April 12, 1938. C. M. HATHAWAY 2,114,184

THERMOSTATIC MECHANISM

Filed Dec. 18, 1935

Fig. 1.

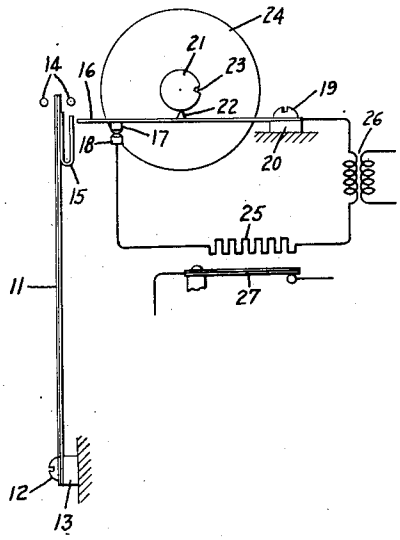


Fig. 2.

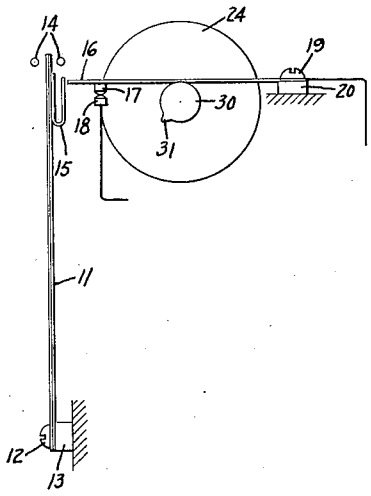


Fig. 3.

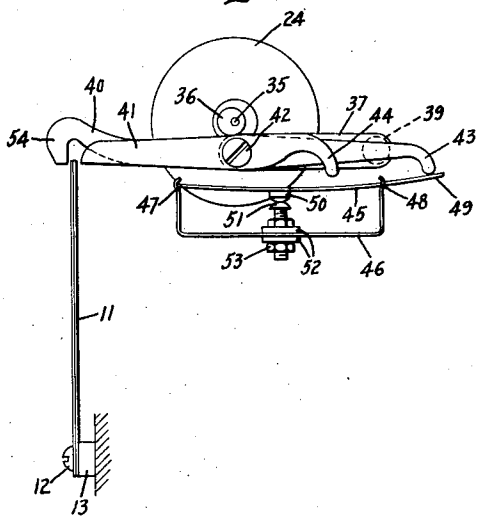
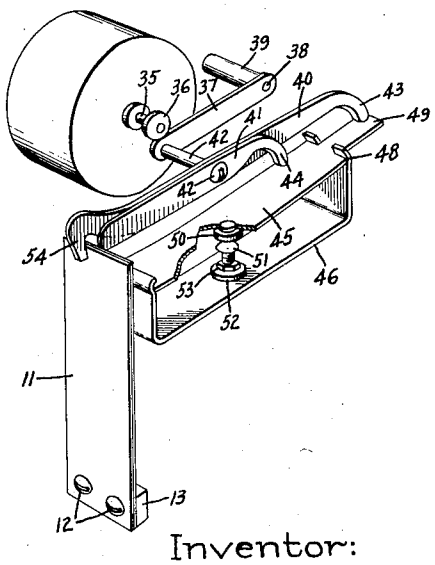


Fig. 4.



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THERMOSTATIC MECHANISM

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12 Claims. (Cl. 200—138)

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

An object of my invention is to provide a thermostatic switch mechanism in which the thermal responsive element merely controls the opening and closing of the contacts and in which the necessary contact pressures are obtained by other means.

A further object of my invention is to provide a switch mechanism in which a thermal responsive member is adapted under predetermined temperature conditions to restrain the movement of a constantly oscillated contact actuating member to control the relative position of circuit controlling contacts.

A still further object of my invention is to provide a switch mechanism with a pair of constantly oscillated switch actuating arms having no effect upon the switch when the temperature is within predetermined limits and which, when the temperature is without said predetermined limits, are selectively restrained in their movement by a thermal responsive element positioned transversely of said pair of arms to operate the switch from one control position to another.

In the past simple bimetallic thermostats provided with contacts on their free ends adapted to cooperate with stationary contacts have been widely used. Difficulties arise in the use of such thermostats due to the low contact pressures obtainable with the small amount of bimetal that must be used to produce a thermostat sufficiently sensitive to temperature changes and the vibration of the contacts resulting when a small amount of bimetal is used causes a great deal of radio interference and relay chattering. Experience indicates that thermostats should follow temperature changes as rapidly as possible and that the contact pressure should not be less than one half ounce for dependable operation over long periods of time. My invention obviates these difficulties and makes it possible to obtain contact pressures as great as desired with any desired differential between the make and break temperatures of the thermostat and in which only a small amount of bimetal is necessary.

My invention will be pointed out with greater particularity in the appended claims and for a complete understanding of my invention reference may be had to the accompanying drawing taken in connection with the following description. In the drawing, Fig. 1 is a diagrammatic illustration of a preferred form of the invention; Fig. 2 is a diagrammatic illustration of a modification of the form shown in Fig. 1; Fig. 3 is a side view of another form of the invention; and Fig. 4 is a perspective view of the modification shown in Fig. 3.

Referring to Fig. 1, I have shown a bimetallic thermal responsive element 11 attached to a suitable support by means of screws 12 and spaced therefrom by spacing member 13. The bimetallic element is responsive to variations in temperature of the air surrounding it and it is obvious that my improved switch mechanism may be placed wherever it is desired to exert a control in response to variations in temperature. The bimetallic element may be arranged to deflect in either direction in response to an increase or decrease in temperature by merely reversing its position and in the embodiments shown in Figs. 1 and 2 it is so arranged that it will deflect in a clockwise direction in response to an increase in temperature. The movement of the element is kept within predetermined limits by means of stops 14 which may be adjustably mounted. Mounted near the upper or free end of the bimetallic element is a U-shaped member 15 made of thin, flat, spring material. The latter is adapted to restrain the movement of an oscillatable arm 16, movable in a predetermined path substantially in alignment with the stationary end of bimetallic element 11, and made in the form of a flat spring and carrying a contact 17 adapted to cooperate with a stationary contact 18. When the movement of member 16 is restrained it may be noted that the resulting pressure on the bimetallic element is transmitted therethrough to its support and that there will be but a relatively small force tending to cause bending of the element about its support. This permits the use of relatively thin bimetallic elements and results in the possibility of obtaining greater sensitivity.

The oscillatable member 16 is mounted upon a suitable support by means of screws 19 and a spacing member 20 and is arranged to oscillate in the same plane as the bimetallic element, the latter being arranged substantially at right angles to the former. The member 16 is biased in such manner that the contacts 17 and 18 tend to separate, but these contacts are held in engagement by means of a cam 21 which cooperates with an upstanding portion 22 on the oscillatable member. The cam is provided with a depressed portion 23 which permits the oscillatable element 16 to move upwardly for a brief period during each revolution of the cam, allowing the contacts 17 and 18 to separate. The cam 21 is mounted on the shaft of a clock mechanism 24, and, although in my preferred embodiment I have illustrated it as a

telechron motor, any suitable timing means may be utilized. The shaft may be rotated once each minute or any other desirable period depending upon the time lag permissible between the attainment of the temperature and the exertion of the control. The contacts 17 and 18 are in series relationship with heating element 25 of a thermal relay and the secondary winding of a transformer 26, the primary of which may be connected to any suitable source of power. Associated with the relay winding is a bimetallic circuit controlling member 27 which, in my preferred embodiment, I have illustrated as adapted to bridge normally open contacts in a control circuit. The relay may, however, be used for any control purpose, whether it be the control of an electric circuit or of mechanical devices. Since the thermal relay operates with a time lag of from 10 to 30 seconds, it is not immediately responsive to the opening of the circuit at 17 and 18 and thus the momentary opening of the contacts by the cam will not deenergize the relay.

The operation of my device will now be described briefly. The telechron motor, energized from any suitable source, rotates cam 21 continuously and, if the temperature conditions are such that the bimetallic element 11 remains in the position indicated in the figure, then the contacts 17 and 18 are closed, except for momentary intervals, by means of cam 21. It is apparent that any contact pressure desired may be applied to the contacts in this manner as the thermal force generated by the bimetallic element is not necessary to open or close the contacts. The oscillatable member 16 moves upwardly once during each rotation of the cam when projection 22 is free to move upwardly into the space defined by depression 23. During this brief period the contacts 17 and 18 are disengaged but, as stated above, the duration of this period is so short that the thermal relay operating with a certain time lag will not become deenergized.

Assuming now that the temperature within the space where the thermostatic switch is located rises to such an extent that it exceeds a certain predetermined limit, then the bimetallic element 11 will move to the right. The movement of the bimetallic element to the right will be limited by member 16 while the latter is held in its lower position by means of cam 21 but upon the movement of the oscillatable member 16 upwardly, the thermal responsive element will move further to the right to an extent limited only by stops 14. As the cam rotates, pressure will be again applied to the oscillatable member tending to force contacts 17 and 18 into engagement, but the U-shaped element 15 attached to the free end of the thermostat will restrain movement thereof and the contacts will remain open. The disengagement of contacts 17 and 18 deenergizes the heater 25 and consequently bimetallic member 27 will cool. As it cools the circuit contacts associated with it will be opened and thus any desired control may be exerted.

As long as the temperature remains above a predetermined limit the contacts 17 and 18 will remain disengaged but when the temperature decreases bimetallic element will move to the left allowing the cam to close these contacts. Thereupon the heater element 25 of the thermal relay will be energized, cause heating of bimetallic element 27 and reclosure of the contacts associated with the latter.

It is evident that my invention provides a simple, reliable and sturdy thermostatic switch which is not liable to get out of repair and one in which positive closure of the contacts is obtainable with a minimum of bimetal.

Fig. 2 discloses a modification of the construction shown in Fig. 1. In this figure as well as in the figures to be described later similar reference numerals are used to indicate like parts. The only difference between the modifications shown in Figs. 1 and 2 lies in the fact that in the latter the movable contact carrying member 16 is biased into contact closing position and is moved upwardly by a projection 31 on a cam 30 for a brief period during each revolution of the cam. The operation of this mechanism is practically identical with that of Fig. 2 and it will not be necesary to go into it in detail. Suffice it to say that with certain temperaure conditions obtaining within the locality of the bimetallic element 11 the contacts 17 and 18 are held in engagement and are opened momentarily periodically by the cam, the duration of the period being so short that the relay associated with the circuit is not deenergized. Upon the change of temperature beyond a certain limit in a predetermined direction the downward closing movement of member 16 is restrained by the bimetallic element 11 and the relay deenergized.

The modification of my invention illustrated in Figs. 3 and 4 is an improved form of my invention. As in the embodiments described above the bimetallic element 11 is affixed to a suitable support by means of screws 12 and spacer 13. On a clock driven shaft 35 and rotatable therewith is mounted an eccentric cam 36 adapted to continuously oscillate a member or arm 37 pivotally mounted as at 38 on a suitable supporting member 39. A pair of members or arms 40 and 41 are copivotally mounted, intermediate their ends, on member 37 by means of screw 42, shown extended in Fig. 4 to more clearly illustrate the construction. As arm 37 is oscillated by cam 36, it is obvious that members 40 and 41 will oscillate therewith. One end of each of members 40 and 41 is provided with a downwardly extending portion 43 and 44, respectively, adapted to cooperate with a flexible buckling spring member 45 of a snap switch. The flexible spring member is mounted on a substantially U-shaped support 46 at one end, as shown at 47, and at a point intermediate its ends, as shown at 48. The flexible member 45 is provided with an extending portion 49 arranged to cooperate with extension 43 of arm 40. It also carries a movable contact 50 adapted to cooperate with a stationary contact 51 carried by and suitably insulated from the support member 46 by means of insulating members 52. The contact 51 is held in spaced relationship to the support by suitable fastening means such as nuts 53.

The other end of member 40 is provided with an inverted substantially U-shaped portion indicated at 54, defining a space therebetween and the like end of member 41 into which the bimetallic element 11 is adapted to project under certain temperature conditions to be described later. If the bimetallic element moves to the right, it restrains motion of member 41 causing the latter to move in a clockwise direction to apply pressure to flexible element 45 at a point intermediate the two points at which it is supported. This causes the flexible element to snap into reverse curvature and carry the movable contact into the position shown in Fig. 3. The switch remains in this position as long as the bimetallic element restrains motion of member 41 or is in the position

indicated in the drawing. However, upon a further change in temperature in the opposite direction bimetallic element 11 restrains motion of member 54 causing the latter to move in a relatively clockwise direction thus causing a pressure to be applied to portion 49 of flexible element 45 by means of the downwardly depending portion 43 of the arm 40. The application of this pressure causes the snapping of movable element 50 out of engagement with the contact 51.

The operation of the embodiment shown in Figs. 3 and 4 will now be described with greater detail. Assuming the temperature conditions to be such as to maintain the bimetallic element in the position shown in Figs. 3 and 4 and the switch to have been last actuated by arm 41 to position the contacts in engagement with each other, the timing means 24 will constantly reciprocate members 37, 40 and 41 without affecting the switch. Assuming that there is an increase in temperature causing the bimetallic element 11 to deflect to the left, then the movement of arm 40 will be restrained by the positioning of the bimetallic element 11 beneath extended portion 54 of the arm. As cam 36 rotates to move arm 37 in a counter-clockwise direction, it is evident that the arm 40 will move in a clockwise direction causing the downwardly extending portion 43 to contact with and apply pressure to extended portion 49 of the flexible contact carrying element 45. This pressure causes buckling of member 45 and the opening of contacts 50 and 51. As long as bimetallic element 11 remains positioned beneath member 54 the switch will remain in its open position. Assuming now that the temperature decreases and that bimetallic element 11 reassumes the position shown in Fig. 3, then the switch will be maintained in its open position. Upon the further decrease in temperature the bimetallic element 11 will finally deflect to the right an amount sufficient to restrain the movement of member 41, causing the latter to be moved in a clockwise direction as cam 46 oscillates member 37 downwardly. Pressure is thus applied through downwardly extending portion 44 of member 41 on the flexible element 45 intermediate the points at which the latter is supported, causing a closing of contacts 50 and 51.

It will be evident to those skilled in the art that my improved thermostatic mechanism may be utilized equally well in control in which it is desired to open or close contacts at a predetermined low temperature merely by modifying the construction of arms 40 and 41 and placing the extended inverted U-shaped portion on arm 41 and making arm 40 similar in shape to 41 as shown in the drawing. It is evident also that the opening and closing of the contacts may be arranged to occur at practically any temperature differences by simply changing the characteristics of the bimetallic member or by properly spacing arms 40 and 41 with respect to each other.

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

1. In a thermostatic control, the combination of circuit controlling means, power operating means therefor including a continuously rotating element, a member continuously oscillated thereby and periodically movable for operating said circuit controlling means, and thermal responsive means forming a stop operable into and out of the path of oscillation of said member for selectively controlling the periodic movement thereof to control the operation of said circuit controlling means.

2. In a temperature control, the combination including circuit controlling means, power operating means therefor including a continuously rotating element having a lever continuously oscillated thereby, and means for periodically rendering said lever effective to operate said circuit controlling means, including thermal responsive means having a movable fulcrum for said lever operable into and out of the path of oscillation thereof.

3. In combination, a switch mechanism having an oscillating operating member, power operating means therefor including a continuously rotating element connected with said operating member for oscillating said member through a predetermined path, and a bimetal strip having one end thereof fixedly mounted and the free end thereof movable in response to temperature variations into and out of said predetermined path for selectively causing oscillation of said operating member in a different path to control the operation of said switch mechanism.

4. A temperature control mechanism including a movable control device, power operating means therefor including a member continuously oscillatable in each of two paths, said member being effective in one of said paths for periodically actuating said device, and means including a bimetal strip having one end fixedly mounted and the other end selectively movable in response to temperature variations into and out of engagement with said member for selectively determining the path of oscillation thereof.

5. In a thermostatic switch, the combination including a stationary contact, a cooperating movable contact, a member mounting said movable contact and biased to move said movable contact out of engagement with said stationary contact, cam means for causing engagement of said contacts, means including said cam for periodically oscillating said member for momentarily disengaging said contacts, and thermal responsive means movable in response to a predetermined temperature variation for restraining movement of said member for preventing closure of said contacts.

6. In a thermostatic switch, the combination including a stationary contact, a movable contact, a member mounting said movable contact and biased to cause engagement of said contacts, cam means for periodically oscillating said member for momentarily disengaging said contacts, and thermal responsive means movable in response to a predetermined temperature variation for restraining movement of said member for preventing engagement of said contacts.

7. In combination, a pivotally mounted member, means for constantly oscillating said member, a pair of members pivotally mounted on said first member for oscillation therewith, an electric switch, means for oppositely actuating said switch upon successive restraint of movement of said last mentioned pair of members, and thermal responsive means for selectively restraining movement of said members upon opposite variation in temperature without predetermined limits.

8. In combination, an overcenter snap action switch, power operating means therefor including a continuously rotating element having a pivotally mounted member oscillated thereby, a pair of levers pivotally mounted on said member and oscillatable as a unit therewith, and thermal

responsive means having a movable fulcrum for selectively engaging either of said levers to oppositely actuate said switch.

9. In a thermostatic switch the combination including a pivotally mounted arm, means for oscillating said arm, a pair of arms pivotally mounted on said first mentioned arm and reciprocable therewith, a pair of cooperating stationary and movable contacts, a member responsive to thermal variations to selectively restrain movement of said pair of arms, means actuated upon the restraint of movement of one of said pair of arms for causing engagement of said contacts, and means actuated upon the restraint of movement of the other of said pair of arms for causing disengagement of said contacts.

10. In combination, a movable member, means for constantly oscillating said member, a pair of members pivotally mounted on said first member and oscillatable therewith, electrical control means, means oppositely actuating said control means upon successive relative movement between said pair of members and said first mentioned member, and thermal responsive means having a stop selectively operable into the paths of said pivoted member to effect relative movement between said members upon opposite variation in temperature without predetemined limits.

11. In combination, a stationary contact mounted on a substantially U-shaped frame, a movable contact mounted on a flexible member supported on said frame at one end and at a point intermediate its ends, said member being adapted to snap into reverse curvature in one direction to cause engagement of said contacts upon the application of pressure thereon at a point intermediate the supports, and in the other direction to cause disengagement of said contacts upon the application of pressure thereon at a point beyond said intermediate point.

12. In combination, a stationary contact mounted on a substantially U-shaped frame, a movable contact mounted on a flexible member supported on said frame at one end and at a point intermediate its ends, said member being adapted to snap into reverse curvature in one direction to cause engagement of said contacts upon the application of pressure thereon at a point intermediate the supports, and in the other direction to cause disengagement of said contacts upon the application of pressure thereon at a point beyond said intermediate point, a pivotally mounted member, means for constantly oscillating said member, a pair of members copivotally mounted intermediate their ends on said last mentioned member and oscillatable therewith, means selectively restraining movement of said pair of members for applying pressure on predetermined portions of said flexible member for causing engagement and disengagement of said contacts in response to temperature variations without predetermined limits, said means including extended portions at one end of each of said pairs of members adapted to cooperate with said flexible member, the other end of each of said pair of members extending different distances in the opposite direction from their pivotal point, the longer of said members having a substantially inverted U-shaped portion extending from its end to a point between the end of the shorter member and said pivotal point, and a thermal responsive element arranged transversely of said oscillatable members permitting free movement thereof when the temperature variation is within said limits and selectively restraining movement of said pair of members when the temperature variation exceeds said predetermined limits.

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