

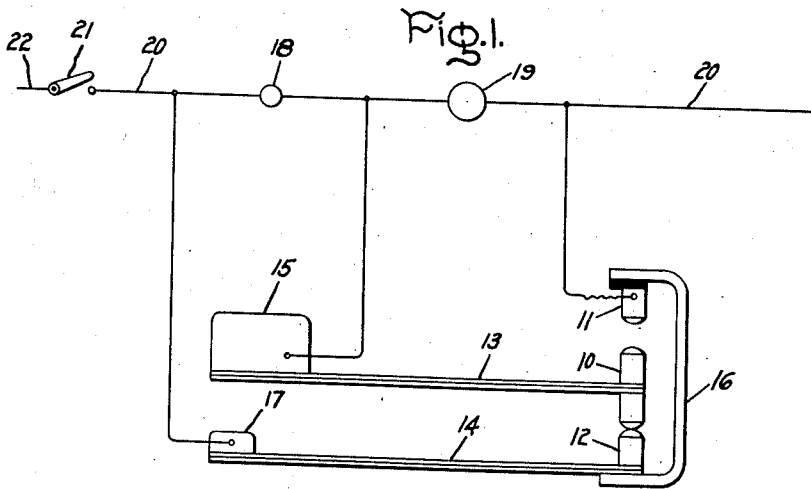
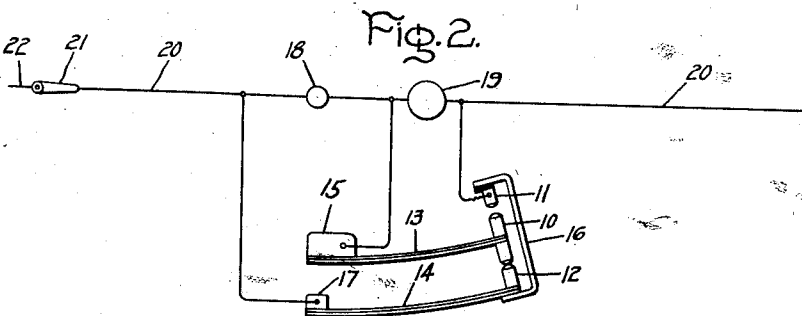
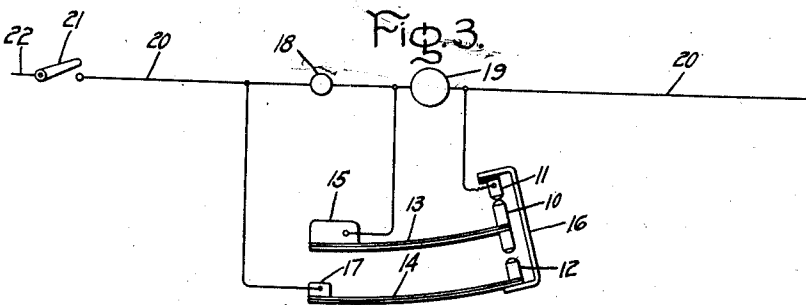
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THERMAL RESPONSIVE CONTROLLING DEVICE

Original Filed Nov. 17, 1924



Inventor;
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UNITED STATES PATENT OFFICE

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THERMAL-RESPONSIVE CONTROLLING DEVICE

Original application filed November 17, 1924, Serial No. 750,264, now Patent No. 1,693,325, dated November 27, 1928. Divided and this application filed March 26, 1926. Serial No. 97,726.

This application is a division of my application Serial No. 750,264, filed November 17, 1924, and issued as Patent 1,693,325, November 27, 1928.

5 The present invention relates to thermal responsive controlling devices, and more particularly to thermal responsive circuit controlling devices having relatively movable thermal responsive operating elements.

10 One of the objects of the invention is to provide a novel form of thermal responsive controlling device of the above character which is operated responsively to the difference in the rates of change of temperature
15 of the operating elements.

Although not limited thereto, the invention is particularly adapted to control the lamps of a dual intensity street lighting system wherein the high intensity lamps are
20 lighted during the earlier part of the night and lower intensity lamps are lighted during the remainder of the night.

In such systems it has been proposed heretofore to effect the changeover from the high
25 intensity to the low intensity lamp by means of lamp switching relays located at each of the lighting units which are arranged to be operated upon a momentary deenergization of the power supply lines for the lamps.
30 The various forms of lamp switching relays with which I am familiar have required the use of electro-magnets for controlling the switch mechanism, thus leaving something to be desired in the way of a less expensive and
35 more simple lamp switching device.

The present invention provides a novel form of thermal responsive circuit controlling switch mechanism which may be inexpensively manufactured and easily installed in a
40 dual intensity lighting system of the above character to effect the changeover from the high intensity lamp to the low intensity lamp in a simple and reliable manner.

In carrying my invention into effect in
45 the form which I now regard as a preferred form, circuit controlling switch mechanism is controlled by means of a pair of thermal responsive movable elements having different heat storage capacities, the elements being
50 arranged to be heated simultaneously respon-

sively to the current in the circuit controlled by the switch mechanism and arranged so as to operate the switch mechanism responsively to the difference in the rate of cooling of the elements upon a momentary interruption of
55 the circuit.

For a better understanding of my invention reference is had to the following description when taken in connection with the accompanying drawings in which Fig. 1 diagrammatically illustrates a preferred form
60 of thermal responsive switch mechanism embodying my invention together with a selective control system employing the same, and Figs. 2 and 3 show the relative positions
65 of the several operating parts of the thermal responsive switch mechanism during different phases of operation thereof.

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

Referring to Fig. 1, the thermal responsive switch mechanism comprises essentially the cooperating circuit controlling contacts 10, 11
75 and 12 and the thermal responsive movable elements 13 and 14. In the preferred form illustrated the thermal responsive elements 13 and 14 are of the bi-metallic current conducting type and in accordance with my invention
80 are designed to have substantially similar thermal characteristics of expansion while having different heat storage capacities. The thermal element 13 is suitably secured at one end to the stationary support 15 and carries
85 the movable circuit controlling contact 10 at the free end thereof. It will be observed that the circuit controlling contacts 11 and 12 are mounted in fixed spaced relation upon opposite ends of yoke 16, the contact 11 being
90 suitably insulated therefrom, and are supported in cooperating relation with the contact 10 by the thermal responsive element 14, one end of which is suitably secured to the stationary support 17 and the other end is
95 secured to the yoke 16.

As will be more fully described in connection with the operation of my invention, the thermal responsive elements 13 and 14 are heated by a common energizing current and
100

cooled by the surrounding air. Since the elements 13 and 14 have substantially similar thermal characteristics, each of the elements will flex substantially the same amount upon a given change of temperature thereof. However, due to the fact that the elements have different heat storage capacities, the rate of change of temperature thereof will vary when they are subjected to a common heating or cooling effect. Thus the element having the lesser heat storage capacity will respond to a given heating and cooling effect more rapidly than the element having the greater heat storage capacity and a resulting relative movement occurs between the contact members which is dependent upon the difference in the rate of change of temperature thereof. It will be evident that the relative heat storage capacities of the thermal responsive elements 13 and 14 may be varied by properly proportioning the relative mass of the supports 15 and 17 with which the respective elements are in heat conducting contact as indicated in the drawing or by properly proportioning the mass of the elements themselves.

In the preferred form of thermal responsive switch mechanism illustrated, the thermal responsive elements 13 and 14 are given an initial bias such that when the elements are at the same temperature, the contact 10 is maintained in firm engagement with the contact 12 and are each arranged to flex in the same direction when heated and cooled. The thermal responsive element 13 has a greater heat storage capacity than element 14 and consequently the former responds more slowly to a heating or cooling effect than the latter.

As shown in Fig. 1, the thermal responsive switch mechanism is connected to selectively control the energization of the electric translating devices 18 and 19 which may be assumed to be respectively the low intensity lamp and the high intensity lamp of a lighting unit employed in a dual intensity street lighting system. In accordance with the usual practice, the lamps 18 and 19 are connected in series in a supply line 20 and the switch 21 is located at the power house or other convenient place in order to control the connection of the supply line 20 to a suitable source of power 22.

In order to separately control the energization of the lamps 18 and 19, the thermal responsive switch mechanism is connected by suitable conductors as shown to establish a short circuit around the lamp 18 when the movable circuit controlling contact 10 is in engagement with the contact 12 and to similarly short circuit the lamp 19 when the contact 10 is in engagement with the contact 11.

As thus constructed and arranged the operation of my improved form of thermal responsive switch mechanism and control system employing the same is as follows.

Upon the operation of switch 21 from the open position to the closed position, the supply line 20 is energized from the source of supply 22 and since the low candle power lamp 18 is short circuited, current flows from the supply line 20 through the thermal responsive element 14, the cooperating contacts 10 and 12, the thermal responsive element 13 and the high intensity lamp 19, thereby lighting the latter to furnish high intensity illumination. As the current flow continues, the thermal responsive elements 13 and 14 are heated and consequently flex in unison in the same direction and carry the cooperating circuit controlling contacts 10, 11 and 12 as a unit into the position shown in Fig. 2. Due to the fact that the heat storage capacity of thermal responsive element 14 is less than that of element 13, the temperature of the former will increase more rapidly and the element 14 will tend to flex at a greater rate and thus force the contact 12 into firmer engagement with the movable cooperating contact 10. After the thermal responsive elements 13 and 14 finally reach a substantially constant temperature, the contacts 10 and 12 are maintained in engagement due to the initial bias of the thermal elements and the high candle power lamp 19 continues to receive energizing current as shown in Fig. 2.

It will be evident that with my improved form of thermal responsive switch mechanism, a temporary failure of the supply source 22 or a temporary decrease in current in the supply line 20 due to accidental ground or other causes occurring during the operation of the lighting system will not produce a separation of the contacts 10 and 12 unless continued for an appreciable length of time. This is due to the fact that the support 17 as well as the mass of thermal element 14 serve as heat storage masses to prevent too rapid cooling of the element 14.

If now it should be desired to deenergize the high candle power lamp 19 and energize the low candle power lamp 18, the change-over is effected simply by opening the switch 21 for a short interval. This interrupts the heating current for both thermal responsive elements 14 and 13 and each thereupon begins to decrease in temperature at a rate dependent upon the heat storage capacity thereof. Since the heat storage capacity of thermal element 14 is relatively low, the temperature of this element will more rapidly decrease and the resulting flexure of the element will carry the circuit controlling contact 12 out of engagement with the contact 10 and operate the circuit controlling contact 11 into engagement therewith. During this interval the movement of contact 10 by thermal element 13 is relatively small due to the fact that the larger heat storage capacity of thermal responsive element 13 causes the temperature of this element to decrease at a much lower rate.

After the engagement of contact 11 with contact 10, the element 13 actively opposes further movement of element 14, thus maintaining the contacts in firm engagement.

The relative positions of the operating parts of the thermal responsive switch mechanism after this phase of operation are illustrated in Fig. 3. It will be evident that upon the reclosure of switch 21 current will flow through the low intensity lamp 18, the thermal responsive element 13 and the cooperating contacts 10 and 11 and the high intensity lamp 19 will be short circuited. The heating effects of the current flowing through element 13 maintains this element flexed with the circuit controlling contact 10 in engagement with contact 11, as long as the low candle power lamp 18 is maintained energized. During this time, no current flows through the thermal element 14 and since the elements are now active in opposition a good electrical contact is secured.

When the low intensity lamp 18 is deenergized by the opening of switch 21, the thermal responsive element 13 is permitted to cool and after a sufficient time interval again will carry the circuit controlling contact 10 into engagement with the cooperating contact 12 as shown in Fig. 1. Thus the electroresponsive switch mechanism is returned to its initial position in which the low intensity lamp 18 is short circuited and the thermal responsive elements 13 and 14 are connected in series with the high intensity lamp 19 to be energized simultaneously therewith upon the reclosure of switch 21.

From the foregoing it will be obvious that in a lighting system employing a plurality of thermal responsive switches embodying my invention, even though the several switch mechanisms may become unsynchronized due to grounds, accidental interruptions of the supply circuit, or other cause occurring during the operation of the lighting system, nevertheless each of the switch mechanisms will automatically return to corresponding initial position upon the interruption of the supply circuit for a sufficient time interval.

In accordance with the provisions of the patent statutes I have described the principle 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. In combination, a plurality of relatively movable members, a plurality of thermal responsive movable elements subject to common heating conditions and having different heat storage capacities, means for varying said common heating condition, and connections between the elements and the members for

imparting relative movement to said members responsively to the difference in the rates of movement of said elements upon a predetermined variation in said heating conditions.

2. In combination, a pair of movable members, a pair of thermal responsive movable elements, each operatively connected to move a corresponding one of said members a corresponding amount responsively to a predetermined variation in heating conditions, means for effecting said predetermined variation in heating conditions said elements having different heat storage capacities whereby relative movement is imparted to said members responsively to the difference in the rates of movement of said elements upon the occurrence of said predetermined variation in heating conditions.

3. A thermal responsive device comprising two movable thermal responsive elements, one of said elements having a greater heat storage capacity than the other, and connections between the elements whereby the elements move in unison when the temperature thereof is varied in one direction and the said one element opposes the movement of the other element when the temperature thereof is varied in the other direction.

4. A thermal responsive device comprising two movable thermal responsive elements arranged to move as a unit in response to simultaneous heating of the elements, one of said elements having a greater heat storage capacity than the other whereby upon cooling the elements have a relative movement, and means operated responsively to relative movement between said elements.

5. In combination, a pair of relatively movable switch members, a pair of thermal responsive movable elements having different heat storage capacities, means for simultaneously heating said elements, and connections between said elements and said members whereby relative movement is imparted to said members only upon the cooling of said elements.

6. A thermal responsive relay comprising circuit controlling switch mechanism, a pair of thermal current responsive movable elements having different heat storage capacities and subject to common heating conditions, and connections between said elements and said switch mechanism whereby the said switch mechanism is operated in response to the difference in the rates of movement of said elements upon a predetermined variation in said heating conditions.

7. A thermal responsive controlling device for electric circuit comprising two thermal current responsive movable elements movable in unison during the heating thereof, circuit controlling contacts for normally connecting the element in series relation in a circuit to be heated by the current therein, and connections whereby upon a predetermined reduction

tion of the current through the element, said contacts are operated to exclude one of said elements from the circuit.

8. A thermal responsive relay comprising cooperating circuit controlling contacts, a pair of thermal current responsive movable elements subject to common variable heating conditions, each operatively connected to a corresponding one of said contacts to move the same in corresponding directions responsively to the heating and the cooling of said element, and a heat storage mass associated with one of said elements to delay changes in the temperature thereof and thereby impart a relative movement to said contacts upon a relatively quick variation in said heating conditions.

9. A thermal responsive relay comprising cooperating circuit controlling contacts, a pair of thermal current responsive movable elements, each separately connected to a corresponding one of said contacts to move the same in unison responsively to the heating of said elements, and a heat storage mass disposed in heat conducting relation with one of said elements to delay the cooling thereof and thereby impart relative movement to said contacts upon the cooling of said elements.

10. A thermal responsive relay comprising a pair of movable circuit controlling contacts disposed in fixed spaced relation, a relatively movable contact biased into engagement with one of said movable contacts and operable into engagement with the other of said movable contacts, and a pair of thermal responsive movable elements operatively connected to move said contacts as a unit upon the heating of said elements and to operate said relatively movable contact into engagement with the other of said movable contacts upon the cooling of said elements.

11. A thermal responsive relay comprising a pair of movable contacts disposed in fixed spaced relation, a relatively movable contact biased into engagement with one of said movable contacts and operable into engagement with the other of said movable contacts, a pair of thermal current responsive movable elements having different heat storage capacities and connected in a circuit controlled by said contacts to be heated responsively to the current therein, and means operatively connecting said thermal elements with said contacts to move the same as a unit upon the heating of said elements and to operate said relatively movable contact into engagement with the said other movable contact upon the cooling of said elements.

12. A thermal responsive relay comprising a pair of bi-metallic thermal responsive movable elements, each having one end fixed and arranged to flex in corresponding directions when heated and cooled, a pair of contacts supported in fixed spaced relation upon the other end of one of said elements, a cooperat-

ing contact supported upon the other end of the other of said elements and biased into circuit controlling engagement with one of said pair of contacts, said elements having different heat storage capacities whereby upon the cooling thereof the said cooperating contact is operated into circuit controlling engagement with the other of said pair of contacts.

13. A thermal responsive relay comprising a pair of bi-metallic thermal current responsive movable members, each having one end fixed, a pair of circuit controlling contacts supported in fixed spaced relation upon the other end of one of said elements, a third circuit controlling contact supported upon the other end of the other of said elements in cooperating relation with said pair of contacts and biased into circuit controlling engagement with one of said contacts, connections controlled by said third contact in its biased position for heating both of said elements to move said contacts as a unit, a heat storage mass associated with said other thermal element to delay the cooling thereof and thereby operate said third contact into engagement with the other of said pair of contacts, and connections controlled by said third contact and said other of said pair of contacts for separately heating said other thermal element.

14. A thermal electric circuit controlling relay comprising a pair of removable contacts disposed in spaced relation, a relatively movable contact operable therebetween, and means comprising a pair of thermal responsive elements having different storage capacities and each operatively connected to a corresponding one of said relatively movable contacts for imparting relative movement thereto responsively to the difference in the rate of change of temperature of said element.

15. A thermal electric circuit controlling relay comprising a pair of movable contacts disposed in spaced relation, a relatively movable contact operable therebetween and biased into engagement with one of said movable contacts, a bi-metallic thermal responsive element operatively connected to said pair of movable contacts for moving the same, in one direction upon an increase in temperature and in another direction upon a decrease in temperature, a second bi-metallic thermal responsive element operatively connected to said relatively movable contact for moving the same in a corresponding direction upon a corresponding variation in temperatures, said second element having a greater heat storage capacity than said first element whereby said relatively movable contact is operated out of engagement with said one movable contact and into engagement with said other movable contact upon the simultaneous cooling of said element.

16. A thermal electric circuit controlling relay comprising a pair of bi-metallic thermal responsive elements having substantially similar thermal characteristics of expansion and different storage capacities, a pair of
5 movable contacts supported in spaced relation by one of said elements, a relatively movable contact supported between said pair of movable contacts by the other of said thermal
10 responsive elements, and biased into engagement with one of said movable contacts, and common means for heating and cooling said element to impart relative movement to said contact responsively to the difference in the
15 rate of change of temperature of said element.

17. In combination, a pair of cooperating movable members, a pair of thermal responsive movable elements connected to said members to effect a movement of the members in
20 unison in response to a temperature variation in one direction, and a heat storage mass associated with one of the elements to retard changes in the temperature thereof and thereby effect relative movement of the members
25 in response to a temperature variation in the opposite direction.

In witness whereof I have hereunto set my hand this 24th day of March, 1926.

OLIVER C. TRAVER.