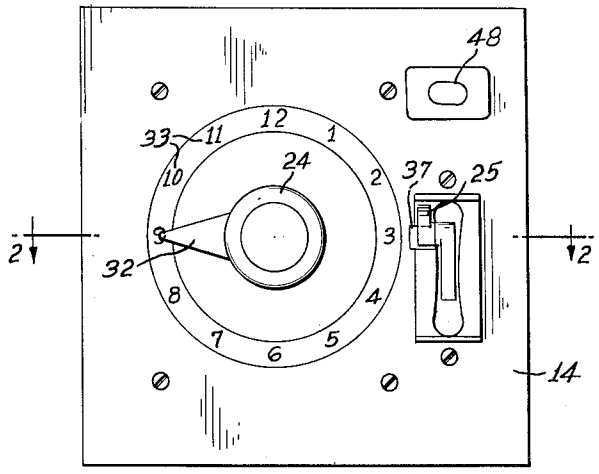
April 22, 1952 H. A. KLIEGL ET AL 2,594,181

SELECTOR SWITCH

Filed July 29, 1950 2 SHEETS—SHEET 1

FIG. 1



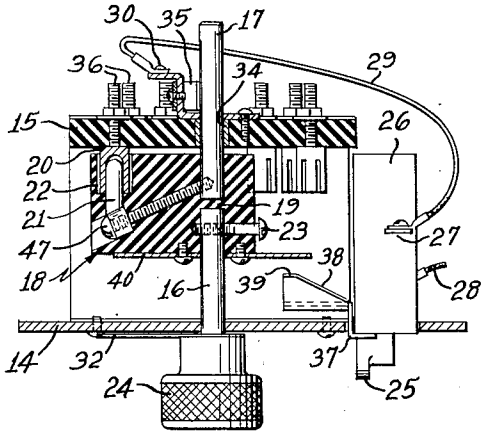


FIG. 2

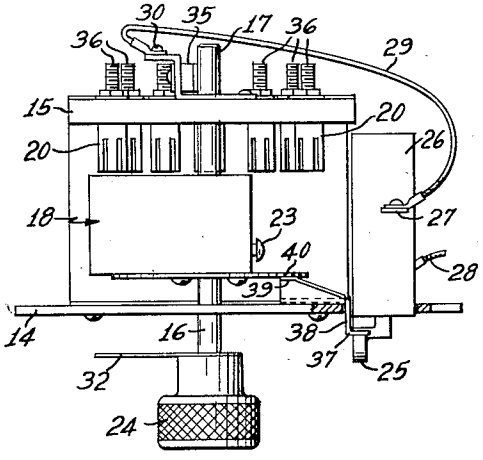


FIG. 3

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FIG. 4

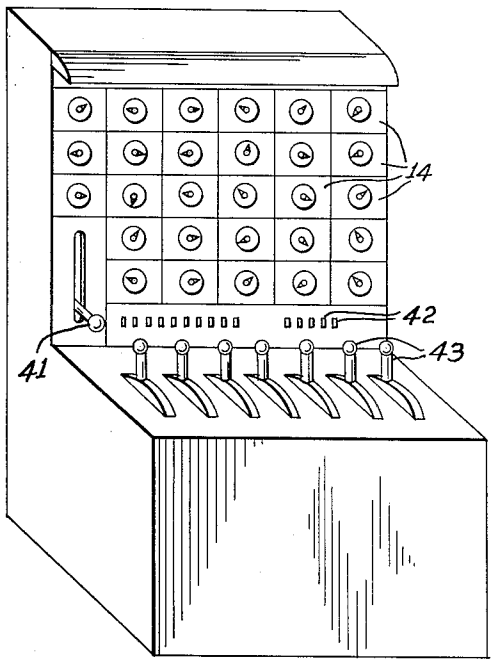

FIG. 5

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Patented Apr. 22, 1952

2,594,181

UNITED STATES PATENT OFFICE

2,594,181

SELECTOR SWITCH

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Application July 29, 1950, Serial No. 176,652

14 Claims. (Cl. 171—97)

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This invention relates to electric control systems, and more particularly to selector switches for controlling multiple electric circuits in such systems. The invention is advantageously adapted to the control of lighting circuits in theatres, television studios, auditoriums, and other places where complex lighting or comparable circuits are employed.

Especially in lighting systems it is often desired to provide several light circuits grouped through the same feeder source and control means so that they may be controlled as a unit. It is also desirable to be able to select any one of a number of control means and connect a particular light circuit to it.

The application of ordinary multi-contact switches in this specialized field has evidenced numerous disadvantages. Among these disadvantages are the arcing when the switch is opened or moved from one contact to another; resulting in poor connections and short life from burning, disturbance of intermediate circuits while moving the switch through intermediate contact points, overloading a feeder circuit temporarily and blowing its fuse or circuit breaker when additional load is connected to the corresponding contact point momentarily in selecting a new switch position, inability to preset light circuits without an identical duplicate set of switches, and the vast multiplicity of switches of ordinary type required to yield the desired flexibility of control.

The present invention overcomes these disadvantages by a novel selective switching device and control system which eliminates arcing and burning of the contacts, permits light or other load circuits to be preset while the switch contacts are automatically de-energized, and affords superior flexibility, speed and facility of control. For example, the invention permits any selection of light circuits to form a group comprising a load suitable for a feeder circuit which includes a dimmer of certain wattage. Thus, the number of feeder circuits required to operate a given number of light circuits properly may be considerably reduced, with resultant economy and simplicity in installation and operation. These, as well as other advantages, will be evident from the following description of a preferred embodiment of the invention, as illustrated by the accompanying drawings, in which:

Fig. 1 is a front or elevational view of a selector switch in accordance with the invention;

Fig. 2 is a cross-sectional view taken along the line 2—2 of Fig. 1;

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Fig. 3 is a top or plan view of the switch of Fig. 1;

Fig. 4 illustrates a control board of a type useful in theatres, and the like, which includes several selector switches and other controls in accordance with the invention;

Fig. 5 is a circuit diagram illustrating the electrical connection of a single selector switch in a lighting circuit control system such as would include a control board as shown in Fig. 4.

Briefly, the switching device of the invention includes two switches connected in series, the first of these being of the selective type and the second being of the circuit breaker type, the first being so constructed that it can be closed only at contact positions, and when it is closed at a given position its contacts are positively locked in contact at that position, both switches being so constructed and interrelated that the first cannot move from one contact position to another without first automatically opening the second switch. The selector switch is adapted to connect to a load circuit such as a light circuit, for example, any one of a number of feeder circuits which may in themselves include any desired equipment such as dimmers, or other circuit-modifying apparatus. For this purpose, the selector switch is arranged to make contact selectively with any one of a plurality of contacts, each connected to a feeder circuit. The second switch may be manually opened and closed, but only when the contacts of the first are positively locked together. The invention will be better understood from the following detailed description.

Referring to Figs. 1, 2 and 3, the selector switch in accordance with the invention comprises a face plate or front panel 14, preferably of metal, and a rear panel 15, preferably of insulating material. Through these panels, which are rigidly secured together and spaced apart, passes a metal shaft preferably of two sections 16, 17, separated by an insulating portion. This separation is effected by drilling two holes on the same axis from opposite sides of a block 18 of insulating material, leaving an insulating portion 19 to separate the shaft sections, thus making the front section of the shaft electrically "dead." Both shaft sections, in effect forming a single shaft, are journalled in the panels so as to be rotatable, and movable axially therein at all positions of rotation.

Secured to the insulating rear panel 15 are a plurality of fixed contacts 20 arranged in a circle. These are connectible to the various branch or

feeder circuits through suitable terminal studs 36 on the rear face of panel 15. If adjacent contacts are spaced from each other by a distance less than the width of block 18, the movable contact element which cooperates with the contacts can be turned from any one to another in either direction, no stop being required. The contacts, are, as illustrated, formed as expansible collars into which a cylindrical contact pin 21 frictionally engages by axial movement.

Contact pin 21 is secured in insulating block 18, as illustrated, a portion of the block being drilled to form a recess 22 around the periphery of the pin to accommodate fixed contact 20 when block 18 is moved toward rear panel 15. The tip of the pin is positioned below the surface of the insulating block. Pin 21 is secured in block 18 and in turn is connected to the rear section 17 of the shaft by screw 47. The block, in turn, is secured to the front section 16 of the shaft by another screw 23. Both screws are threaded into the shaft. On the extended end of shaft section 16 a suitable manipulating knob 24 is secured in front of panel 14.

By means of knob 24 the shaft may be rotated or moved axially, as desired. To rotate the shaft for purposes of selecting a desired fixed contact and its feeder circuit, knob 24 is pulled out from panel 14 to disengage pin 21 from the fixed contact. It may then be rotated until index 32 (Fig. 1) is adjacent a desired one of the indicia 33 indicating that the indicated contacts are in alignment. Those contacts are then engaged by pushing knob 24 inwardly toward panel 14, moving the shaft axially and similarly moving contact pin 21 into engagement with the newly selected contact to which the desired feeder circuit is connected. This operation is interlinked with the operation of the second switching means in a manner later to be described.

Forms of locking means other than that illustrated may be employed. For example, a positioning pin secured to arm or block 18 and holes radially disposed in rear panel 15 concentric with the contacts 20 will cooperate to lock the arm 18 when such a pin is inserted in one of the holes by the axial movement of the shaft to complete the electrical connection to one of the contacts. Such a positioning pin when of proper length would also serve the purpose of preventing wiping connection between contact pin 21 and any of the fixed contacts while the switch is being rotated for selected alignment. When this type of positioning pin is employed, the contacts need not be of the type shown, but may be of any acceptable design, preferably spring pressed, to secure positive electrical contact.

In order to assure adequate electrical contact at all angular and axial positions of shaft 17, two connection means to the shaft are provided. First, shaft 17 is journalled in insulating panel 15 by means of a metallic bearing 34. Secondly, a metallic spring wiper contact 35 wipes at all times against shaft 17 assuring a clean contact. The resulting pressure of spring 35 against shaft 17 urges shaft 17 against one side of bearing 34 tending to maintain better electrical contact between bearing 34 and shaft 17. The combined current-carrying capacity of the shaft 17 with wiper contact 35 and with bearing 34 is ample to assure reliable and cool operation. Terminal 30 is electrically connected to both wiper contact 35 and bearing 34.

The second switching means above mentioned may here be assumed to comprise a switch 26 of the circuit breaker type which is manually operable from the front of the panel, as by knob 25, to open and close the circuit in which it is connected. The particular type of switch here termed "circuit breaker" is immaterial provided it be of sufficient current-carrying capacity. The circuit breaker as illustrated is of the spring-biased toggle type, being "closed" or "on" in the upper position of the knob 25 (Figs. 1 and 2), and "open" or "off" in the lower position (Fig. 3). This circuit breaker preferably includes the usual overload release device which will automatically open the breaker when the load current exceeds a predetermined value. Two terminals 27, 28 of circuit breaker 26 permit its external connection. Terminal 27 is connected through jumper 29 to wiper terminal 30, and terminal 28 permits connection to a load circuit such as light circuit 31 (Fig. 5).

So called toggle switches, mercury pool switches, or other suitable switches may be substituted for circuit breaker 26. If a mercury switch of the toggle type be substituted, substantially no other modification would be required. Other types of mercury switches could also be employed by obvious modification of the linkage mechanism by which axial movement of the shaft 16—17 tends to rock the mercury pool of the switch.

A pilot light 48, shown in Fig. 1, may be connected from the power line to output terminal 28 of the circuit breaker so that the pilot is illuminated only when the circuit is completely closed and current is flowing to the bank of lights or other load to be controlled. This pilot thus not only indicates whether that particular circuit is "on" or "off," but it also indicates to some extent the adjusted condition of the circuit, viz., the change of adjustment of a dimmer will affect the brilliancy of the pilot light.

An important feature of the invention resides in the interlocking action between the two switching devices. As previously mentioned, the invention includes means automatically actuated by movement of the selector switch to maintain the circuit through that switch open while the movable contact is not in complete engagement with a fixed contact. To this end a stop 37 is provided on the front of panel 14 to prevent the closing of the circuit breaker, if it is initially in the "open" position, or to release or trip the circuit breaker, if it is initially in the "closed" position. To move stop 37, a link arm 38 having a follower piece 39 is provided. As can be seen from Figs. 2 and 3, a straight portion of link arm 38 passes through a hole in panel 14 permitting stop 37 to be either in the position illustrated in Fig. 2 where it is in contact with the face of panel 14, or to be extended therefrom, as illustrated in Fig. 3. When stop 37 is in the extended position of Fig. 3, the circuit breaker cannot be closed. If stop 37 is in the position of Fig. 2 and the circuit breaker is closed, the circuit breaker will be tripped and opened if link arm 38 is moved so that the stop 37 assumes the position of Fig. 3.

To control the movement of link arm 38, and hence the position of stop 37, a link disc 40 is secured to the front surface of insulating plate 18 so as to move with it. Since disc 40 is flat and normal to the axis of shaft 16, its position with respect to follower 39 is unchanged by rotation of shaft 16. However, the relative positions of disc 40 and follower 39 do change in accordance with axial movement of shaft 16. The relative positioning and dimensions of these

components are such that when knob 24 assumes the "in" position, at which time the movable contact and a fixed contact are completely engaged, stop 37 will assume the position shown in Fig. 2, permitting closure of the circuit breaker. When knob 24 is pulled out, withdrawing the movable contact from a stationary contact, as shown in Fig. 3, disc 40 contacts follower 39, urging stop 37 outwardly and tripping the circuit breaker, as illustrated. Thus it is impossible to rotate shaft 16 unless the circuit breaker 26 is open, and conversely it is impossible to close the circuit breaker unless knob 24 is "in," at which position the movable contact pin is engaged with a fixed contact. Because of the fact that insulating block 18 is wider than the space between any two adjacent contacts it is impossible to push knob 24 inwardly unless the movable contact pin is in alignment with one of the fixed contacts. When this alignment occurs, index 32 (Fig. 1) will coincide with a corresponding one of the indicia 33.

From the foregoing it will be understood that knob 24 is not rotatable except when pulled out, as shown in Fig. 3. When it is in this position the selector switch is not energized, so that while selection of the desired feeder circuit is being made by rotating the movable switch arm, no other circuit or feeder is contacted or affected in any way. When the knob has been rotated to the desired position it is pushed in to complete the connection between contact pin 21 and a fixed contact beneath it. However, the circuit is not then energized because the circuit breaker is still open, being manually closable only. The circuit breaker may then be closed to complete the circuit, providing contact pin 21 has been fully inserted in the fixed contact collar. In this manner the desired feeder can be selected and the switch preset, to be later energized by closing the circuit breaker. If one or more positions of the selector switch are not to be used, the hole within the collar may be temporarily filled with a plug so that the switching knob 24 cannot be pushed in at that position, or suitable stops may be employed to prevent the switch from being rotated into such unused positions. It is preferable, however, to have the selector switch arranged so that it may be turned continuously clockwise or counterclockwise to facilitate rapid selection of the desired positions.

A typical switchboard or control panel which incorporates 28 selector switches in accordance with the invention, is illustrated in Fig. 4, showing the manner in which these switching devices may be employed in theatres, for example. This panel includes a main switch 41, a row of feeder line switches 42 and a number of dimmers or other circuit-modifying devices 43. Each of the selector switches would be connected to a group or bank of lights, and as below explained, current must pass from the power line through the feeder circuit which is selected by a selector switch in order to pass through the appropriate bank of lights.

The schematic diagram of Fig. 5 illustrates the control system in accordance with the invention and shows one manner in which the selector switch may be connected in such a system. For example, in a control panel such as shown in Fig. 4, each selector switch mounted on panel 14 may be connected as shown in Fig. 5. In such panel there would actually be 28 connections from each feeder line, one from each feeder to its respectively numbered contact on each of the other selector switches. To be consistent with Figs. 1, 2 and 3, there would be 12 feeder lines (instead of 8 as shown in Fig. 5) connected to each selector switch. The omissions in the drawing are for the purpose of clarifying it. The actual number of feeder circuits and selector switches will, of course, vary with the relative complexity of the lighting system, as well as in accordance with the nature of the different lighting effects desired.

In Fig. 5 one side of a single-phase power system is shown, the other side being grounded. With a three-phase source of supply the system can be wired in different ways depending upon whether the lighting system operates at 220 volts or at 115 volts. For example, in a 220-volt system two of the three phases would supply the feeders by each of the two being connected to alternate feeders with the third of the three phases connected as ground to all of the feeders, thus imposing a 220-volt potential across each of the feeders (line-to-line). In a 115-volt system each of the three-phase lines would be connected to every third feeder, consecutively, and the other side of the feeder would be connected to ground (line-to-ground).

Power line 44 is connected through main switch 41 to a bus feeding the feeder line switches 42. In feeder lines 1—5, dimmers 43 are shown to be connected for controlling the degree of illumination of the lights. These dimmers are represented as comprising rheostats or potentiometers, but in accordance with modern practice they would usually be of the autotransformer type or of the reactor type. In an actual installation, some feeders would include non-current-modifying equipment as shown in feeders 6 and 7 of Fig. 5. However, any desired circuit- or current-modifying apparatus may, of course, be connected in any desired feeder, and such apparatus is generally represented by box 45 in feeder line 8. Each of the feeder lines is connected to its terminal, respectively numbered, on all of the selector switches mounted on the control panel, and in turn, the movable switch member of each selector switch is connected (through its circuit breaker) to its particular branch of the system. As is customary in the art, the various circuits are fused with fuses of appropriate capacity.

From the output terminal 28 of the circuit breaker the light circuit 31 is energized and, as indicated, this circuit includes lines 46, or any other desired load.

It can be seen in Fig. 5 that, in the typical system employed in connection with this invention, when the selector switches are in the "in" position with the circuit breakers closed and the feeder switches closed, the entire system can be controlled through the main switch 41. With the main switch and selector switches closed, each feeder and its connected selector switches can be controlled as a group, viz., either "on and off" control through the feeder switch or variable control through the dimmer, or other apparatus connected in the feeder. When the feeder switch and the main switch are closed the selector switch can be preset at any desired position and will draw current from the selected feeder by closure of the circuit breaker of that selector switch to complete the circuit.

It is to be understood that the embodiment of the invention herein described and illustrated comprises but one example of the many applications of the present invention and that the

scope of the invention is to be limited only as defined in the appended claims.

We claim:

1. A selector switch including a face plate, selective switching means supported on said face plate and being movable in two directions in each of two degrees of freedom with respect to said face plate, a plurality of current-carrying contacts supported in fixed relation to said face plate, said switching means being movable in either direction of the first degree of freedom for selective alignment with any one of said contacts, and being movable in one direction of the second degree of freedom to effect mechanical engagement with a selected contact thereby preventing further movement in the first degree of freedom, and to effect electrical engagement with said selected contact thereby completing electrical continuity from the selected contact through said switching means, said switching means being also movable in the opposite direction of said second degree of freedom to effect mechanical and electrical disengagement thereof from said selected contact, a terminal, a circuit breaker of the spring-actuated snap-opening type adapted to break heavy current, and being connected in series between said selective switching means and said terminal, said circuit breaker being operable independently of said switching means to assume a fixed open circuit position, and means actuated in response to initial movement of said switching means in said opposite direction of said second degree of freedom to free said spring to open said circuit breaker so as to disconnect said switching means from said terminal.

2. A selector switch in accordance with claim 1, which includes a movable element on said circuit breaker, and linkage means linking said switching means to said movable element and disposed so as to release said spring and open said circuit breaker to disconnect said switching means from said terminal prior to the disengagement of the switching means from said selected contact.

3. A selector switch in accordance with claim 1, which includes stop means associated with said circuit breaker, said stop means being mechanically linked to said selective switching means and being actuated by movement of said selective switching means in said second direction of said second degree of freedom, said circuit breaker having a movable element, and said stop means coacting with said movable element to prevent closure of the circuit breaker when the selective switching means are disengaged.

4. A selector switch including a face plate, selective switching means supported on said face plate and being movable in two directions in each of two degrees of freedom with respect to said face plate, manual means for moving said switching means, a plurality of contacts supported in fixed relation to said face plate, said switching means being movable by said manual means in either direction of the first degree of freedom for selective alignment with any one of said contacts, and being movable in one direction of the second degree of freedom to effect electrical connection with the selected contact thereby completing electrical contact through said switching means, locking means so disposed as to coact with said switching means in said movement of second degree of freedom to lock said switching means and prevent movement in said first degree of freedom, said switching means being also movable in the opposite direction of said second degree of freedom to effect electrical disconnection thereof from said selected contact and to unlock said locking means and thereby allow selective alignment by movement in the first degree of freedom, a terminal, a circuit breaker connected in series between said selective switching means and said terminal, means for operating said circuit breaker independently of said manual means, means independent of said manual means automatically actuated in response to movement of said switching means in said opposite direction of said second degree of freedom to open said circuit breaker so as to disconnect said switching means from said terminal, and means actuating said locking means when said circuit breaker is closed.

5. In a selector switch, a movable switching member, a plurality of spaced electrical contacts cooperating therewith a terminal for external connection to said switching member, a circuit breaker connected in series between said switching member and said terminal, said circuit breaker having a movable member adapted to assume open and closed positions, locking means for locking said movable member against moving to closed position, and linkage means connecting said switching member to said locking means, said locking means being operable in response to operation of said linkage means, said linkage means and said locking means being disposed and arranged to lock said circuit breaker against closure except when said switching means is electrically connected to one of said contacts.

6. In a selector switch, a movable switching member, a plurality of fixed spaced electrical contacts cooperating therewith, a terminal for external connection to said switching member, a circuit breaker connected in series between said switching member and said terminal, said circuit breaker including a movable element operable to open and close said circuit breaker, said element being operable to open said circuit breaker independently of the switching member, and linkage means interconnecting said switching member and said circuit breaker, said linkage means being operable in response to movement of said switching member in a direction to effect disconnection of said switching member from a contact and being disposed so as to actuate said movable element and open said circuit breaker coincident with said movement of said switching member prior to disconnection thereof from a contact.

7. In a selector switch, a movable switching member; a plurality of fixed spaced electrical contacts cooperating therewith; a terminal for external connection to said switching means; a circuit breaker connected in series between said switching member and said terminal; said circuit breaker including a movable element operable to open and close said circuit breaker; first locking means for locking said switching member in contact position; second locking means for locking said movable element in open circuit position; and linkage means coacting with both said locking means; said element, said member, said locking means and said linkage means being operatively associated to comprise interlocking means operative to lock said switching member in contact position except when said element is in open circuit position and to lock said element in open circuit position except when said switching member is in contact position.

8. In a selector switch, a movable switching

member and a shaft for moving the same, a plurality of fixed spaced electrical contacts electrically cooperating therewith, said member being adapted to assume contact and out-of-contact positions, a terminal for external connection to said switching member, a circuit breaker electrically connected in series between said switching member and said terminal, said circuit breaker including a movable element operable to open and close said circuit breaker, means independent of said circuit breaker for moving said shaft, linkage means actuated by movement of said switching member, and stop means actuated by said linkage means, said stop means being disposed so as to coact with said movable element to lock said circuit breaker open when said switching member assumes an out-of-contact position.

9. In a selector switch, a movable switching member, a plurality of spaced fixed electrical contacts cooperating therewith, each said contact comprising an area permitting limited movement of said member while maintaining connection therewith, a terminal for external connection to said switch, a circuit breaker connected in series between said switching member and said terminal and having a movable element, linkage means connecting said switching member to said movable element and disposed so that the movement of said switching member which disconnects said switching member from one of said contacts actuates the movable element of the circuit breaker, disconnecting said terminal from said switching member during said limited movement and prior to disconnection of said switching member from said contact.

10. A selector switch including, two switching means, the first of said switching means having selective contacting means and a plurality of fixed contacts cooperating therewith, said contacts being spaced apart in the same plane, said contacting means being movable parallel to said plane for selective electrical connection with said contacts, said contacting means being also movable toward and away from said plane, a terminal for external connection to said contacting means, second switching means connected in series between said selective contacting means and said terminal such that the opening of said second switching means disconnects said contacting means from said terminal, a movable element on said second switching means operable to open the same, mechanical linkage means connecting said selective contacting means to said movable element and operable in response to movement of said selective contacting means away from said plane to move said movable element of said second switching means and thereby open said second switching means.

11. A selector switch including, a shaft, selective switching means mounted thereon, a support in which said shaft is journalled for axial and rotary movement with respect thereto, a plurality of contacts supported in fixed relation to said switching means for electrical cooperation therewith, said switching means being rotatable for selective alignment with any one of said contacts only when disconnected therefrom, and being movable axially to effect electrical connection of the switching means to a selected contact, a terminal, a circuit breaker connected in series between said terminal and said switching means, said circuit breaker having a movable element by which said circuit breaker

is opened and closed and which is movable independently of said shaft, linkage means mechanically linking said switching means to said movable element and disposed so as to actuate said movable element and open the circuit breaker in response to and coincident with axial movement of said shaft and said switching means in a direction to effect disconnection from said contact, and stop means on said circuit breaker actuated by said linkage means, said stop means coacting with said movable element to prevent closure of said circuit breaker while said selective switching means is disconnected from said contact.

12. A selector switch including a shaft, selective switching means movable therewith, a support in which said shaft is journalled for axial and rotary movement with respect thereto, said shaft comprising two sections, an insulating block interposed between said two sections so as to mechanically link and electrically insulate said sections, means connecting said switching means to one of said sections, a plurality of fixed contacts arranged in a closed circle on a single plane to provide uninterrupted rotation of said switching means in both clockwise and counterclockwise directions for selective alignment thereof with any one of said contacts, said shaft being movable axially in said support to effect electrical connection of said switching means to a selected contact, a spring contact in connection with said section of said shaft disposed so as to wipe said section of the shaft in both its axial and rotary movement, a terminal, a circuit breaker having a movable member and being connected through said spring contact in series between said terminal and said switching means, linkage means mechanically linking said switching means to said circuit breaker and disposed so as to actuate said movable member and open said circuit breaker in response to and coincident with axial movement of said switching means in a direction away from said plane to effect disconnection from said contact, and stop means on said circuit breaker actuated by said linkage means, said stop means coacting with said movable member to prevent closure of said circuit breaker while said selective switching means is disconnected from said contact.

13. An electrical control system including a load to be controlled, a source of electric power, a plurality of feeder circuits having various electrical characteristics, means connected in said feeder circuits for controlling said characteristics, said feeder circuits being connected in common to said power source, selective switching means for connecting said load to said power source through any one of said feeder circuits, said switching means comprising, a plurality of contacts each of which is connected to one feeder circuit, selective contacting means disposed for rotary movement to permit selection of any one of a plurality of contacts, and disposed for axial movement in one direction to connect the selected contact with said contacting means, locking means including extensions of said contacting means and said contacts coacting in said axial movement so as to lock said contacting means against rotary movement while said selective contacting means is electrically connected to a selected contact, a terminal connectible to said load, a circuit breaker connected in series between said terminal and said selective contacting means, and linkage means mechanically connecting said

selective contacting means to said circuit breaker positioned and arranged so as to open said circuit breaker and thereby de-energize said contacting means in response to axial movement of said contacting means in a direction opposite to said first-named direction, whereby said contacting means and contacts are de-energized when said contacting means are axially positioned for rotary selective movement.

14. An electrical control system including an electric power source, control devices of various electrical characteristics connected on one side in common to said source, a plurality of selector switches, a plurality of fixed contacts on each of said selector switches, the other side of each of said devices being connected to a different one of the contacts on each switch, the corresponding one of said contacts of each switch being connected to and identified with the same one of the said control devices, a movable contactor on each switch disposed for selective connection to any one of the fixed contacts thereon, a circuit breaker on each switch connected on one side to the movable contactor of that switch, and a separate electrical load connected to the other side of each circuit breaker, whereby any load can be connected to any control device, and any group of loads can be connected to any control device.

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