Oct. 11, 1927. 1,645,290

A. J. MOTTLAU

THERMOSTATIC SWITCH

Filed April 8, 1924 2 Sheets-Sheet 1

Fig. 2.

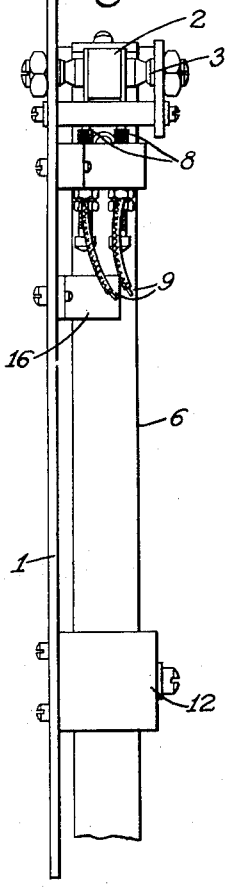


Fig. 1.

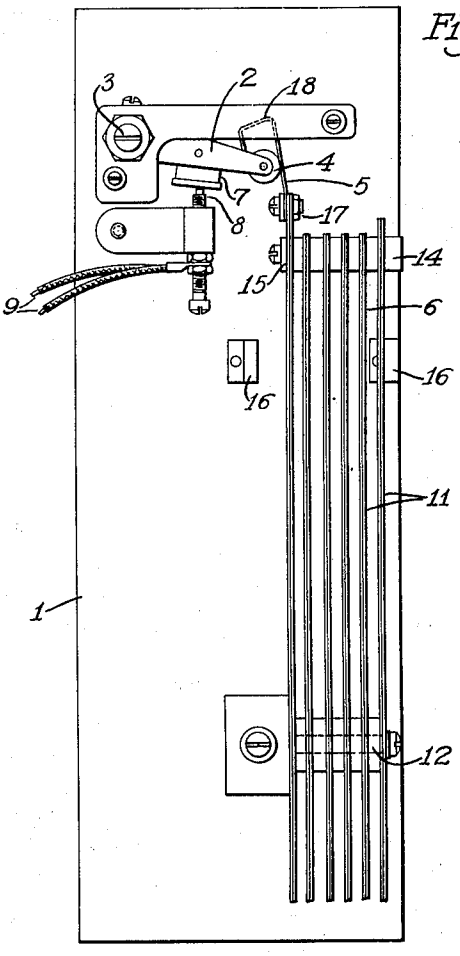
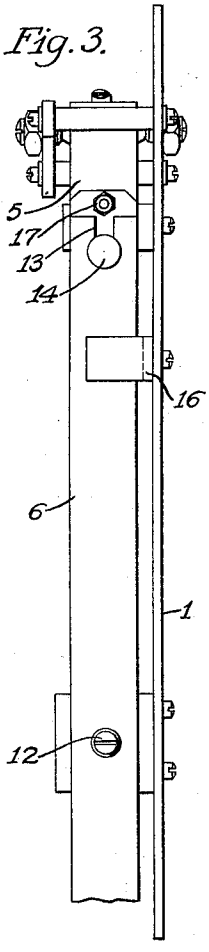


Fig. 3.



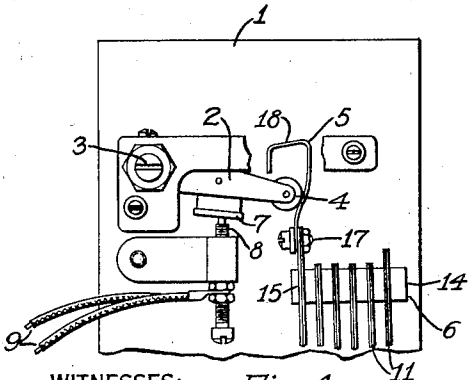


Fig. 4.

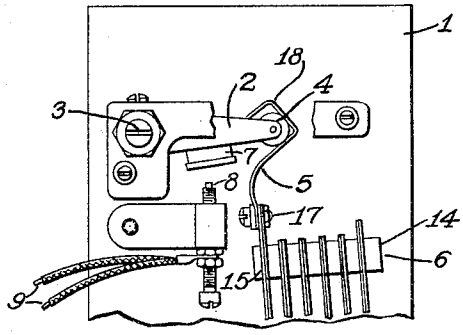


Fig. 5.

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THERMOSTATIC SWITCH

Filed April 8, 1924 2 Sheets-Sheet 2

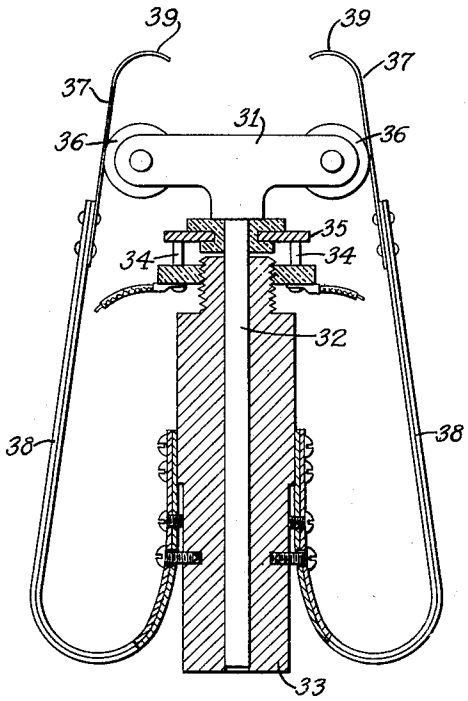


Fig. 6.

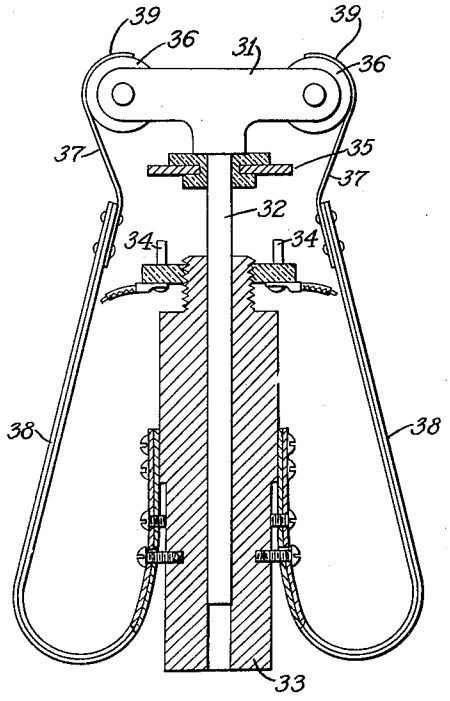


Fig. 7.

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UNITED STATES PATENT OFFICE.

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THERMOSTATIC SWITCH.

Application filed April 8, 1924. Serial No. 704,988.

My invention relates to electrical switches and particularly to thermostatic switches.

One object of my invention is to provide an electrical switch that shall respond abruptly upon the accumulation of a certain amount of energy by reason of a succession of minute temperature changes.

Another object of my invention is to provide a switch that shall operate in a plurality of directions by reason of minute changes in pressure applied thereto over an extended period of time.

Another object of my invention is to provide a snap switch that shall operate only when a given amount of mechanical energy has been developed in a thermal-responsive member and that returns abruptly to its initial position after the thermal-responsive member again becomes de-energized.

In the operation of snap switches by thermal-responsive means, it has been found that the energy stored in the thermal-responsive member increases slowly and that, if the switch is directly operated by the thermal-responsive member, there is a tendency for the switch to flutter or chatter near its operating point. In order to avoid this difficulty, it has been found advisable to so construct the thermal-responsive member that it tends to retain the switch in its advanced or closed position until a sufficient amount of energy has been stored in the thermal-responsive member to operate it with a positive or snap action. The present invention contemplates the provision of an improved means for actuating the switch in accordance with the foregoing principles.

In the accompanying drawings,

Figure 1 is an elevational view of a switch embodying my invention.

Figs. 2 and 3 are left and right-hand edge views thereof, respectively.

Fig. 4 is a fragmentary view of Fig. 1 showing the position of the switch prior to the opening thereof.

Fig. 5 is a similar view showing the switch in its open position.

Fig. 6 is a view, partally in elevation and partially in section, of a modified form of my switch in its closed position.

Fig. 7 is a similar view showing the switch in its open position.

Referring to Figs. 1 to 5, inclusive, my invention comprises, in general, a base member 1 on which a lever 2 is pivotally mounted, as at 3, and which terminates in a roller 4 in tangential relation to a flexible spring 5 controlled by a thermal-responsive member 6.

The lever 2 carries a bridging member 7 that co-operates with stationary contact members 8 for controlling a circuit 9 extending to any suitable electrical translating device (not shown) over which it is desired to exercise control.

The thermal-responsive member 6 comprises a plurality of strips 11, each of which comprises a pair of strips of metals having different co-efficients of expansion, such as brass and nickel alloy. These strips are so adjustably mounted, as at 12, on the base member 1 that their effective length may be varied as desired. The strips are so arranged that they all move in the same direction and by substantially the same amount with a given change in their thermal condition. The other ends of the several strips are provided with slots 13 for engagement with a stud 14. The stud 14 extends thru and unites the several bimetallic strips 11 so that the combined energy of the thermal-responsive device 6 is concentrated at the base 15 of the stud 14. The purpose of the several slots 13 in the strips 11 is to avoid any tendency toward longitudinal constriction of the strips during their changes of shape when subjected to different temperatures.

Suitable stop members 16 are mounted on the base 1 in order to limit the movement of the thermal-responsive device 6. The spring 5 is secured to the thermal-responsive device 6, as at 17, adjacent to the end 15 of the stud 14 whereby the end of the spring 5 is subjected to the accumulated pressure of the thermal responsive device 6. The other end of the spring 5 terminates in a hook 18 of such shape that it constitutes a stop for the roller 4 under conditions hereinafter described.

Referring to Fig. 1, the switch is shown in the position assumed when the thermal responsive device 6 is at a low or inoperative temperature. In this figure, the point of tangency between the roller 4 and the spring 5 is above the axis of the lever 2, the axis

of the lever 2 being defined by the pivot 3 and the center of the roller 4. The angle above the lever 2 between the axis of the lever 2 and the plane of tangency between the roller 4 and the spring 5 is less than a right angle. Under these conditions, the pressure exerted by the spring 5 on the roller 4 tends to bias the lever 2 in a downward direction, whereby the bridging member 7 engages the stationary contact members 8.

Referring to Fig. 4, it is assumed that the thermal responsive device 6 has become heated to an appreciable degree and the stud 14 has moved to the left of the base member 1, with the result that the spring 5 has become slightly distorted and the plane of tangency between the roller and the spring is substantially at a right angle to the axis of the lever 2. In this position, the bridging member 7 still engages the stationary contact members 8.

Referring to Fig. 5, the thermal-responsive device 6 is shown as having moved further to the left of the base member 1 and the spring 5 has become still further flexed, thereby causing the angle above the lever 2 between the axis of the lever 2 and the plane of tangency defined by the spring 5 and the roller 4 to become shifted so that it is greater than a right angle. Under these conditions, it is obvious that the spring 5 biases the lever 2 in an upward direction.

Movement of the lever 2 from the lower to its upper position is accomplished with a snap action at a time when the angle between the axis thereof and the plane of tangency is substantially a right angle. Unlimited upward travel of the lever 2 is prevented by the engagement of the roller 4 with the hook 18. If desired, the weight of the lever 2 may be made such that the influence of the force of gravity opposes the action of the spring 5 until the angle above the lever 2 between its axis and the plane of tangency is slightly above 90°. This construction is somewhat preferred for the reason that the weight of the lever 2 and connected parts aids in a return movement hereinafter described.

Upon the interruption of the circuit between the bridging member 7 and the stationary contact members 8, the connected translating device (not shown) may go through any desired cycle of operation, such that the thermal responsive member 6 is permitted to cool, during which operation the stud 14 is moved to the right of the base member 1. As the stud 14 moves to the right, the deflection of the spring 5 and, accordingly, the pressure exerted by it upon the roller 4 decreases and the angle between the plane of tangency and the axis of the lever 2 gradually reapproaches a right angle. The shape of the hook 18 is such as to exert a certain pressure on the lever 2 tending to move it downwardly in addition to the natural closing tendency of the spring returning to its initial position, when the angle between the plane of tangency and the axis of the lever 2 again reaches substantially a right angle, and the lever 2 returns to the position shown in Fig. 1 with a snap action.

In Figs. 6 and 7 is shown a modified form of my invention. A frame 31, having a plunger 32, is secured to a polygonal base member 33. Stationary contact members 34 are mounted on the base member 33, and a bridging member 35 is carried by the frame 31, the extremities of which terminate in rollers 36.

Springs 37, in tangential relation to the rollers 36, are secured to the base member 33 through the medium of curved bimetallic elements 38. Springs 37 terminate in hooks 39 for a purpose similar to the hooks 18 heretofore described.

The operation of this form of my invention is similar to that shown and described in connection with that form shown in Figs. 1 to 5, inclusive. Upon the heating of the bimetallic members 38, the points of tangency between the rollers 36 and springs 37 vary until the angles between the planes of tangency and the axis of the frame 31 result in an upward movement of the frame 31 and the disconnection of the bridging member 35 and the stationary contact members 34, as is shown in Fig. 7. As the bimetallic members 38 are permitted to cool, the angles between the axis of the frame 31 and the planes of tangency defined by the rollers 36 and the springs 37, vary until the frame 31 returns abruptly to the position shown in Fig. 6.

While I have shown and described a bimetallic element, in both forms of my invention, as the actuating element for the springs 5 and 37, it is to be understood that any other source of mechanical energy may be applied to the springs for operating the switch and that such devices are considered to fall within the scope of the hereinafter appended claims.

By my invention, I have provided a switch that operates upon the accumulation or dissipation of a given amount of energy in small increments. For this reason, my improved switch is particularly adapted for use in connection with the control of temperatures where temperature changes are relatively slow in their manifestation, thereby avoiding the fluttering or chattering experienced when a switch is directly operated by such thermal responsive devices.

I do not wish to be restricted to the specific circuit connections or arrangement of parts herein set forth, as various modifications thereof may be effected without departing from the spirit and scope of my in-

vention. I desire, therefore, that only such limitations shall be imposed as are indicated in the appended claims.

I claim as my invention:

1. In a switch structure, a pivoted lever, a roller carried at an extremity thereof, a pair of relatively movable contact members controlled thereby, and a resilient member cooperating with the roller, in tangential relation therewith and thermally-influenced means for actuating said resilient member.

2. In a switch structure, a pivoted lever, a roller carried at an extremity thereof, a pair of relatively movable contact members controlled thereby, and a curved resilient member co-operating with and bearing against the roller, and thermally-actuated means for varying the point of tangency between the roller and the resilient member by varying the pressure exerted by the resilient member on the roller.

3. In a switch structure, a pair of relatively movable contact members, controlling means therefor comprising a roller, a resilient member in tangential relation to the roller, and thermally-actuated means for varying the pressure exerted by the resilient member on the roller.

4. In a switch structure, a pair of relatively movable contact members, controlling means therefor comprising a roller, a resilient member in tangential relation to the roller, and thermally-actuated means for varying the pressure exerted by the resilient member on the roller whereby the tangential relation between said roller and said member is varied.

5. In a switch structure, a pair of relatively movable contact members, controlling means therefor comprising a roller, a resilient member in tangential relation to the roller, and thermally-actuated means for varying the pressure exerted by the resilient member on the roller, whereby, at any time, the tangential relation between said roller and said member is dependent upon the pressure exerted by the resilient member on the roller.

6. In a switch structure, a pair of relatively movable contact members, controlling means therefor comprising a roller, a resilient member in tangential relation to the roller, and thermally-actuated means for varying the pressure exerted by the resilient member on the roller, whereby the angular relation between the plane of tangency defined by the roller and the resilient member and an axis of the controlling means varies in accordance with the pressure exerted by the resilient member on the roller.

7. In a switch structure, a pair of relatively movable contact members, controlling means therefor comprising a roller, a resilient member in tangential relation to the roller, and thermally-actuated means for varying the pressure exerted by the resilient member on the roller, whereby the angular relation between the plane of tangency defined by the roller and the resilient member and an axis of the controlling means varies in accordance with the pressure exerted by the resilient member on the roller, the controlling means tending to suddenly change its position when said angular relation is approximately a right angle.

8. In a switch structure, a pair of relatively movable contact members, controlling means therefor comprising a roller, a resilient member in tangential relation to the roller, the resilient member terminating in a hook, and thermally-actuated means for varying the pressure exerted by the resilient member on the roller whereby the angular relation between the plane of tangency defined by the roller and the resilient member and an axis of the controlling means varies in accordance with the pressure exerted by the resilient member on the roller, the controlling means tending to suddenly change its position when said angular relation is substantially a right-angle, said hook serving to limit the movement of said controlling means in one direction.

9. In a switch structure, a pair of relatively movable contact members, controlling means therefor comprising a roller, a resilient member in tangential relation to the roller, the resilient member terminating in a hook, and bimetallic means for varying the pressure exerted by the resilient member on the roller whereby the angular relation between the plane of tangency defined by the roller and the resilient member and an axis of the controlling means varies in accordance with the pressure exerted by the resilient member on the roller, the controlling means tending to suddenly change its position when said angular relation is substantially a right-angle, said hook serving to limit the movement of said controlling means in one direction and to initiate a reverse movement of the controlling means under certain conditions.

10. In a switch structure, a pair of relatively movable contact members, controlling means therefor comprising a roller, a resilient member in tangential relation to the roller, and bimetallic means supporting the resilient member for varying the pressure exerted by the resilient member on the roller.

11. In a switch structure, a pair of relatively movable contact members, controlling means therefor comprising a roller, a resilient member in tangential relation to the roller, the resilient member terminating in a hook, and bimetallic means for varying the pressure exerted by the resilient member on the roller whereby the angular relation between the plane of tangency defined by

the roller and the resilient member and an axis of the controlling means varies in accordance with the pressure exerted by the resilient member on the roller, the controlling means tending to suddenly change its position when said angular relation is substantially a right-angle, said hook serving to limit the movement of said controlling means in one direction.

12. In a switch structure, a pair of relatively movable contact members, controlling means therefor comprising a roller, a resilient member in tangential relation to the roller, the resilient member terminating in a hook, and bimetallic means for varying the pressure exerted by the resilient member on the roller whereby the angular relation between the plane of tangency defined by the roller and the resilient member and an axis of the controlling means varies in accordance with the pressure exerted by the resilient member on the roller the controlling means tending to suddenly change its position when said angular relation is substantially a right-angle, said hook serving to limit the movement of said controlling means in one direction and to initiate a reverse movement of the controlling means under certain conditions.

13. In a switch structure, co-operating relatively movable contact members, controlling means therefor comprising a roller, a resilient member in tangential relation to the roller, the resilient member terminating in a hook at one end, and thermally-actuated means secured to the other end of the resilient member for varying the point of tangency between the roller and the resilient member, said hook serving to limit the variation in the point of tangency in one direction.

14. In a switch structure, a pivoted lever, a pair of relatively movable contact members controlled thereby, a resilient member cooperating with the free end of said lever in tangential relation therewith, and thermally-influenced means for actuating said resilient member.

15. In a switch structure, a pivoted lever, a contact member controlled thereby, a resilient member engaging a free end of said lever in tangential relation therewith, and thermally-actuated means for varying the pressure exerted by the resilient member on said free end of the pivoted member.

In testimony whereof, I have hereunto subscribed my name this 28th day of March 1924.

AUGUST J. MOTTLAU.