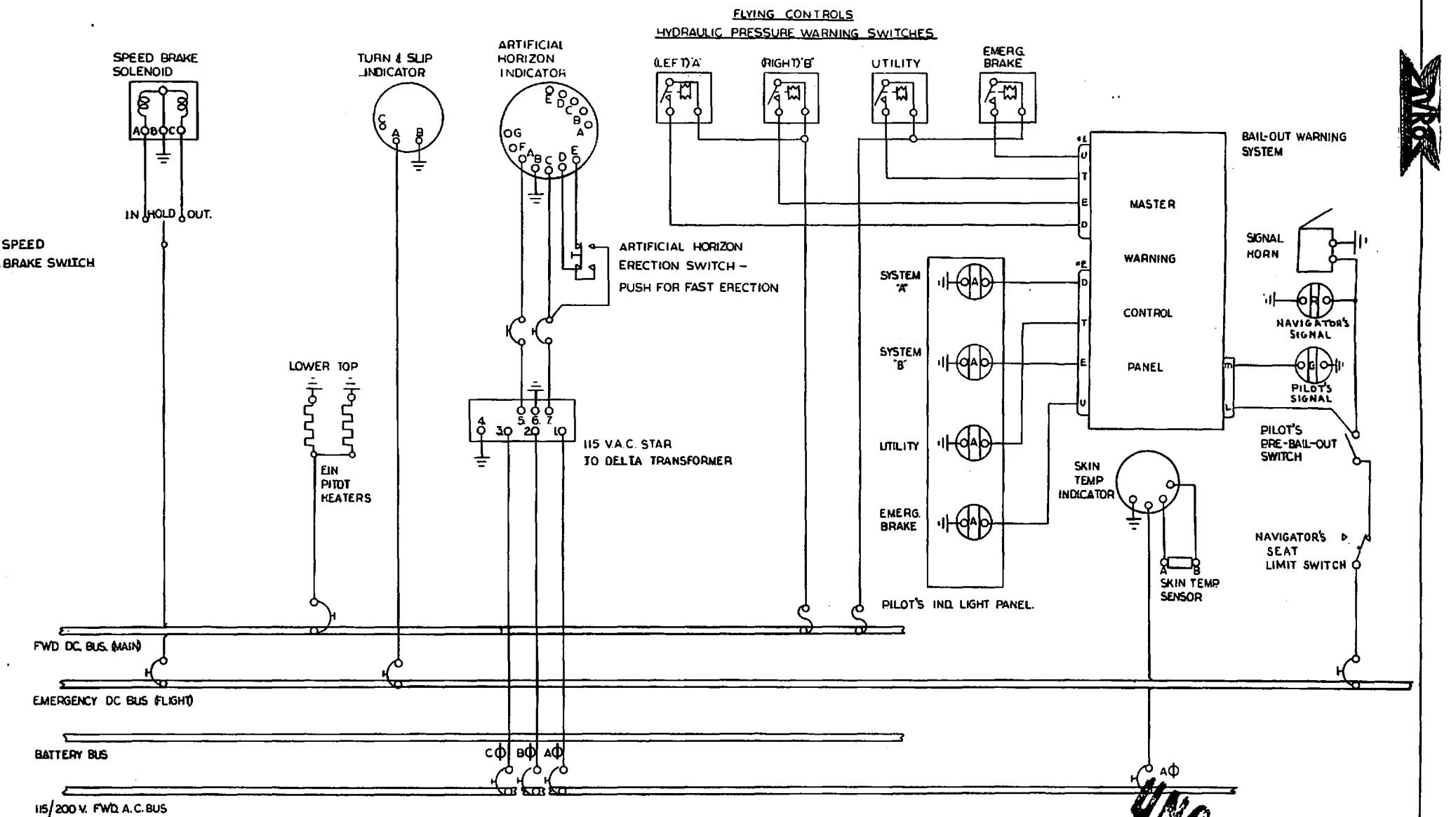
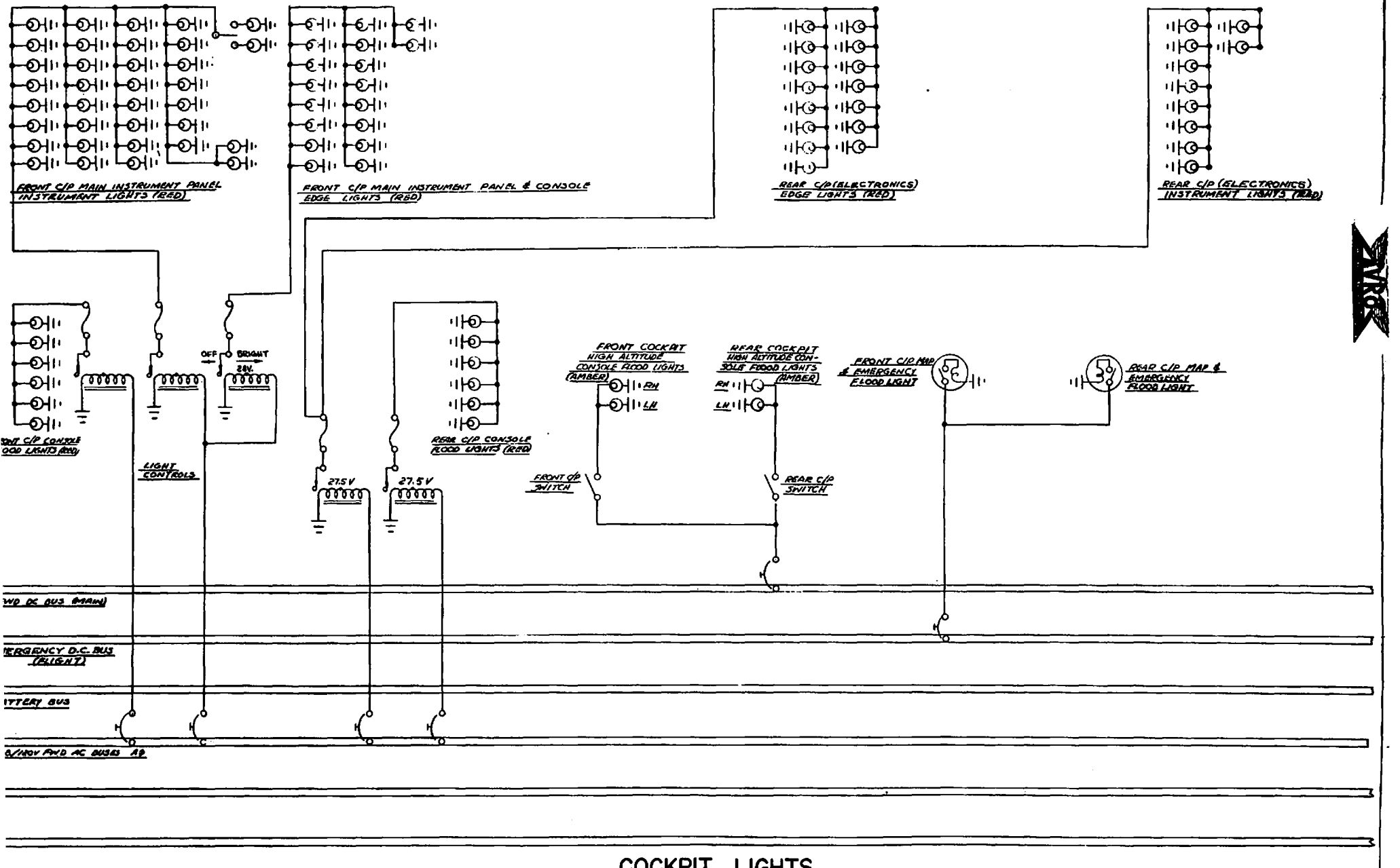


UNCLASSIFIED

SPEED BRAKE SOLENOID | TURN & BANK INDICATOR | ARTIFICIAL HORIZON | HYDRAULIC PRESSURE WARNING.

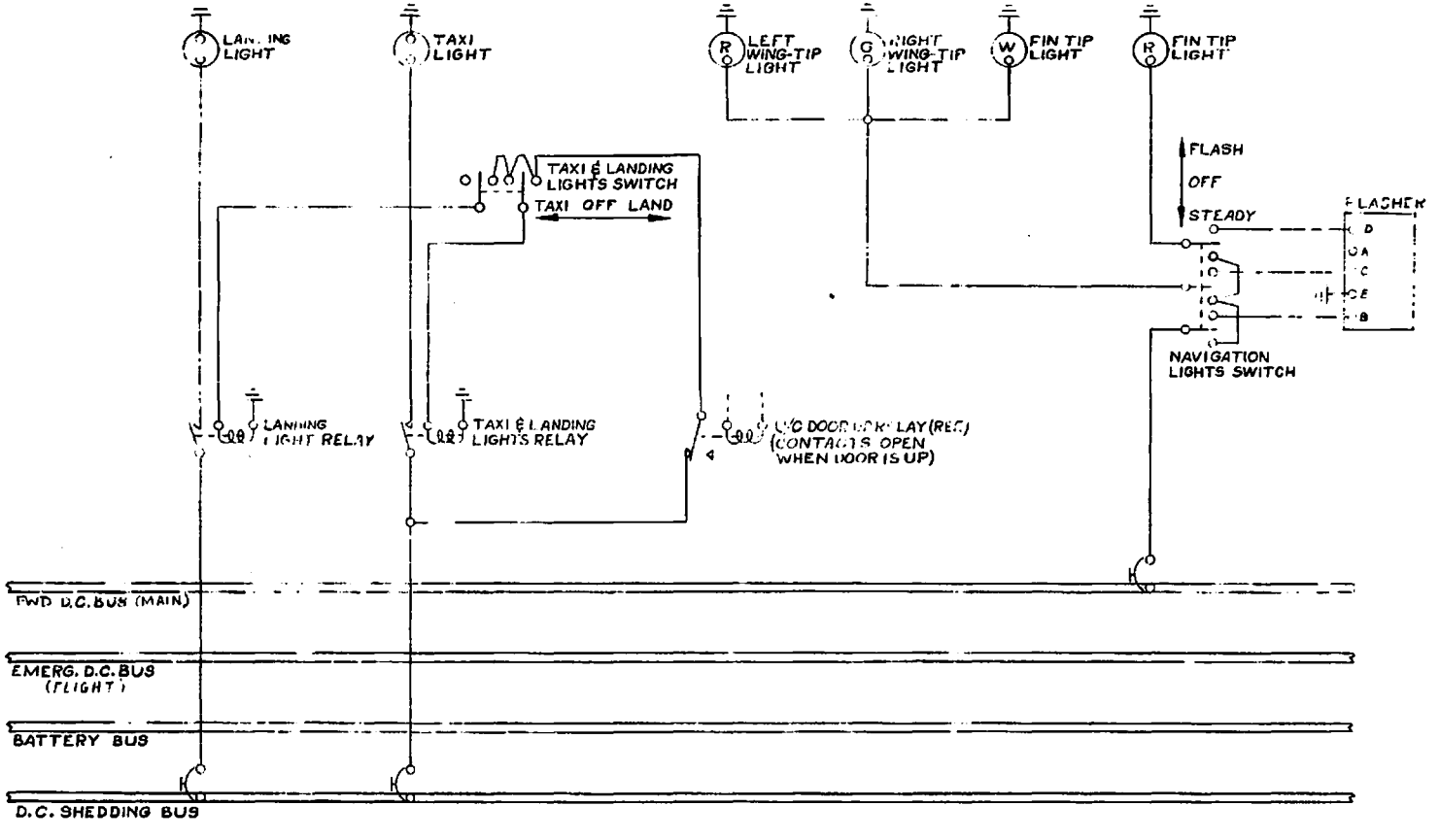
FIG. 11.

SECRET



COCKPIT LIGHTS
FIG. 12

SECRET



EXTERNAL LIGHTS

FIG. 13

SECRET

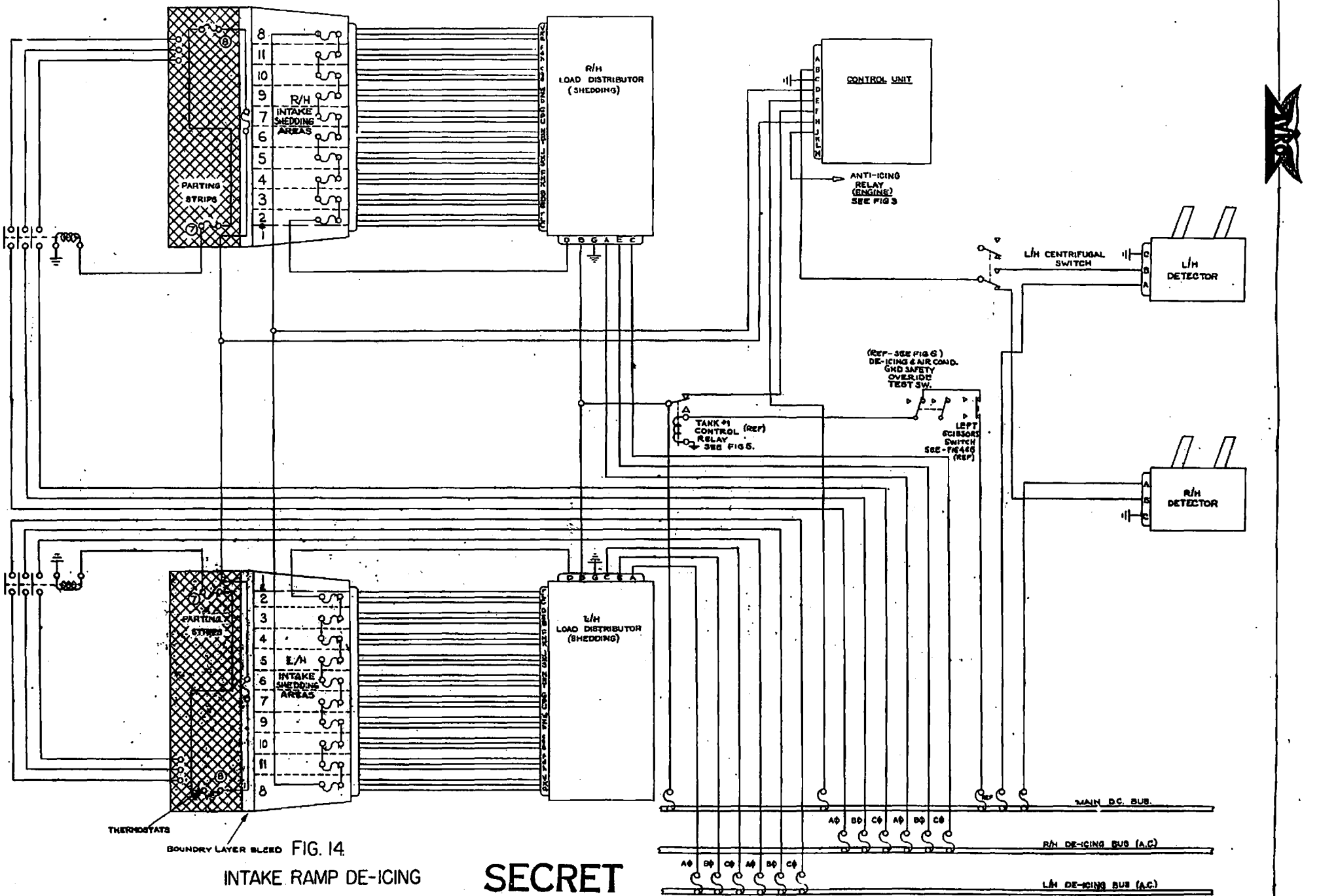
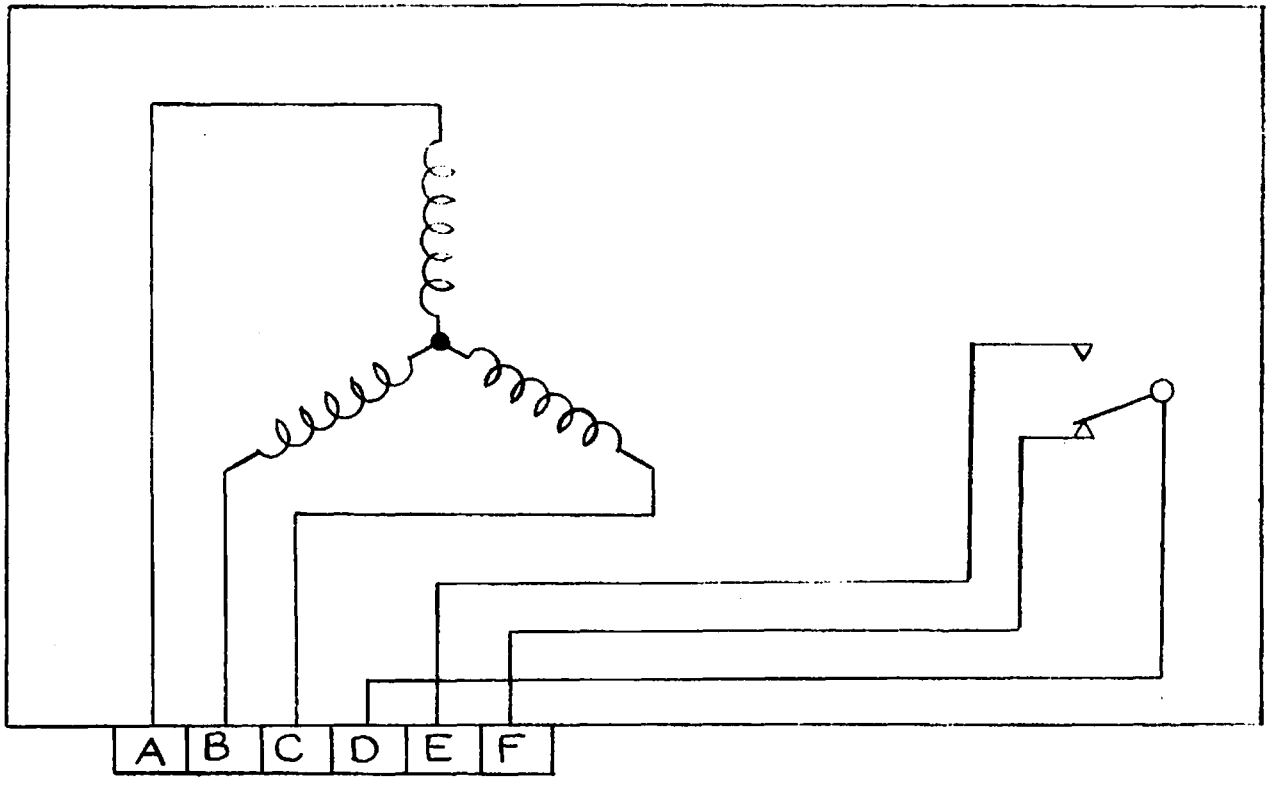


FIG. 14.

INTAKE RAMP DE-ICING

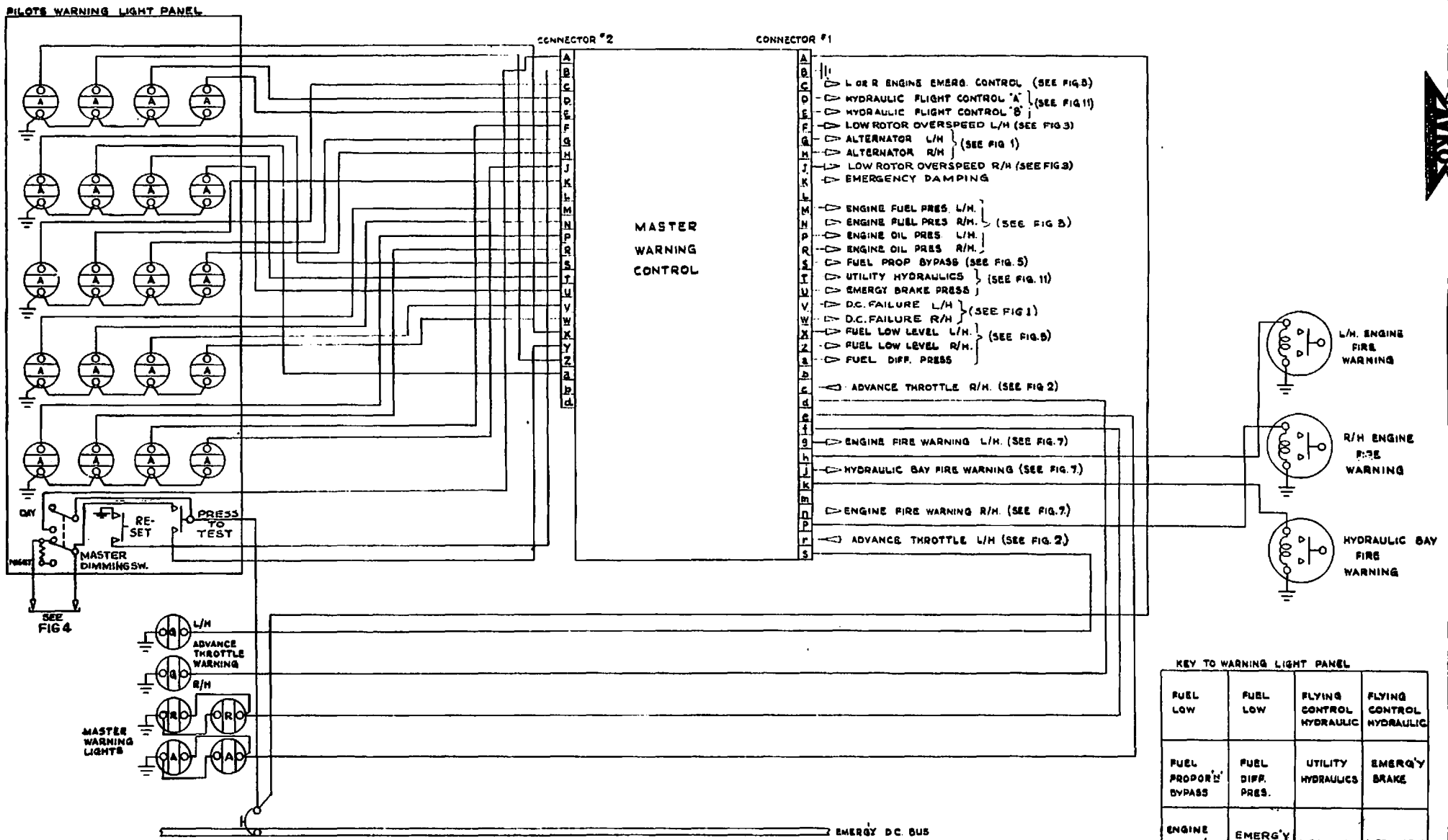
SECRET



WIRING DIAGRAM-POWER FAILURE DETECTOR.

FIG 15.

SECRET



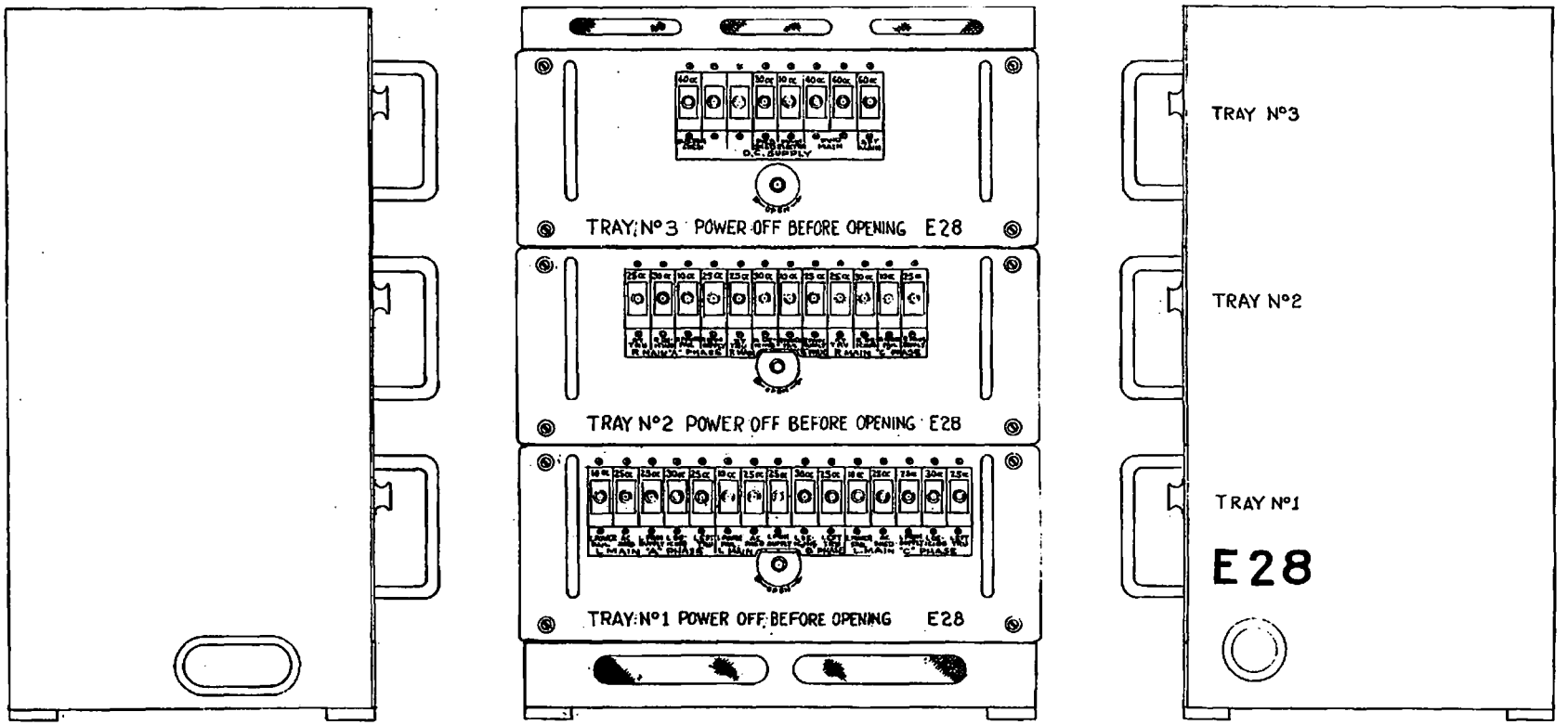
KEY TO WARNING LIGHT PANEL

FUEL LOW	FUEL LOW	FLYING CONTROL HYDRAULIC	FLYING CONTROL HYDRAULIC
FUEL PROPOR'N BYPASS	FUEL DIFF. PRES.	UTILITY HYDRAULICS	EMERG'Y BRAKE
ENGINE EMERG'Y FUEL	EMERG'Y DAMPING	ALTERNATOR	ALTERNATOR
ENGINE FUEL PRES.	ENGINE FUEL PRES.	D.C. FAILURE	D.C. FAILURE
OIL PRES	OIL PRES.	LOW ROTOR OVERSPEED	LOW ROTOR OVERSPEED

MASTER WARNING CONTROL SYSTEM

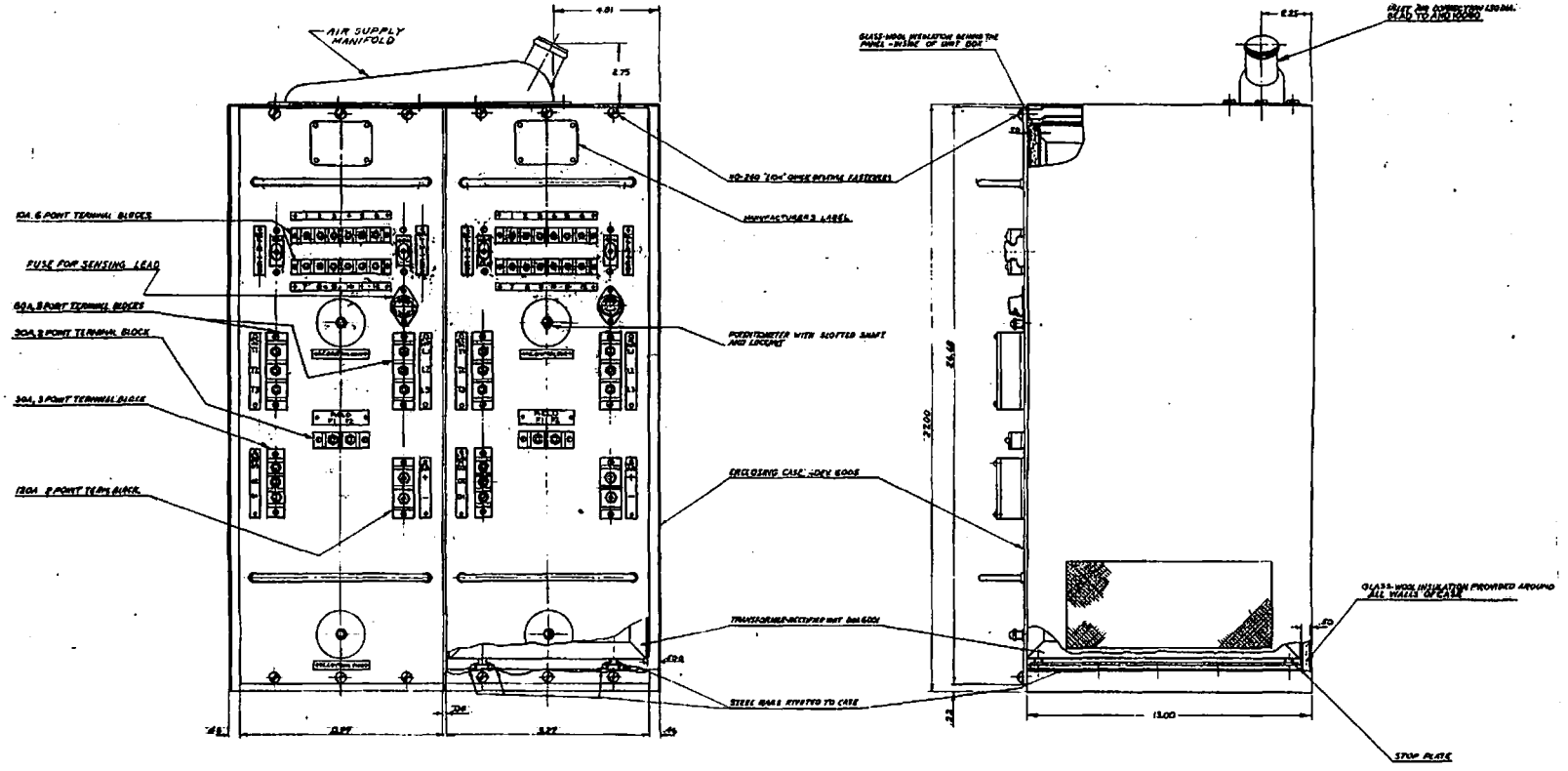
FIG. 16.

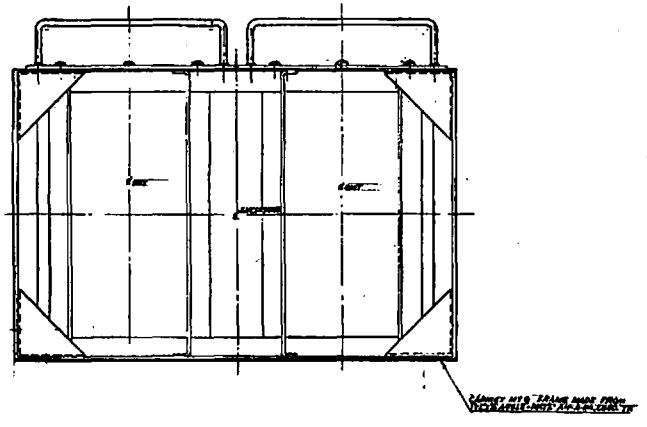
SECRET



MAIN POWER PANEL
FIG - 17

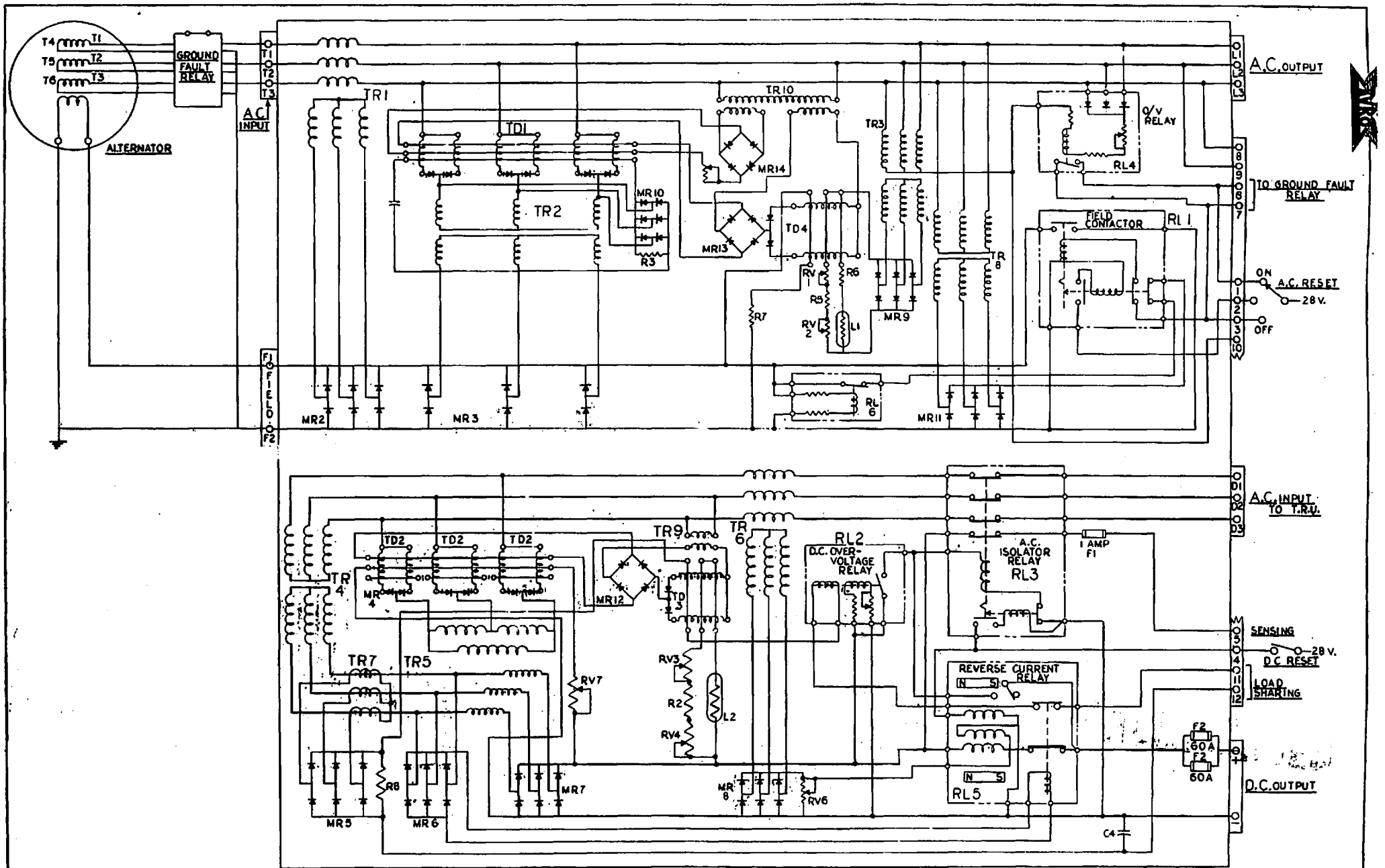
SECRET



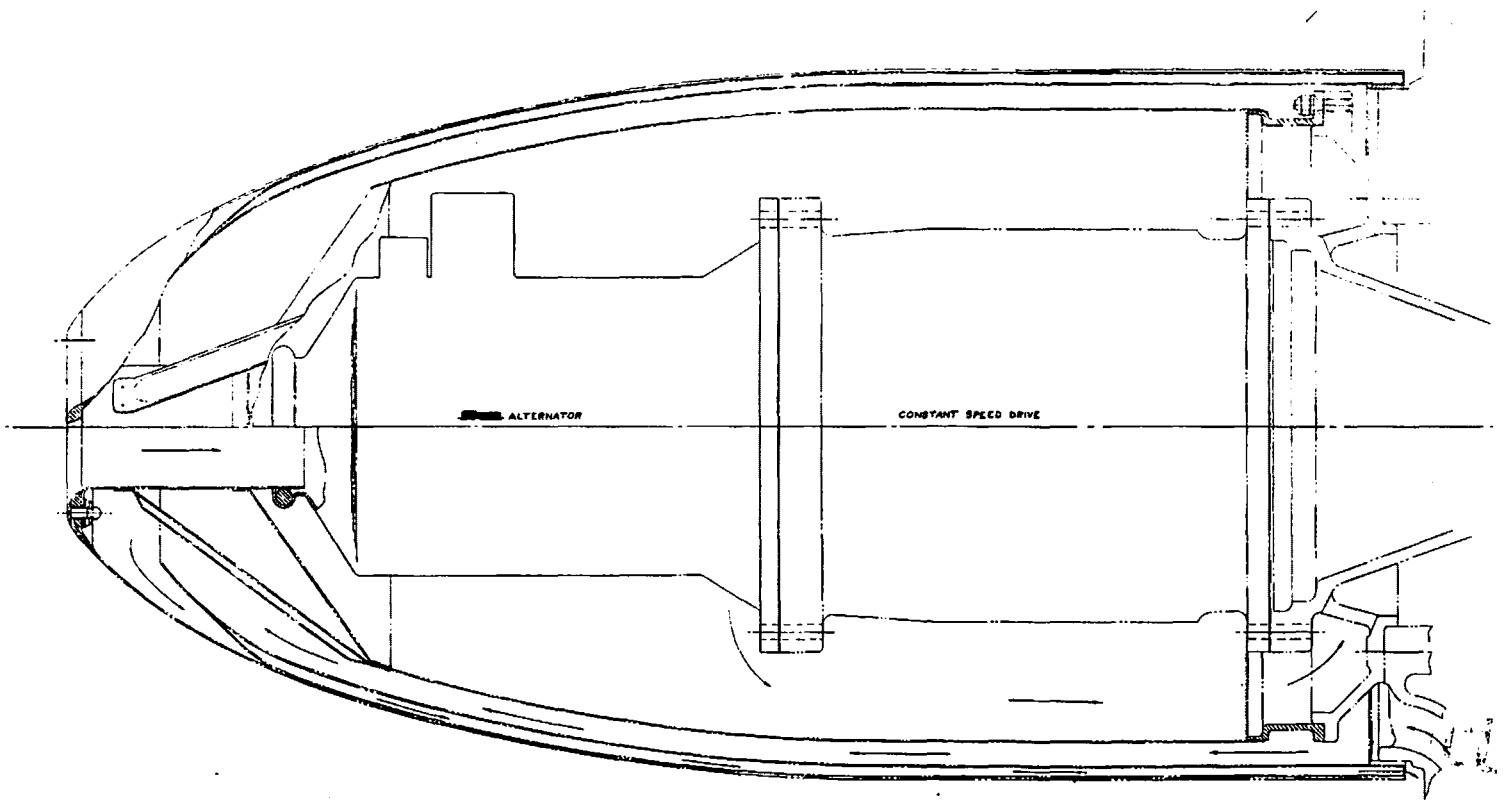


A.C. CONTROL AND
TRANSFORMER – RECTIFIER UNIT
FIG. 20

SECRET

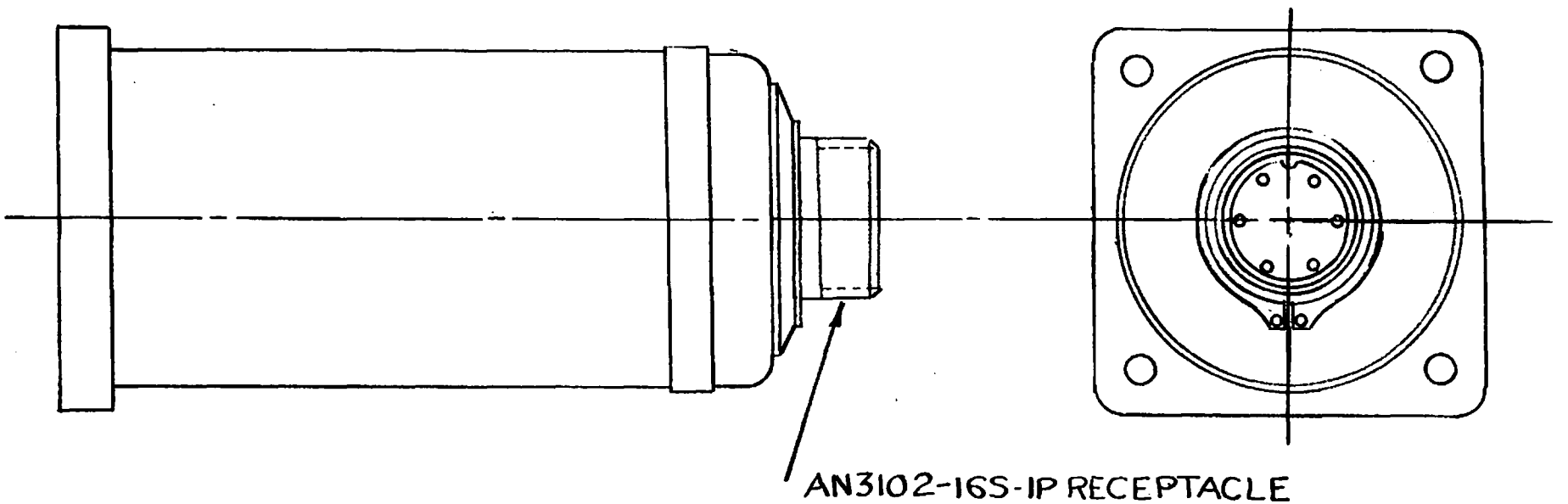


WIRING DIAGRAM A.C. CONTROL AND TRANSFORMER RECTIFIER UNIT. FIG. 21. SECRET



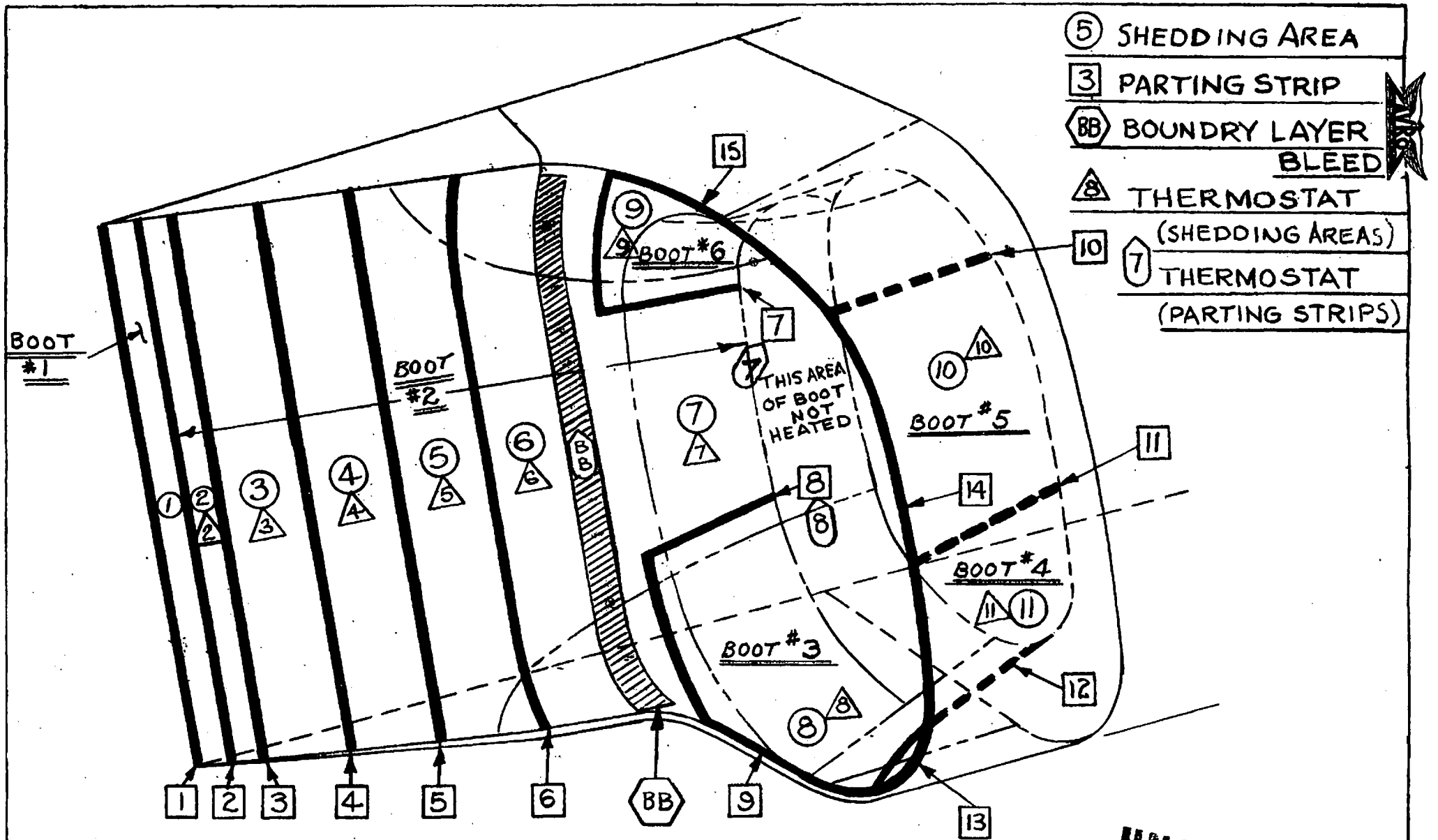
ALTERNATOR & CONSTANT SPEED DRIVE INSTALLATION

FIG. 22



POWER FAILURE DETECTOR

FIG. 23



DUCT DE-ICING BOOTS

FIG. 24

UNCLASSIFIED

SECRET