

Jan. 19, 1943.

E. J. LEUTHOLD
THERMAL RELAY SWITCH
Filed Aug. 22, 1939

2,308,522

Fig. 1.

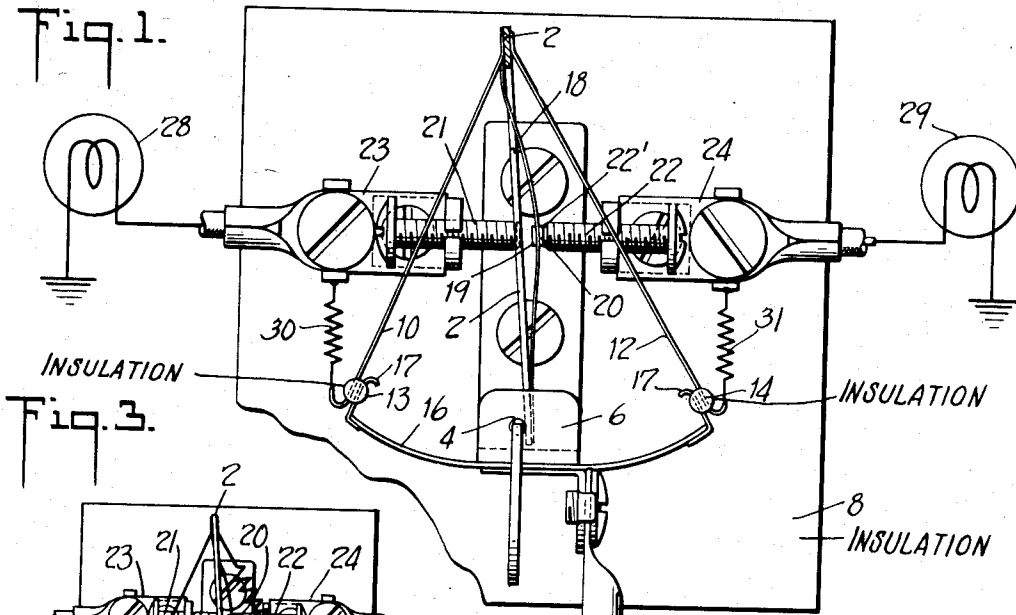


Fig. 3.

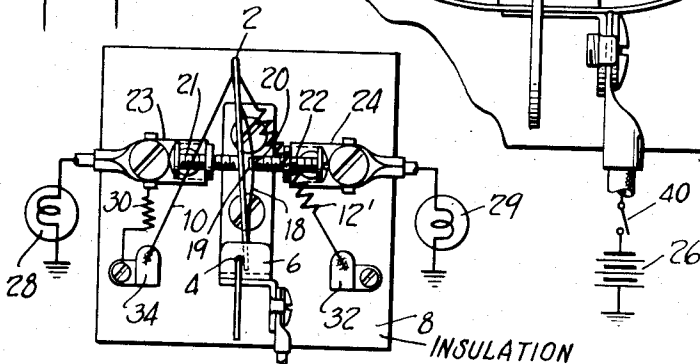
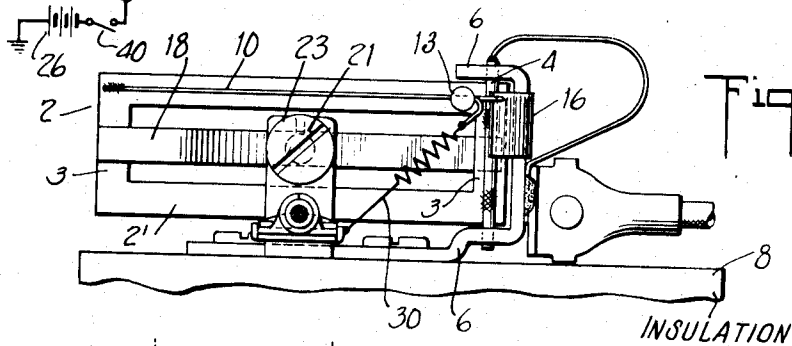


Fig. 2.

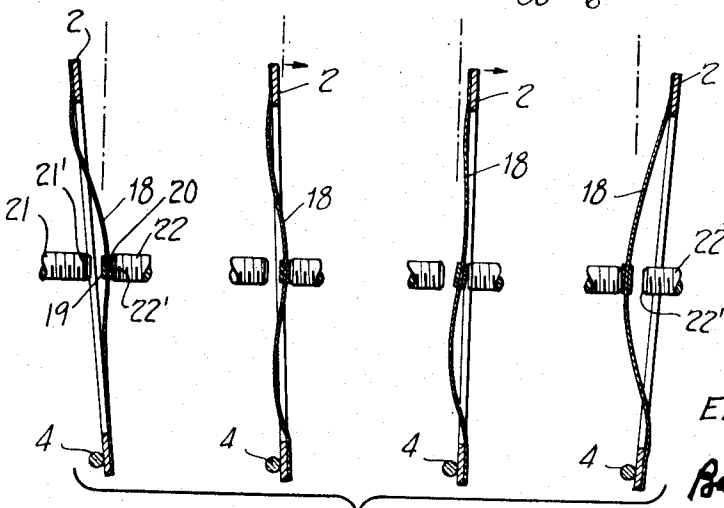


Fig. 4.

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2,308,522

THERMAL RELAY SWITCH

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Application August 22, 1939, Serial No. 291,282

13 Claims. (Cl. 200—113)

The present invention relates to thermal switches.

One object of the invention is an improved switch of this character which is of simple, sturdy construction and is efficient in operation.

A further object of the invention is to provide a novel and improved switch of this type which may be economically manufactured and yet will be of durable and compact construction.

A further object of the invention is to provide a novel switch of this type which will have a positive snap action in operation.

Other objects and features of the invention will be apparent as the description proceeds.

Of the accompanying drawing,

Fig. 1 is a plan view of a switch embodying the invention and arranged for alternate variation of the series resistance of two circuits;

Fig. 2 is a side view of the device of Fig. 1; Fig. 3 is a plan view representing another embodiment of the invention; and

Fig. 4 is a view showing four positions of the movable element of the switch to illustrate the operation thereof according to one embodiment.

Referring to Figs. 1 and 2, the switch comprises a rectangular frame 2 of conducting material of any suitable sheet metal, with the side members indicated at 2' and the end members at 3. The frame 2 is mounted and fastened at one end upon a bracket 6 which in turn is mounted upon and secured to an insulating base 8. The other or free end of the frame is biased and operated from one position to the other by one or more expansible wires, and in the embodiment of Fig. 1 by two such wires 10 and 12. The latter are connected to the free end in any suitable manner and extend outwardly at an angle from opposite sides of the frame and pass through insulating anchoring beads 13 and 14 respectively. The latter are carried by the bracket 6 in any suitable manner, as for example by a flat leaf-spring 16 which is centrally mounted on the bracket 6 and has its ends secured to the beads 13 and 14 by means of short lengths of wire 17 which are welded at one end to the spring and have their other ends embedded in the beads.

The movable element 2 of the switch carries a bowed flexible strip or vane 18 which is secured to the free end 3 of frame 2, and also in the particular embodiment shown to the other end of the frame. In the particular embodiment shown the vane 18 is formed separately from the member 2 and welded to the end parts 3, with the

vane slightly longer than necessary to bridge the ends 3 and bowed outwardly from the plane of the frame as shown in Fig. 1. Contacts 19 and 20 are centrally located on opposite sides of the strip 18 and co-operating contacts 21' and 22' carried by screws 21 and 22, mounted in screw brackets 23 and 24 respectively, are positioned to be engaged by the contacts 19 and 20 respectively upon biasing or swinging movement of the frame 2. When the free end of frame 2 is in the position indicated in Fig. 1, contact 20 on strip 18 is in engagement with the contact on screw 22. Clockwise movement of the free end of the frame 2 (Fig. 1) about the fastened end causes strip 18, assisted by pressure exerted by screw 22, to snap to the opposite bowed position, at which time contacts 19 and 21' are in engagement and contacts 20 and 22' are out of engagement. In Fig. 4 are shown the various approximate positions assumed by the strip 18 during the above described movement of the frame in a clockwise direction from the position shown in Fig. 1 to the final position shown in Fig. 4, for a particular adjustment and mounting. When the frame moves back to the position of Fig. 1 the reverse movement of strip 18 occurs with snap opening of contacts 19 and 21' and closure of contacts 20 and 22'.

Movement of frame 2 is controlled in response to expansion and contraction of wires 10 and 12 as will now be explained. A battery 26, or other source of electromotive force, is electrically connected to bracket 6 and thence through vane 18 to lamps 28 and 29 or other devices, the current through which is to be varied by the device. The lamps 28 and 29 are connected on one side to screw brackets 23 and 24 respectively, with their other terminals connected to ground, and one side of the battery is also connected with the ground. A resistance element 30, which may be a continuation of wire 10, is connected between the insulated end of wire 10 and screw bracket 23 and a similar resistance element 31 is connected between wire 12 and screw bracket 24.

With the above described connections and the parts in the position indicated in Fig. 1, current will flow from the battery 26 through bracket 6, element 18, contacts 20 and 22', bracket 24 to the lamp 29 and ground. Lamp 29 will consequently be lighted with full current. Current will also flow from the battery through bracket 6, strip 18, wire 10, resistance 30, bracket 23 and lamp 28 to ground. This current, because of the inclusion of wire 10 and resistance 30 will be insufficient to light the lamp 28 but will heat wire

10 causing it to expand and release the tension on the frame 2. Wire 12 (assisted by the half of spring 16 connected thereto through bead 14) will then cause the frame to swing about its pivot into the final position indicated in Fig. 4. Closure of contacts 19 and 21' cuts wire 10 and resistance 30 out of the circuit of lamp 28, which will consequently burn brightly and opening of contacts 20 and 22' causes the current through lamp 29 to be reduced by the inclusion of wire 12 and resistance 31 in the circuit thereof. Wire 10 being thus cut out of the circuit of lamp 28 cools and contracts and wire 12 being thus included in the circuit of lamp 29 heats and expands until the reverse operation occurs and the parts return to the position of Fig. 1. Thus with the various elements properly adjusted, the frame will continue to swing back and forth, causing alternate illumination of the lamps so long as the battery is connected to the device.

Where equal periods of operation of each lamp or other device are desired and the resistance of the lamps is the same, resistances 30 and 31 should be of equal value and the lengths and tensions of wires 10 and 12 should be the same. The various elements are in proper balance if, when no current is supplied to the device and the screws 21 and 22 are withdrawn sufficiently to be out of engagement with the strip 18, the frame 2 is held in a plane half way between the two operating positions with the strip 18 bowed to either side depending upon the position it was last in. The screws 21 and 22 are then advanced equally until one or the other touches a contact on strip 18 and causes slight movement of the strip into substantially the second position shown in Fig. 4 if contacts 20 and 22' are in engagement or into the position reverse thereto if contacts 19 and 21' are in engagement.

The device of Figs. 1 and 2 when adjusted and proportioned as above described will give equal periods of illumination to each lamp as the heating effect is the same on each wire irrespective of the voltage of the battery. This illuminating period of the lamps may be varied as desired either by change in voltage, or of distance between the screw contacts or by variation of the resistances 30 and 31. If unequal periods of illumination are desired the tension of the wires 10 and 12 may be adjusted initially or the resistance 30 and 31 can be made unequal.

In the particular embodiment of Fig. 1, the frame 2 is provided with a pin 4 at its fastened end which is journaled in the bracket 6, but it is understood that any other suitable mounting for the biased frame 2 may be provided.

In the embodiment of Fig. 3, the frame 2 is biased in one direction by a spring 12' which is connected between the movable end of the frame 2 and a bracket 32 on the insulating base 8. Wire 10 is connected between the movable end of the frame 2 and a bracket 34 on the base 8, to which latter bracket is also connected one end of resistance 30. With the device of Fig. 3 the tension of wire 10 when the wire is cold should be sufficient to overcome that of the spring 12' to hold the frame in the position shown in the drawing. When in this position, if the battery 26 is connected, current flows to lamp 29 because of the closure of contacts 20 and 22' and current flows through wire 10, resistance 30 and lamp 28 in series. Expansion of wire 10 due to the heating effect of the current therethrough permits spring 12' to swing the frame into the other position with consequent opening of contacts 20 and 22'

and closure of contacts 19 and 21'. The circuit for lamp 29 will now be open completely and increased current will flow through lamp 28. The shunting of wire 10 by contacts 19 and 21 permits cooling and consequent contraction of the wire and return of the frame to its initial position. Thus, as with the device of Figs. 1 and 2, the frame will continue to oscillate back and forth so long as voltage is supplied to the device. The rate at which the device operates will depend, of course, upon the voltage of the battery, the tension of wire 10 and spring 12' and the resistance of the circuit. The periods of illumination of the lamps may be made equal or different as desired as in the case of the device of Figs. 1 and 2.

The invention has now been described in connection with two embodiments thereof. In each a biased frame member 2 of the construction shown carries the bowed vane 18 which is buckled or snapped over from one position to the other to control a circuit and the movement of the contact making part of the vane is in a direction opposite to that of the frame member.

The improved switch, in each embodiment, has been described and illustrated as controlling the circuits of lamps but it will be understood that lamps are illustrative only. Other elements or circuits may be controlled by the device, and the switch may be used generally as a thermal relay or thermally operated switch.

The following is claimed:

1. In a thermal switch, a sheet metal frame element comprising a pair of parallel spaced arms joined by an end cross member and carrying a vane bowed out of the plane of and disposed between the arms of the frame element and joined to the end member, said frame element together with the vane being mounted and fastened at the opposite end, an expansible wire connected with said element at a point adjacent said cross member and tending to move the same about the mounted end, a contact controlled by said vane and means for energizing said expansible wire.

2. In a thermal switch, a sheet metal frame element comprising a pair of parallel spaced arms joined by an end cross member and carrying a vane bowed out of the plane of and disposed between the arms of the frame element and joined to the end member, said frame element together with the vane being mounted and fastened at the opposite end, an expansible wire connected with said element at a point adjacent said cross member and tending to move the same about the mounted end, a contact controlled by said vane and means for energizing said expansible wire, the contact being carried by the vane member at a point intermediate its ends and the vane member moving oppositely to the frame element in the contact controlling operation thereof.

3. In a thermal switch, a sheet metal frame element having a pair of spaced parallel arms joined at their ends by a cross member and a vane member bowed out of the plane of and disposed between the arms of said element and joined to said cross member, means for mounting said element and said vane at one end and biasing the same for movement of the other end perpendicularly to the plane thereof including an expansible wire connected at one end to the free end of said frame element, a contact carried and controlled by said vane and means for energizing said expansible wire.

4. In a thermal switch, a sheet metal frame

element having a pair of spaced parallel arms joined at their ends by a cross member and a vane member bowed out of the plane of and disposed between the arms of said element and joined to said cross member, means for mounting said element and said vane at one end and biasing the same for movement of the other end perpendicularly to the plane thereof including an expansible wire connected at one end to the free end of said frame element, a contact carried and controlled by said vane and means for energizing said expansible wire, the direction of movement of the vane being in the opposite direction to that of the frame element.

5. A device of the type described, comprising in combination a circuit to be controlled, an expansible resistance wire, a frame fixedly mounted at one end and secured at its other end to an end of said wire, said frame having a centrally disposed vane bowed out from the plane of the frame, a contact on said vane and a fixed contact positioned to be engaged by the contact on said vane upon movement of said frame in one direction, including spring means tending to move said frame to one position in opposition to the tension of said wire whereby when said wire expands due to the passage of current there-through the contacts are controlled by said spring means.

6. A device of the type described, comprising in combination a circuit to be controlled, an expansible resistance wire, a frame fixedly mounted at one end and secured at its other end to an end of said wire, said frame having a centrally disposed vane bowed out from the plane of the frame, a contact on said vane and a fixed contact positioned to be engaged by the contact on said vane upon movement of said frame in one direction, including spring means tending to move said frame to one position in opposition to the tension of said wire whereby when said wire expands due to the passage of current there-through the contacts are controlled by said spring means, a second circuit to be controlled, a second contact on said vane and a second fixed contact adapted to be engaged by said second contact on said vane upon movement of said frame under influence of the contraction of said wire, and to be opened upon movement of said frame in the opposite direction, said second fixed contacts and said second contact on said vane being part of said second circuit to be controlled.

7. A device of the type described, comprising in combination a circuit to be controlled, an expansible resistance wire, a frame fixedly mounted at one end and secured at its other end to an end of said wire, said frame having a centrally disposed vane bowed out from the plane of the frame, a contact on said vane and a fixed contact positioned to be engaged by the contact on said vane upon movement of said frame in one direction, including spring means tending to move said frame to one position in opposition to the tension of said wire whereby when said wire expands due to the passage of current there-through the contacts are controlled by said spring means, a second circuit to be controlled, also having an expansible resistance wire therein, said last mentioned wire being connected at one end to the movable end of said frame so as to oppose movement thereof upon contraction of said first mentioned wire, a second contact carried by said vane and a second fixed contact positioned to be engaged thereby upon movement of the frame in the direction opposite to that causing closure of

the first mentioned pair of contacts, said second contacts when in engagement shunting said second expansible wire, said spring means comprising a member fixed at its center and insulatedly connected at each end with one of said wires to provide the tension therein, whereby current flowing through one of said wires will permit said spring means and the contraction of the other wire to move the frame into position to cause shunting of the current carrying wire and the opening of the shunt about the other with consequent continued oscillation of said frame.

8. In a thermal switch of the type wherein an expansible wire, when heated by the passage of current therethrough, permits movement of an element into position to shunt the wire and thereby cause the wire to contract and cause movement of the element into non-shunting position, the improved combination comprising a frame mounted at one end for movements thereabout and connected at its other end to the expansible wire, a bowed vane secured at its ends to said frame with the central portion thereof bowed out from the plane of the frame, a contact carried by said vane and a fixed contact positioned to be engaged by said first mentioned contact upon movement of said frame about its mount, said fixed contact serving to cause the bowed portion of said vane to move oppositely to the direction of movement of said frame to give a snap action opening and closing of the switch.

9. A device of the type described comprising in combination a pair of circuits to be controlled each including a fixed contact, a resistance and an expansible wire in series, a movable member adapted in one position to cause a shunting of the resistance and wire of one circuit and in another position to cause shunting of the resistance and wire of the other circuit, said member comprising a frame pivoted at one end and having a central flexible contact carrying strip adapted to snap from one bowed position with the contact thereon engaging one of said fixed contacts to another bowed position with the other contact thereon engaging the other fixed contact upon movement of the frame about its pivot, said expansible wire being connected under tension to the movable end of said frame to control the movement thereof by expansion and contraction.

10. A device of the type described comprising in combination a pair of circuits to be controlled, each including a fixed contact, a resistance and an expansible wire in series, a movable member adapted in one position to cause a shunting of the resistance and wire of one circuit and in another position to cause shunting of the resistance and wire of the other circuit, said member comprising a frame pivoted at one end and having a central flexible contact carrying strip adapted to snap from one bowed position with the contact thereon engaging one of said fixed contacts to another bowed position with the other contact thereon engaging the other fixed contact upon movement of the frame about its pivot, said expansible wire being connected under tension to the movable end of said frame to control the movement thereof by expansion and contraction, and resilient means insulatingly connected with said wires to provide the tension therein.

11. A thermo-relay switch comprising in combination an insulating base, a conducting bracket on said base, a pin rotatably and vertically mounted in said bracket, a conducting frame secured at one end to said pin, a buckled vane

secured to said frame with the central portion thereof bowed out from the plane of the frame so as to snap back and forth through the frame upon oscillation thereof, a contact on the bowed portion of said strip, a contact ended screw 5 carried by said base with the contact end thereof positioned to be engaged by the contact on said strip upon movement of the frame in one direction, spring means connected to said frame tend- 10 ing to move the same toward contact closing position, an expansible resistance wire electrically connected at one end to said fixed contact and connected under tension at its other end to the movable end of said frame, said wire when cold preventing movement of said frame by said spring 15 means to contact closing position, whereby when a circuit including a source of electric motive force is connected across the bracket and fixed contact current will flow through said wire until the expansion thereof permits closure of said con- 20 tacts by said spring means and the consequent shunting of said wire.

12. In a thermal switch structure of the character set forth, a sheet metal frame mounted at one end for movement thereabout, an expansible wire fastened to the free end of said frame and adapted to impart to and permit movements of

the free end of the frame in directions at right angles to the plane thereof, said frame having a bowed vane secured at its ends thereto and adapted to occupy two different positions with respect to the frame, a contact carried by said vane, a stationary contact engaged by said first 5 named contact in one position of said vane and said first named contact being adapted to be moved over out of contact with the fixed contact to a second position when the free end of the 10 frame is moved in a direction to increase the pressure between the contacts.

13. A device of the type described, comprising in combination a circuit to be controlled, an ex- 15 pansible pull wire, a frame fixedly mounted at one end, said pull wire being fastened at one end adjacent the free end of said frame, said frame being biased against the pull of said pull wire and having a buckling vane bowed out from the 20 plane of the frame, a contact on said vane and a second contact positioned to be engaged by the contact on said vane upon movement of said frame in one direction whereby the contraction and expansion of said pull wire together with 25 the bias of said frame control said contacts.

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