

Feb. 25, 1930.

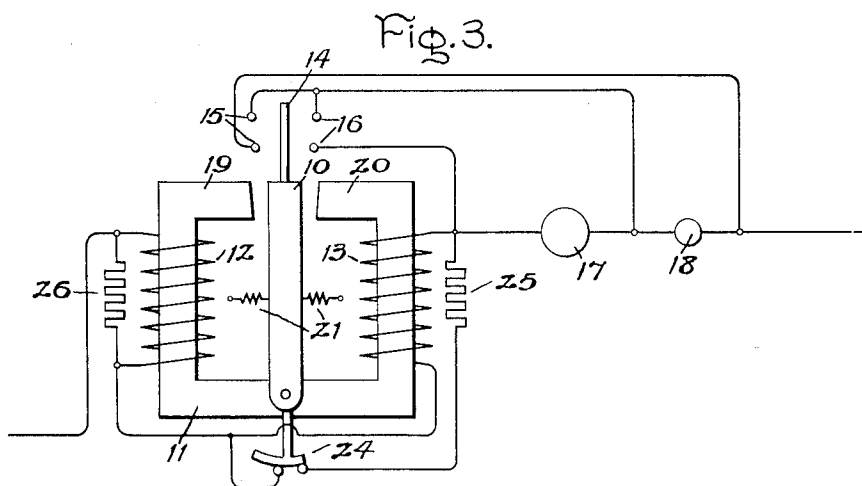
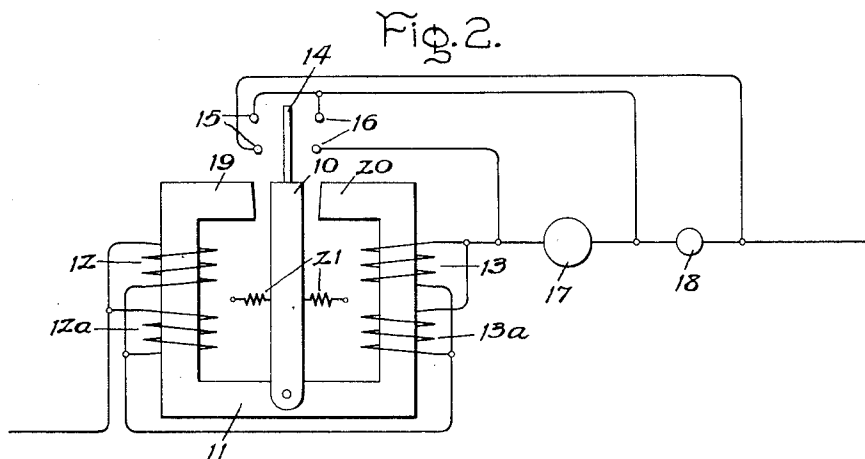
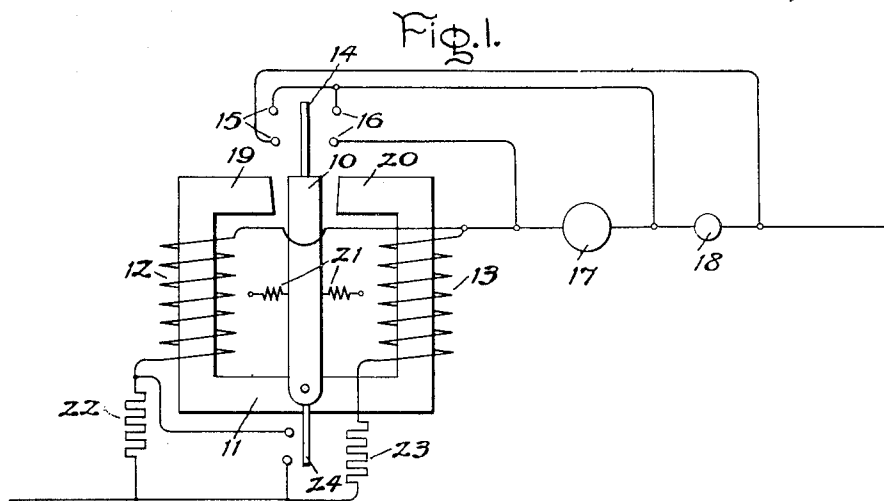
H. W. BROWN

1,748,862

ELECTRORESPONSIVE DEVICE

Filed Dec. 10, 1925

2 Sheets-Sheet 1



Inventor:
Harold W. Brown,
by *Wm. H. S. Lane*
His Attorney.

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2 Sheets-Sheet 2

Fig. 4.

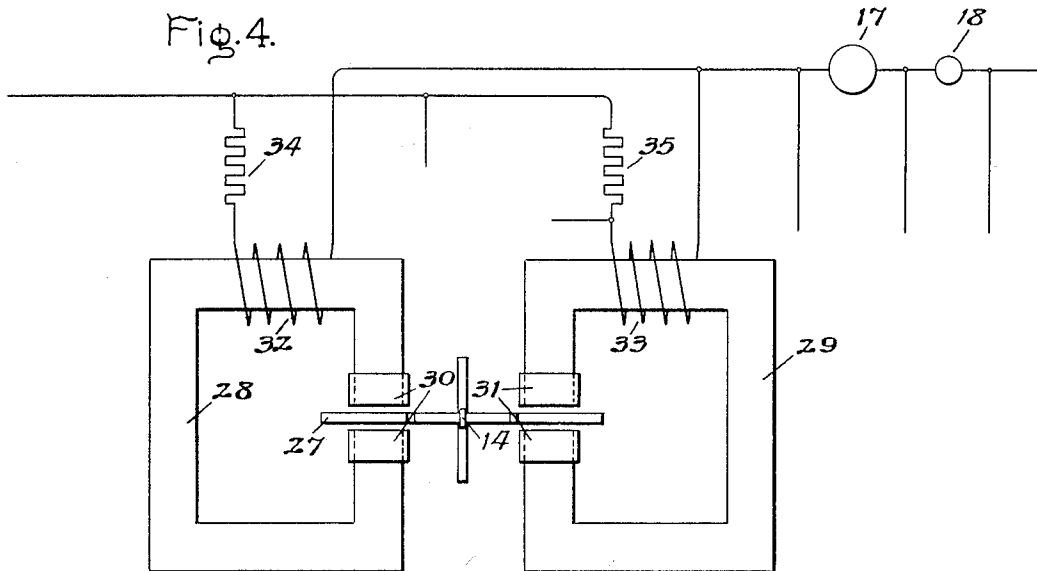
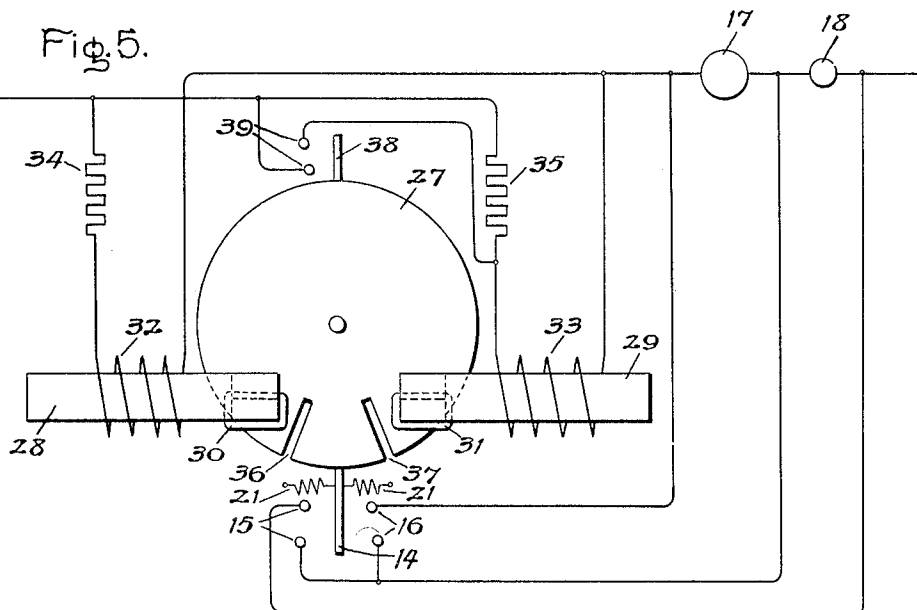


Fig. 5.



Inventor:
Harold W. Brown.

by

Alexander S. Lunt.
His Attorney.

UNITED STATES PATENT OFFICE

HAROLD W. BROWN, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK

ELECTRORESPONSIVE DEVICE

Application filed December 10, 1925. Serial No. 74,664.

The invention relates to electroresponsive devices, particularly those having a controlled member operable between several positions, such for example, as circuit controllers, re-

5 lays, regulators, indicators and the like. The improvements provided by the present invention enable electroresponsive devices of the above character to respond in such manner that the controlled member is
10 operated into each of a plurality of positions when the device is successively energized.

The invention particularly provides for insuring operation of the controlled member into a predetermined one of the positions
15 when the electroresponsive device is energized after a substantial period of de-energization and into a different position when the electroresponsive device is re-energized after a temporary de-energization thereof.

20 In accordance with a preferred form of the invention I provide the electroresponsive device with a plurality of operating windings arranged so that the action of one winding predominates to operate the controlled
25 member always to a predetermined position when the device is initially energized. The windings may be formed of suitable material having different temperature coefficients of resistance, or preferably, resistors having different temperature coefficients are connected
30 in circuit with the windings in such manner that the action of another winding becomes predominant to operate the controlled member to a different position after a temporary interruption of the energizing circuit of the
35 device.

Although my invention may be applied generally to controlling, operating and indicating electroresponsive devices, it is particularly advantageous when applied to the
40 lamp switching relays in a dual intensity street lighting system wherein high candle power lamps are lighted during one part of the night and lower candle power lamps
45 are lighted during the remainder of the night.

The accompanying drawing illustrates the invention applied to lamp switching relays and Fig. 1 diagrammatically shows a lamp switching relay embodying a preferred form
50 of the invention. Figs. 2 and 3 illustrate

modifications of the operating winding arrangement of the relay shown in Fig. 1 and Figs. 4 and 5 show an induction type relay embodying the invention.

The electroresponsive relay shown in Fig. 55 1 comprises a movable magnetic member 10 which is pivotally mounted upon a magnetic structure 11 having the magnetizing windings 12 and 13. The magnetic member 10 carries the movable circuit controlling switch
60 member 14 which cooperates with the stationary contacts 15 and 16 to control shunt circuits about the electric lamps 17 and 18 respectively. The movable member 10 is biased to a mid position between the poles 19
65 and 20 of the magnetic structure 11 by any suitable means such as the springs 21.

A resistor 22 having a fairly high positive temperature coefficient is connected in series with the winding 12 and a resistor 23 having
70 a considerably lower temperature coefficient is connected in series with the winding 13. It will be observed that the windings 12 and 13 are connected in parallel in the circuit through which the electric lamps 17 and 18
75 are energized. The windings 12 and 13 and the resistors 22 and 23 are designed so that the winding 12 initially receives sufficient current to exert a magnetic attraction at the pole 19 upon the movable member 10 greater
80 than the attraction exerted by the pole 20. However after the windings of the relay have been energized for an interval of time the positive temperature coefficient of resistor 22 causes the resistance thereof to increase and
85 thereby reduce the energization of winding 12. Since the resistance of resistor 23 does not vary materially from the initial value, the energization of winding 13 remains substantially constant. Under these conditions
90 the magnetic attraction at the pole 19 decreases below its initial value and permits the attraction of pole 20 upon the magnetic member 10 to predominate when the member 10 is in the mid position. Consequently if the energizing circuit of the device is interrupted momentarily the magnetic member 10 returns to the mid position in accordance with its bias. When the relay is reenergized the pre-
95 dominating attraction of the pole 20 serves
100

to move the magnetic member 10 to the right.

Thus, the operation of the relay controlling the energization of the lamps 17 and 18 is as follows:

When the energizing circuit for the lamps and also the operating windings of the relay are initially closed, the relay responds to move the contact 14 in engagement with the stationary contacts 15 and thereby short circuits the low candle power lamp 18. Under these conditions the high candle power lamp 17 is lighted and the resistors 22 and 23 are heated as the flow of current through the circuit continues.

Should it now be desired to deenergize the high candle power lamp 17 and light the low candle power lamp 18 it is only necessary to interrupt the energizing circuit of the lamp for a brief interval. As previously pointed out, when the circuit is interrupted, the magnetic member 10 returns to its mid position and thereby disengages the movable contact 14 from the stationary contacts 15. Upon the reclosure of the energizing circuit the magnetic member 10 moves to the right and carries the movable contact 14 into engagement with the stationary contact 16. This completes the short circuit around the high candle power lamp 17 and permits the low candle power lamp 18 to be energized as long as the continuity of the circuit is maintained.

It will be observed that the magnetic member 10 is arranged to operate an auxiliary contact 24 so as to short circuit the resistor 22 when the member 10 is moved into its right hand position. This allows the resistor 22 to cool. Consequently, when the relay is deenergized after having been in the right hand position it is again substantially in the initial condition in which the winding 12 predominates to move the member 10 to the left when the relay is reenergized. This permits the member 10 to be operated to the left hand position immediately upon opening and again closing the energizing circuit without maintaining the circuit deenergized to permit the resistor 22 to cool. This feature is of considerable practical advantage since the lamp switching relay may be operated from each of its circuit controlling positions to the other by simply interrupting the energizing circuit and reclosing the circuit. Hence, in shifting either from the high candle power lamps to the low candle power lamps, or from the latter to the former, there is only a very brief interval during which neither of the lights is lighted.

When the lighting circuit is interrupted during the day time, the magnetic member 10 is maintained in the mid position in which it is shown. When the lamp circuit is energized the next evening the magnetizing action of the winding 12 again predominates and causes the magnetic member 10 to move to the left to engage contact 14 with the stationary

contacts 15 and thereby short circuit the low candle power lamp 18. The cycle of operation of the magnetic member 10 between its left and right hand positions to control the lighting of the lamps 17 and 18, as previously described is repeated when the lamp circuit is successively interrupted and reestablished.

The lamp switching relay shown in Fig. 2 is similar to that shown in Fig. 1 except that the resistors 22 and 23 are omitted and the arrangement of the energizing windings of the relay is somewhat modified. In this case the pair of parallel connected energizing windings 12 and 12^a are arranged differentially or in opposition and the pair of energizing windings 13 and 13^a are connected and arranged in a similar manner. Furthermore, the windings 12^a and 13^a are formed of material having a higher temperature coefficient than the material of which windings 12 and 13 are formed. The windings are so designed that when the relay is initially energized the magnetization set up by winding 12^a predominates over that set up by the winding 12, while the magnetization set up by the windings 13 and 13^a is substantially equal and, consequently the effects of the windings neutralize each other. Thus, when the device is initially energized, the magnetization of the pole 19 by the winding 12^a serves to attract the magnetic member 10 to the left, the attraction of the pole 20 being negligible. As the energization of the device is continued the temperature of the windings increases. Due to the higher temperature coefficient of windings 12^a and 13^a, the resistance of these windings increases a much greater amount than the resistance of the windings 12 and 13. When properly designed the resistance of winding 12^a is increased sufficiently to cause the magnetization of the windings 12 and 12^a to be nearly equal and thus tend to neutralize each other. The increased resistance of winding 13^a reduces the current flowing there-through and permits the magnetization of winding 13 to predominate. Thus under these conditions when the relay is temporarily deenergized the magnetic member 10 returns to mid position and when the relay is reenergized, member 10 moves to the right into engagement with the pole 20.

The contact 14 engages with the contacts 15 when the magnetic member 10 is moved to the left to short circuit the low candle power lamp 18 in exactly the same manner as previously described. Likewise, the contact 14 serves to short circuit the high candle power lamp 17 when the magnetic member 10 moves to the right.

In the arrangement shown in Fig. 3 the winding 13 of the relay is shunted by the resistor 25 which has a relatively high positive temperature coefficient and the winding 12 is shunted by the resistor 26 which preferably has a negligible temperature coefficient.

cient. The windings 12 and 13 are designed so as to have substantially equal temperature coefficients and so that when the resistors 25 and 26 are cool the magnetization of winding 12 predominates over that of winding 13. Thus, when the relay is initially energized the magnetic member 10 moves to the left. As the resistor 25 heats up the energizing current of winding 13 is increased sufficiently to attract the magnetic member 10 to the right when the relay is deenergized for a short interval and again energized. The resulting operation of the contact 14 to initially short circuit the low candle power lamp 18 and subsequently short circuit the high candle power lamp 17 is substantially the same as that previously described.

The invention may be embodied in an induction type relay as illustrated in Figs. 4 and 5. The induction type relay consists essentially of the induction disc 27 which is rotatably mounted to move under the influence of the alternating current operating electromagnets 28 and 29, which are of the well known type having short circuited shading windings 30 and 31 enclosing a portion of the pole faces of the respective operating electromagnets in order to produce a shifting flux to rotate the induction disc. The operating electromagnets 28 and 29 are designed so as to produce rotation of the disc 27 in opposite directions. As better shown in Fig. 5, the operating electromagnet 28 is arranged to produce rotation of the disc 27 in a counter-clockwise direction, while the electromagnet 29 rotates the disc in the clockwise direction.

The magnetizing winding 32 of the operating electromagnet 28 and the magnetizing winding 33 of the electromagnet 29 are arranged to be energized in parallel circuit with the resistor 34 having a low or practically negligible temperature coefficient connected in series circuit with the winding 32 and the resistor 35 having a relatively high temperature coefficient in series circuit with the winding 33. The arrangement of the resistors, the windings and the electromagnets, with respect to the induction disc 27, is such that when the relay is initially energized the action of the operating electromagnet 29 predominates to drive the induction disc in the clockwise direction. Consequently, the disc carries the switch contact 14 into engagement with the left hand stationary contacts 15, which it will be understood are connected to control the short circuit about the low candle power lamp in the manner shown in the preceding figures. Preferably the induction disc is provided with the slots 36 and 37 as shown in Fig. 5, and the slots are disposed so that the slot 36 is under the poles of electromagnet 28 when the contact 14 is operated to the left and the slot 37 is under the poles of electromagnet 29 when the contact 14 is operated to the right. With the slot 36 under

the poles of magnet 28, the actuating influence of the magnet upon the disc is very greatly reduced corresponding to the reduction of the eddy currents induced in the disc. As the energization of the relay continues the resistance of resistor 35 increases due to the relatively high temperature coefficient thereof and the magnetization of electromagnet 29 consequently is reduced. The action of magnet 29 upon the disc 27, however, still predominates over that of magnet 28 since the action of the latter is weakened by the slot 36. The predominating actuating force of magnet 29 serves to maintain the contact 14 in engagement with the contacts 15.

Upon deenergization of the induction relay the induction disc 27 is biased to return the contact 14 to the mid position between the contacts 15 and 16 by the springs 21, or other suitable means. When the relay is reenergized before the resistor 35 cools the inductive action of electromagnet 28 upon the disc 27 predominates over the action of electromagnet 29. In this way, the disc is rotated in the counter-clockwise direction to carry the contact 14 into engagement with the contacts 16 which, as previously pointed out, are connected to control a short circuit around the high candle power lamp.

If desired, the induction disc 27 may be provided with an auxiliary contact 38 for engaging the stationary contacts 39 to short circuit the resistor 35 when the contact 14 is moved to the right in substantially the same manner and for the same purpose as described in connection with the auxiliary contact 24 of Fig. 1. This permits the action of electromagnet 29 to predominate instantaneously in case the relay is temporarily deenergized after the contact 14 has been in engagement with the right hand contacts 16.

From the foregoing it will be seen that my invention in each of the forms illustrated and described enables the movable controlled member of the relay to be operated to a predetermined position when initially energized and to operate to a different position when re-energized after a temporary deenergization of the relay.

While I have shown several preferred forms of relay construction embodying my invention, it will be understood that the invention may be carried into effect in other forms.

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

1. An electroresponsive device comprising a controlled member movable between a plurality of positions, and electromagnetic means for controlling the movement of the member and arranged to set up a predetermined magnetic force for moving the member into a predetermined position when said means is energized after a substantial period of de-energization and to set up a different magnetic force for moving said member in-

to a different position when said means is reenergized after a temporary deenergization thereof, said means being adapted to move said controlled member to said predetermined position when said means is reenergized after a second temporary deenergization thereof.

2. An electroresponsive device comprising a controlled member movable between a plurality of positions, electroresponsive means for controlling the movement of the member and normally arranged to insure operation of the member to a predetermined position whenever said means is energized after a substantial period of de-energization and thermal responsive means heated during energization of the electroresponsive means and effective during a temporary deenergization thereof for insuring operation of the member to a different position upon reenergization of the electroresponsive means, and means responsive to movement of said movable member for controlling said thermal responsive means to move said member to said predetermined position upon reenergization of said electroresponsive means following a second temporary deenergization thereof.

3. In a circuit controlling device, the combination of a switch member operable between a plurality of circuit controlling positions, electroresponsive means for operating the member to each of said positions, and thermal responsive means associated with said electroresponsive means for automatically controlling the energization thereof to effect operation of the switch member into one position when said electroresponsive means is energized after a substantial period of de-energization thereof and into a different position when said electroresponsive means is reenergized after a temporary deenergization thereof and into said one position when said electroresponsive means is reenergized after a second temporary deenergization thereof.

4. A circuit controlling device comprising a rotatable member, an electro-magnet adjacent said member having windings for producing a shifting flux tending to rotate said member in one direction, another electro-magnet adjacent said member having windings for producing a shifting flux tending to rotate said member in the other direction, a switch member biased to one position and movable to each of two other positions, and thermal responsive means dependent upon the heating effect of the energizing currents of said windings for controlling the predominance of the shifting fluxes of the corresponding electromagnet to effect rotation of said member in one direction to move said switch member to one of said two other positions upon energizing said windings after a substantial period of deenergization and to move said switch member to the other of

said two other positions upon reenergizing said windings after a temporary deenergization thereof.

5. An electroresponsive device comprising a magnetic structure having a plurality of poles, a member disposed adjacent each of said poles and movable to a plurality of positions under the joint magnetic influence of said poles, and windings disposed upon said magnetic structure for simultaneously magnetizing each of said poles and arranged to set up a predominating magnetization of one portion of the poles to move the member to one position when the said windings are energized after a substantial period of deenergization of the windings and to set up a predominating magnetization of another portion of the poles to move the member to a different position when the said windings are reenergized after a temporary deenergization thereof.

6. An electroresponsive device comprising a magnetic structure having a plurality of poles, a rotatable member disposed adjacent each of said poles and movable under the joint influence of said poles, a plurality of magnetizing windings disposed upon said structure for simultaneously magnetizing each of said poles, resistance means having a predetermined temperature coefficient associated with said windings for causing the magnetization of one portion of the poles to predominate to operate said member to one position when the windings are initially energized and for causing the magnetization of another portion of the poles to predominate and operate the member to a different position when the windings are reenergized after a temporary deenergization thereof, and means for automatically decreasing the magnetic influence of each portion of the poles upon said rotatable member upon movement of the said member under the predominating magnetization of the other portion of the poles.

7. In a circuit controlling device, the combination of a movable switch member operable between a plurality of circuit controlling positions, a magnetic structure having a plurality of poles, a movable member operable under the magnetic influence of said poles and connected to operate said switch member, windings having energizing circuits of different thermal coefficients of resistance disposed upon said magnetic structure for simultaneously magnetizing said poles and arranged to set up a predominating magnetization of one portion of the poles to operate the switch to one position when the said windings are energized after a substantial period of de-energization and to set up a predominating magnetization of another portion of the poles to operate the switch to a different position when the windings are reenergized after a temporary deenergization thereof, and means

for automatically decreasing the magnetic influence of each portion of the poles on said member upon movement of the same under the predominating magnetic influence of the other portion of the poles.

In witness whereof, I have hereunto set my hand this 8th day of December, 1925.

HAROLD W. BROWN.

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