

July 5, 1927.

H. W. BROWN

1,634,973

CONTROLLING DEVICE AND SYSTEM EMPLOYING THE SAME

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Fig. 1.

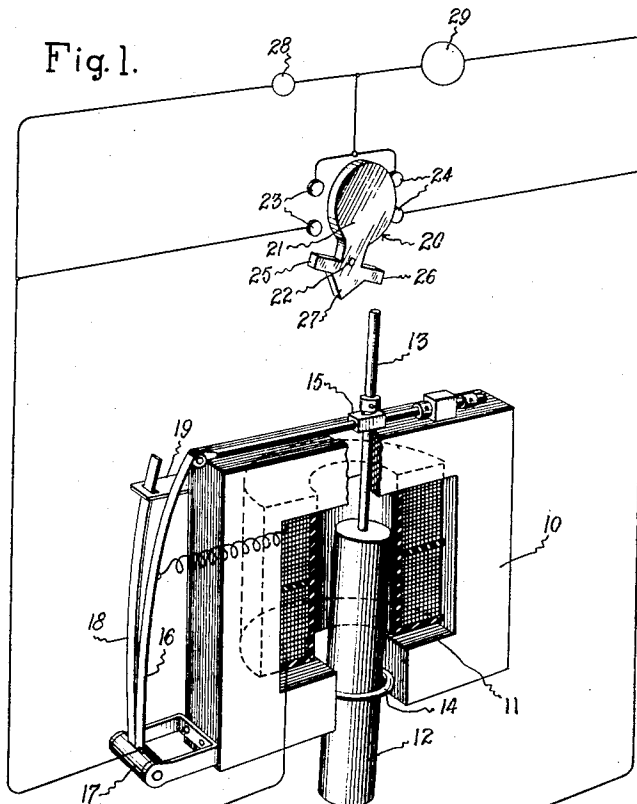
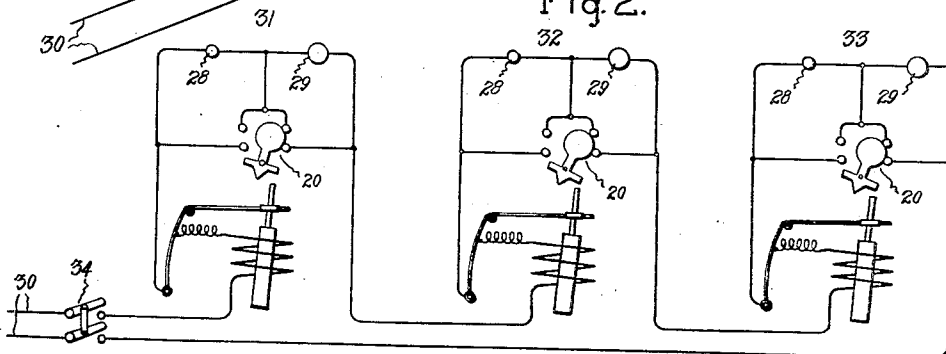


Fig. 2.



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UNITED STATES PATENT OFFICE.

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CONTROLLING DEVICE AND SYSTEM EMPLOYING THE SAME.

Application filed December 17, 1924. Serial No. 756,608.

This invention relates to controlling devices, particularly circuit controlling devices and the like which are operable to a plurality of controlling positions, and also to selective control systems employing the same.

One of the objects of the invention is to provide a simple and reliable controlling device which is operable to a plurality of positions by the combined or joint action of electro-responsive and thermal responsive means.

Another object of the invention is to provide an improved form of controlling device of the above character which is responsive to both the electro-magnetic and the thermal effects of an electric current and is operated to one position when initially energized and to another position when re-energized after a momentary interruption of the energizing circuit of the device.

Although not necessarily limited thereto my invention may be carried into effect in a circuit controlling device having relatively movable contact members adapted to be operated into a plurality of circuit controlling relations by providing electro-responsive means having a substantial operating force such as an electromagnet together with a thermal responsive element which are arranged to cooperate so as to operate the device upon the energization of the electromagnet into one circuit controlling relation when the thermal element is cool and into another relation when the element is hot. Furthermore, by arranging the thermal element to be heated responsively to the energizing current of the electromagnet, the contact members may be operated into one relation when the electromagnet is initially energized and into another relation after a momentary interruption of the energizing circuit.

While my invention may be applied generally to controlling, operating, and indicating devices, it is of particular utility when employed to control the lamp switching relays in a dual intensity street lighting system. In such lighting systems each of the lighting units is provided ordinarily with two or more electric lamps of relatively high and low candle power respectively, the high candle power lamps being lighted to provide high intensity illumination during the earlier part of the night and the low candle

power lamps then being lighted to supply lower intensity illumination during the latter part of the night as a matter of economy. It has been proposed to effect the change-over from the high to the low intensity lamp by means of lamp switching relays located at the several lighting units which are energized directly from the current supply lines of the lamps and are operated from one circuit controlling position to the other by opening and then re-closing the supply lines at the power station.

One form of a lamp switching relay suitable for such lighting systems is described and claimed in the copending application, Serial Number 690,086, of Henry E. Butler, assigned to the same assignee as my present invention. This type of lamp switching relay is provided with a single operating electromagnet which cooperates with an over center contact mechanism to alternately energize the high and the low candle power lamp upon the successive opening and closing of the supply lines of the lamps. Such a lamp switching relay, while entirely operative for the ordinary conditions encountered leaves something to be desired for protection against certain special conditions. Thus, if the current in the supply line fails or decreases below a certain minimum value, some of the lamp switching relays may operate and others may fail to operate so that at some lighting units the high candle power lamps may be burning and at other units the low candle power lamps may be burning. Should the lamp switching relays thus get out of synchronism, it is necessary for an operator to go from lighting unit to lighting unit and individually reverse those of the lamp switching relays which are out of step.

Hence, a further object of my present invention is to provide an improved combined thermal and electroresponsive selective circuit controller for a plurality of electrical translating devices whereby different portions of the devices may be selectively energized at will by controlling the energization of the circuit controller although a predetermined portion of the devices is always energized when the selective circuit controller is initially energized.

For a better understanding of my invention reference is had to the accompanying drawing in which Fig. 1, shows a preferred form of selective circuit controlling device

embodying my invention for the purpose of explaining the principles thereof and Fig. 2 diagrammatically illustrates my invention applied to selectively control the lamps of a dual intensity lighting system.

The novel features which I believe to be characteristic of my invention are pointed out with particularity in the appended claims.

Referring to Fig. 1, the circuit controlling device comprises an operating electromagnet 10, having an energizing winding 11, and a movable magnetic member or plunger 12 which is connected to the operating or controlling member 13. A fixed guide 14, preferably of non-magnetic material maintains the lower end of plunger 12 centrally located between the poles of the electromagnet 10 and the movable guide 15 is arranged to direct the operating member 13 through different paths when the plunger 12 is reciprocated under the magnetic influence of winding 11. The movable guide member 15 is mechanically connected to one end of the thermal responsive element 16 which as shown is of the bi-metallic type and is electrically connected in circuit with the energizing winding 11 so as to be responsive to the heating effect of the energizing current thereof. The element 16, however, may be arranged to respond to other temperature conditions if desired.

Thermal responsive element 16 may be fixedly mounted upon the frame of the electromagnet 10 or where it is desired to prevent movement of the guide 15 responsively to changes in the ambient temperatures, the fixed end of thermal responsive element 16 is mounted in a pivotal support 17 and a compensating thermal responsive element 18, similar to the element 16 but with the component parts thereof disposed in reverse relations, is connected between the pivotal support 17 and the adjustable stop 19 as shown.

A two position electric switch 20 is arranged with its movable circuit controlling contact 21, which is pivotally supported on the pin 22, in position to be operated into a plurality of cooperating relations with the stationary contacts 23 and 24 by the operating member 13. It will be seen that the lower end of contact 21 is formed with the arms 25 and 26 extending on opposite sides of the pivot 22 and the V shaped extension 27 centrally located thereon. As shown the circuit controlling contact 21 of the switch is operable into engagement with either the stationary contacts 23 or the stationary contacts 24 to close a short circuit around the electric translating devices 28 and 29 respectively which for the purposes of illustration may be assumed to be the low and the high candle power lamps of a dual intensity lighting system, which is supplied with current from the supply lines 30.

It will be observed that the translating devices 28 and 29 are connected in a series circuit which also includes a portion of the thermal responsive element 16 and the operating winding 11 of the electromagnet 10.

As thus constructed and arranged and with the parts in their respective positions shown in the drawing the operation of my improved circuit controlling device in a dual intensity lighting unit is as follows:

When the supply lines 30 are initially energized from a suitable source of power, current flows through a circuit including the operating winding 11, a portion of the thermal responsive element 16, the low candle power lamp 28, the circuit controlling element 21, and the stationary contacts 24. The resulting energization of electromagnet 10 attracts the plunger 12 and the latter moves the operating member 13 into operating engagement with the right hand arm 26 of contact 21 and rotates the same around the pivot 22 to move the circuit controlling contact from the position shown into engagement with stationary contacts 23. This opens the short circuit around the high candle power lamp 29 and establishes a short circuit around the low candle power lamp 28. As the energizing current of the high candle power lamp 29 passes through a portion of the thermal responsive element 16, the latter is gradually heated and is strained, imparting a tendency for the guide 15 to move to the left. This tendency however is restrained by the engagement of the operating member 13 with the V-shaped extension 27.

If now the supply lines 30 are momentarily deenergized, thereby demagnetizing the electromagnet 10, the magnetic member 12 returns to the lower position in which it is shown and the operating member 13 is disengaged from the right hand arm 26 of contact 21. Upon the release of member 13 from the V-shaped extension 27, the guide 15 then is free to be moved to the left by the thermal responsive element 16. This carries the member 13 into a second operating relation with the contact 21 in which the member 13 will engage with the left hand arm 25 when the contact 21 bridges the stationary contacts 23 and will engage with the right hand arm 26 when the contact 21 bridges the stationary contacts 24. Hence upon the reconnection of the supply line 30 to the source of power and the reenergization of the electromagnet 10, the operating member 13 is brought into engagement with the left hand arm 25 and operates the circuit controlling contact 21 out of engagement with the stationary contacts 23 and into engagement with stationary contacts 24, thus opening the short circuit around the low candle power lamp 28 and reclosing the short circuit around the high candle power lamp 29. Obviously this extinguishes the high candle power lamp

and leaves the low candle power lamp burning.

If the supply lines 30 are disconnected from the source of power for an extended interval, the plunger 12 returns to its lower position and the thermal responsive element 16 is no longer heated. As the element 16 cools, it moves the guide 15 to the right and returns the operating member 13 into the first operating relation with contact 21 in which the member 13 always engages with the right hand arm 26 of contact 21 as indicated in the drawing. Thus upon reenergizing the supply lines 30 the high candle power lamp 29 will again be lighted and at the proper time the changeover from the high candle power lamp 29, to the low candle power lamp 28 is effected by simply deenergizing the supply line 30 for a short interval of time in the manner previously described.

During the operation of the low candle power lamp 28 the operating member 13 is maintained in the second operative relation with contact 21 due to the continued heating of thermal element 16 by the energizing current of lamp 28. If, under these conditions lamp 28 is deenergized due to failure of the supply source or from any other cause, the electromagnet 10 is also deenergized and the plunger 12 drops carrying the operating member 13 out of engagement with the left hand arm 25 of contact 21. If the voltage of supply line 30 is returned to normal value before the temperature of thermal element 16 has appreciably decreased the resulting energization of electromagnet 10 will raise the plunger 12 and carry member 13 into engagement with the arm 26. This operates the pivoted contact 21 out of engagement with contacts 24 and into engagement with the stationary contacts 23, thereby extinguishing the low candle power lamp 28 and again lighting the high candle power lamp 29. However, if desired, the contact 21 may be returned into bridging engagement with the stationary contact 24 by simply opening the energizing circuit of supply line 30 for a short interval. Upon the resulting deenergization of electromagnet 10 the plunger 12 falls and carries the operating member 13 out of engagement with the right hand arm 26. Since the movable contact 21 now bridges the stationary contacts 23 upon the reenergization of electromagnet 10, the operating member 13 is carried into engagement with the left hand arm 25 to operate the movable contact 21 into bridging engagement with the stationary contacts 24, thereby extinguishing the high candle power lamps 29 and again lighting the low candle power lamp 28.

From the foregoing it will be evident that if during the operation of the high candle power lamp 29 the supply lines 30 should

be deenergized due to failure of voltage or other cause which continues for a time interval sufficient to permit the cooling of thermal element 16 to substantially ambient temperature, the movable contact 21 will not be operated upon the reenergization of supply line 30. This is due to the fact that the operating member 13 is moved by the thermal element 16 upon the cooling of the latter into the operating relation with contact 21 in which the member 13 always engages with right hand arm 26. Since the movable contact 21 is already in bridging engagement with the stationary contacts 23 no further operation of the contact 21 is effected upon the reengagement of member 13 with the right hand arm 26. Thus it will be observed that when the thermal element 16 is at substantially ambient temperature the movable contact 21 is always in engagement with the stationary contacts 23 after energization of the electromagnet 10. However, when the thermal responsive element 16 is at a higher temperature such that the operating member is carried into the second operating relation with the movable contact 21, the latter may be operated from either circuit controlling position to the other by a momentary deenergization of electromagnet 10.

Referring to Fig. 2, which diagrammatically illustrates a dual intensity lighting system composed of a plurality of lighting units 31, 32, 33, it will be seen that each unit comprises a low candle power lamp 28, a high candle power lamp 29 and a circuit controlling device 20 like that shown in Fig. 1. The lighting units 31, 32, and 33, together with any additional number of units desired may be connected in a series lighting circuit according to the usual practice and the controlling switch 34 is located at a convenient place such as the power station for controlling the energization of the lighting circuit. It will be evident that with the circuit controlling device constructed according to my invention, the high candle power lamp 29 of each lighting unit will be lighted upon the initial energization of the lighting circuit at the beginning of each night. Thereafter the changeover from the high candle power lamps 29 to the low candle power lamps 28 may be effected at the proper time simply by opening and then reclosing the switch 34, thus momentarily interrupting the flow of current in the lighting circuit. If, however, due to an accidental lowering of the voltage of the series circuit through a ground or other fault, one or more of the lamp switching relays is thrown out of synchronism with the others, it will be evident that this condition will be automatically corrected during the deenergization of the lighting system on the following day since the circuit controlling devices 20 will all return to similar positions as indi-

cated in the drawing. Thus by means of my invention, the lamp controlling switches 20 are automatically brought into synchronism to initially light the high candle power lamps of each lighting unit when the lighting circuit is closed at the beginning of each night.

In accordance with the provisions of the patent statutes, I have described the principles of operation of my invention together with the apparatus which I now consider to represent the best embodiment thereof, but I would have it understood that the apparatus shown is only illustrative and that the invention may be carried out by other means.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. The combination with relatively movable members adapted to be moved into a plurality of co-operating relations, of an electromagnet having a movable magnetic member mechanically arranged for imparting relative movements to said members to bring the same into each of said relations, and a thermal responsive element for controlling the relative movements of said members to bring the same into one of said relations upon the energization of said electromagnet when said thermal element is at one temperature and into another of said relations upon the energization of said electromagnet when said element is at a higher temperature.

2. The combination with relatively movable members adapted to be moved into a plurality of co-operating relations, of an electromagnet for imparting relative movements to said members to bring the same into each of said relations, and a thermal-responsive element arranged to be heated responsively to the energizing current of said electromagnet for controlling the relative movements of said members to bring the same into one of said relations upon the initial energization of said electromagnet and into another of said relations upon the re-energization of said electromagnet after a momentary de-energization thereof.

3. The combination with relatively movable members adapted to be moved into a plurality of cooperating relations, of an electromagnet having a movable magnetic member mechanically arranged for imparting relative movement to said members to bring the same into each of said relations and a thermal responsive element mechanically cooperating with said movable magnetic member for controlling the relative movement of said member to bring the same into a predetermined one of said relations upon the energization of said electromagnet when said thermal element is at one temperature and to alternately bring said members into another of said relations and into

said one of said relations upon the successive energization of said electro-magnet when said element is at a higher temperature.

4. The combination of a member adapted to be moved through a plurality of paths, electromagnetic means for moving said member through said paths, and thermal-responsive means for mechanically directing the movement of said member into each of said paths responsively to different temperature conditions.

5. The combination of a member adapted to be moved through a plurality of paths, an electromagnet having a movable magnetic member connected to said member for moving the same through said paths, and thermal current-responsive means connected in circuit with said electromagnet and mechanically connected to control the movement of said member through said paths responsively to the heating effect of the energizing current of said electromagnet.

6. The combination of a device movable to a plurality of positions, means for operating said device to each of said positions comprising an electromagnet, a movable magnetic member arranged to operate under the magnetic influence of said electromagnet, an operating member connected to said magnetic member and moved thereby into a plurality of operating relations with said device, a movable guide for directing the said operating member into each of said relations, and thermal-current responsive means connected in circuit with said electromagnet for moving the said guide to each of a plurality of positions corresponding to said relations responsively to the heating effect of the energizing current of said electromagnet.

7. The combination of an electric switch having a movable contact operable between two positions, an electromagnet having a movable magnetic member mechanically connected for alternately operating said contact from each of said positions to the other upon successive energizations of said electromagnet, and a thermal responsive element for controlling said mechanical connections of said magnetic member to prevent the operation of said contact from one of said positions responsively to predetermined temperature conditions.

8. The combination of an electric switch having a movable contact operable between two positions, electromagnetic means for alternately operating said contact from each of said positions to the other, and a thermal responsive element arranged to be heated responsively to the energizing current of said means for controlling the same to prevent the operation of said contact from one of said positions until after a predetermined energization of said means.

9. In an electro-responsive switch, the combination with relatively movable con-

tacts having a plurality of circuit controlling positions, of means for moving said contacts to each of said positions comprising an electromagnet having a movable magnetic member and a thermal responsive element mechanically cooperating therewith to move said contacts upon the energization of said electromagnet to one of said circuit controlling positions when said thermal element is cool and to another of said positions when said element is hot.

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10. In an electro-responsive switch, the combination with relatively movable contacts having a plurality of circuit controlling positions, of means for moving said contact into each of said positions comprising an electromagnet and a thermal responsive element mechanically cooperating therewith and arranged to be heated responsively to the energizing current of said electromagnet, said means being arranged to move said contact to one of said circuit controlling positions upon the initial energization of said electromagnet and to another of said positions upon energization of said electromagnet after a momentary deenergization thereof.

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11. The combination of an electric switch having a pivotally supported contact operable between two circuit controlling positions, an operating electromagnet therefor

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having a movable member arranged to engage with said contact on opposite sides of the pivotal support thereof for operating the said contact from each of said positions to the other, and a thermal responsive element mechanically connected to said member and arranged to direct the movement of the same into engagement with one side of said contact when said element is hot and into engagement with the other side of said contact when said element is cool.

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12. The combination of an electric switch having a pivotally supported contact operable between two circuit controlling positions, an operating electromagnet therefore having a movable member arranged to engage with said contact on opposite sides of the pivotal support thereof for alternately operating the said contact from each of said positions to the other, and a thermal responsive element mechanically connected to said member and arranged to be heated responsively to the energizing current of said electromagnet to prevent the engagement of said movable member with the contact on one side of said support until after a predetermined energization of said electromagnet.

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In witness whereof, I have hereunto set my hand this 16th December, 1924.

HAROLD W. BROWN.