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SUBJECT: AIRPORT LIGHTING CONTROL

1. PURPOSE. This circular describes various schemes for control of airport lighting systems.

2. DESCRIPTION OF PUBLICATION. A number of control schematics are presented for use with power supply equipment developed for airport lighting systems. The control schemes employ simple switching of circuits to control lamp brightness and to turn circuits on or off.

3. CANCELLATION. This advisory circular replaces Airport Engineering Data Sheet No. 35, dated December 1961. No substantive changes have been made to the prior publication in placing it in the Advisory Circular System.

4. REFERENCES. The following publications provide further guidance and technical information as may be required:

   a. Federal Aviation Agency Specifications. Copies of FAA Specifications may be obtained from the Federal Aviation Agency, Distribution Section, HQ-438, Washington, D. C. 20553.

      (1) L-811 - Static Indoor Type Constant Current Regulator Assembly; 2 1/2 and 4 KW; With Brightness Control and Runway Selection for Direct Operation, August 1959.

      (2) L-812 - Static Indoor Type Constant Current Regulator Assembly; 4 KW and 7 1/2 KW; With Brightness Control for Remote Operation, November 1960.

      (3) L-813 - Static Indoor Type Constant Current Regulator Assembly; 4 KW and 7 1/2 KW; For Remote Operation of Taxiway Lights, November 1960.

      (4) L-816 - Circuit Selector Cabinet Assembly for 600 Volt Series Circuits, September 1962.

(5) L-821 - Airport Lighting Panel for Remote Control of Airport Lighting, March 1961.

(6) L-828 - Saturable Reactor Type Constant Current Regulator With Stepless Brightness Control, March 1961.

(7) L-841 - Auxiliary Relay Cabinet Assembly for Pilot Control of Airport Lighting Circuits, February 1961.

(8) Specification for L-847 Circuit Selector Switch, 5000 Volt 20 Ampere, Advisory Circular No. 150/5345-5, September 1963.

(9) Specification FAA-1046b, No. 19 Gauge Thermoplastic-Insulated Thermoplastic-Jacket Telephone Cable.

b. Rural Electrification Administration. Copies of Rural Electrification Administration specifications may be obtained from the United States Department of Agriculture, Rural Electrification Administration, Information Services Division, Washington, D. C.

(1) REA Bulletin 345-14, REA Specification for Fully Colored-Coded, Polyethylene-Insulated, Double Polyethylene-Jacketed Telephone Cable for Direct Burial.

5. HOW TO GET THIS PUBLICATION.

a. Order additional copies of this advisory circular from:

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FAA Advisory Circular AC 150/5340-2
Airport Lighting Control
Dated 11/4/63

c. There is no charge for this publication.

Cole Morrow, Director
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1. INTRODUCTION. Airport lighting control design employs simple switching of circuits to control lamp brightness and to turn circuits on or off. The design problem varies from that at a small airport, where all control equipment and circuitry may be self-contained in the power supply equipment, to that at a very large airport where the problem of a complex control system is compounded by requirements for space and cost savings.

   a. Scope. This guide presents the various schemes of control that are used with power supply equipment developed for airport lighting systems. Detailed descriptions will be presented of the factors affecting the interconnection of this equipment, but only the most essential aspects of the equipment's internal workings will be presented. Further details on the equipment may be obtained from the equipment manufacturer, or they may be found in the individual FAA specification covering the item.

2. DIRECT CONTROL SYSTEMS.

   a. Direct control systems are those where the lighting systems are normally controlled directly at their power supply equipment. Direct control may be used exclusively for control of lighting systems at small airports and is frequently used for control of miscellaneous circuits at larger airports.

   b. Low intensity lighting systems are directly controlled by turning on the 120 volt branch circuits supplying their power. Similarly, associated obstruction, wind cone, and beacon 120 volt supply circuits may be turned on directly through their branch circuit breakers.

   c. Medium intensity series lighting systems may also be controlled directly at small airports when a Specification L-811 constant current regulator is used. This regulator includes brightness control and runway selector switches, as well as circuit breakers, to control miscellaneous associated lighting circuits.

   d. Figure 1 shows a typical application of a Specification L-811 regulator at a small airport. In the application shown, the regulator has been connected to supply any one of three runway lighting circuits. Normally, each runway circuit should be supplied from a separate regulator, but runway selection through a switch, as shown, is permitted at small airports without control towers.

   e. A Specification L-811 regulator assembly is shown in Figure 2. The constant current regulator is contained in the lower portion of the unit and the controls are located on the top.

f. Airport lights should be operated during all periods of darkness. Sometimes it is not practical to have an operator present nightly to turn the lights on, and a photoelectric or astronomic time switch may be installed to operate the airport lights automatically. Direct, automatic switching by means of photoelectric or astronomic time switches is also frequently used for the control of isolated lights, such as obstruction lights and beacons, when they are located far away from the main airport lighting control point. When automatic switches are used, their contacts should be rated to switch the loads which they control.

3. REMOTE CONTROL.

a. At larger airports the field lighting is controlled from a central control panel which is located in the cab of the control tower. If there is no control tower, the panel may be located at some convenient location such as the manager's office. This control panel is covered by FAA Specification L-821.

b. The control panel contains switches and other devices which control the operating relays in the power supply regulators, located in a separate vault. All of these relays have coils which are rated to operate on 120 volts, A. C., and many of them require relatively large currents for operation. If the distance between the control panel and vault is short, the control panel switches may be used to switch the 120-volt control power to operate the relays directly. This is the simplest and most commonly used wiring method. Multiple conductor No. 12 AWG control cables are used to connect the control panel to the power supply equipment vault. Each regulator, or group of regulators with controls paralleled, should have its control circuit supplied from a separate 15 or 20 ampere circuit breaker in the vault.

c. The control circuit voltage drop increases as the distance separating the control panel from the vault increases. At some point, depending on the equipment controlled, 120-volt control circuits become impractical due to excessive voltage drops. The current demands and pull-in voltages of the relays used in airport lighting equipment are listed later with the description of the equipment.

d. Another system of control wiring is available for use where circuit lengths are too long to use 120-volt control at the control panel. This system utilizes sensitive, low burden pilot relays in the vault which are activated by the control panel switches. The pilot relays act as switches, in turn, to control the high burden regulator relays. This system is known as low voltage control as it employs a control voltage of 48 volts, D. C.

e. Low voltage control may be chosen over 120-volt control for considerations other than voltage drop. Low voltage control utilizes telephone cable to connect the control panel to the vault equipment. Where there are many control circuits to be installed, use of low voltage control may permit large savings in installation costs. Also, low voltage control permits compact wiring of control panels and use of miniature switches, a factor which, in itself, may dictate the use of low voltage control.

f. The pilot relays used with low voltage control are available in a complete assembly built to FAA Specification L-841. This assembly consists of twenty pilot relays, each with two normally open contacts, a power supply which rectifies 120-volt power to supply the 48 volt D. C. control voltage, terminal boards, and an enclosure. Figure 3 is a wiring diagram of this assembly. In addition to the major components shown, various filtering and spark suppression devices are used to assure proper relay operation.

g. The assembly requires one 120-volt branch circuit to supply its control power through a rectifier in the assembly and a separate 120-volt branch circuit should be connected to each set of relay contacts to furnish control power for the different circuits being controlled. Normally, a 25 pair, No. 19 AWG control cable would be used to connect an L-821 control panel to an L-841 pilot relay assembly. With No. 19 control wires and an L-841 pilot relay assembly, it is practical to control equipment up to 10,000 feet away from the control tower. Each contact on the relays is rated to carry an inductive load of 4 amperes with an inrush current of 10 amperes at 120 volts, 50/60 cycles.

h. Figure 4 shows the manner in which an L-841 relay assembly should be used in a control system. Note the use of protected terminal boxes installed at the points where the telephone cable enters the vault and control tower. Terminal boxes are recommended at these points to facilitate circuit testing, and they should incorporate lightning arrestors ("protectors") when more than 500 feet of cable is installed underground.

4. CONTROL PANELS.

a. The standard airport lighting control panel, covered by FAA Specification L-821, consists of a metal housing containing circuit control switches and brightness control components, as well as terminal blocks and internal wiring. The panel is available in several sizes for either flush or surface mounting.

b. The Type F panel is designed for flush mounting in a console. This is generally the preferred mounting method in control tower cabs, as it is desirable that the lighting panel be compatible in appearance with other panels by not projecting above the surface of the console.

The FAA installs standardized consoles in control tower cabs to hold the various control and communications equipment. Installation of these consoles may be limited to new control towers, but wherever they are to be installed, Type F panels should be used as they are designed to fit into the standardized console. Figure 5 illustrates an L-821 panel installed in a typical console.

c. The Type F panel is available in three sizes, 12" high by 16" wide, 12" high by 12" wide, and 6" high by 16" wide. The size used will depend on the number of control devices needed at the airport. Generally, at airports with control towers, the 12" by 16" size will be needed. The other sizes may be used at smaller airports, and where an addition is being made to an existing control system a 6" by 16" size may be used.

d. The Type S panel enclosure is designed for surface mounting on top of a flat surface such as a desk top. This type panel is available in sizes 12" high by 12" wide and 12" high by 16" wide and has a sloping top. Figure 6 shows a Type S panel being operated by an air traffic controller.

e. Specification L-821 covers control devices as well as the panel enclosures. Basically, there are two types of control devices covered in the specification, circuit switches and brightness controls. Circuit switches are toggle switches used to energize and de-energize regulators and other supply circuits. The toggle switches may be multiple pole and multiple position, as required by particular circuitry needs. Brightness controls for medium intensity runway lights are three-position rotary switches. Brightness controls for high intensity runway lights are potentiometers. The use of these devices is explained elsewhere in this guide, in detail, in connection with descriptions of the control systems for the various types of supply equipment. Panels may be built for either 48 volt, D. C. or for 120 volt, A. C. control, as ordered.

f. The loading of the relay coils in the L-841 relay assembly is such that it is not necessary to consider switch ratings when grouping or paralleling controls on the L-821 panel with a 48-volt control voltage. However, switch ratings will limit the number of controls that can be grouped on a switch when a 120-volt control voltage is used. The medium intensity brightness switch has a current rating of 10 amperes.

g. The toggle switches on the panel can carry and switch a lamp load of 1000 watts at 120 volts, and can carry an inrush current of 10 amperes. These switch ratings must be taken into account if controls are to be grouped with a 120-volt control voltage.

h. The designer has great flexibility in the choice and arrangements of control components on the panel. This is necessary as the control system must be adapted to each airport's individual needs in the case of large airports with many special control circuits. On the other hand, at smaller airports, it may be preferable to avoid special design and fabrication for the control panel. Specification L-821 recommends a standard design panel for those cases where it is preferable to take advantage of it. This standard panel provides for control of up to three runways, nine taxiway circuits, and twelve miscellaneous circuits. Designers should refer to Specification L-821 for further details concerning the ordering of panels.

i. The arrangement of control devices on the panel should approximate the arrangement of the corresponding lighting circuits as viewed by the air traffic controller. In general, all toggle switches shall be located along the upper part of the panel and all brightness control devices along the lower part. Also in general, toggle switches controlling equipment associated with a particular runway shall be located above that runway's brightness control.

j. In designing the control circuit and panel arrangement for an airport, the FAA Regional lighting engineer should be consulted for advice on the arrangement of the control panel. He will also coordinate the panel arrangement with the appropriate Air Traffic Service personnel if the airport has a control tower. When the panel arrangement is planned, provision should also be made for future additions to the control system as it may be extremely difficult to arrange for later conversions.

k. Figure 7 illustrates the application of an L-821 control panel adapted for use at a hypothetical airport. In this application of the panel, the runway controls, at the bottom of the panel, are located from left to right in the same manner as are the corresponding runways, as viewed by the air traffic controller. Taxiway controls are located above the controls for the particular runway most closely associated with the taxiway.

l. Labeling of the control panel switches may be specified on the panel order or it may be done in the field. Usually runway lighting controls should be labeled with the runway's direction numbers, and taxiway lighting controls should be labeled with "T/W" or "TAXI" preceding the taxiway's identifying letter. Figure 7 shows typical switch labeling.

5. CONTROL OF SPECIFICATION L-812 REGULATORS.

a. The Specification L-812 constant current regulator is intended to supply medium intensity runway lighting circuits and taxiway circuits where brightness control is used. It is available in 4 and 7 1/2 KW

sizes. The regulator is energized by means of a primary contactor with a 120-volt operating coil, and the output current of the regulator is selected by one of three brightness relays, all of which have a 120-volt operating coil. The primary contactor and one of the brightness relays are energized when the regulator is turned on. The coil characteristics are as follows:

COIL	REGULATOR SIZE	INRUSH AMPERES	PULL-IN VOLTAGE	HOLDING AMPERES	DROP-OUT VOLTAGE
Primary Contactor	4KW	1.4	99	.22	77
Brightness Relay	4KW	0.92	99	.20	77
Primary Contactor	7½KW	5.0	99	.78	77
Brightness Relay	7½KW	0.93	99	.38	77

b. The regulator is also equipped with relays to open the primary contactor when an open circuit occurs on the output side of the regulator. There are no manual controls on the regulator for its local operation. The brightness relays may be controlled to operate the regulator at an output current of 6.6, 5.5, or 4.8 amperes, corresponding to a lamp brightness of 100, 30, or 10%.

c. The L-812 regulator is controlled by switches in an L-821 remote control panel, either directly or through relays in an L-841 relay assembly. It may be necessary to parallel the controls of several regulators supplying taxiways. The rating of the switches in the L-821 panel and of the L-841 relay contacts will limit the number of regulators that may have their controls paralleled.

6. MEDIUM INTENSITY RUNWAY LIGHTING CONTROL. Medium intensity runway lights should be controlled to permit selection of any one of the three brightness steps. The remote controls in the L-821 panel for this application consist of a SPST toggle switch and a three-position rotary switch.

a. Figure 8 is a connection diagram for the control circuit of a medium intensity runway-lighting circuit when a 120-volt control voltage is used. The wire connecting the 120-volt source to terminal "CC1" on the control panel will carry control current for both the primary contactor and one brightness relay. The wire between the two terminals marked "CC" carries control current to the primary contactor, and wires between terminals marked "B10," "B30," and "B100" carry control current to the brightness relays.

b. Figure 9 is a control diagram for a medium intensity runway circuit using a 48 volt, D. C. control voltage for the L-812 regulator. For this control circuit, three relays are used in the L-841 relay assembly to control the regulator; and two pairs of wires are used to connect the L-821 remote control panel to the L-841 assembly in the vault. If regulators are to have their controls paralleled in this application, the control circuits should be paralleled at the regulator terminal blocks.

7. TAXIWAY LIGHTING WITH BRIGHTNESS CONTROL.

a. Brightness control for taxiway lighting is normally used where a concentration of lighted taxiing areas could produce a mass effect of blue light. Reduced light intensity alleviates this undesirable condition, especially in good visibility weather. Brightness control could also result in much longer lamp life and somewhat lower electric bills. Taxiway circuits with brightness control are supplied by series circuits. The control is accomplished by a specific toggle switch on an L-821 panel. The L-812 regulator shall be used with brightness control. However, only two of the brightness steps, i.e., 100% and 30%, are used. The 10% brightness step does not provide adequate intensity through blue lenses to be of any value.

b. The connections for controlling an L-812 regulator used on a taxiway circuit with brightness control are similar to those used on a medium intensity runway lighting circuit. However, the only control needed on the L-821 remote control panel is a single pole, three-position toggle switch. This switch should be connected to provide the following: The regulator is off when the switch is thrown to the left; the regulator's primary contactor and the 100% brightness relay are energized when the switch is in its center position; and the primary contactor and the 30% brightness relay are energized when thrown to the right. When so connected, the switch's operation is consistent with other switches by being off in its left-hand position, and on in a normal manner (with taxiway lights dim) in its right-hand position. Figure 10a is a connection diagram for 120-volt control of an L-812 regulator for a taxiway circuit with brightness control, and Figure 10b is a similar connection diagram for a 48 volt, D. C. control voltage. Note that auxiliary relays are needed near the regulator when 120 volts is used as the control voltage. These relays may be a commercial type with contacts of adequate size to carry the current of the regulator's control coils.

8. CONTROL OF SPECIFICATION L-813 REGULATORS.

a. Taxiway lighting without brightness control is normally used for simple taxiway layouts and where taxi lights clearly define taxiing paths without confusion. A rarely used taxiway light application is for a 120-volt multiple circuit to operate a small number of lights at

short distances. Normally, they are switched by on-off branch circuit breakers near the power source. This detail is not included herein.

b. The Specification L-813 constant current regulator is intended to supply series taxiway lighting circuits without brightness control. It is similar in design to the Specification L-812 regulator, but it has no brightness relays. It is available in 4 and 7½ KW sizes, and its primary contractor coil has the same characteristics as the coil in an L-812 regulator.

c. The regulator is controlled by a toggle switch in the L-821 control panel, as illustrated in Figure 11. Design considerations concerning paralleling of regulators, voltage drop, etc., are the same as for the L-812 regulator.

9. CONTROL OF SPECIFICATION L-828 REGULATORS.

a. The Specification L-828 constant current regulator is intended to supply high intensity runway lighting series circuits where L-819, L-838, L-842, or L-845 lighting fixtures are used. The regulator may be supplied with an output current of either 6.6 or 20 amperes. Thus, it should not be necessary to parallel regulators on the same runway lighting system, as the 20 ampere regulator may be obtained in sizes adequate to handle the load of any single runway lighting system. However, where in-runway lighting is used in addition to runway edge lighting, it will be necessary to gang the controls for all associated lighting systems.

b. The L-828 regulator is designed to be energized by means of a separate primary switch whose operating coil is energized by a 120-volt control voltage received from the L-828 regulator. The primary switch should be selected to handle the load and voltage for which the regulator is rated, and the most commonly used switch has an operating coil with the following characteristics: Pull-in voltage - 100; inrush current - 5.0 amperes; drop-out voltage - 65; holding current - 1.5 amperes.

c. Brightness control for the regulator is accomplished by means of a potentiometer in the L-821 control panel. This potentiometer is described in Specification L-821 and is to be connected to the control terminals marked "81," "82," and "83" in the regulator by three separate wires. As the remote potentiometer is rotated, the output current of the regulator will be varied to produce a runway lamp brightness of from 0.2% to 100%.

d. The control power for the brightness control of the regulator is supplied from the 120-volt power which is fed into the regulator control terminal "72." This power is rectified within the regulator to provide a 48 volt, D. C. control voltage for the potentiometer

circuit. The design of the regulator is such that the 48 volt, D. C. control voltage, generated within the regulator, is adequate for proper operation when No. 19 AWG wires, up to 10,000 feet in length, are used to connect the remote brightness control potentiometer to the regulator.

e. The internal control devices within the regulator include an open circuit relay and an over current relay, which interrupts control power to the external primary switch when an open circuit occurs on the output side of the regulator, or when an over current condition exists. These relays and other control components use a total of approximately 0.4 ampere during normal operation and result in an inrush current of approximately 1.1 amperes when the regulator is energized. The current required by the operating coil of the primary switch must be added to the above values when designing the external control circuit for the regulator.

f. The controls used on an L-821 control panel for this regulator consist of the brightness control potentiometer and an on-off switch which should be a DPST toggle switch, one pole of which is used to energize the circuit leading to the operating coil of the primary switch. The other pole is used to disconnect the center leg of the brightness control circuit when the switch is "OFF." Where dual panels are to be utilized in the tower, the appropriate FAA office should be contacted since this type of installation requires an additional 1000-ohm resistor be installed in parallel with the regulator's motor driven 1000-ohm potentiometer to compensate for paralleling the two 1000-ohm control panel potentiometers.

g. Figure 12a illustrates the connections to be used to control an L-828 regulator with a 120-volt control system, and Figure 12b shows the control connection used with a 48-volt control system.

10. SELECTOR SWITCHES.

a. Remote control selector switches, used for airport lighting circuits, are remotely controlled to separately switch different series circuits supplied by a single regulator. These switches are available for special applications and are so designed that when series circuits are being switched, the regulator supplying them is never left in an open circuit condition.

b. One such switch is that built to FAA Specification L-816 which is capable of switching series circuits supplied by 4 KW, 6.6 ampere constant current regulators. This switch may be used for switching short segments of taxiway lights, on separate series circuits, supplied from the same regulator. The Specification L-816 switch is available in two types: Type I for control of a single series circuit and Type II for control of up to three series circuits. The selector

switch assembly consists of an enclosure containing a relay for each series circuit controlled and a set of plug-in series disconnects. The relay operates to close contacts connecting in the load circuit when the relay coil is energized. The relay has another set of contacts which short circuit the supply leads before the above contacts open. Each relay coil has the following characteristics: Inrush current - 0.75 ampere; pull-in volts - 100; holding current - 0.18 ampere; drop-out volts - 70. The series disconnects are so connected that removal of the disconnect plug short circuits the supply leads and isolates the load circuit from the power supply. Figure 13 shows the proper control connections when a Type II, Specification L-816 selector switch assembly is used with a 120-volt control system.

c. When high voltage series circuits are to be switched, a switch built to Specification L-847 may be used. This switch is similar in principle to the Specification L-816 switch except that its contacts are rated for 20 amperes at 5000 volts, and it is built to switch two series circuits. It has no plug-in series disconnects, but it does have a local, manual control switch. An application of this switch is shown in Figures 14 and 15, and its relay coil characteristics are listed in the following section.

11. COMBINED CONTROL SYSTEMS.

a. It is often necessary to gang the controls of several lighting circuits to achieve a convenient, logical control system. When this is done, the general principles presented on the preceding pages should be applied to the separate control circuits, and the overall ratings of the control devices should be checked to see that their capacity is not exceeded.

b. Figures 14 and 15 illustrate a combined control system where five runway lighting systems have their controls ganged. In this instance it is required that runway edge, touchdown zone, and centerline lights be controlled from the same brightness control as either of two taxiway turnoff centerline lighting systems. Three brightness control potentiometers are ganged on one control to simultaneously control the output of the three regulators used. Located above the brightness control on the L-821 control panel is a 6 pole, single throw toggle switch to turn on or off all the regulators. This master switch would normally be used to control all the runway lights. In addition, separate SPST toggle switches should be located at the top of the L-821 control panel to provide individual on-off control of each of the three regulators.

c. One regulator has been used to supply the centerline lighting system and both of the taxiway turnoff lighting systems. In the application shown, it is assumed that only the taxiway turnoff lighting system serving traffic from one direction should be turned on when the runway

centerline circuit is on. To achieve this, a Specification L-847 selector switch is used to select the proper taxiway turnoff system, and a single pole, three-position toggle switch is installed above the master switch in the L-821 control panel.

d. The Specification L-847 selector switch contains two main contactors whose operating coils are energized when pilot relays are energized. The pilot relay coils are connected to terminals "R1" and "R2" and have the following characteristics: Inrush current - 0.18 amperes; pull-in volts - 80; holding current - 0.16 amperes; drop-out volts - 38. The main contactors receive their control power from terminal "L1" and their coils have the following characteristics: Inrush current - 10 amperes; pull-in volts - 80; holding current - 1.3 amperes; drop-out volts - 55.

e. In some cases, there may be required two L-821 panels in a control tower. These may contain complete duplicate controls or selected circuit controls for ground operations and special conditions. A detailed study will be required for such installations with the coordination of the appropriate FAA offices to determine the means and methods of establishing master control areas and the proper transfer devices to achieve positive controls.

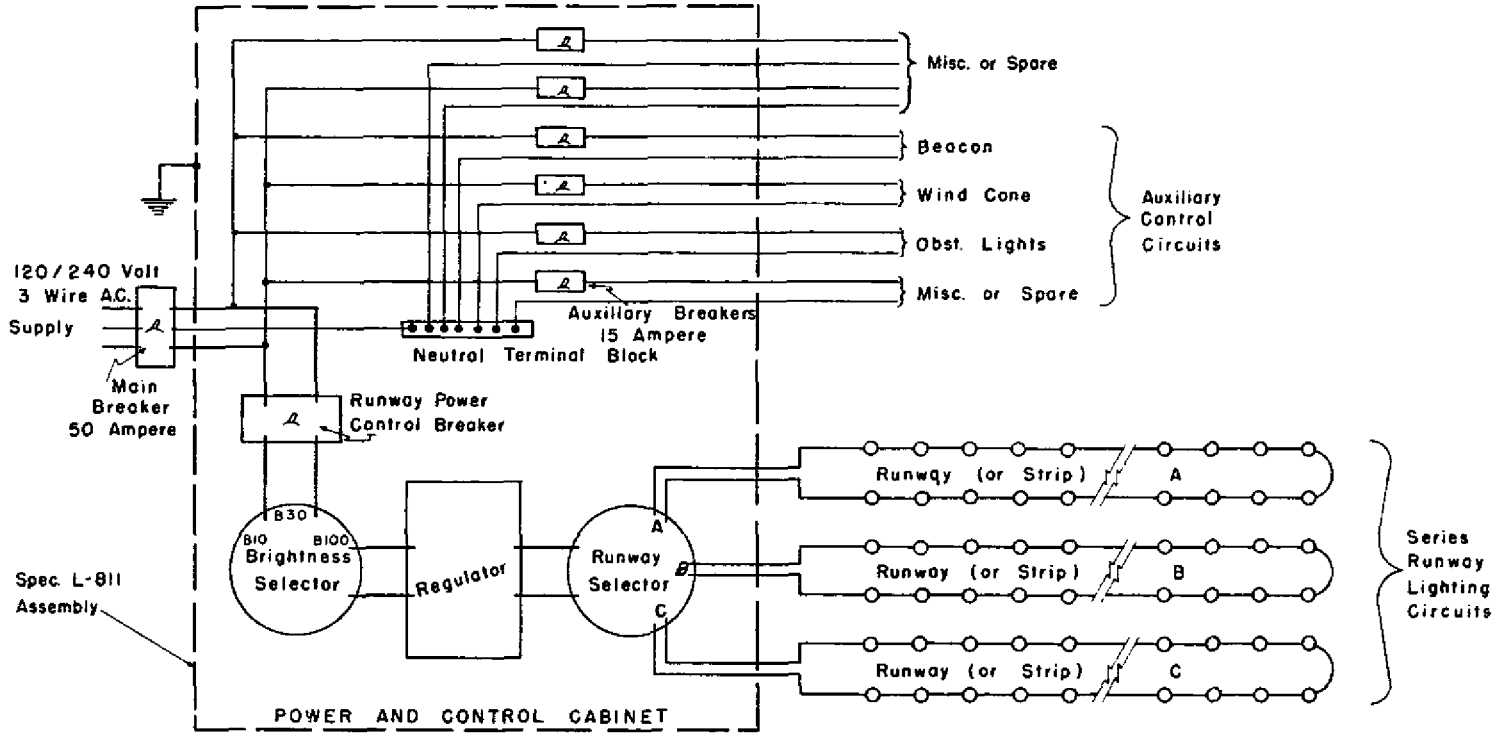


FIGURE 1. TYPICAL APPLICATION OF L-811 REGULATOR

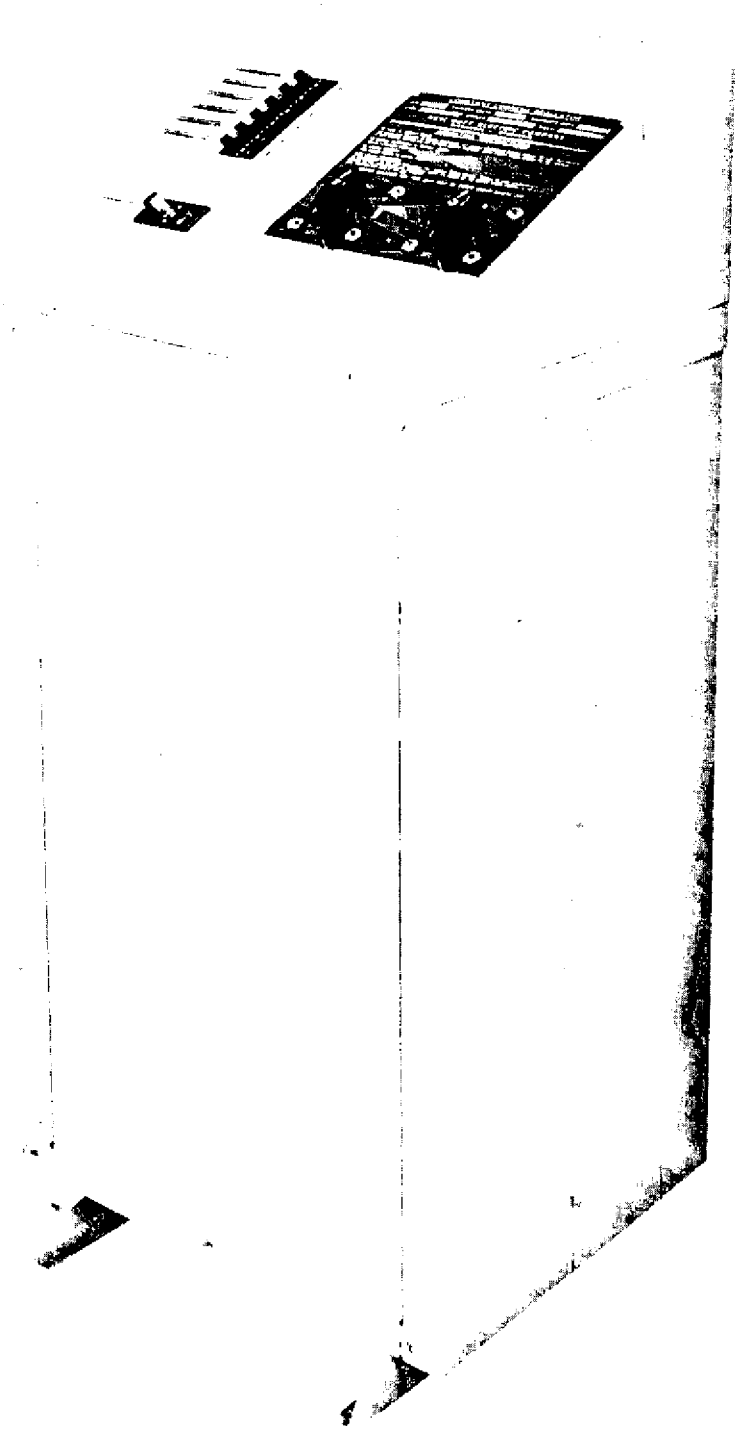


FIGURE 2. TYPICAL L-811 REGULATOR

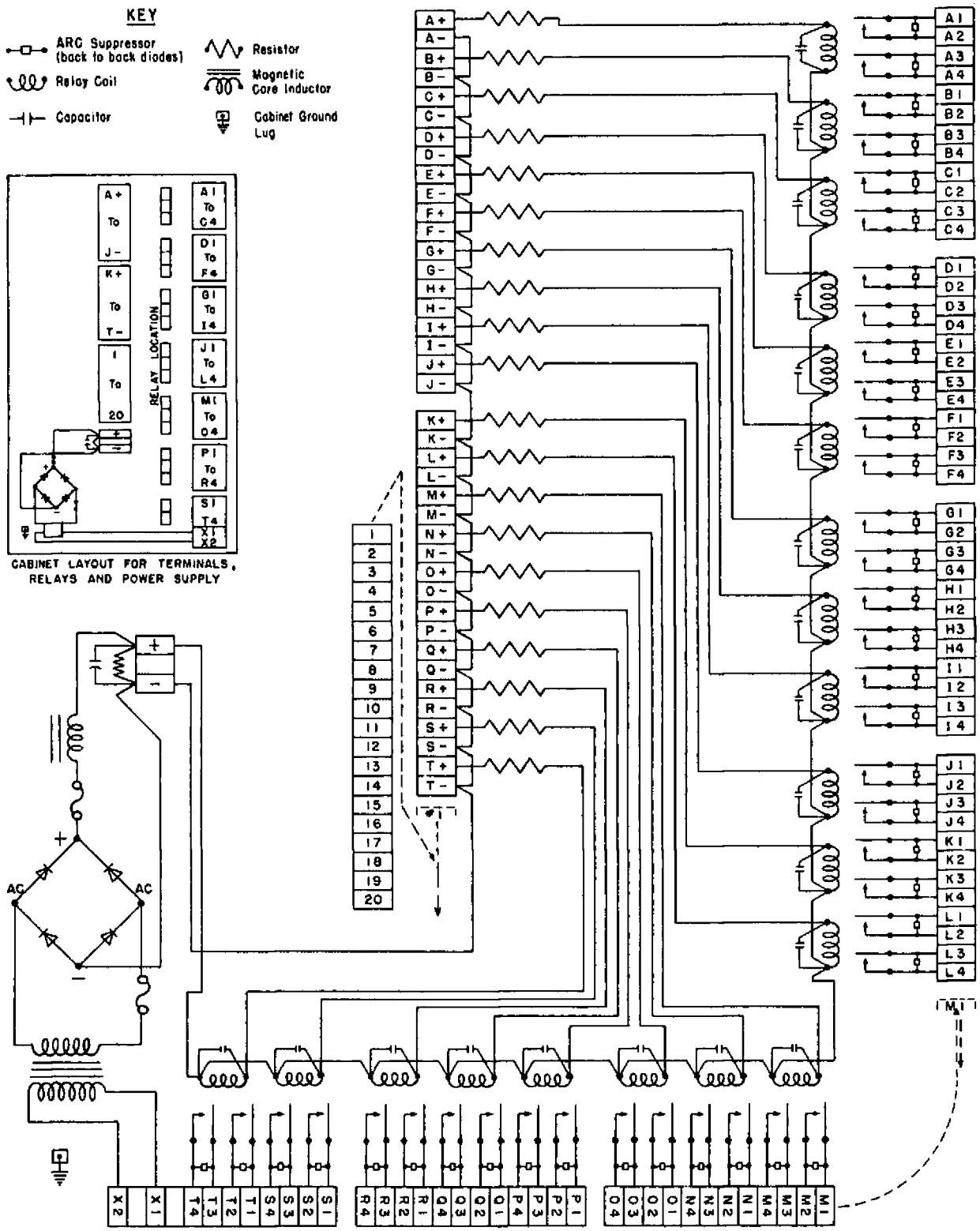


FIGURE 3. TYPICAL WIRING DIAGRAM OF L-841 RELAY ASSEMBLY

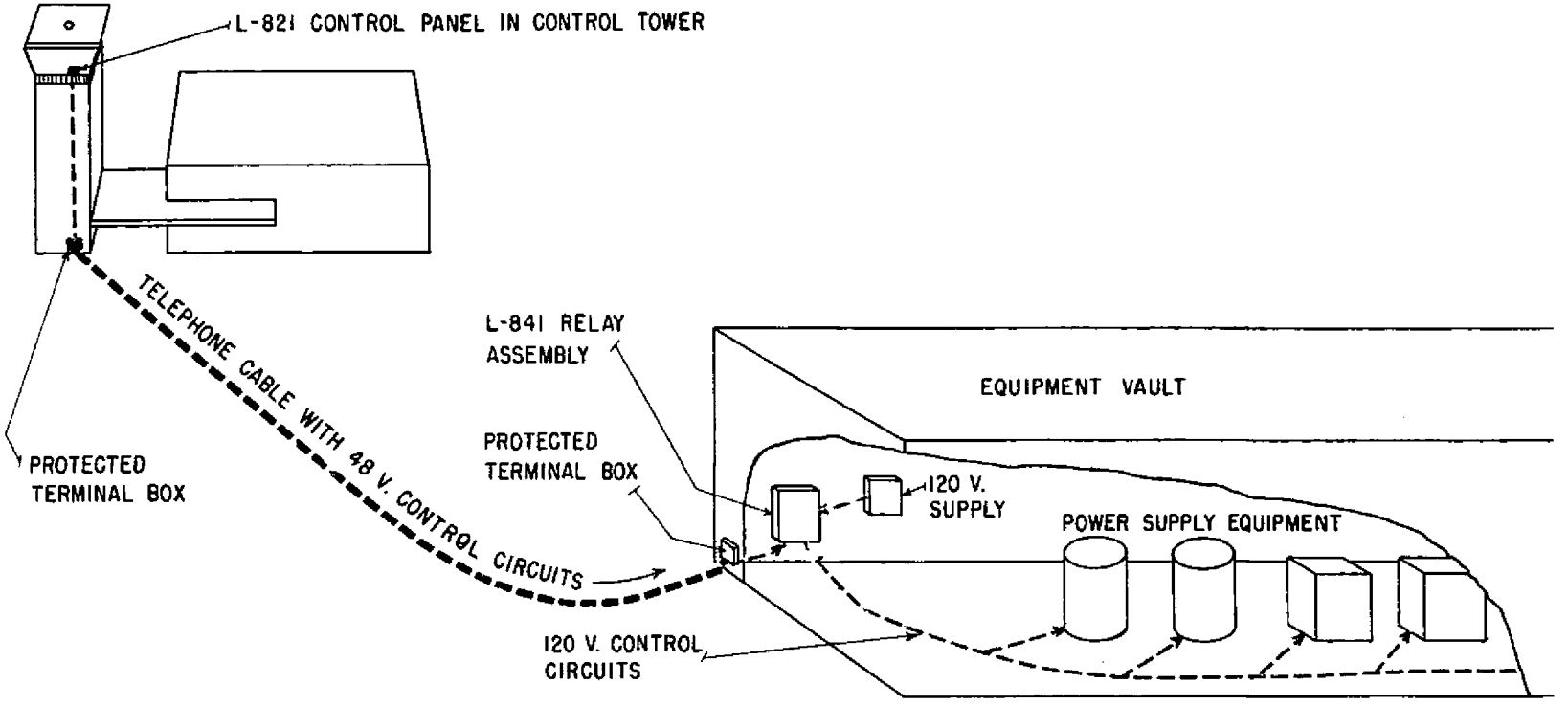


FIGURE 4. APPLICATION OF L-841 RELAY ASSEMBLY

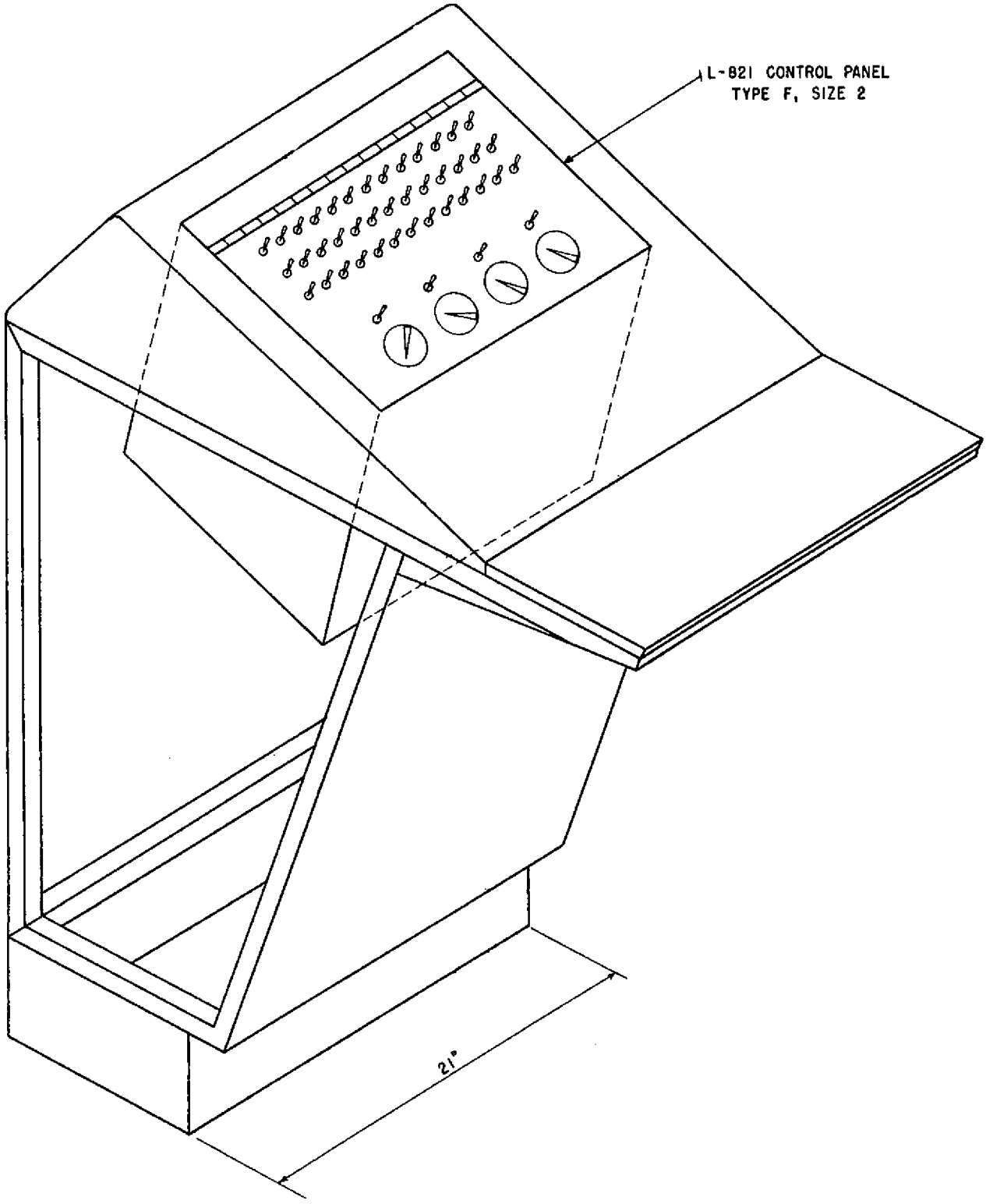


FIGURE 5. L-821 CONTROL PANEL INSTALLED IN CONSOLE

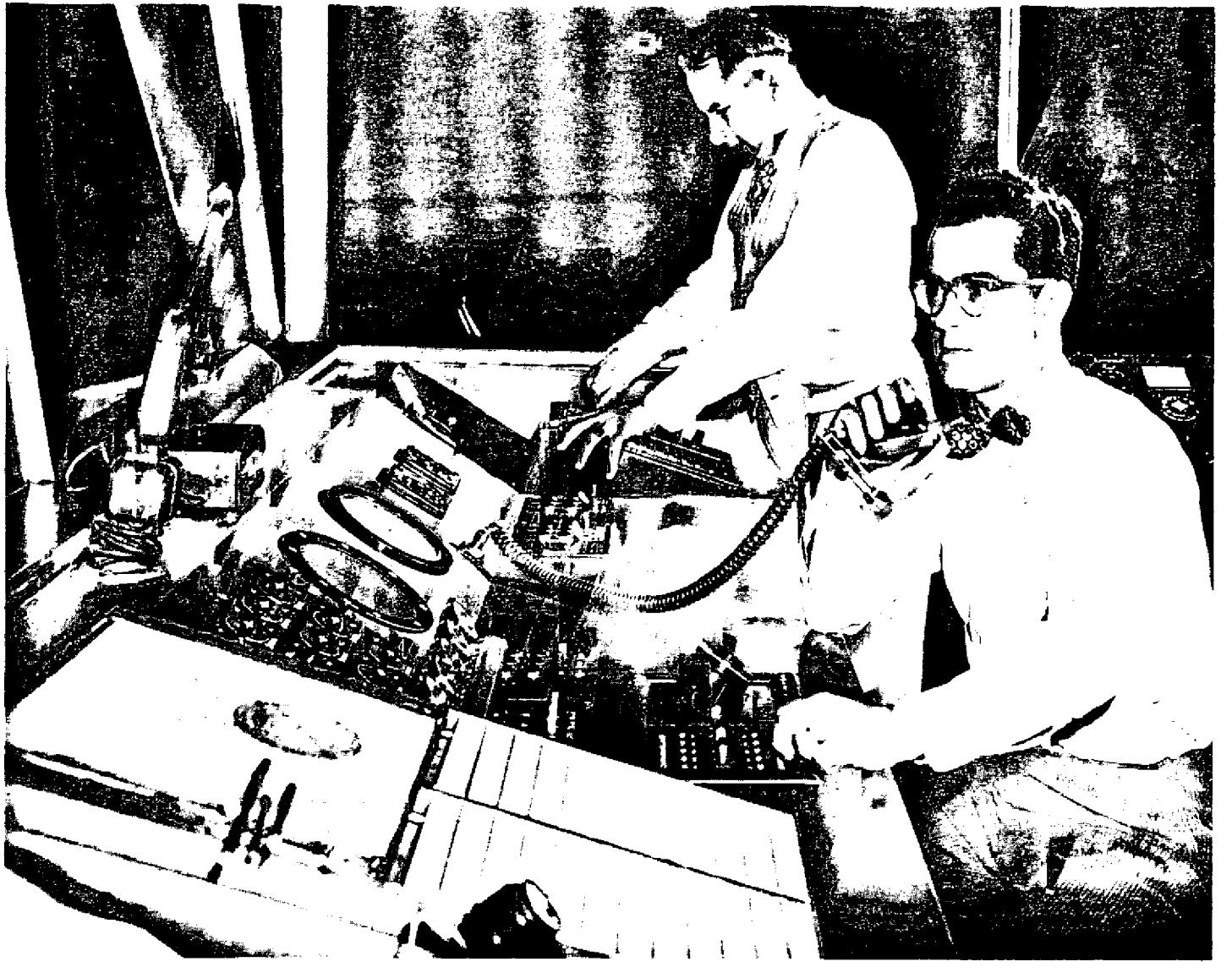


FIGURE 6. L-821, TYPE S CONTROL PANEL IN OPERATION

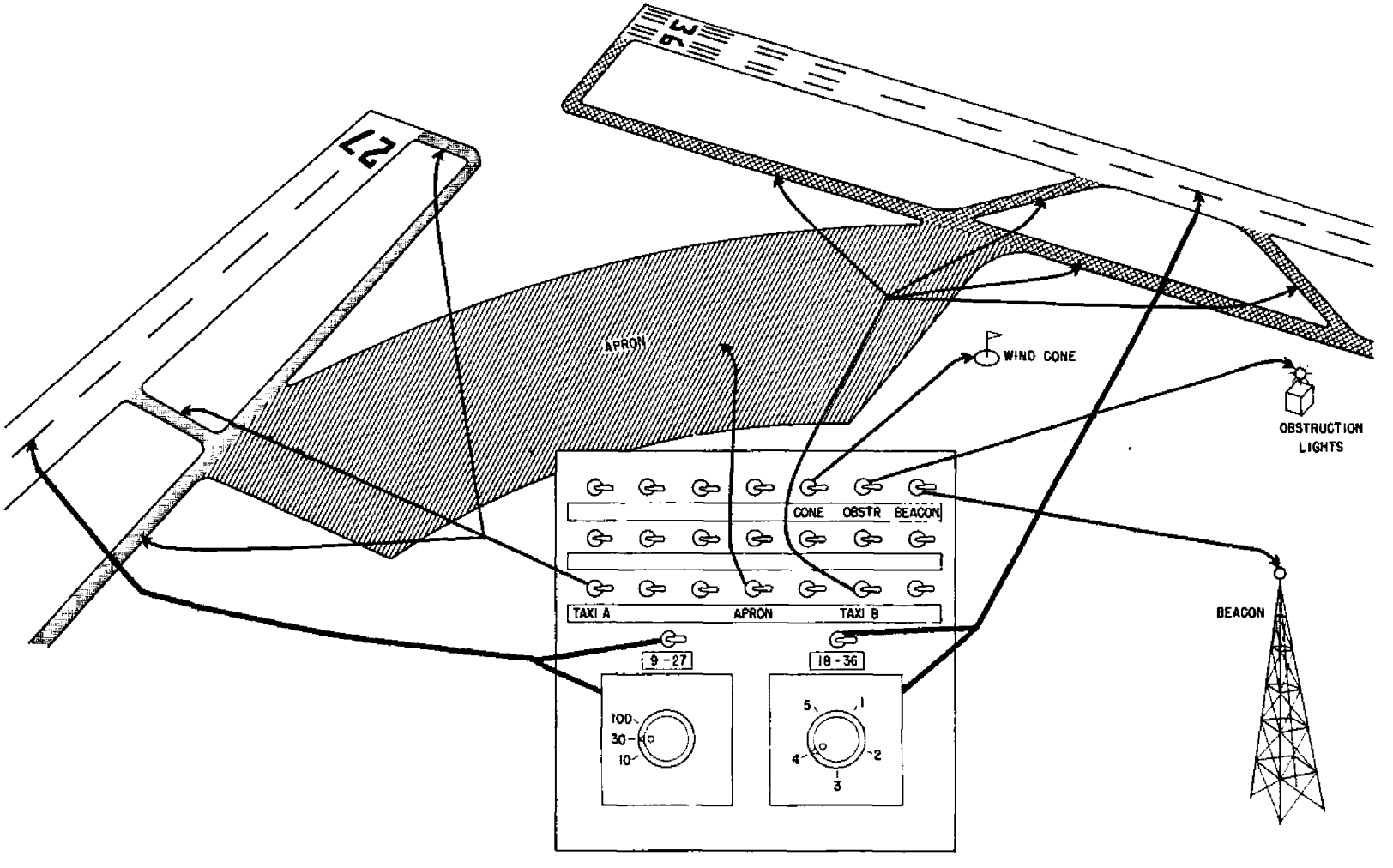


FIGURE 7. APPLICATION AND SWITCH LABELING OF L-821 CONTROL PANEL

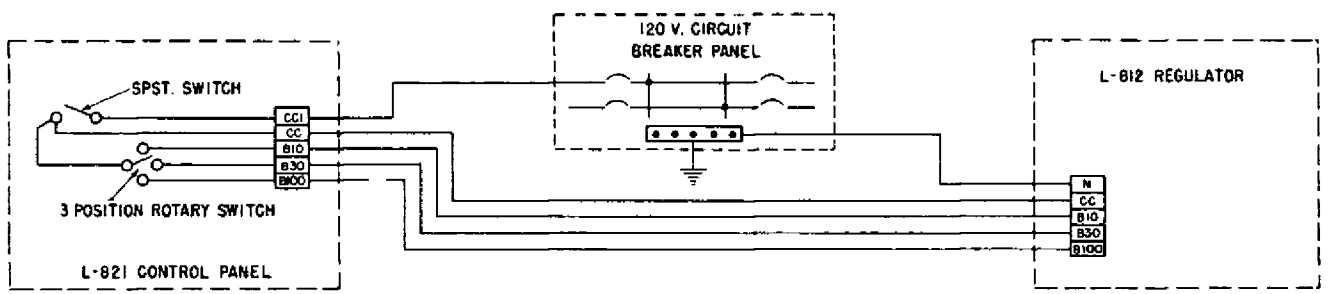


FIGURE 8. TYPICAL RUNWAY LIGHTING WIRING
DIAGRAM FOR 120 VOLT CONTROL FOR AN L-812 REGULATOR

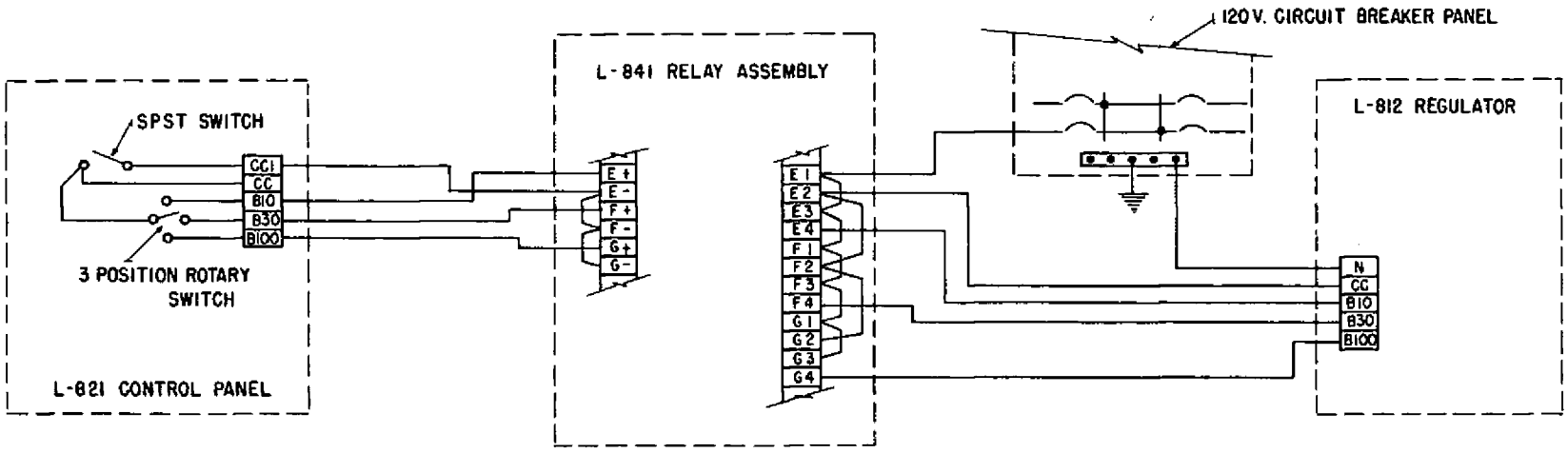
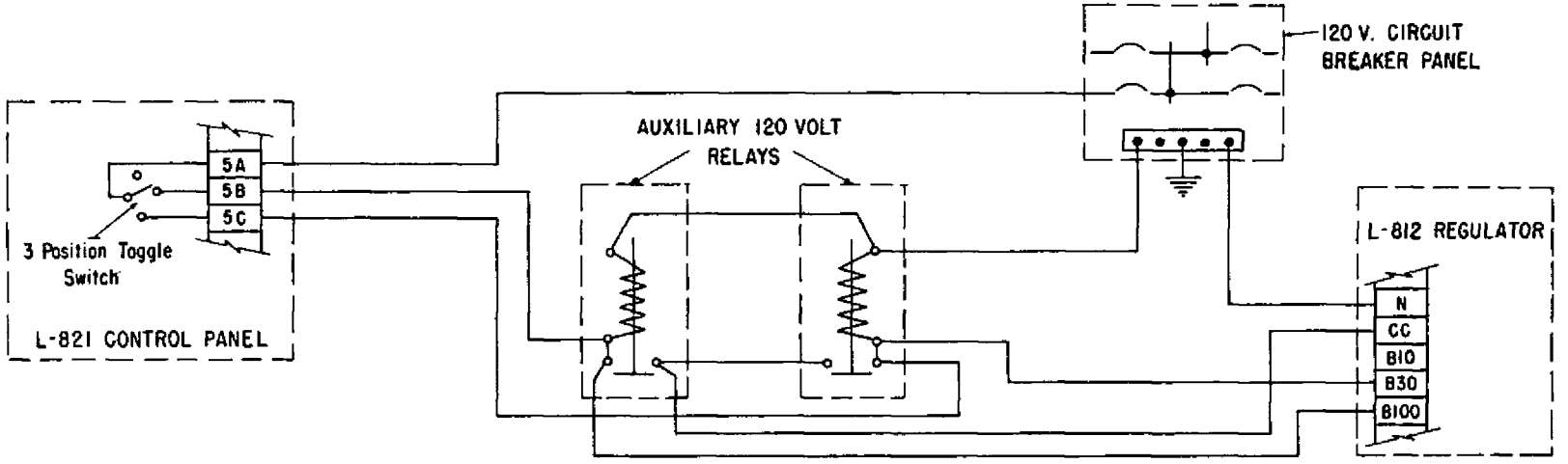
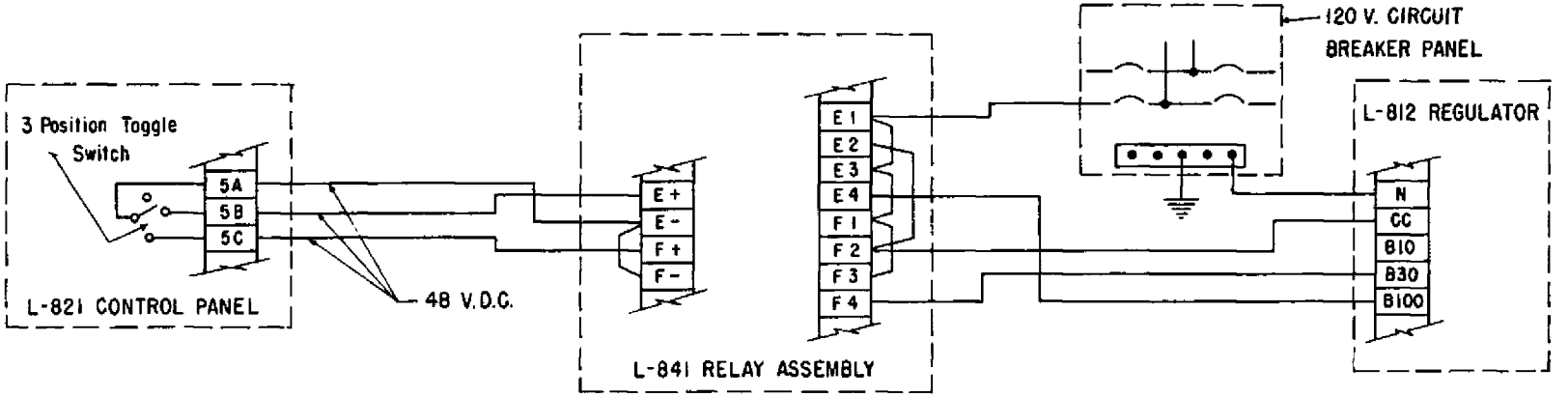


FIGURE 9. TYPICAL RUNWAY LIGHTING
DIAGRAM FOR 48 VOLT CONTROL FOR AN L-812 REGULATOR



a) 120 VOLT CONTROL VOLTAGE



b) 48 VOLT CONTROL VOLTAGE

FIGURE 10. TYPICAL TAXIWAY LIGHTING
DIAGRAMS FOR 120 AND 48 VOLT CONTROL FOR AN L-812 REGULATOR

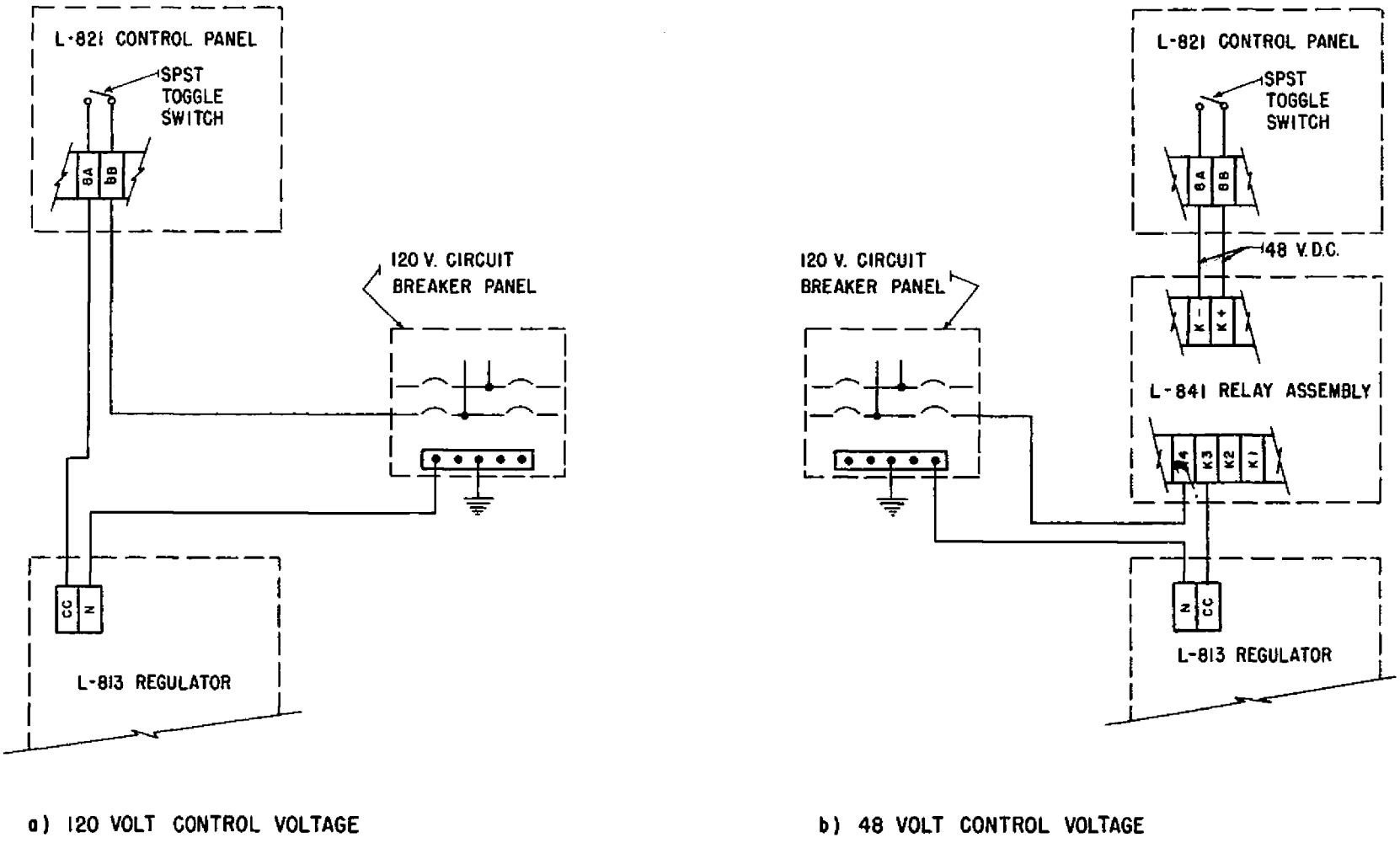
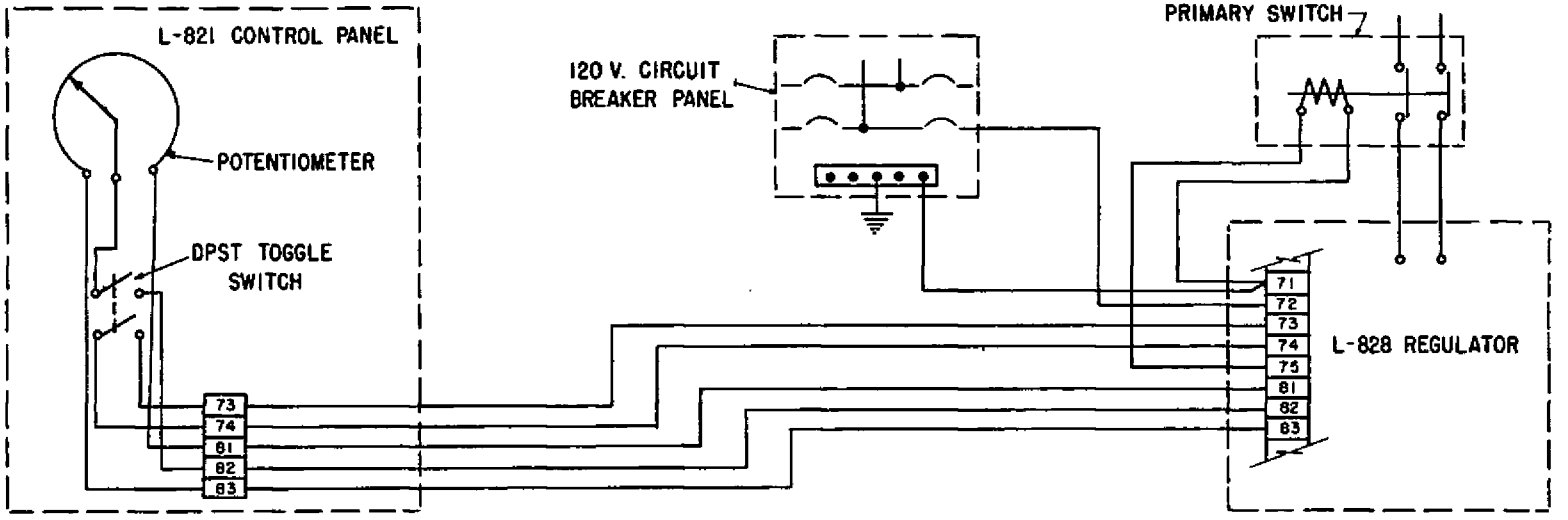
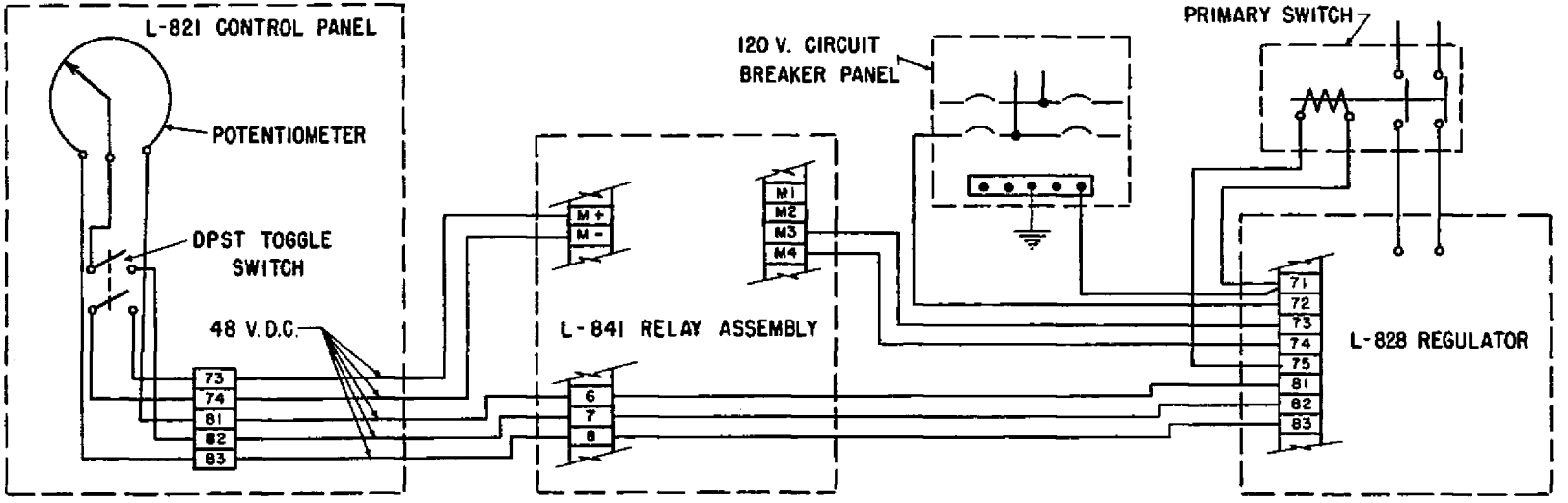


FIGURE 11. TYPICAL TAXIWAY LIGHTING
DIAGRAM FOR 120 AND 48 VOLT CONTROL FOR AN L-813 REGULATOR



a) 120 VOLT CONTROL VOLTAGE



b) 48 VOLT CONTROL VOLTAGE

FIGURE 12. TYPICAL RUNWAY LIGHTING
DIAGRAM FOR 120 AND 48 VOLT CONTROL FOR AN L-828 REGULATOR

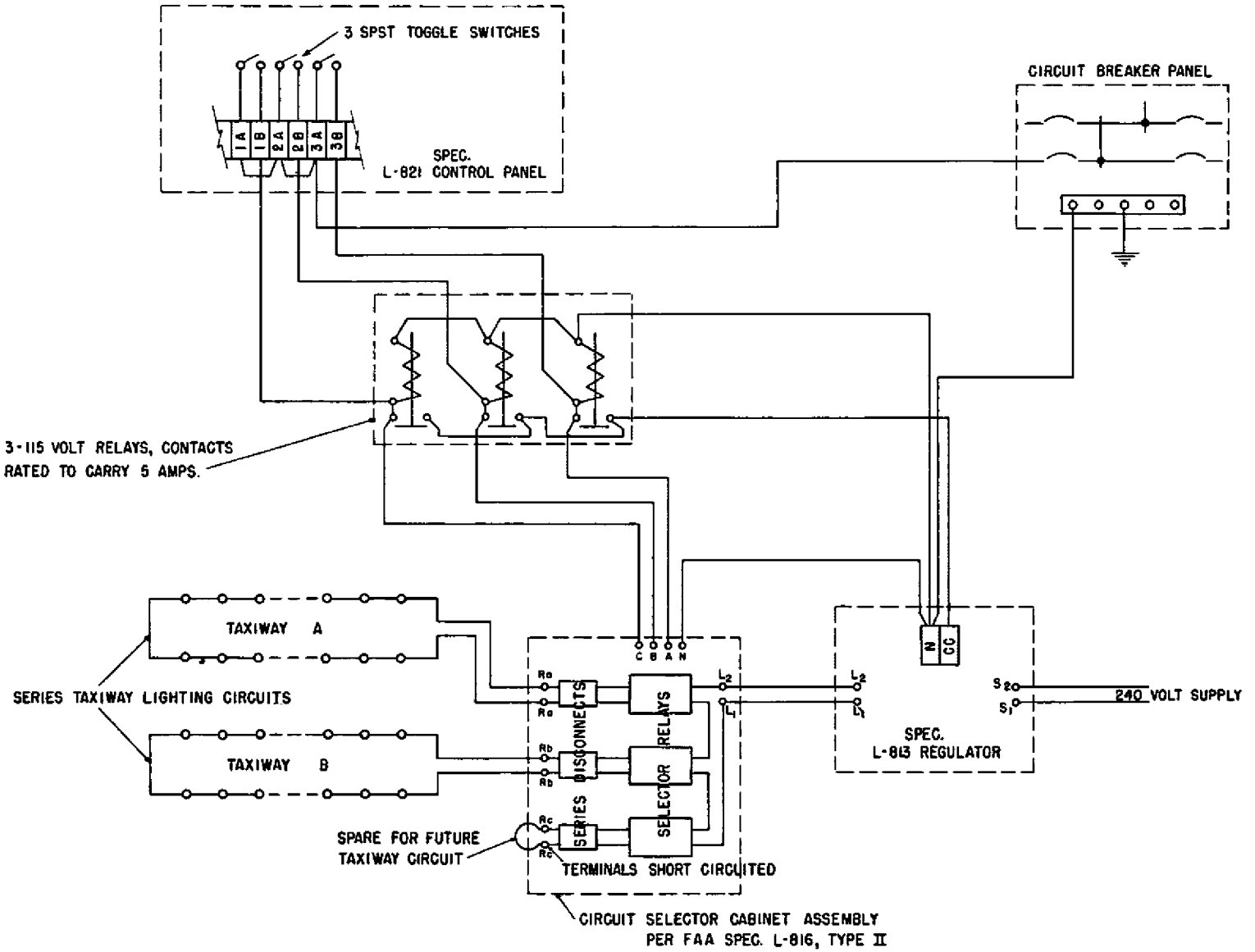


FIGURE 13. APPLICATION OF L-816 SELECTOR SWITCH
FOR TAXIWAY LIGHTING 120 VOLT CONTROL FOR AN L-813 REGULATOR

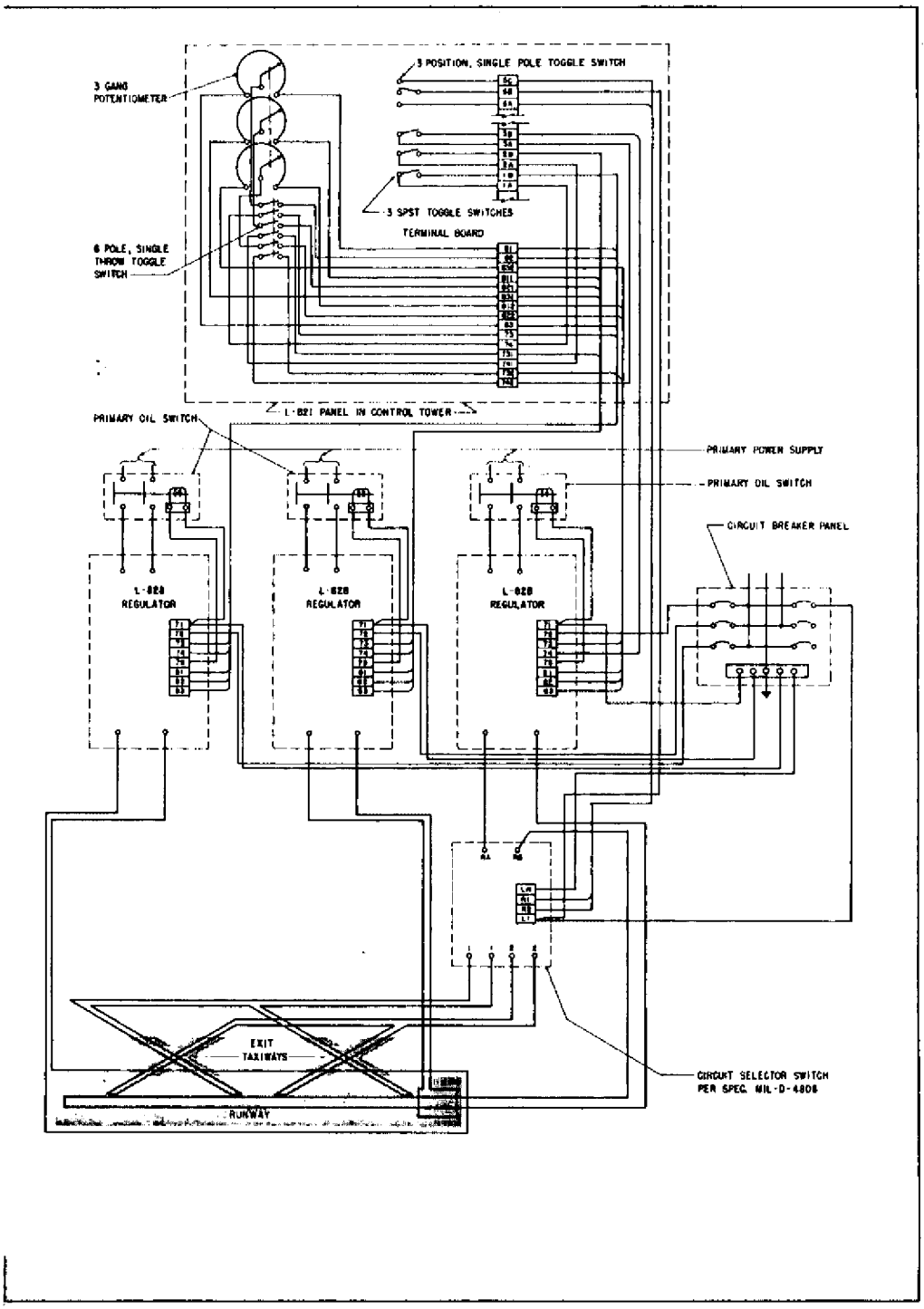


FIGURE 14. WIRING DIAGRAM FOR SIMULTANEOUS CONTROL OF TOUCHDOWN ZONE, RUNWAY CENTERLINE, AND TAXIWAY TURNOFF LIGHTING FOR 120 VOLT CONTROL FOR AN L-828 REGULATOR

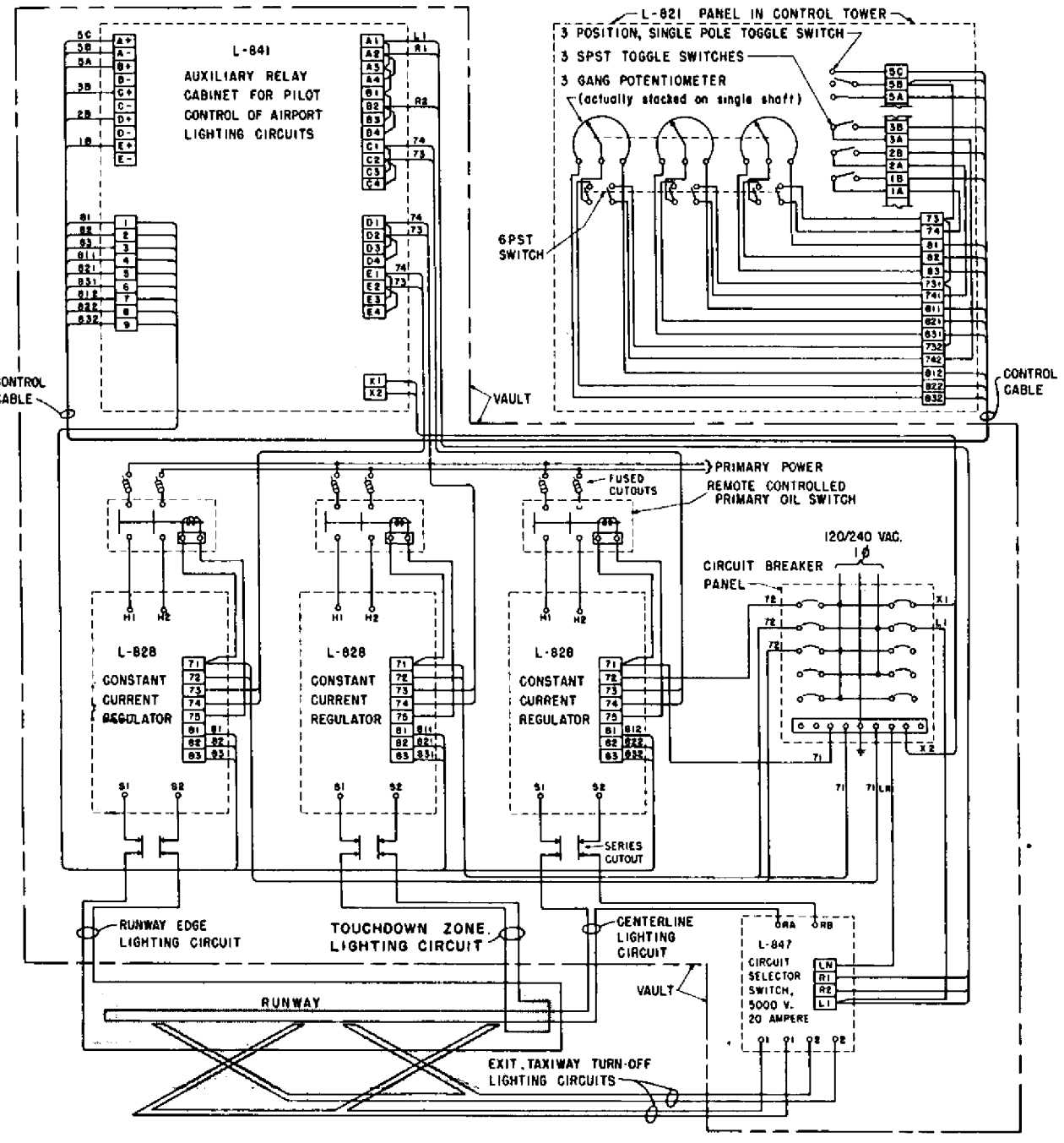


FIGURE 15. WIRING DIAGRAM FOR SIMULTANEOUS CONTROL OF TOUCHDOWN ZONE, RUNWAY CENTERLINE, AND TAXIWAY TURNOFF LIGHTING FOR 48 VOLT DC CONTROL FOR AN L-828 REGULATOR