MISCELLANEOUS ELECTRICAL

LIGHTING SYSTEM

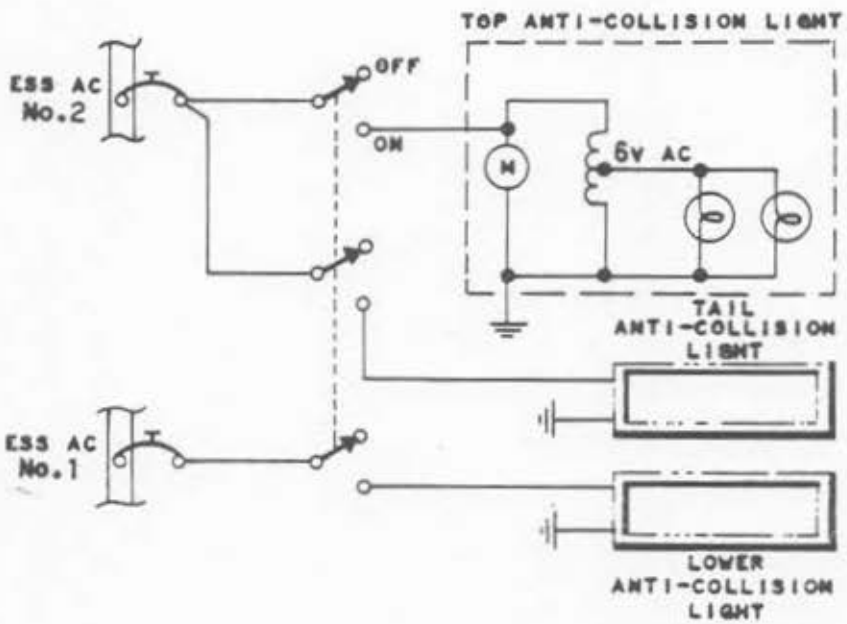
The light system consists of the exterior, interior, and emergency lighting. Exterior lighting consists of anti-collision, taxi, wing leading edge, formation, navigation, and landing lights. The exterior lighting is controlled from the overhead panel in the flight station.

The interior lighting provides illumination of the flight station and cargo areas and consists of dome lights, instrument panel lights, utility lights and reading lights in the flight station. The cargo area lighting consists of dome lights, cargo loading lights, jump platform lights, lavatory lighting, and maintenance lighting. Maintenance lights are provided in the underdeck equipment rack area, aft crawlway, vertical stabilizer tunnel, and wheel well areas. The interior lighting is controlled from the overhead panel and switch panels at the various light locations. Emergency lights are provided next to each exit. Relays and autotransformers of the lighting systems are located in the flight station relay panel and the center fuselage junction box.

ANTI-COLLISION LIGHTS

Three anti-collision light assemblies are installed on the aircraft. The lights are on the bottom fuselage, top fuselage, and top of the

horizontal stabilizer. The top lights are energized from the essential A-C bus No. 2 and bottom light from essential A-C bus No. 1.



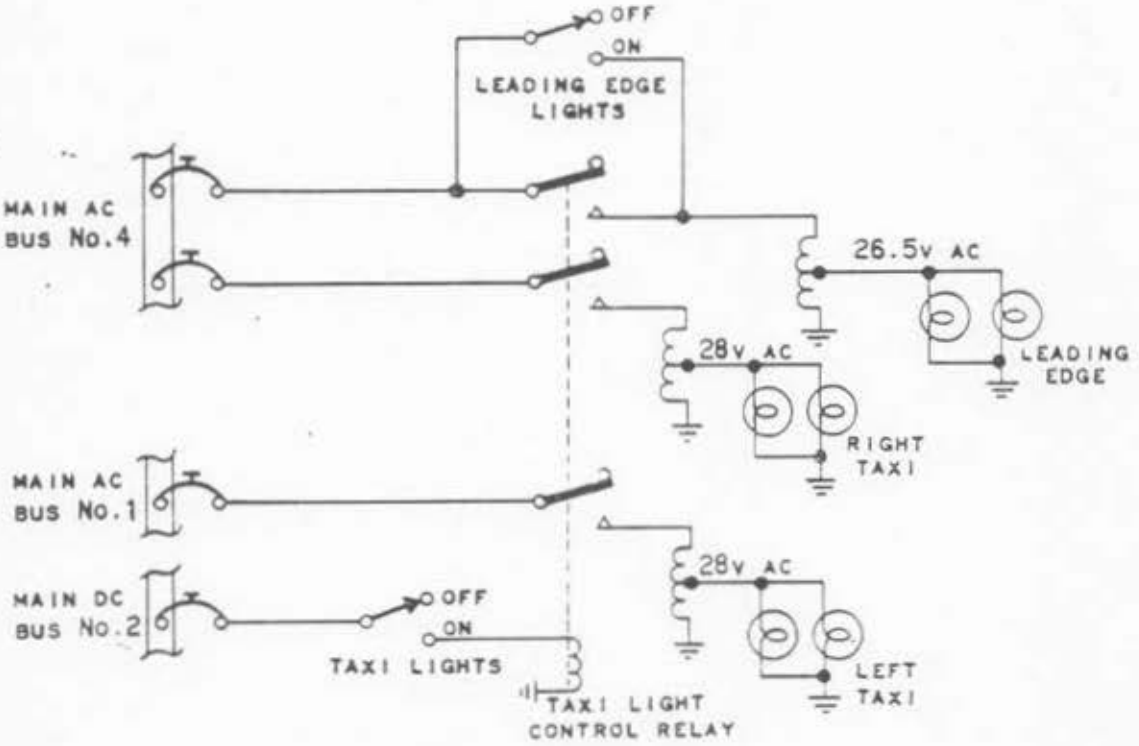
ANTI-COLLISION LIGHTS

Each light assembly consists of a motor, autotransformer, and two clear sealed-beam lamps. The sealed-beam lamps produce a high intensity direction beam of light that is only visible when the beam is directed toward the observer.

The lamps are placed back-to-back and swept through an arc of 180 degrees by the drive motor. This produces the illusion of a single beam rotating through an arc of 360 degrees. The drive speed is adjusted to produce 50 flashes per minute.

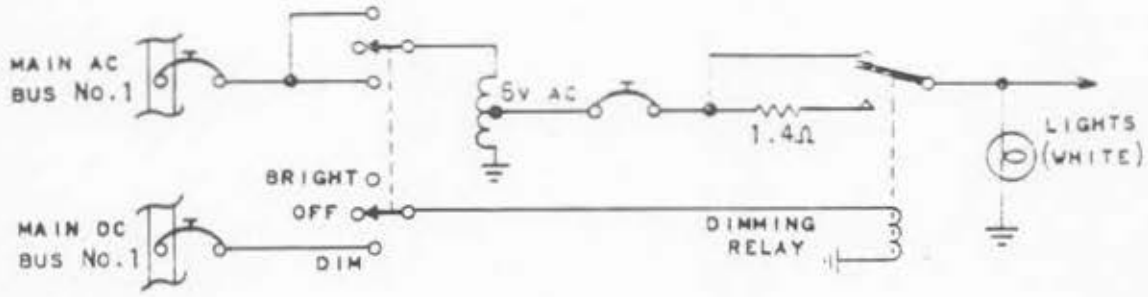
TAXI LIGHTS AND LEADING EDGE LIGHTS

Two taxi lights are installed on each main landing gear door. The lower light faces forward and the upper light faces outboard. Autotransformers reduce the A-C voltage to 28-volt, AC, for the lights. When the control switch is "ON," a taxi light control relay is energized to connect AC to the transformers.



TAXI AND LEADING EDGE LIGHTS

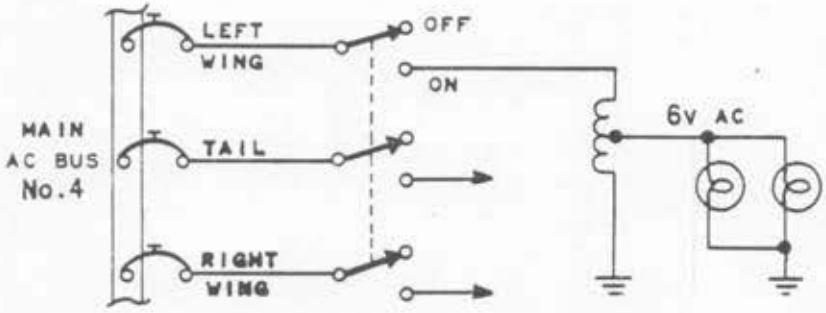
One leading edge light is located on each side of the fuselage. A prismatic lens bends the light beam 30 degrees aft to illuminate the wing leading edge and nacelle inlet, as well as the area forward of the wing. The lights are controlled by a switch and autotransformer. The switch is bypassed by contacts of the taxi lights control relay when the taxi lights are "ON."



FORMATION LIGHTS

FORMATION LIGHTS

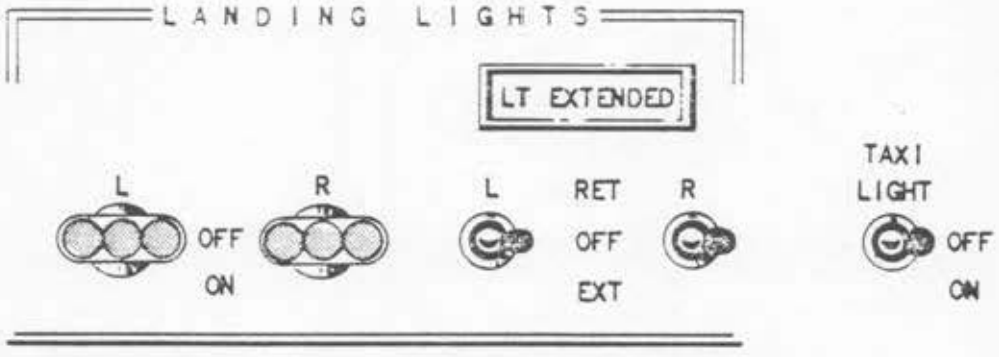
Nine formation lights are installed on the aircraft. Three lights are in a row on top of the fuselage, and three lights are on each of the outer wing panels. An autotransformer reduces the A-C voltage to 6-volt, AC, for the lights. The "BRIGHT" position of the formation lights switch connects 6-volt, AC, to the lights. The "DIM" position energizes the dimming relay which adds a resistor in series with the lights.

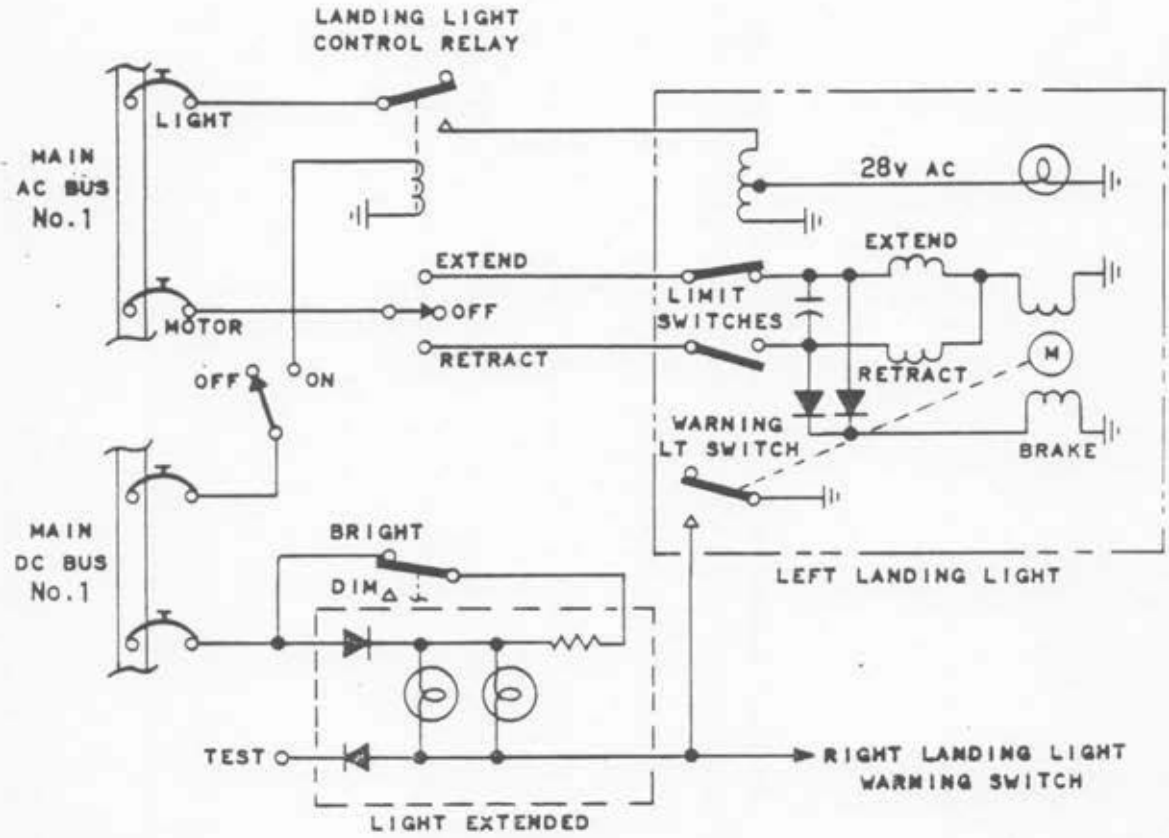


NAVIGATION LIGHTS

NAVIGATION LIGHTS

The navigation lights consist of three light assemblies. A red light assembly is on the left wing tip, and green is on the right wing tip. White lights are on the tail. Each assembly contains an autotransformer and two lights. The autotransformer reduces the 115-volt, AC, to 6-volt, AC, for the lights. When the navigation lights switch is "ON," the lights illuminate. The wing tip lights may be observed through the flight station windows.





LANDING LIGHTS

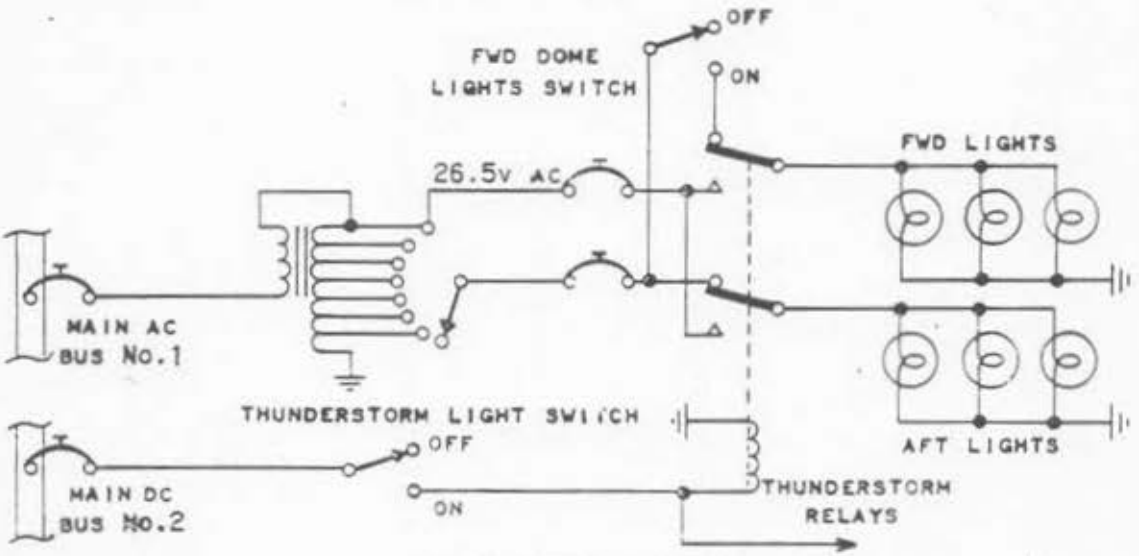
LANDING AND TERRAIN CLEARANCE LIGHTS

One landing light assembly is mounted on the bottom of each wing between the inboard and outboard flaps. Each assembly contains a motor, a light, limit switches, and a warning light switch. The extend limit switch is open when the light is fully extended. The retract limit switch is open when the light is retracted. Between the extended and retracted positions, both switches are closed allowing motor operation in either direction. The warning light switch is closed when the light is not fully retracted, causing illumination of the LT EXTENDED warning light.

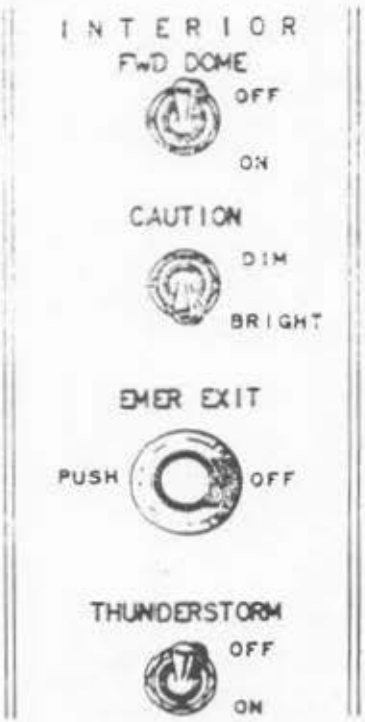
When the landing lights switch is "ON," the landing light control relay is energized. The autotransformer reduces the 115-volt, AC, to 28-volt, AC, for the light. The motor control switch in the "EXTEND" position energizes the opposite motor field and the motor reverse direction. The A-C voltage is rectified and applied to a brake coil to allow motor rotation.

FLIGHT STATION DOME (FLOOD) AND THUNDERSTORM LIGHTS

Six flight station dome lights are controlled by a variable tapped autotransformer. The autotransformer output is variable from a maximum of 26.5 volts, AC, to a minimum of 3 volts, AC, or "OFF." The aft dome lights are controlled from the autotransformer. The forward dome lights are controlled from the autotransformer and a forward dome lights ON-OFF switch. The thunderstorm lights switch energizes a relay causing illumination of the six dome lights at maximum brightness, thus bypassing the normal circuit.

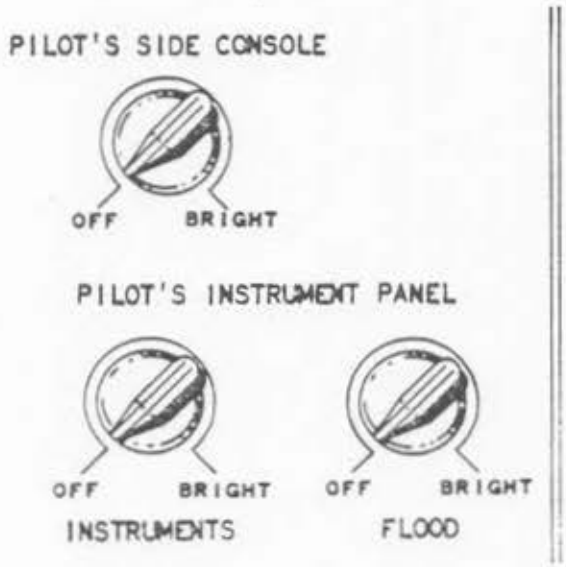


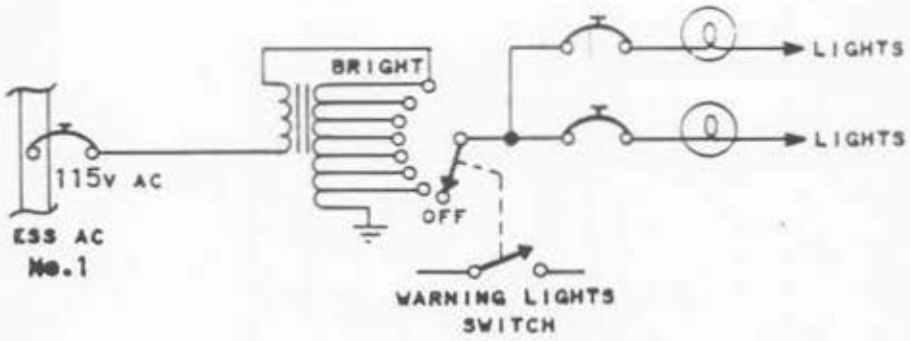
THUNDERSTORM LIGHTS



PILOT"S LIGHTING

The pilot's lighting consists of instrument lights, side console lights, overhead panel lights, instrument panel floodlights, and overhead panel floodlights. The instrument panel floodlights are controlled by a rheostat from the 28-volt, D-C, source. The rheostat is bypassed by the thunderstorm lights switch for maximum brightness. The other lights are controlled through variable autotransformers. The voltage varies from zero to a maximum of 5.4 volts, AC. The overhead panel floodlights autotransformer varies from zero to 26.5 volts, AC. The pilot's instrument light switch also controls the warning lights dimming circuit. When the pilot's instrument panel lights are "OFF," a switch is open. The switch ensures bright warning light illumination during daytime operation when the instrument lights are "OFF." The thunderstorm switch also bypasses the overhead floodlights autotransformer for maximum illumination.





PILOT'S INSTRUMENT PANEL LIGHTS

COPILOT'S LIGHTING

The copilot's lighting consists of instrument lights, side console lights, and instrument panel floodlights. The circuits use variable autotransformers which provide a maximum of 26.5 volts, AC to the floodlights and 5.4 volts, AC, to the other lights. The lights and controls function similar to the pilot's circuits.

Center instrument panel and center console lighting variable autotransformers control the voltage to the center instrument panel and center console lights. The maximum voltage is 5.4 volts, AC.

UTILITY LIGHTS

Three utility lights are installed in the flight station. Each light has an ON-OFF switch and rheostat brightness control. The lights are type C-4 and are provided at the pilot, copilot, and flight engineer stations. The lights operate from 28-volt, AC, which is provided from the flight station lighting bus.

FLIGHT ENGINEER'S LIGHTING

The flight engineer's lighting consists of instrument panel lights, instrument lights, circuit breaker panel lights, floodlights, and worktable light. The circuit breakers and controls for the lights are on the flight engineer's lighting control panel. The floodlights and worktable lights are controlled by a FLOOD-BOTH-TABLE switch in addition to the autotransformer. The individual lights can be selected in "FLOOD" or "TABLE." All flood and table lights can operate in "BOTH." The thunderstorm lights switch also controls the floodlights. The remaining lights function similar to the pilot's lights.

NAVIGATOR'S LIGHTING

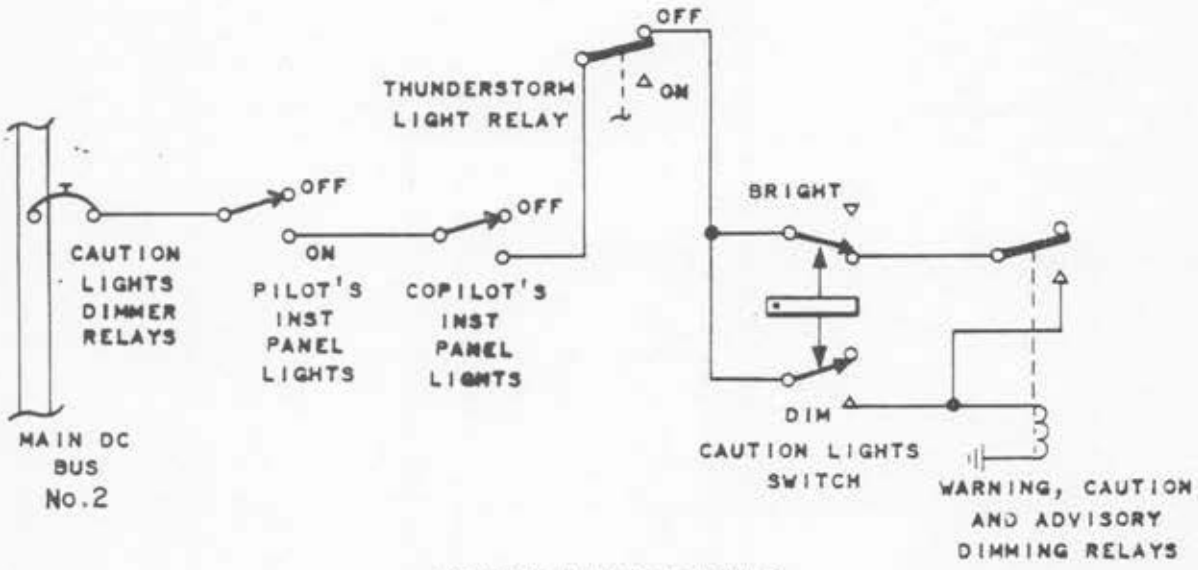
The navigator's lighting consists of instrument panel lights, instrument lights, floodlights and worktable light, similar to the flight engineer's lighting. The controls and switches are on the navigator's lighting control panel.

READING LIGHTS

Five floodlights are provided in the crew rest area. Each light has an on-off switch and operates from 28-volt, AC.

WARNING LIGHTS DIMMING

The warning lights are controlled by relays for bright or dim indications. The relays energize and remain energized when the BRIGHT-DIM switch on the overhead panel is positioned to "DIM" (momentary switch). Dimming resistors in each light assembly are inserted in series with the light to decrease intensity. The



WARNING LIGHTS DIMMING

pilot's and copilot's instrument panel lights switch must be "ON," and the thunderstorm lights switch must be "OFF," before the warning lights dimming circuit is operational. The instrument lights are normally used at night and allow the warning lights to be dim or bright as required.

CARGO COMPARTMENT DOME LIGHTS.

Cargo compartment dome lights consist of white and red lights. Control is provided by the CARGO COMPARTMENT LIGHTS switch, and BRIGHT-DIM switch. The switches are mounted on the forward crew door interphone panel. Secondary control of the system is provided by a CARGO COMPT DOME LITS switch located on the flight station. This guarded switch overrides the other switches to provide maximum illumination of the white lights. A CARGO COMPT LIGHTS RED-WHITE switch is mounted on the ramp control panel. The switch permits selection of white or red cargo compartment lighting. Red is used during night operations to enable personnel in the cargo area to adapt their vision to darkness. The autotransformer provides a fixed 28-volt A-C output and a variable A-C output up to 28-volts. The variable output adjusts the intensity of the white lights and can only be used when "DIM" is selected on the CARGO COMPARTMENT LIGHTS switch.

CARGO RAMP LOADING LIGHTS.

Two loading lights are located overhead at the paratroop doors. Each light is mounted on a swivel base for adjustment. The lights are controlled by the RAMP LOADING LIGHTS switch on the ramp control panel.

PARATROOP JUMP PLATFORM LIGHTS.

Jump platform lights are mounted on each side of the fuselage at the jump doors. Red lights illuminate the platform area. The PLATFORM LIGHTS switch on the left jumpmaster panel controls the left light. The right light is controlled by the PLATFORM LIGHTS switch mounted on the right jumpmaster panel.

AFT CRAWLWAY AND VERTICAL STABILIZER LIGHTS

Clear-vision lights are installed in the aft crawlway and vertical stabilizer area for maintenance. Control is provided by the VERT STAB LIGHTS switch on the ramp control panel.

WHEEL WELL LIGHTS

One clear-vision light is installed in each wheel well area. The lights provide illumination for inspection of the gear down-lock assembly. Control is provided by WHEEL WELL LIGHT switches. One switch is mounted beside each observation window.

LAVATORY LIGHT

Two clear-vision lights are installed in the overhead area of the lavatory. Control is provided by the LIGHT switch located on the left side of the canted ceiling.

UNDERDECK EQUIPMENT RACK LIGHTS

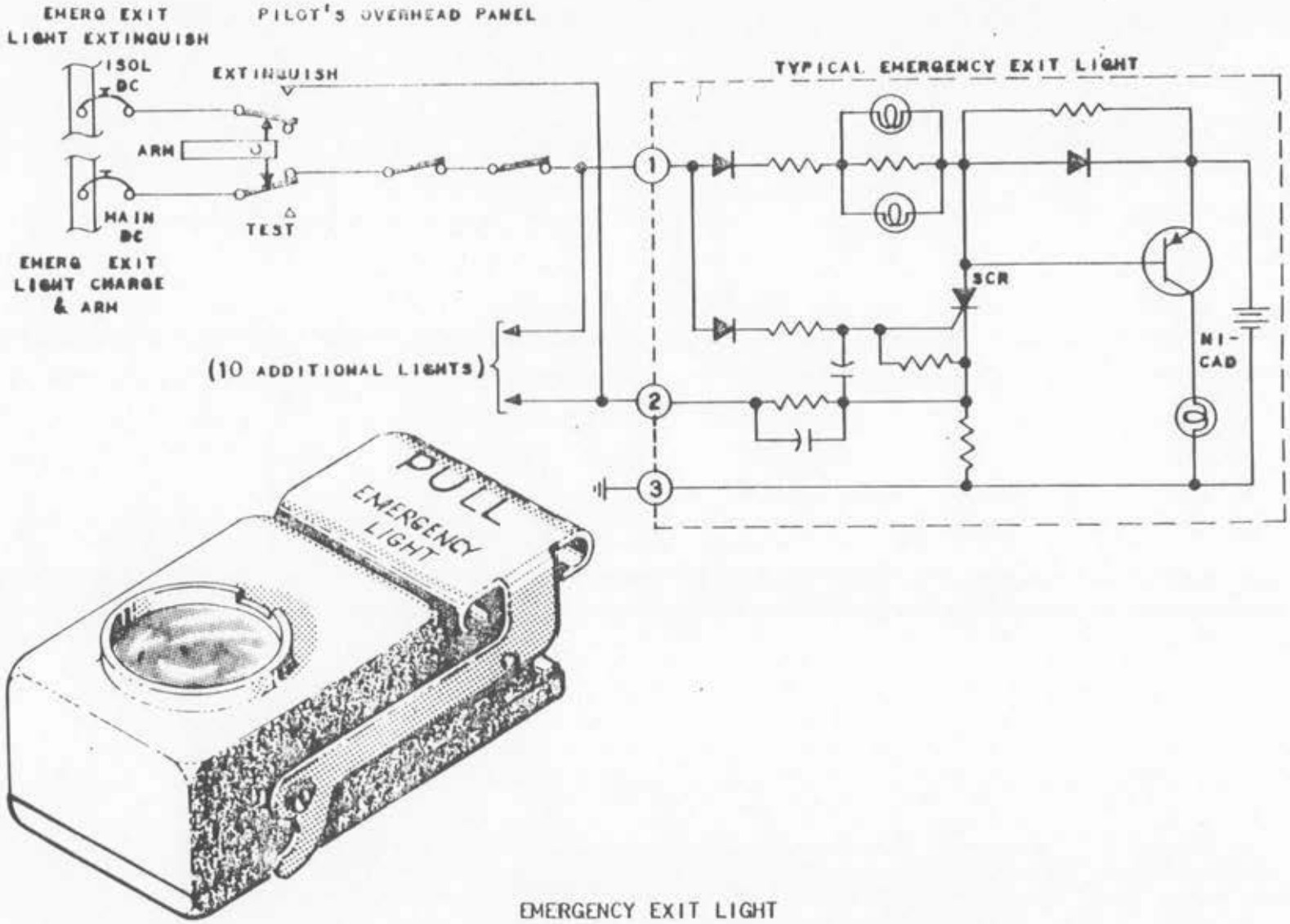
Two clear-vision lights are installed in the underdeck rack area. The lights provide illumination of the avionics and electrical equipment racks. Control is provided by switches adjacent the lights.

FLIGHT STATION ACCESS LIGHTS

A clear-vision light is installed to the right of the flight station door. The light provides illumination of the flight station access door and ladder area. Control is provided by the LADDER LIGHTS switch on the left side of the flight station area.

EMERGENCY EXIT LIGHTS

Portable, battery operated, emergency exit lights are installed next to each door and emergency exit. Eleven light assemblies are installed. Each light assembly



EMERGENCY EXIT LIGHT

contains two nickel-cadmium batteries, one transistor, one silicone controlled rectifier, three bulbs, and associated circuitry. The emergency exit lights control switch is on the pilot's overhead panel. During normal operation, the aircraft bus maintains the nickel-cadmium batteries fully charged.

The lights will be illuminated automatically in the event of loss of main D-C bus power or a deceleration force of 2 g's. Also, when the lamp is removed from the mounting bracket, the handle will close an internal switch to illuminate the lamp.

CAUTION LIGHTS

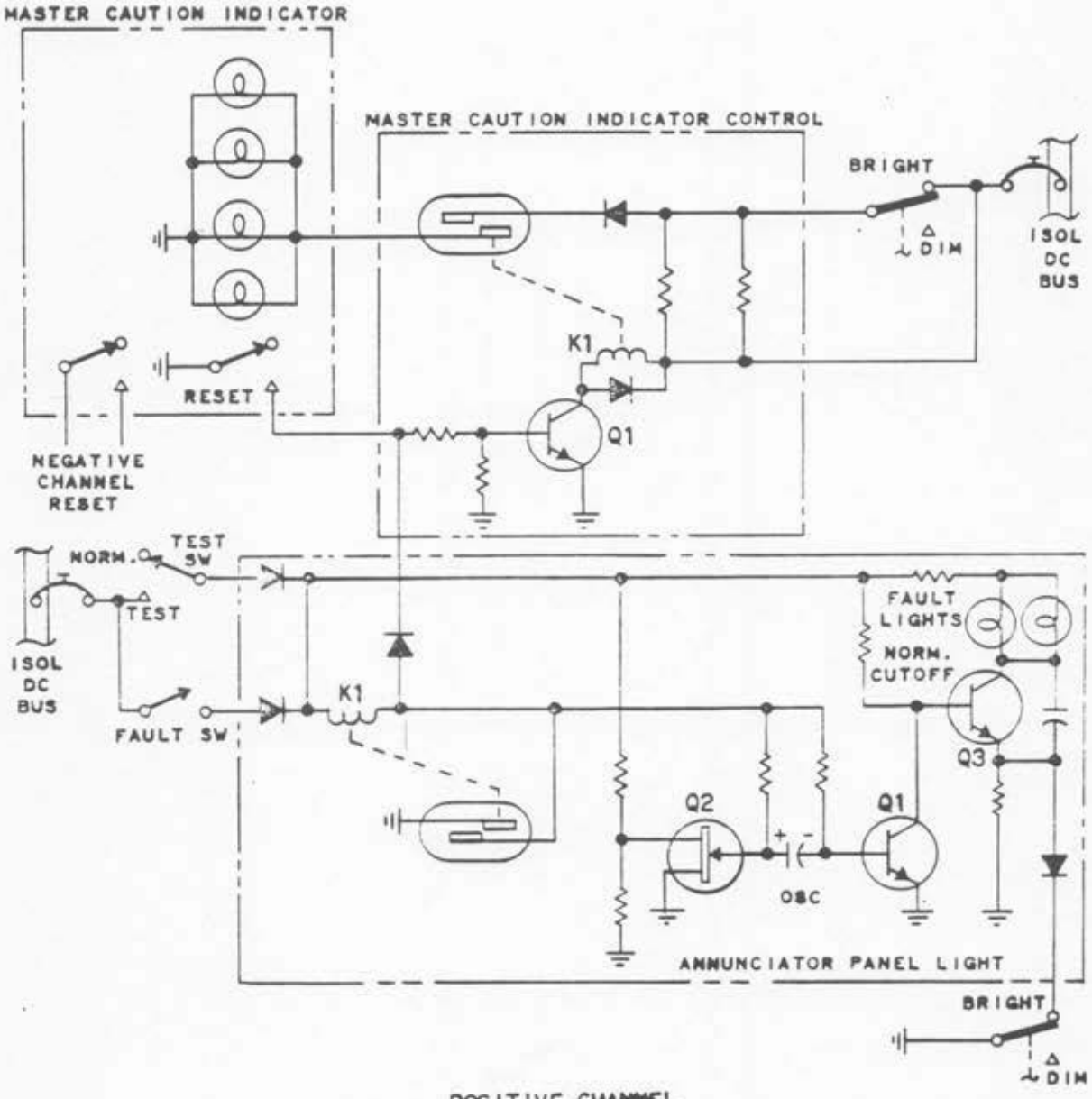
The caution lights consist of 10 annunciator assemblies, two master caution light assemblies, and one master caution indicator control unit. Each annunciator assembly contains five caution lights allowing a maximum of 50 systems to be monitored. The annunciator panel is the forward part of the center console. The master CAUTION lights are on the pilot's and copilot's instrument panel. The control unit is below the center main instrument panel.
When a monitored system fails, an annunciator light flashes and the master caution lights illuminate. The annunciator light faceplate indicates which system has failed. The master caution lights contain lamps and reset switches. The master caution light should be pushed to reset after a trouble. When reset, the master light is extinguished until another trouble occurs and the annunciator illuminates continuously. The annunciator light is extinguished when the monitored system trouble is corrected or when the power source is removed. The annunciator may contain positive or negative channels. A positive channel receives a positive D-C signal when the monitored system fails, and a negative channel receives a ground. The positive and negative channels supply signals to the control unit causing illumination of the master caution lights.

If a fault is detected for a positive channel, a D-C voltage is supplied into the annunciator. Transistor Q3 is controlled by an oscillator and is normally cutoff. The fault voltage causes Q1 in the oscillator to conduct, charging the base capacitor. When the capacitor voltage is sufficient, the unijunction transistor is forward biased into conduction. The capacitor then discharges, cutting off Q1. When Q1 is cutoff, Q3 conducts and the annunciator lights illuminate. The capacitor discharges to a low voltage until Q2 turns off. Transistor Q1 again conducts and Q3 turns off causing the annunciator lights to extinguish. The RC time constant of the capacitor charge and discharge path determines the flashing rate. The rate is 100 to 175 flashes per minute. The warning lights dimming circuit controls light intensity by adding resistors in series with the lights.

AILERON SYS 1 PWR	AILERON SYS 2 PWR	F_T PUSHER OFF	ENG 1 FUEL PRESS	ENG 2 FUEL PRESS	ENG 3 FUEL PRESS	ENG 4 FUEL PRESS	DOOR OPEN	PITOT HEAT	CO-PLT PUSHER OFF
ELEV FEEL MALFUNC	ELEV EMER PWR	YAW DAMPER FAULT	FIRE BOTTLE 1	FIRE BOTTLE 2	FIRE BOTTLE 3	FIRE BOTTLE 4	MACH TRIM INOP	WG ANTI-ICE OVHT	RAIN REMOVAL OVHT
ELEV SYS 1 PWR	ELEV SYS 2 PWR	UNDR SPLR SPEED	SPARE	CADC 1 INOP	CADC 2 INOP	SPARE	FLT REC INOP	OXY QUANTITY LOW	ICING
RUDDER SYS 1 PWR	RUDDER SYS 2 PWR	RUDDER OVERPRESS	SPARE	L AIL. TAB OPER	R AIL. TAB OPER	STALL PREV 1	CABIN PRESS LOW	SPARE	CARGO SMOKE
FLAP ASYM DET	FLAP ASYM	L BLEED DUCT OVHT	2 SPOILER INOP	3 SPOILER INOP	SPARE	STALL PREV 2	R BLEED DUCT OVHT	APU FIRE	SPARE

ANNUNCIATOR PANEL

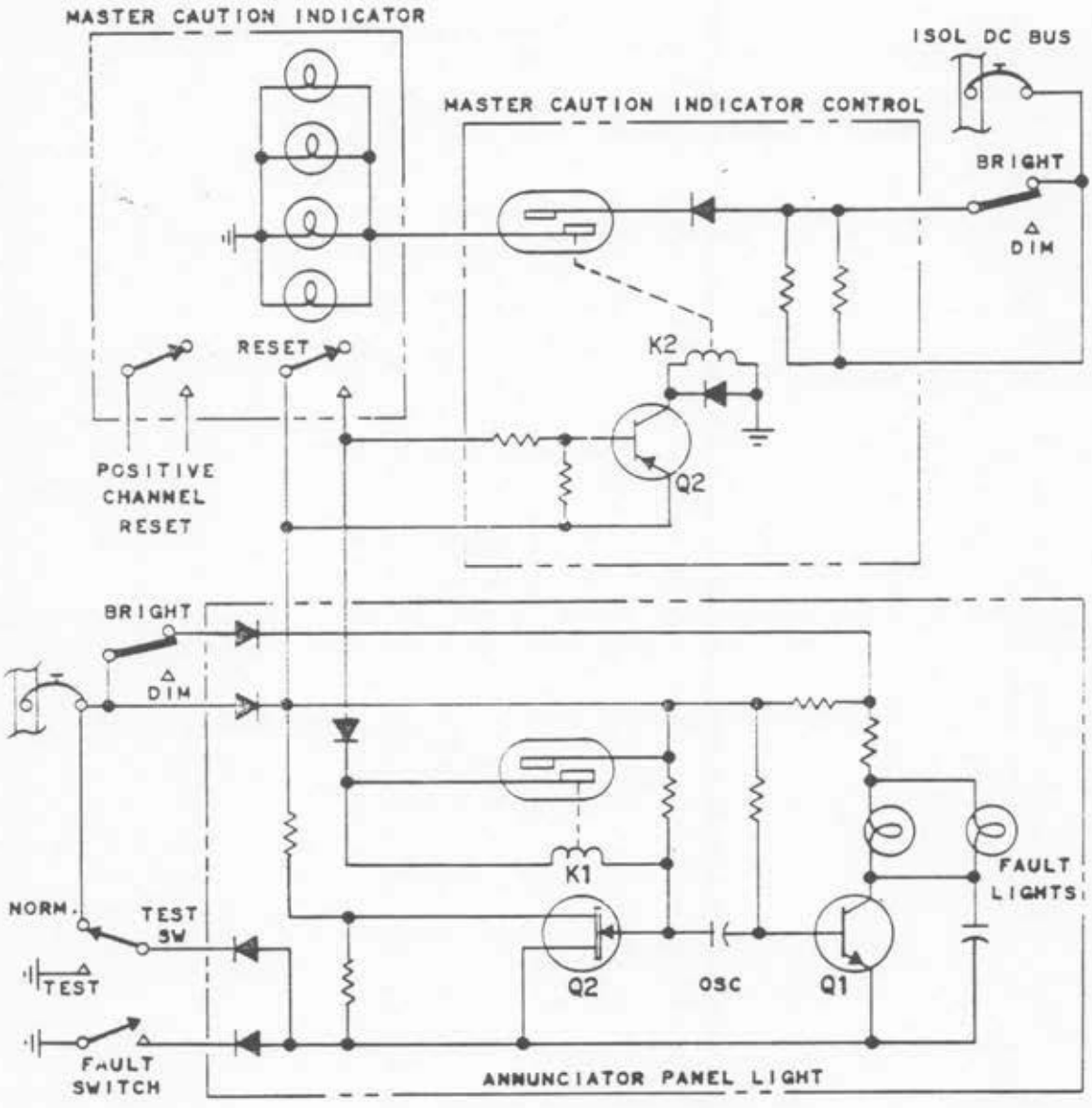
The fault voltage is also supplied to a transistor amplifier in the control unit. The transistor conducts, energizing a magnetic reed relay. The relay completes the circuit to the master CAUTION light which illuminates continuously. If the master CAUTION light is pushed to "RESET," a ground is supplied to a relay in the annunciator. The relay did not energize during the fault due to the low oscillator current. Reset causes the relay to energize and provide a holding circuit through relay contacts. The relay remains energized as long as the fault exists. The fault signal is grounded when reset to extinguish the master CAUTION light. Reset also stops the oscillator with Q1 cutoff and Q3 from conducting. The annunciator illuminates continuously until the fault is cleared. The TEST switch bypasses the fault circuit in "test" for fault simulation. When the switch is released, the simulated fault is cleared.



POSITIVE CHANNEL

The negative channel functions similar to the positive channel but uses a different section of the control unit and a second reset switch in the master CAUTION light. The fault provides a ground to the oscillator allowing the capacitor to alternately charge and discharge. Two transistors are used in the oscillators, and Q1 conduction controls annunciator lights.

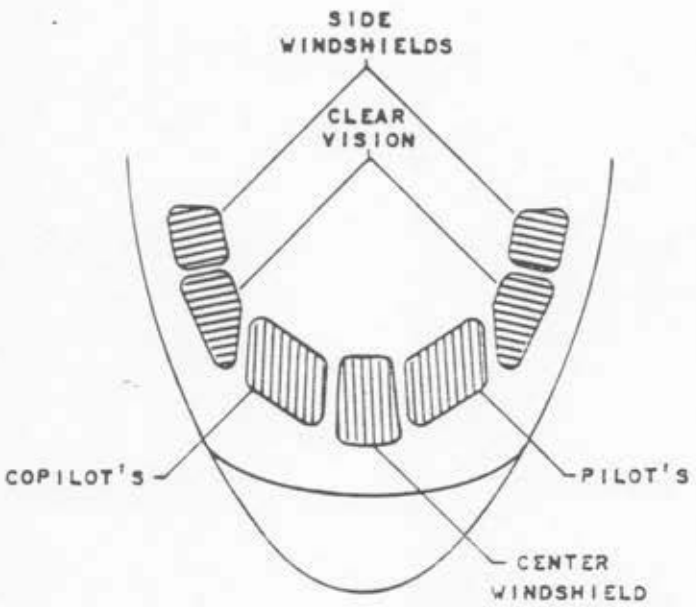
The master CAUTION light is controlled by a transistor and the magnetic reed type relay in the control unit. The transistor conducts when the oscillator is operating due to the reduced positive base voltage. The reset switch causes the control unit amplifier to cutoff and stops the oscillator with both transistors conducting. The oscillator relay is energized when reset due to emitter current through the unijunction transistor. It is held energized through relay contacts. After reset, the annunciator light illuminates continuously and the master CAUTION light is extinguished.



NEGATIVE CHANNEL

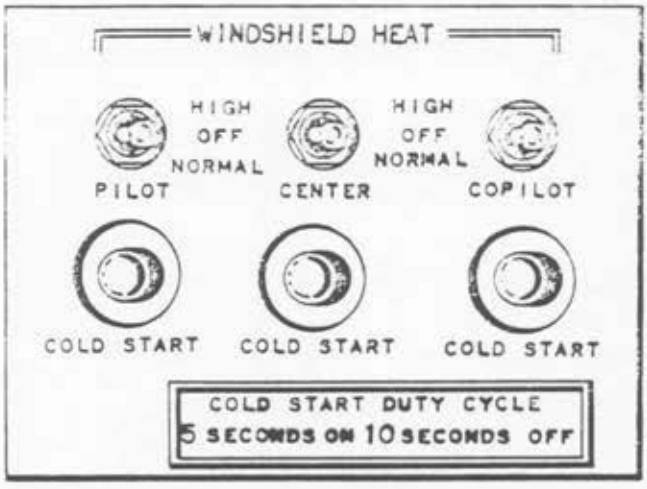
WINDSHIELD ANTI-ICING AND DEFOGGING SYSTEMS.

Seven windshields are electrically heated to prevent icing or fogging from distorting the pilot's and copilot's vision. The three main windshields are anti-iced, and the four side windshields are defogged. Windshield temperature is automatically maintained at approximately 94°F. The pilot's and copilot's windshield heating is interconnected with the rain removal system to prevent use of electrical anti-icing when the rain removal system is operating.



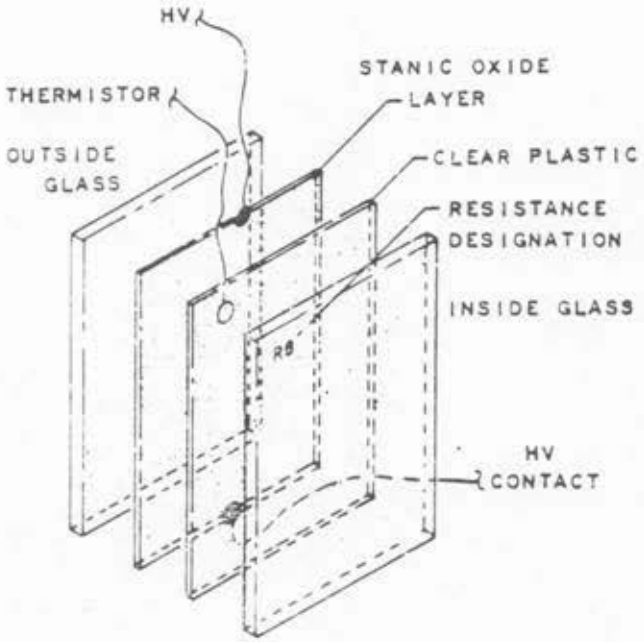
The pilot's, copilot's and center windshield heat control switches are located on the over head panel in the flight station. Each of the three anti-icing systems consist of a windshield, autotransformer, control box, two power relays and control switch.

Each defogging system consists of two windshields, autotransformer, control box, window cutoff switch, and control relay. The pilot's defogging system is controlled from the pilot's WINDSHIELD HEAT switch and the copilot's is controlled from the copilot's WINDSHIELD HEAT switch. the autotransformers and control boxes are located in the electrical equipment rack. The relays are located in the underdeck relay panel.



Each windshield is constructed of a layer of vinyl plastic and coating of stannic oxide sandwiched between two plates of glass. The plastic is for safety in case the glass shatters. The stannic oxide layer is on the inner surface of the outer glass plate and is the heating element of the window. Stannic oxide is a compound which dissipates power in the form of heat due to current through the high resistance oxide.

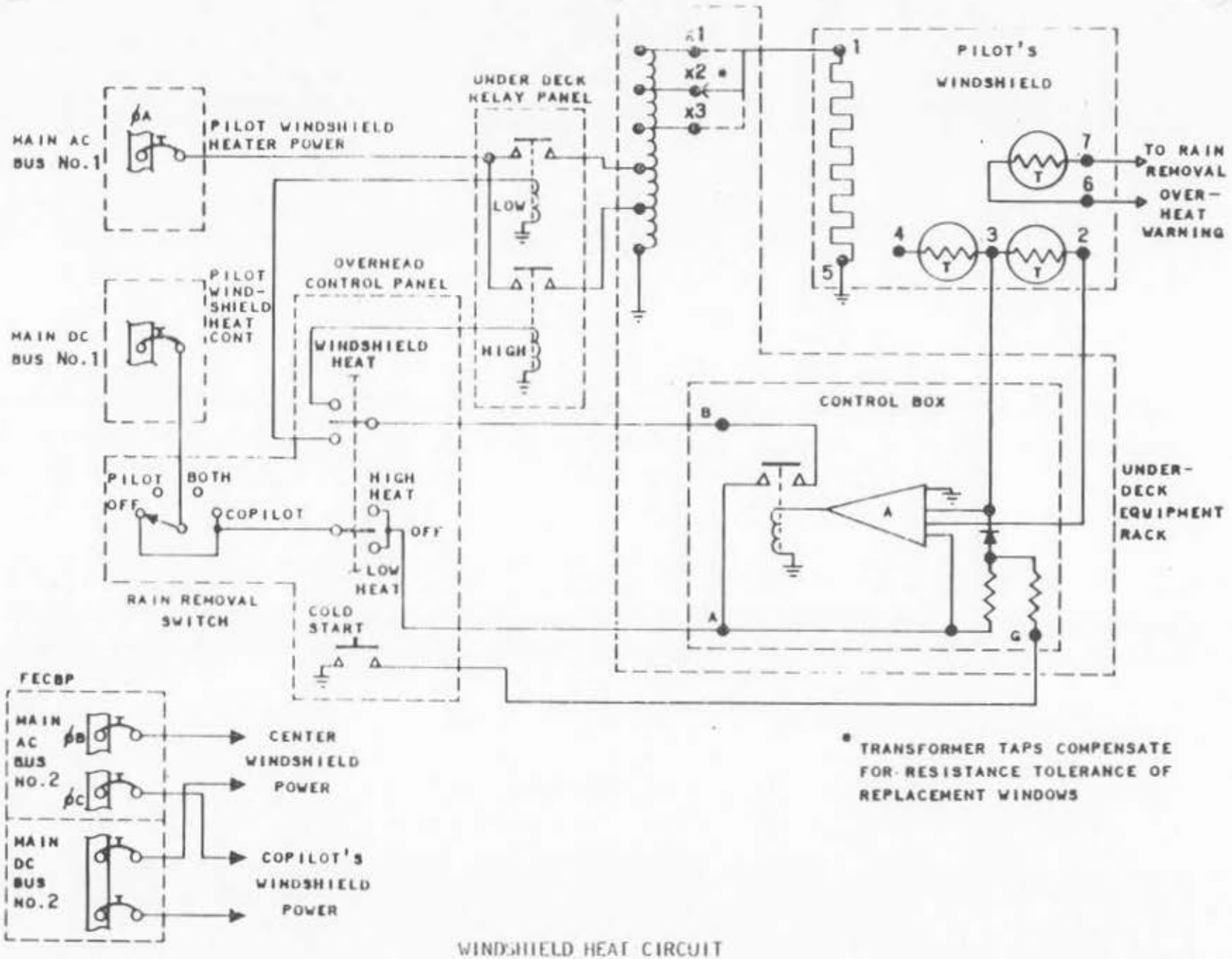
Thermistors are imbedded in the plastic of all but the clear-vision windows. One thermistor connects into the control unit temperature control circuit for automatic windshield temperature control. The second thermistor is a spare. The pilot's and copilot's windshields contain a third thermistor which is used with the rain removal system.



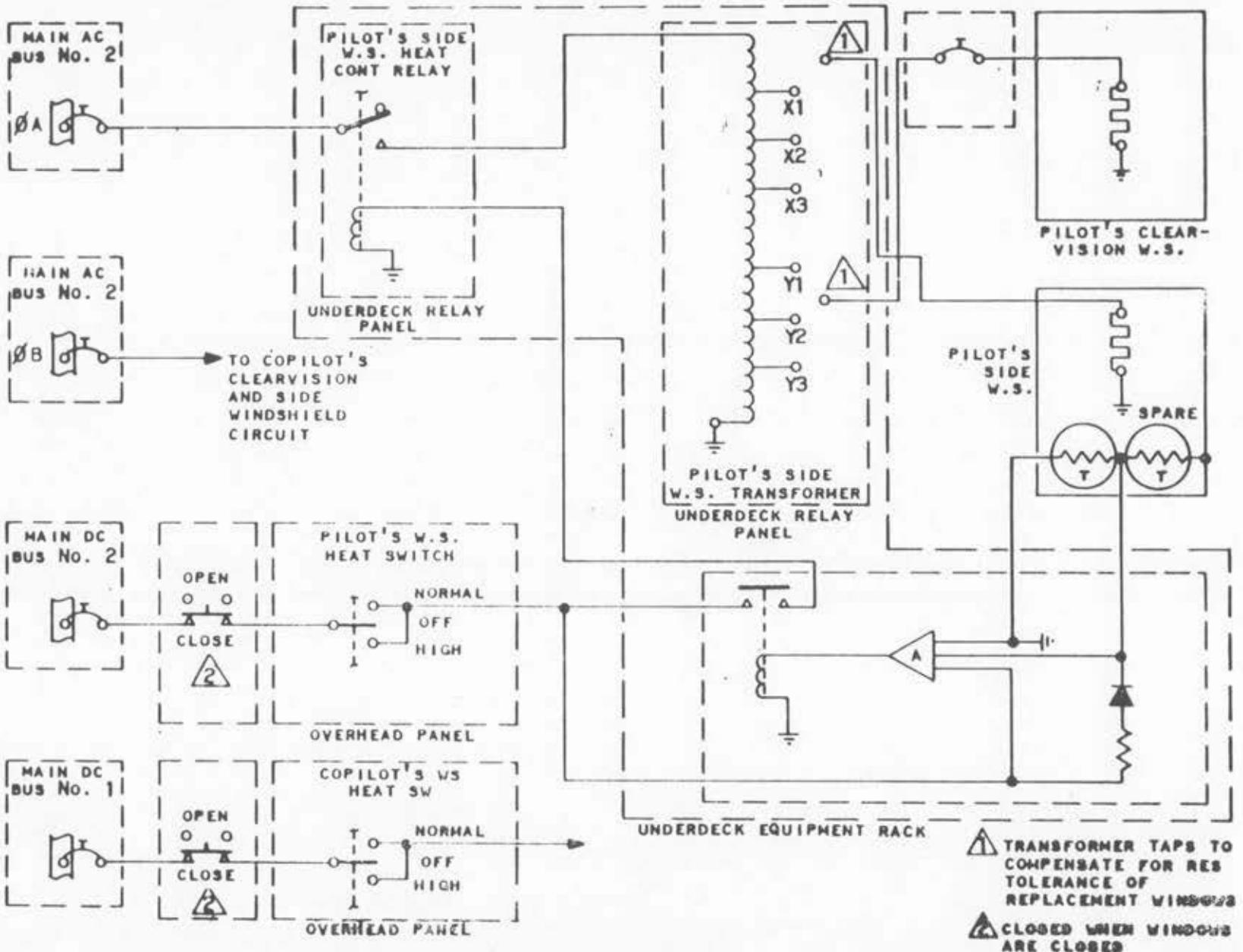
NESA WINDOW BREAK-DOWN

A thermistor is the temperature sensing element of the system and has a negative temperature coefficient. Thermistor resistance decreases as windshield temperature increases. The resistance determines when the heating voltage is to be applied or removed from the windshields.

When the WINDSHIELD HEAT control switch is positioned to "NORMAL" or "HIGH," the control box is energized. The transistor amplifiers in the control box sense thermistor resistance and energize a control box relay if heat is required. The relay contacts cause a power relay to energize, applying 115-volt, AC, to the autotransformer. A low-heat relay is energized in "NORMAL," resulting in a high voltage output to the windshield. If the high-heat relay is energized, the autotransformer high voltage output is increased due to the transformer turns ratio. The high heat relay is energized when "HIGH" is selected on the control switch.



WINDSHIELD HEAT CIRCUIT



RAIN REMOVAL CIRCUIT

As the windshield temperature increases, the thermistor resistance decreases. When resistance is equivalent to a 94°F windshield temperature, the control box relay is deenergized, turning off the high voltage. As the windshield cools, thermistor resistance again causes the control box relay to energize, and the heating cycle is repeated.

If the automatic control circuits fail to operate due to extreme cold or thermistor failure a COLD START pushbutton allows manual control of the automatic circuits. When the pushbutton is pressed, the thermistor is bypassed, causing the control box relay to energize. The duty cycle of cold start is 5 seconds on and 10 seconds off. High heat should be used only in flight when normal heat is insufficient. In "NORMAL" or "HIGH" the thermistor controls windshield maximum temperature, but the higher voltage increases the rate of temperature change.

DEFOGGING CIRCUITS

The defogging circuits are similar to the windshield anti-icing circuits. The cold start circuit is not used, and only one heating voltage is provided. A window switch on each clear vision window opens the defogging control circuits when the window is open. A single tapped autotransformer provides outputs to the two side windshields. The pilots defogging circuit is controlled by the pilot's WINDSHIELD HEAT switch and the copilot's by the copilot's switch.

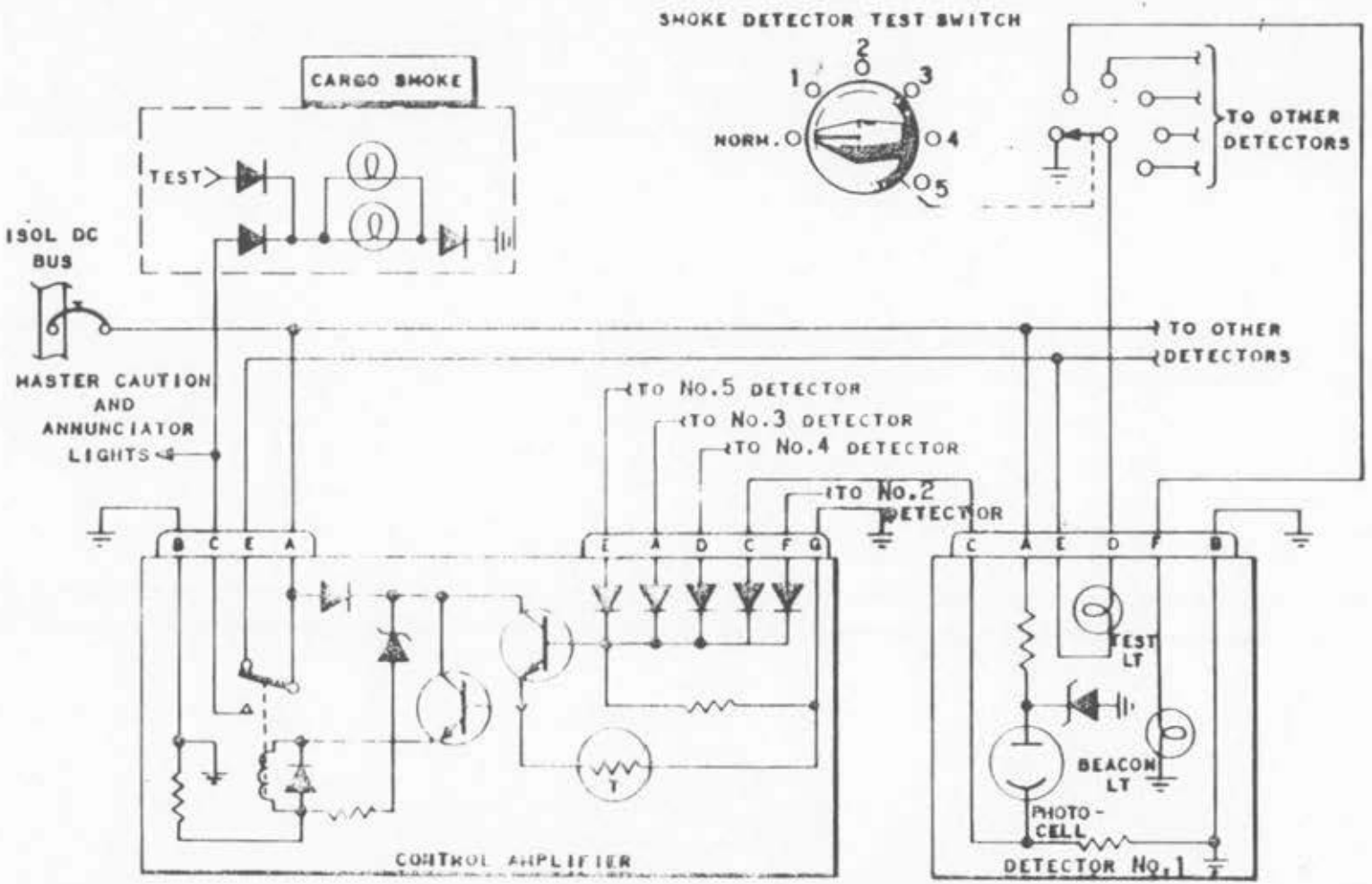
Resistance of the oxide varies between replacement windows. Each panel is marked with letters "RA," "RB" OR "RC" according to resistance. A replacement window containing different letters than the existing window requires a different voltage for proper heating. Each autotransformer contains voltage taps which are selected according to the window resistance letters. The autotransformer taps and wire number are listed for each type window in a chart on the aircraft wiring diagram of the windshield anti-icing systems.

SMOKE DETECTION SYSTEM

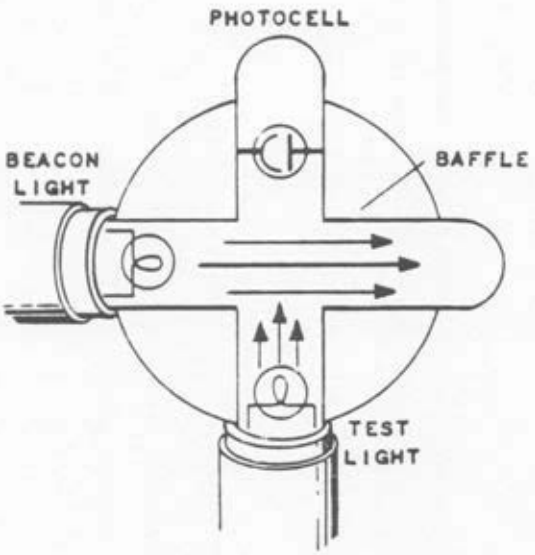
The smoke detection system consists of a control amplifier, warning lights, and five smoke detectors. One detector is mounted under the flight deck and four detectors within the cargo compartment. The control amplifier is located in the electrical equipment rack.

DETECTOR

Each detector consists of a photocell, two lights, and a baffle. The beacon light operates continuously but is shuttered from the photocell by the baffle. The beam from the beacon light is parallel to the photocell face. If air within the vented baffle is clear, the beam bypasses the photocell. If smoke is present, the light is diffused into the photocell causing conduction. Photocell conduction produces an output voltage which is supplied to the amplifier.



SMOKE DETECTION SYSTEM SCHEMATIC



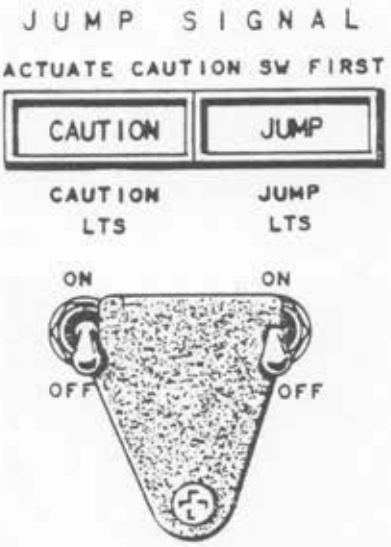
SMOKE DETECTOR

CONTROL AMPLIFIER

The control amplifier contains isolating diodes, power supply, transistor amplifiers, and control relay. The diodes isolate the detector signal lines into the amplifier. A positive detector signal through a diode causes the two transistors to conduct, energizing the relay. The relay provides a D-C output to the CARGO SMOKE light at the flight engineer's position and to the annunciator and master CAUTION lights. The annunciator light flashes and the other lights illuminate continuously. A Zener diode provides regulated DC to the transistor circuits. A transient protector diode protects against D-C bus transient negative pulses.

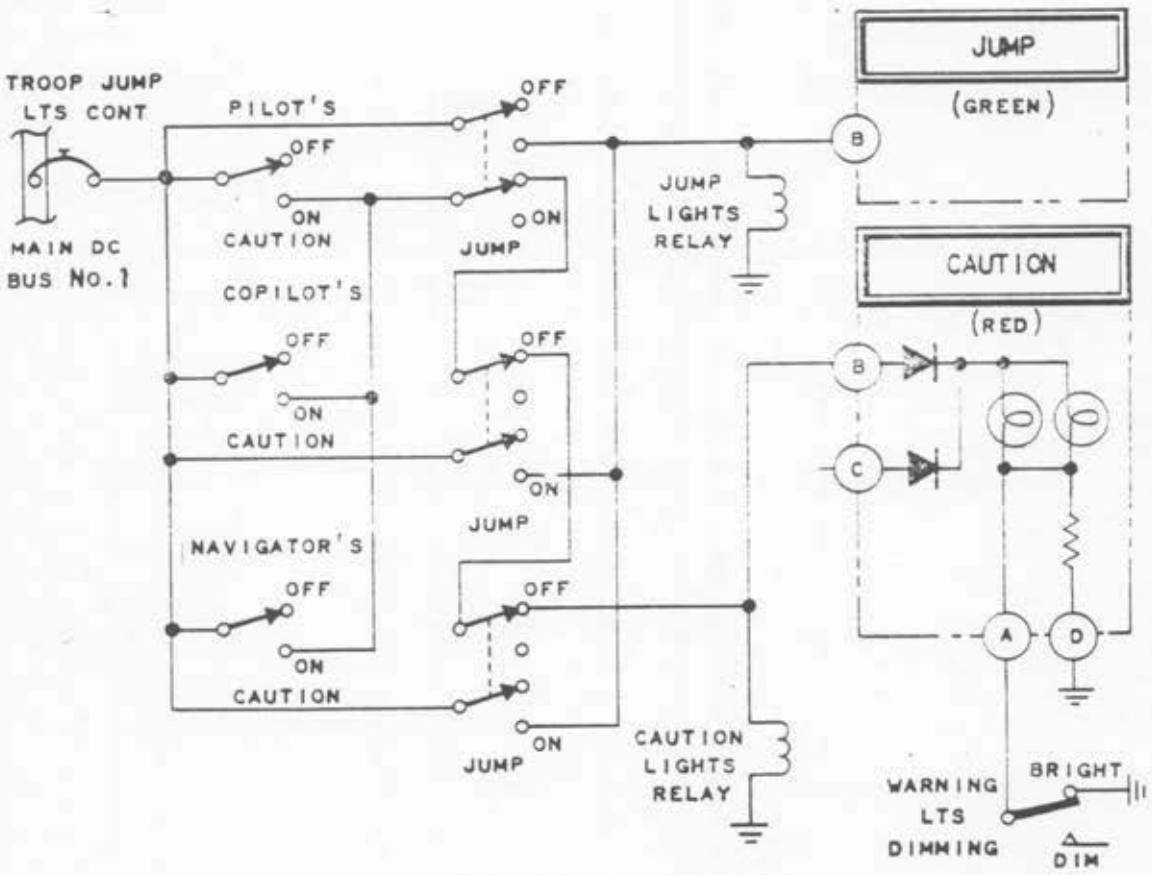
A SMOKE DETECTOR TEST switch is on the flight engineer's smoke detector panel. The "NORMAL" position should be used in flight. Positions "1" through "5" allow checkout of the five individual detectors and amplifier. In each position a switch connects a detector test light in series with the beacon light. The test light beam is directed into the photocell face, causing the photocell to conduct simulating smoke. The test light is in series with the beacon light to ensure that both lights are good. Time should be allowed between each test switch position to ensure that the previous detector has returned to normal.

TROOP JUMP LIGHTS



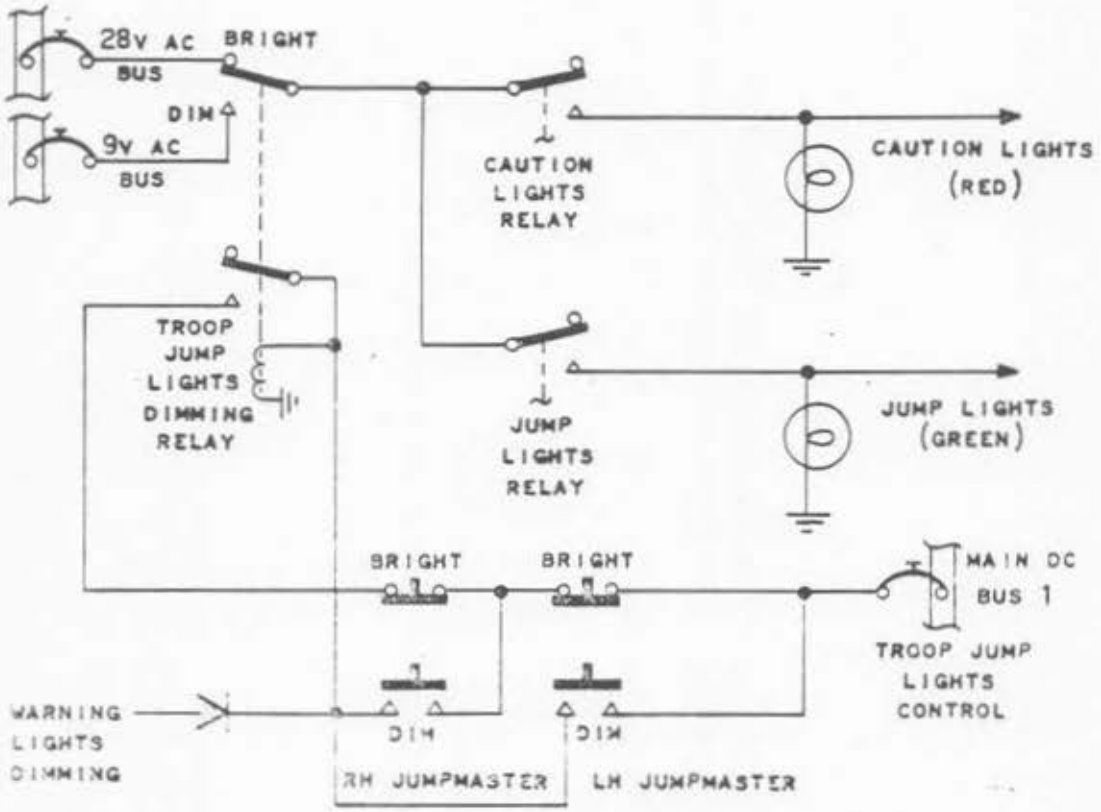
The troop jump lighting consists of three control panels and seven sets of lights. The control panels are located on the pilot's side console, copilot's side console and navigator's panel. Each control panel contains a CAUTION light, JUMP light, and two switches. The switches are mechanically interconnected to prevent actuation of the JUMP switch prior to actuation of the caution switch.

Each set of lights consist of a red caution and green jump light. The lights are located next to the crew entrance door, each side of the ramp, and both sides of each paratroop door. The ramp lights are not visible until the pressure door is opened.



CAUTION - JUMP SWITCHES

When a caution switch is "ON" and the jump switches are "OFF," the caution lights on the control panels illuminate and the caution lights relay is energized. The relay causes illumination of all caution lights in the cargo area. If the jump switch is positioned to "ON," the caution lights extinguish and the JUMP lights illuminate. The jump lights relay is energized to control the cargo area lights. The pilot's, copilot's, or navigator's switches may be used for the lights.

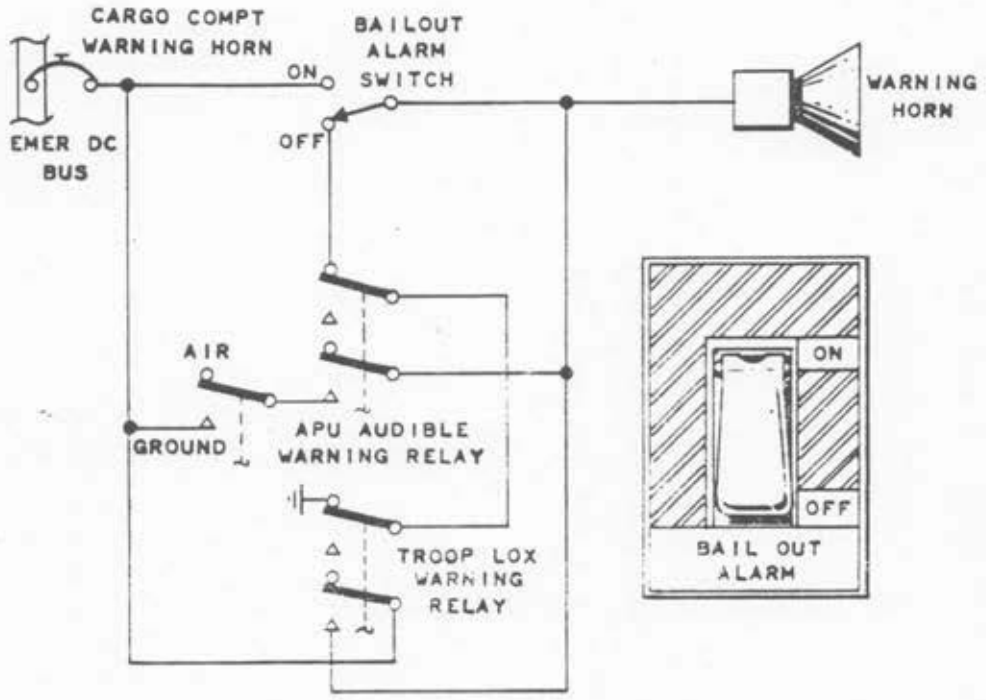


CARGO AREA CAUTION - JUMP LIGHTS

The control panel light intensity is controlled by the warning lights dimming circuit. The cargo area lights are controlled by BRIGHT-DIM pushbutton switches on the right and left jumpmaster panels and by the warning lights dimming circuit. The dimming switch causes the TROOP JUMP LIGHTS DIMMING relay to energize. Holding contacts keep the relay energized through the bright pushbuttons. The relay changes the power source to the lights from 28-volt, AC, in bright to 9 volts, AC in dim. If the BRIGHT switch is actuated, the dimming relay is deenergized. The A-C lighting voltage is supplied from the main A-C bus No. 1 through the miscellaneous lighting transformer.

BAILOUT ALARM SYSTEM

The bailout alarm system consists of a warning horn and control switch. The horn provides a manually controlled or automatic audible warning. The horn audible warning is automatically actuated if the troop liquid oxygen quantity decreases below 10 percent capacity (7.5 liters). A warning is also provided in case of an APU fire condition when the aircraft is on the ground.



BAILOUT ALARM

The warning horn is located overhead in the aft cargo area. The BAILOUT ALARM control switch is on the pilot's overhead panel, covered by a switch guard.

Emergency D-C bus power is supplied to the warning horn when the control switch is "ON." If the switch is "OFF," the horn can be automatically energized through the TROOP LOX WARNING RELAY or the APU AUDIBLE WARNING RELAY.

FIRE AND OVERHEAT DETECTION SYSTEM

An overheat or fire condition must be detected quickly for safety and to prevent damage to the aircraft. If detected early, corrective action can be taken minimizing damage. Overheat detection is provided in the four engines, and fire detection is provided in the engines and APU compartment. The fire and overheat detection system consists of sensing elements and five control units. The

control units are identical, containing overheat and fire detection circuits and relays. The overheat output of the APU detector is not used. The sensing elements are installed in the engines, pylons, and APU compartment. The detectors are located in the forward electrical equipment rack. Audible warning relays and fire warning relays are controlled by the control units to provide an overheat or fire indication.

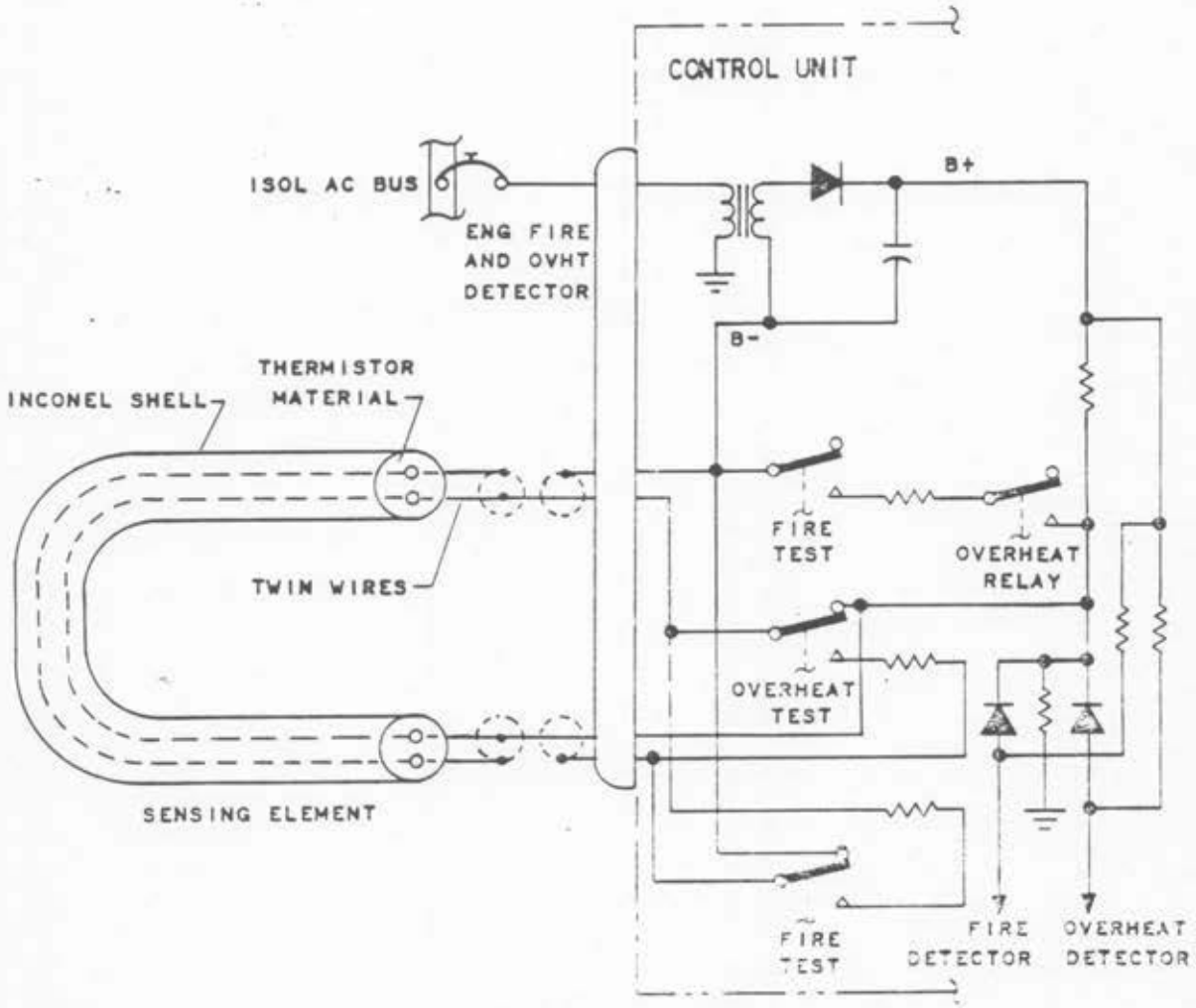
An engine fire or overheat condition is indicated by illumination of the pilot's and copilot's master FIRE warning lights and the fire emergency handle lights. An APU fire warning is indicated by illumination of the APU FIRE light on the annunciator panel; the pilot's and copilot's master CAUTION lights; the light in the emergency handle, located at the flight engineer's station; and another light in the cargo area. Audible fire warning is provided through the audible warning system. Test switches for checkout are located on the center console of the fire and overheat systems.

SENSING ELEMENT

The sensing element is a twin wire continuous loop inside several sections of metal tubing. The tube is inconel, a metal which does not harden with temperature variations. The wires are held in position within the shell by a thermistor material which has a negative temperature coefficient.

The twin wires are isolated from ground to prevent false alarm signals due to a single ground in the loop. Resistance of the thermistor material between the wires controls the detector. With wires isolated from ground, a single ground does not change the resistance between the wires.

The thermistor is a variable resistance controlled by temperature. As temperature increases, resistance decreases to a value related to an overheat condition. If temperature continues to increase, resistance decreases to a lower value related to a fire condition. Thermistor resistance is an overheat condition is approximately 1100 ohms, and a fire condition is 260 ohms.

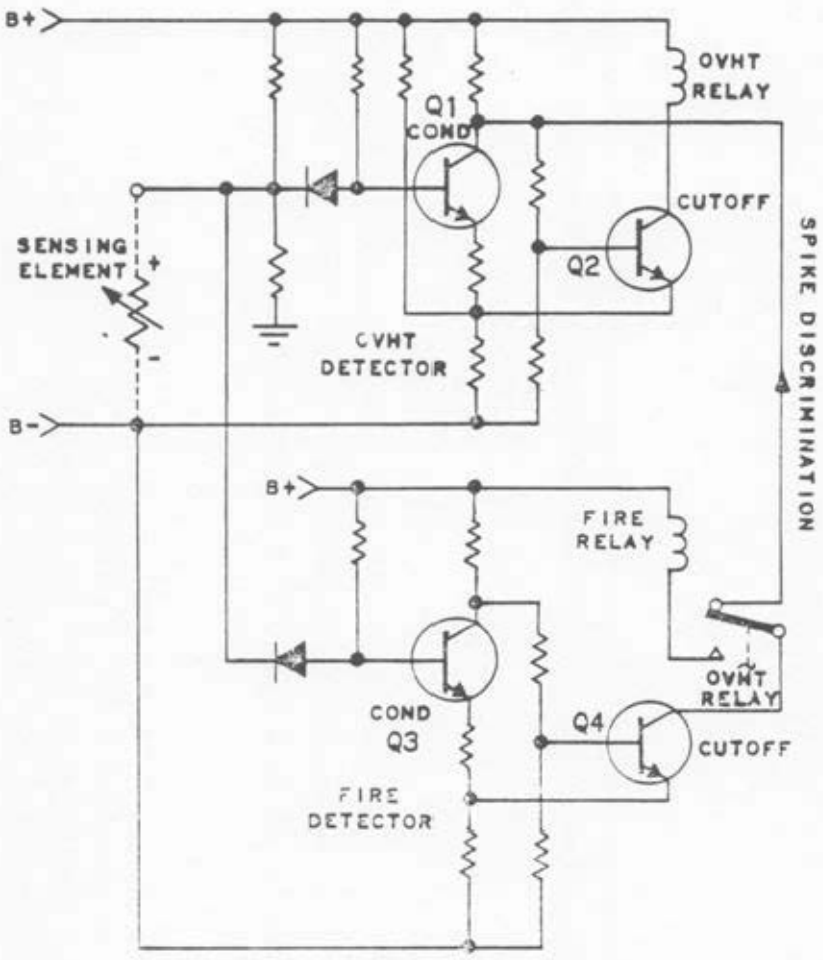


OVERHEAT AND FIRE SENSING

CONTROL UNIT

The control unit contains an overheat detector, fire detector, power supply, and test circuit. The power supply changes AC to DC for the transistorized detectors. The sensing element resistance controls D-C voltage into the detectors. The first transistor in each detector is normally conducting and the second is cutoff.

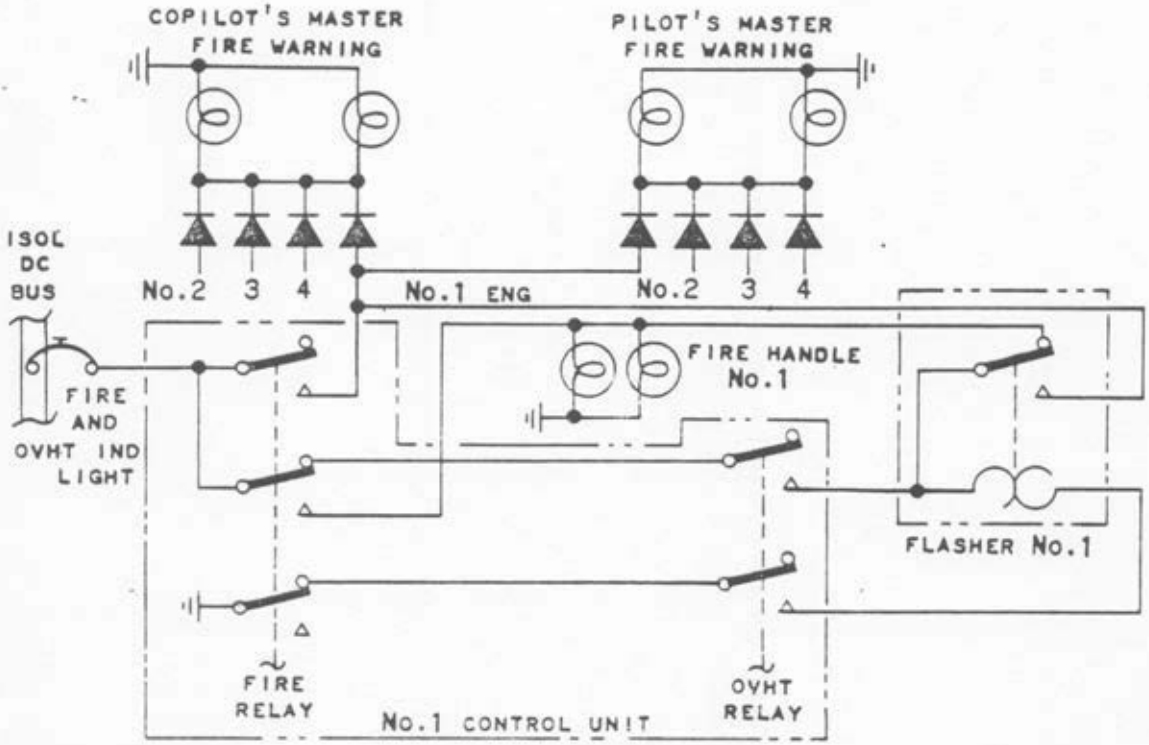
As the sensing resistance decreases, voltage to the base of the first transistor in the overheat detector decreases. The decreasing voltage decreases transistor current. When the first transistor is cutoff, the second transistor conducts to energize the overheat relay. A slight delay in circuit operation prevents relay actuation during a transient condition. Relay contacts complete a circuit to the warning lights flasher unit. This unit is thermally controlled



OVERHEAT AND FIRE DETECTION

to cycle between the master FIRE warning lights and fire handle lights, causing a flashing overheat indication.

If sensing resistance continues to decrease, the fire detector energizes the FIRE relay. The relay contacts bypass the overheat flasher causing a constant fire warning indication. An overheat indication occurs before a fire indication is possible due to overheat relay contacts in the fire detector. The sensing element returns to normal when the overheat or fire condition is corrected.



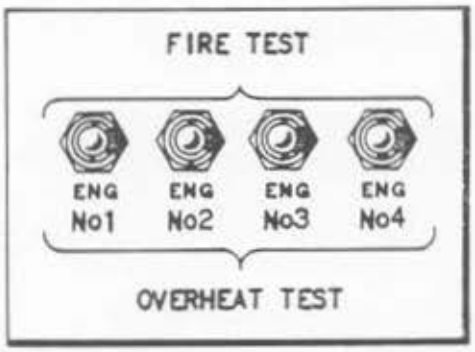
MASTER FIRE - OVERHEAT WARNING

The fire detector also discriminates against a short circuit, or transient, if the overheat relay is not energized. A rapid change in sensing resistance causes the fire detector transistors to change condition immediately before the overheat detector transistors. Collector voltage of the second transistor in the fire detector is supplied to the overheat detector through overheat relay contacts. Conduction in the second transistor of the fire detector keeps the overheat detector second transistor cutoff, preventing a fire or overheat indication.

The APU control unit operates identically to the engine system. The APU overheat detector output is not used. An overheat condition causes the overheat relay and fire relay to energize. The fire relay contacts complete the APU FIRE and fire handle lights circuit.

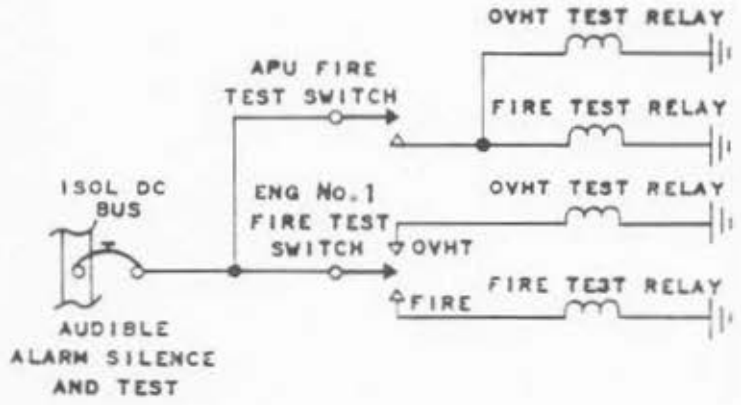
Fire and overheat test switches on the center console allow checkout of the detectors, sensors, and lights. Test relays insert resistors across the sensing lines to simulate a fire or overheat. The OVERHEAT TEST relay connects a sensing wire into a series loop and inserts a resistance equivalent to an overheat

condition. The fire test relay connects the second sensing wire into a series loop and inserts a resistance equivalent to an overheat condition, then contacts of energized overheat relay insert a second resistance equivalent to a fire condition. Each test checks continuity of one sensing wire. The APU fire test controls both test relays to simulate a fire condition and check continuity of both sensing wires.

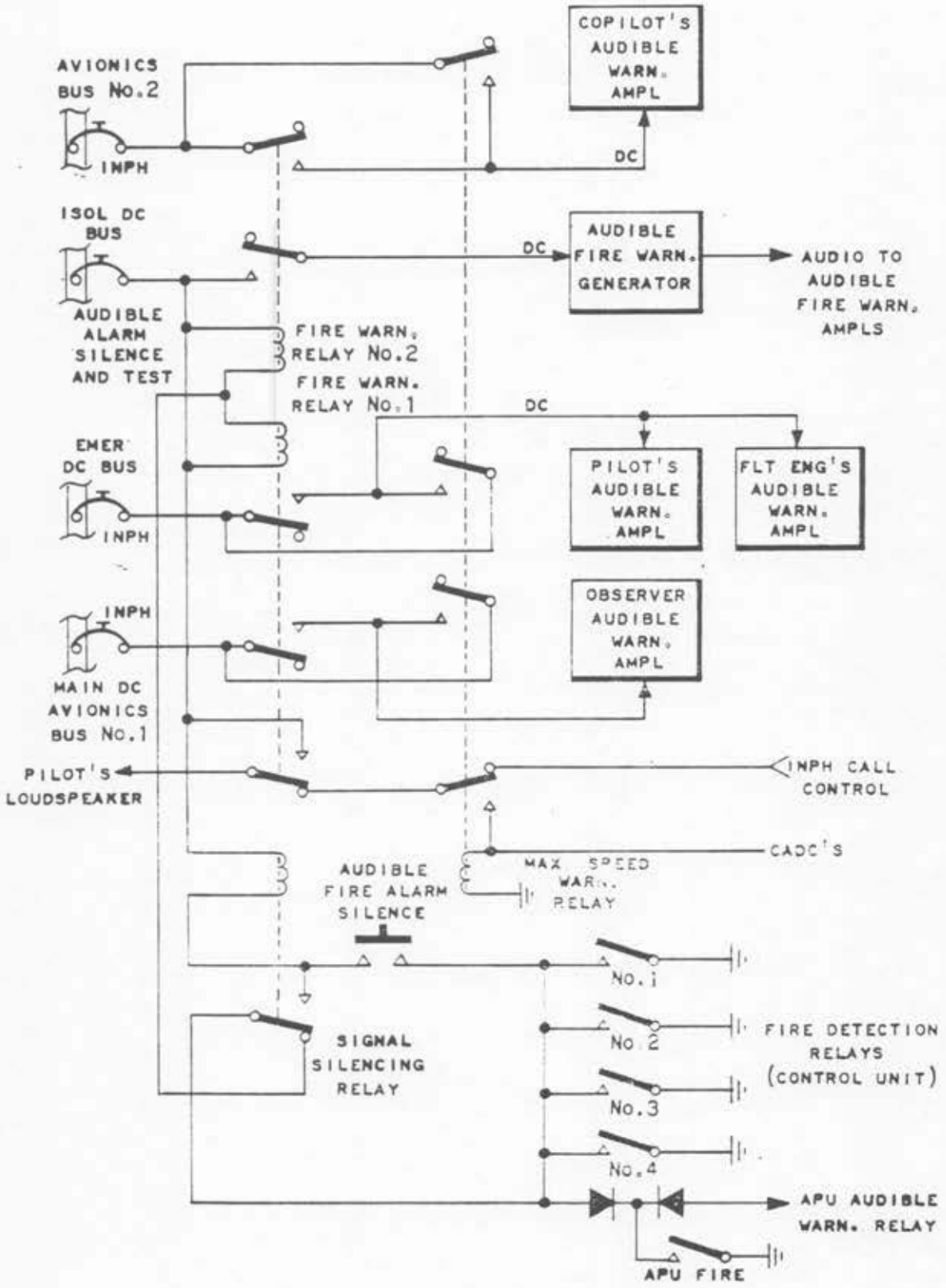


AUDIBLE WARNING SYSTEM

The warning system provides a varying tone audible warning if a fire condition is detected or if the aircraft exceeds a maximum speed limits. The warning signal is supplied to the pilot's copilot's, flight engineer's, and observer's headsets and to the pilot's loudspeaker. The fire warning is provided through the fire detection system, and the maximum speed warning is controlled by the Central Air Data Computers (CADC's). The audible fire warning is provided by a fire warning generator and four audible warning amplifiers. The amplifiers are also used with the maximum speed audible warning generator.

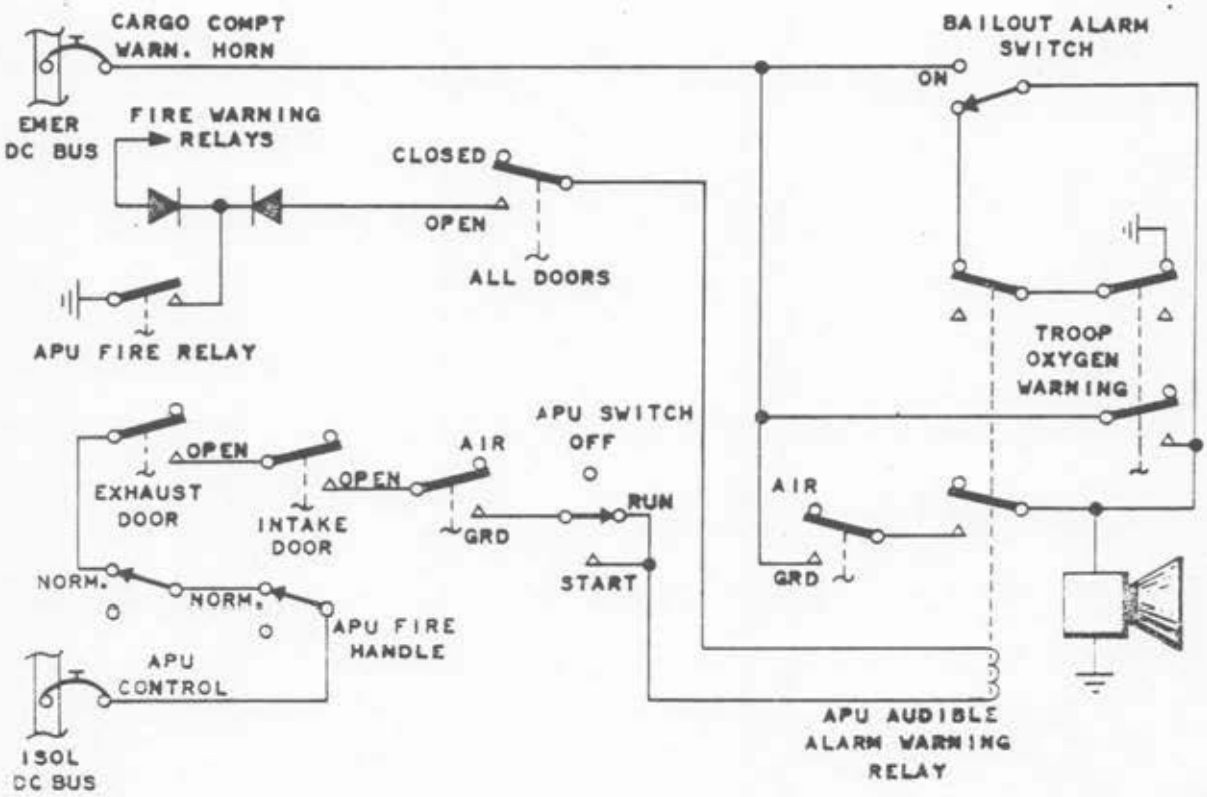


If a fire is detected in an engine, pylon, or the APU compartment, the respective fire relay in the fire detector control unit is energized. The control unit causes two fire warning relays to energize, turning on the audible warning generator and amplifiers. The generator supplies a varying tone into the amplifiers which control the headsets and loudspeaker. The generator, amplifiers, and relays are located in the audible warning relay panel in the center avionics equipment rack.



AUDIBLE WARNING RELAY CIRCUITS

The audible signal can be silenced by pressing the audible fire alarm silence switch located on the engine fire emergency panel. The pushbutton switch energizes the signal silencing relay. Relay contacts provide a holding circuit to the relay, keeping the relay energized until the fire is extinguished. Relay contacts also open the fire warning relay circuit to turn off the audible warning generator.

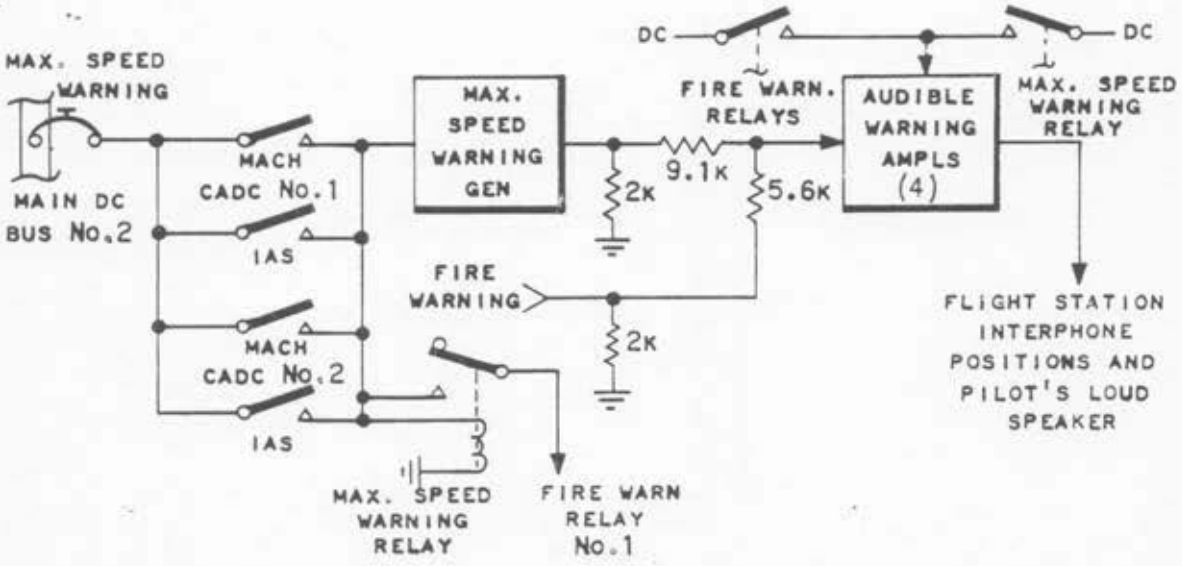


APU AUDIBLE WARNING

The APU fire detector controls the audible warning generator and also controls the cargo compartment warning horn. An APU fire energizes the fire warning relays to turn on the flight station audible warning generator and amplifiers. An APU fire also energizes the APU audible alarm warning relay which controls the warning horn. The relay can energize during an APU fire if the following conditions exist:

1. Door open (All doors circuit)
2. APU switch in "Run" or "Start" (APU Control)
3. Aircraft on the ground (Touchdown relay)
4. Exhaust and Intake Doors open (APU Control)
5. Both APU fire handles in normal

The warning horn can be silenced by pulling the warning horn circuit breaker or by pulling the APU fire emergency handle. The fire handle controls the APU system.



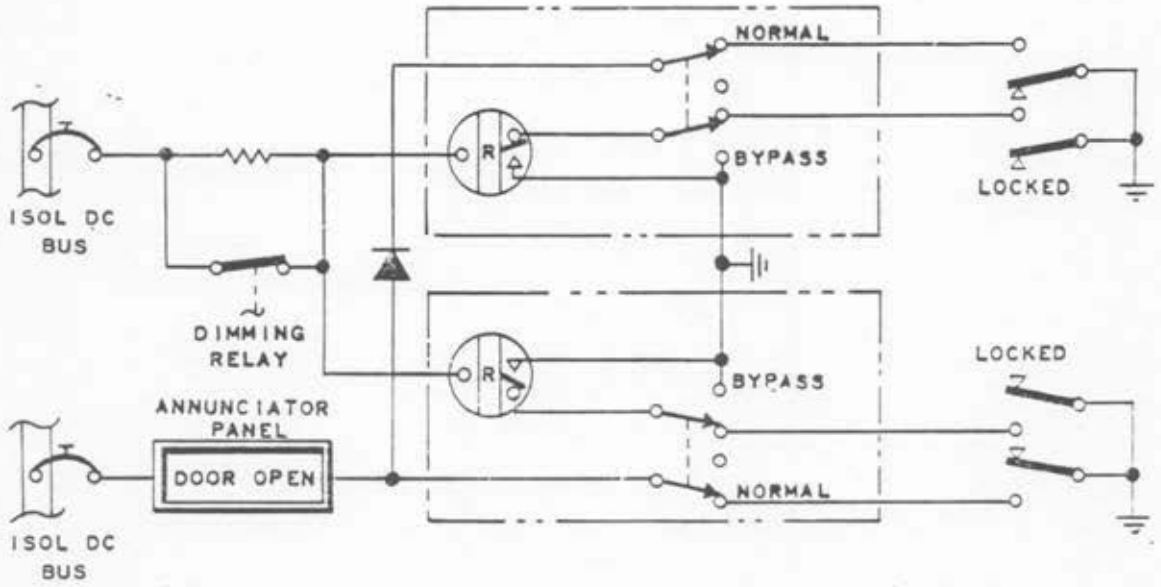
MAXIMUM SPEED WARNING

MAXIMUM SPEED WARNING SYSTEM

The maximum speed warning system provides an audible warning if the aircraft exceeds an Indicated Airspeed (IAS) of 350 knots or a Mach number of 0.825. The warning is provided through the pilot's loudspeaker and audible warning amplifiers.

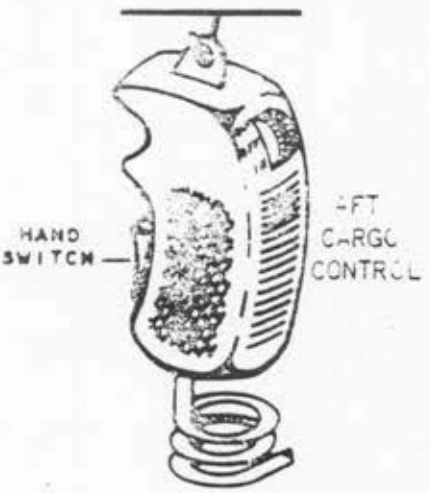
The system consists of a maximum speed warning generator, control relay, and the four audible warning amplifiers. The units are located on the audible warning terminal panel in the center avionics equipment rack.

Aircraft speed is sensed by the CADC's. Switches in the CADC's close when the maximum IAS or maximum Mach number is exceeded, applying 28-volt, AC, to the maximum speed warning generator. The generator output is supplied through the four amplifiers to the flight crew headsets. The generator output is a varying audio tone. The MAX SPEED WARNING relay is also energized to turn on the pilot's overhead loudspeaker. The same amplifiers are used with the audible fire warning generator.



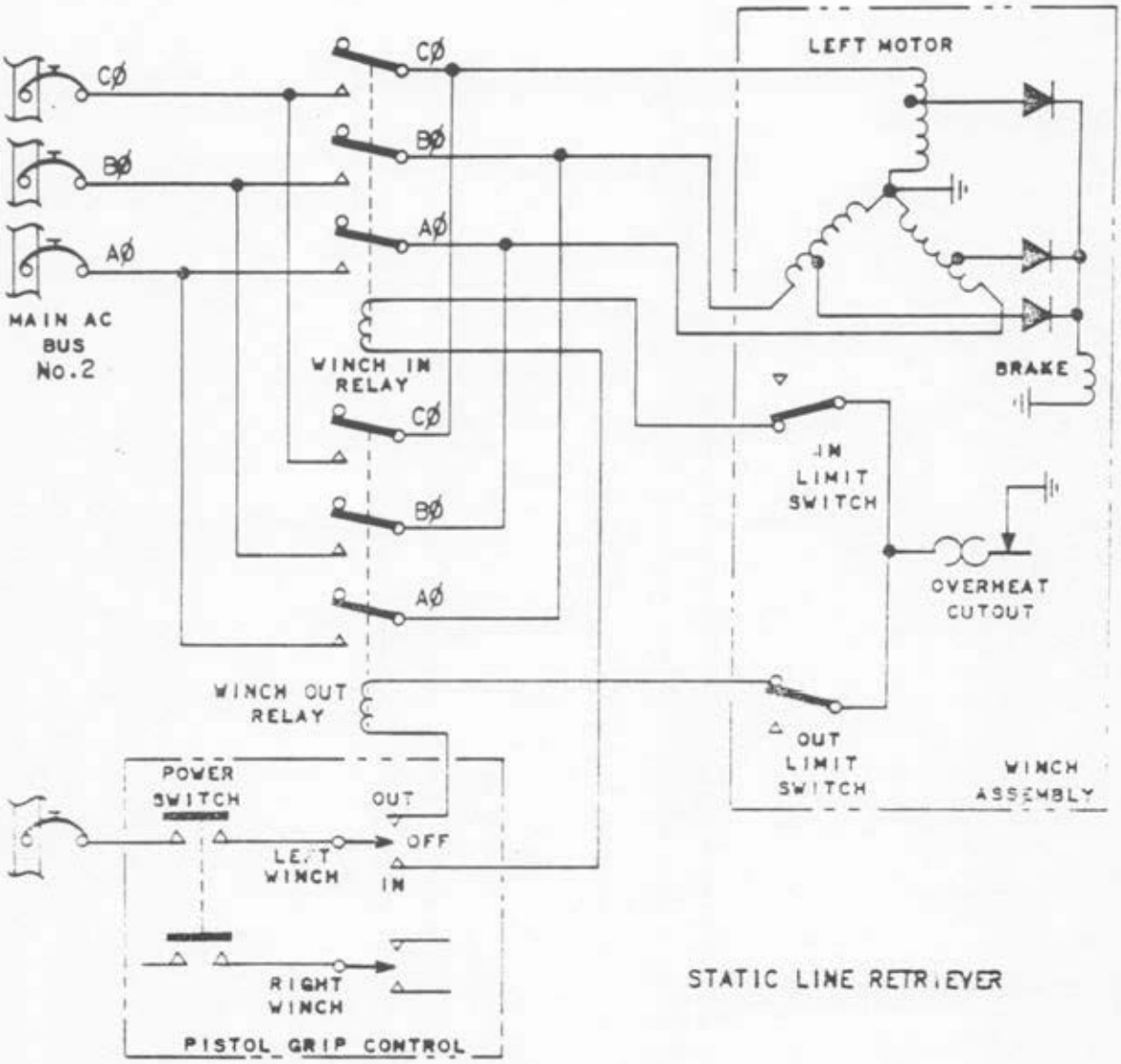
DOOR OPEN WARNING SYSTEM

The door warning system provides a visual indication when a door is not closed properly. The warning is provided by illumination of the DOOR OPEN light on the annunciator panel and the master CAUTION lights on the instrument panels. The annunciator lights flash and the CAUTION light is steady. When all doors and the ramp are closed and locked, microswitches are opened and the lights are extinguished. An open door microswitch completes the warning light circuit. Each door contains a door open light and bypass switch. The light illuminates to indicate which door is open, and the bypass switch isolates the annunciator and master CAUTION lights. The bypass is used to extinguish the master CAUTION and annunciator lights when a specific door is to remain open. If any other door opens, the lights again illuminate to provide a warning.



PARATROOP STATIC LINE RETRIEVER SYSTEM

During an air drop mission, anchor cables are extended from one end of the cargo area to



STATIC LINE RETRIEVER

the other. The cables allow parachute static lines to be attached prior to the airdrop. Static lines open the parachutes on the packs when the packs are released. The static lines are retracted into the aircraft after the drop is completed by static line retrievers.

The retrieval system consists of two winch and cable assemblies, extension cables, control relays, and a pistol grip control. The two winch and cable assemblies and four control relays are located on the forward cargo area bulkhead. The retrieval cable attaches to an extension cable which fastens to spools on the anchor cables. The spools are pulled forward on the anchor cables to retrieve the static lines.

Anchor cables are secured between the forward and aft cargo area. The cables attach at the forward cargo support beam with anchor arms on each side of the ramp. A turnbuckle is used to adjust cable tension. Sliding spools on each cable attach to the retrieval winch cable. The winch rewinds the retrieval cable pulling the spool and static lines foward into the aircraft.

A pistol grip control is provided in the aft cargo area next to the ramp control panel. An extension cord permits freedom of movement while controlling the retriever system. The pistol grip contains an ON-OFF switch and two winch control switches. The ON-OFF switch is actuated by holding the pistol grip and the winches are controlled by thumb switches. Identical switches control the left or right winch to extend, stop, or rewind the cables. The "OUT" position energizes the WINCH OUT relay, which completes the power circuit of the motor. The left winch motor is supplied three-phase AC from main A-C bus No. 2; the right is supplied from main A-C bus No. 3. The winch drives the cable assembly to unwind the cable which must be extended manually. If the switch is released, or the maximum cable limit is reached, the winch stops. The control switch or limit switches deenergize the control relays to stop the winch.

The "IN" position energizes the WINCH IN relay, reversing the motor. Motor reversal is accomplished through the relay by reversing the Phase A and B power source to the motor. The motor rewinds the cable until the switch is released or until the rewind limit switch is actuated.

A thermal overheat cutout is provided in each winch assembly in case overheating occurs. The cutout opens the relay ground circuit to stop the winch. The cutout automatically resets after cooling. A brake holds the winch and cable assembly when power is removed. Rectifiers change AC to DC to release the brake when the motor is driving.

IRON LUNG OUTLETS

Two special 28-volt DC outlets are used to furnish power to iron lungs for medical evacuations. One is in the forward section of the cargo compartment and the other in the center section. Power to these outlets is furnished from the main D-C buses.

CARGO COMPARTMENT RECEPTACLES.

General service, three-phase A-C outlets are located at convenient positions in the cargo compartment. Power for the right side receptacles is furnished from the main A-C bus No. 2. Power for the left side receptacles is supplied from the main A-C bus No. 3.

CARGO WINCH POWER OUTLET

A special receptacle is on the left side of the forward cargo compartment bulkhead. It is used for a portable cargo winch to aid in loading the aircraft. The outlet is supplied three-phase, A-C power from main A-C bus No. 3.

AVIONICS TEST RECEPTACLES

Three avionics test receptacles are installed. The receptacles provide a source of A-C and D-C power for test equipment. Two receptacles are mounted in the underdeck avionics equipment area. A test receptacle is also installed in the nose wheel well area.

Power for the receptacles is supplied by main D-C bus No. 2 and phase A of main A-C bus No. 4.

GALLEY RECEPTACLES

Two galley receptacles are installed. One is provided for the crew galley, and the other is used when the comfort pallet is installed on the airplane.

The crew galley receptacle is supplied three-phase A-C power from main A-C bus No. 2. The receptacle used with the comfort pallet is installed on the right side in the forward cargo compartment. It is supplied from main A-C bus No. 3.

SIGNAL LIGHT RECEPTACLES

Two signal light receptacles are installed on the airplane. One is on the pilot's side console in the map cases and the other is on the copilot's side console in the map cases.

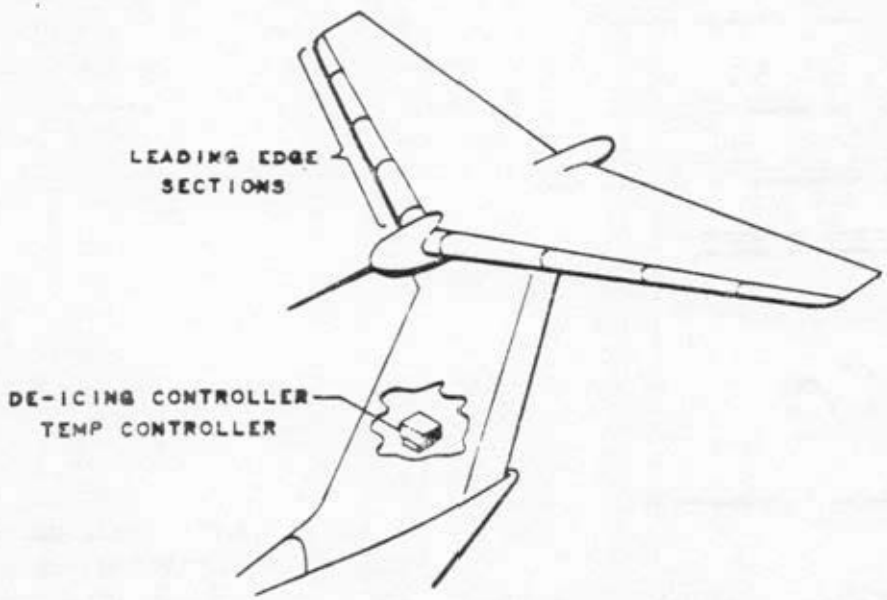
ELECTRIC LAVATORY SYSTEM

An electrically operated flush mechanism is used to remove waste products from the crew toilet. Power to the mechanism is supplied by main A-C bus No. 2.

An electric shaver outlet is provided in the crew lavatory. The circuit converts 115-volt, single-phase AC to 115-volt DC. Power to the outlet is supplied from phase B of main AC bus no. 2.

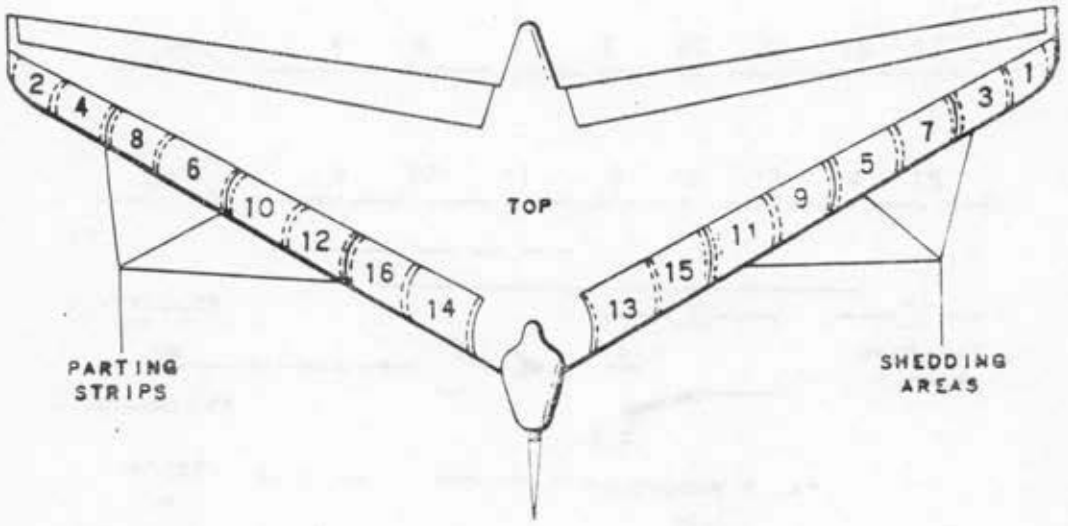
EMPENNAGE (HORIZONTAL STABILIZER) DE-ICING SYSTEM

The leading edge of the horizontal stabilizer portion of the empennage is electrically de-iced. Anti-icing and de-icing heaters are used to remove or prevent ice formation as required. Anti-icing is accomplished by use of shedding area heaters. The shedding area heaters are cycled on and off in a particular sequence by a de-icing controller. The same controller causes the parting strip heaters to operate continuously.

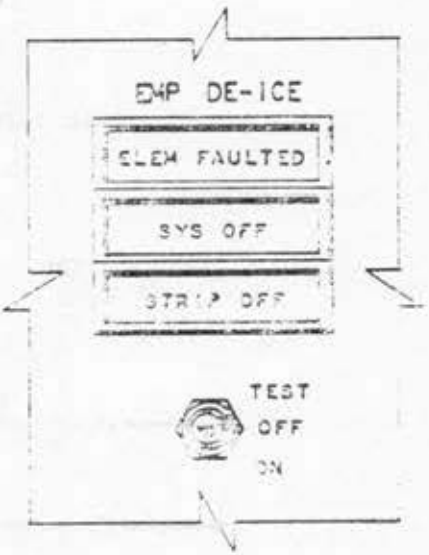


EMPENNAGE LEADING EDGE

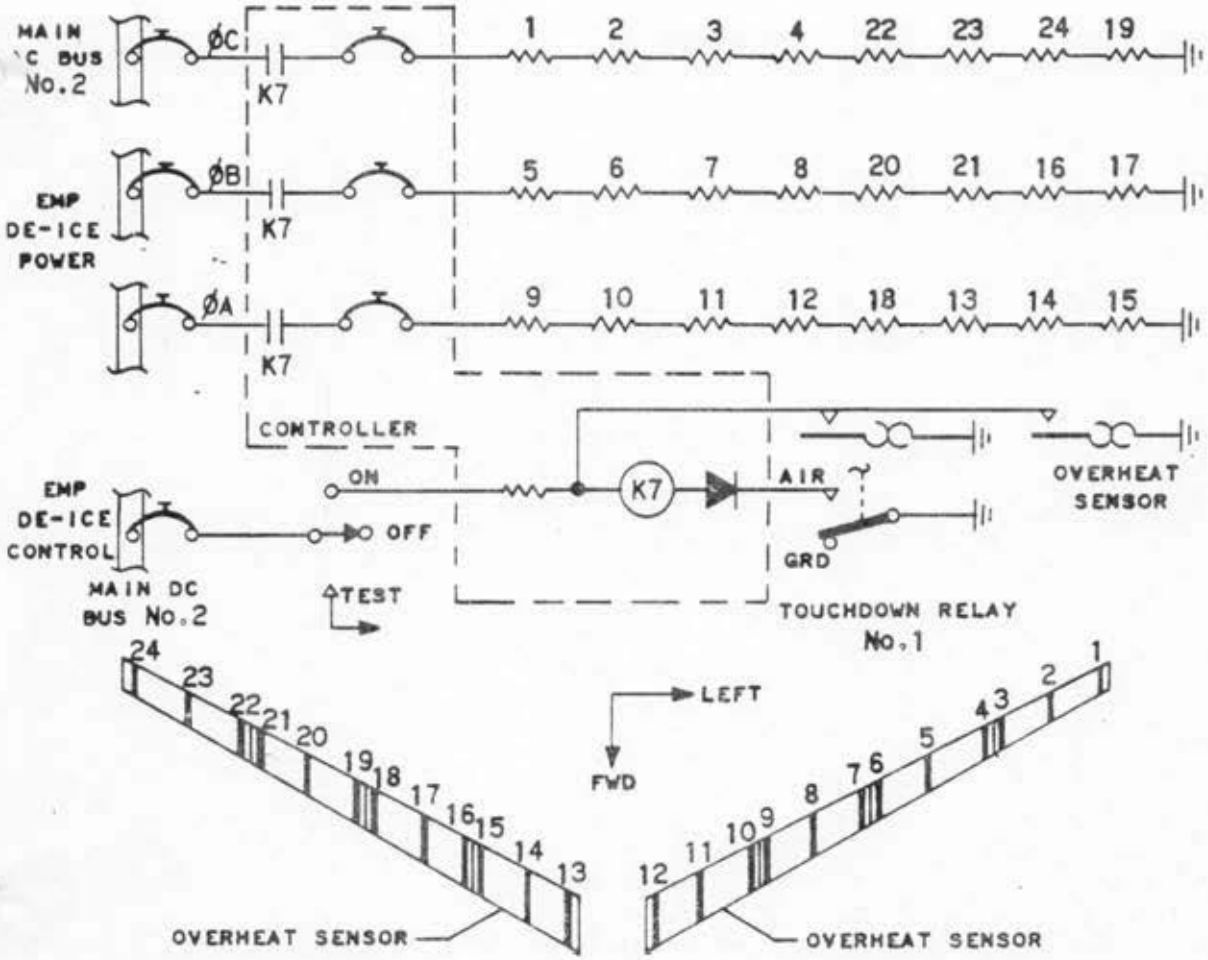
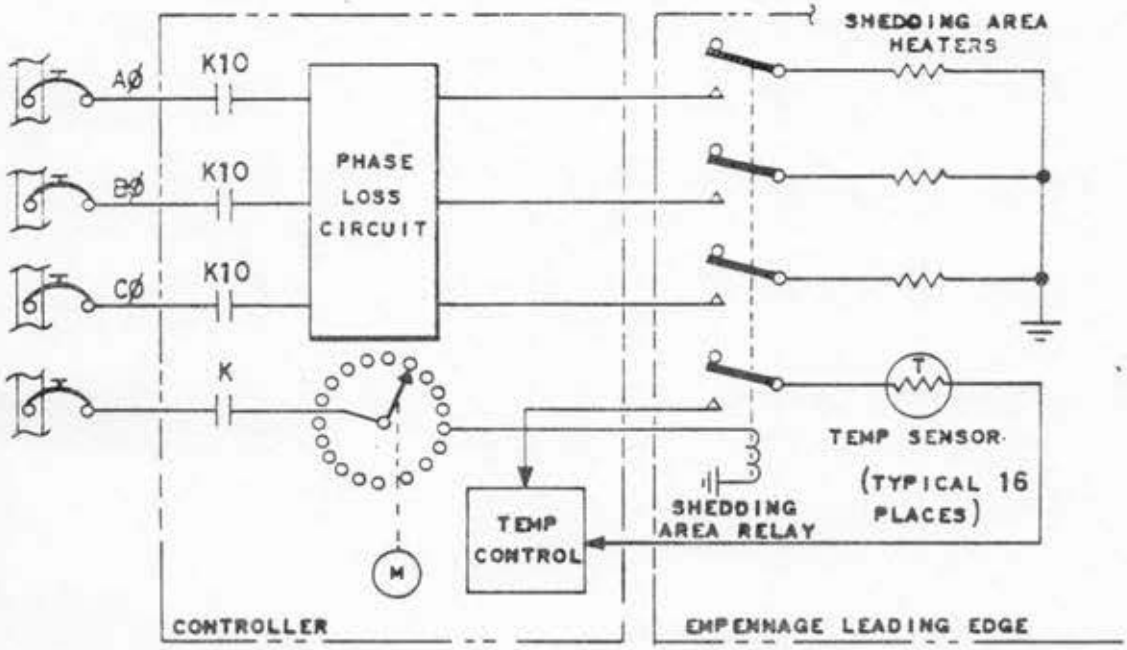
The empennage leading edge is constructed of fiberglas layers with a stainless steel outer layer. Resistive heating elements and temperature sensors (thermistors) are imbedded in the fiberglas. The leading edge is divided into eight approximately equal sections. Each section contains three parting strip and two shedding area heaters.



SHEDDING AREA NUMERICAL DESIGNATION



The de-icing cycle begins at the outboard shedding area and progresses inboard in numerical sequence; therefore the cycle alternates left and right shedding areas to maintain symmetrical ice removal. The controller allows shedding area an ON time of 15 seconds maximum during low-temperature icing conditions. However, the controller is capable of tailoring the ON time of the shedding areas, e.g. the controller will switch to the next shedding area when the temperature at the sensor reaches a predetermined value. Under relatively high icing temperatures, the entire de-icing cycle (all 8 sections) could possibly be completed in less than three minutes. Should this occur, the controller will delay the beginning of the next cycle until three minutes have elapsed since the beginning of the previous cycle. An open or shorted heater would cause the ELEM FAULTED lights on the overhead panel to illuminate. If the controller stops cycling, heater power is removed and the SYS OFF lights on the overhead panel will illuminate. Should the parting strip temperature exceed 90°F (anti-icing), the temperature controller removes power from the heater and illuminates the STRIP OFF light on the overhead panel. The controller may be tested when the aircraft is on the ground; however, power is not applied to the heaters at this time.



PARTING STRIP HEATERS