H. A. MULVANY & H. E. KENNEDY.

THERMOSTAT.

APPLICATION FILED MAR. 2, 1916.

1,294,141.

Patented Feb. 11, 1919.

2 SHEETS—SHEET 1.

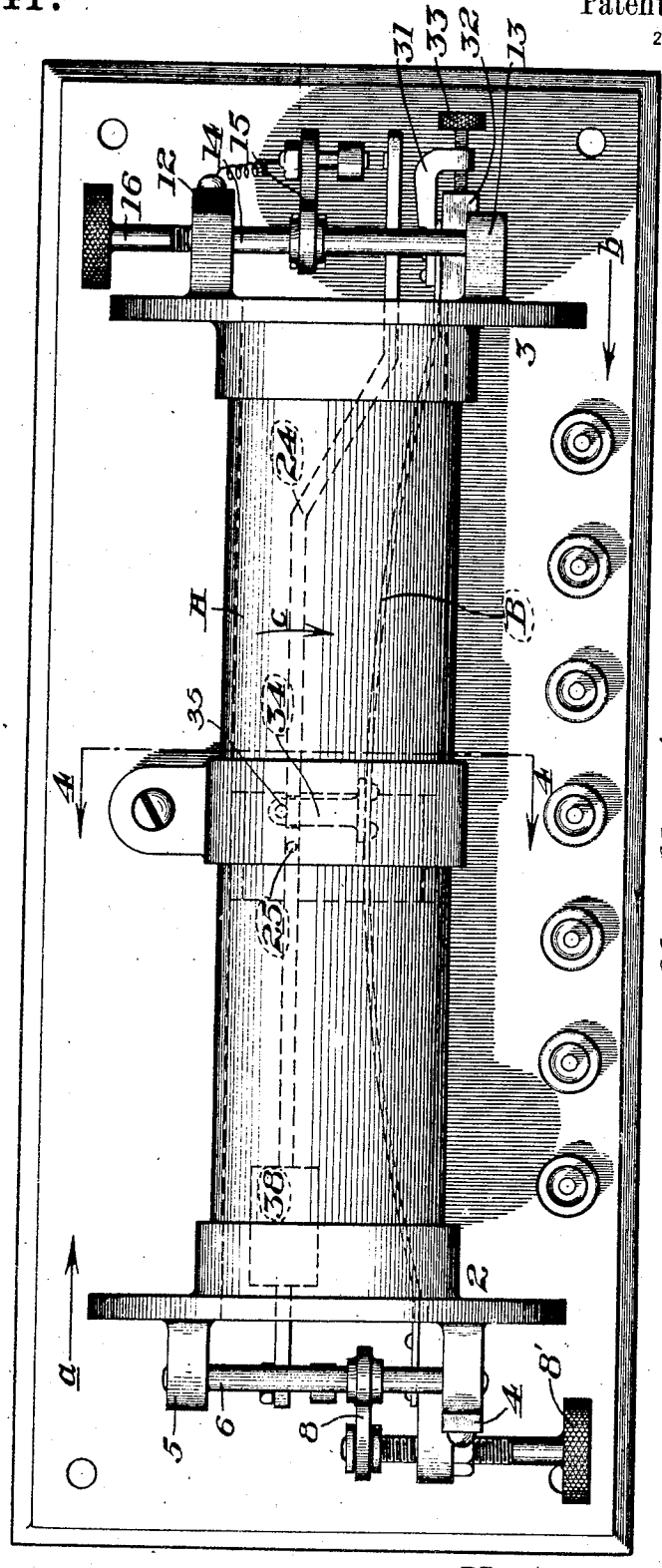


Fig. 1.

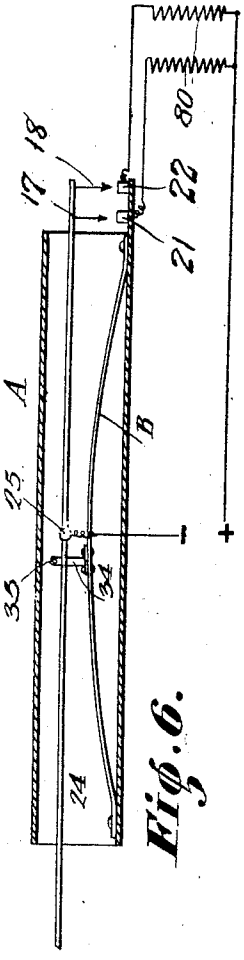


Fig. 6.

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2 SHEETS—SHEET 2.

Fig. 2.

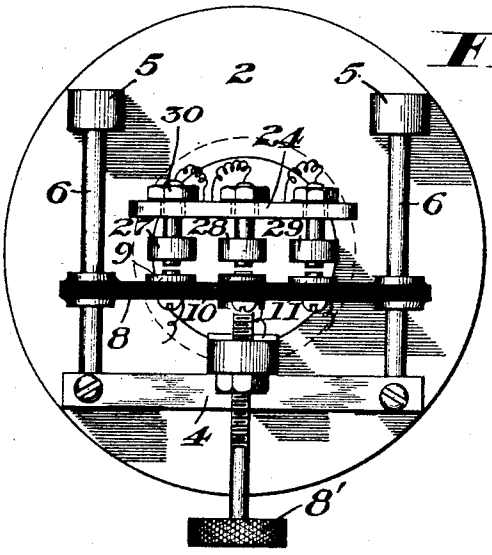


Fig. 7.

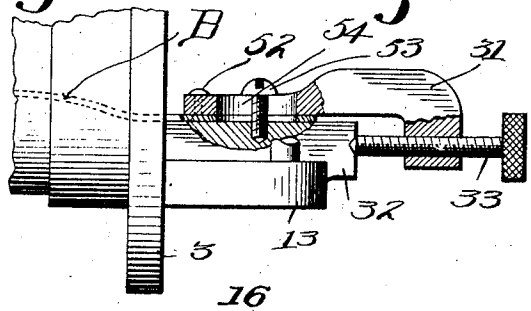


Fig. 3.

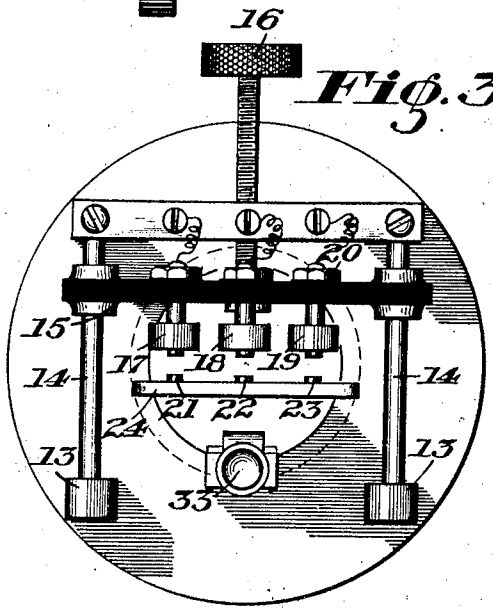


Fig. 5.

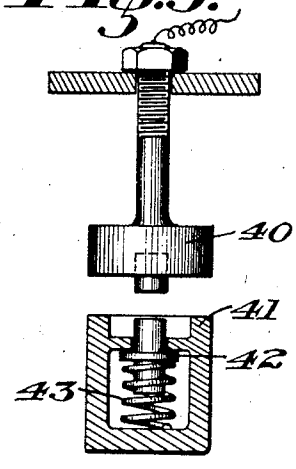
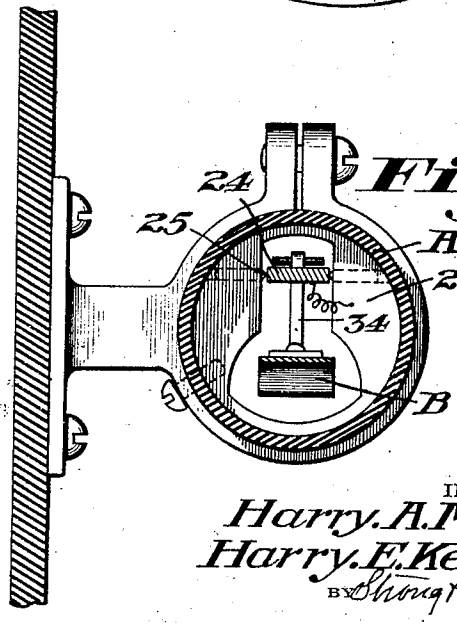


Fig. 4.



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UNITED STATES PATENT OFFICE.

HARRY A. MULVANY AND HARRY E. KENNEDY, OF BERKELEY, CALIFORNIA, ASSIGNORS TO ELECTRIC SALES SERVICE CO., OF SAN FRANCISCO, CALIFORNIA, A CORPORATION OF CALIFORNIA.

THERMOSTAT.

1,294,141. Specification of Letters Patent. Patented Feb. 11, 1919.

Application filed March 2, 1916. Serial No. 81,653.

To all whom it may concern:

Be it known that we, HARRY A. MULVANY and HARRY E. KENNEDY, citizens of the United States, residing at Berkeley, in the county of Alameda and State of California, have invented new and useful Improvements in Thermostats, of which the following is a specification.

This invention relates to a thermostat.

One of the objects of the present invention is to provide a simple, substantial, easily adjusted thermostat capable of accurately regulating temperatures of either liquids or fluids, and also adapted to make or break in unison or successively a plurality of separate electric circuits.

Another object of the invention is to so construct and arrange the thermostat that no cramping or distortion of same will result from unusual high or low temperatures. Another object is to provide means for snapping or quickly separating the contacts when breaking a circuit to prevent flashing or burning of the points. Further objects will hereinafter appear.

The invention consists in the parts and the construction and combination of parts, as hereinafter more fully described and claimed, having reference to the accompanying drawings, in which—

Figure 1 is a side elevation of the thermostat.

Fig. 2 is an end view looking in the direction of arrow *a*.

Fig. 3 is an end view looking in the direction of arrow *b*.

Fig. 4 is a cross section on line 4—4, Fig. 1.

Fig. 5 shows a modified form of the contacts.

Fig. 6 is a diagrammatic view of the electric circuit through the thermostat and the heaters controlled thereby.

Referring to the drawings in detail, A and B indicate respectively the movable elements of the thermostat. These elements are constructed of different metals or materials, whose coefficients of expansion are as different as possible. The element A is in this instance constructed of hard rubber and is tubular in shape, while the element B consists of a thin steel spring adjustably mounted with relation to the tube A, as will hereinafter be described. Suitably secured on each end of the tube is a head member, such as indicated at 2 and 3, and formed on the front face of the head 2 is a bracket plate 4 and above the same, a pair of extension lugs 5 between which and the bracket 4 is mounted a pair of guide rods 6. Slidably mounted on the rod 6 is a cross-bar 8 which may be raised and lowered by means of a thumb screw 8′ and suitably secured in the cross-bar and insulated therefrom is a plurality of contact members 9, 10 and 11. Similarly formed on the opposite head 3 is a bracket plate 12 and a pair of extension lugs 13 between which is secured a pair of guide rods 14, and slidably mounted on said rods is a cross-bar 15, the position of which may be adjusted by means of a thumb screw 16. The cross-bar is in this instance provided with a plurality of slidably mounted drop head contact members 17, 18, and 19, the position of which may be adjusted by means of nuts 20 secured on their upper ends. By this arrangement it becomes possible to adjust the position of the contacts 17, 18 and 19, thus permitting one or more circuits to be closed either simultaneously or in successive order by means of the coöperating contact members 21, 22 and 23. Mounted intermediate of the tube is a switch lever 24 which is pivotally supported as at 25, in a bearing member 26 positioned interior of the tube centrally between the heads 2 and 3. The switch lever extends through the tube as shown and one end is provided with a plurality of drop head contact members 27, 28 and 29, which coöperate with the contacts 9, 10 and 11. These drop head contacts are also adjustably and slidably mounted, the adjustment being secured by the nuts 30. A plurality of circuits separated from the circuits controlled by the opposite drop heads may thus be opened or closed either in unison or in successive order. The element B or the steel spring is secured at one end to the bracket plate 4 and at the opposite end by rivets 52 to a plate 31, which is slidably mounted on a lug 32 formed on the head 3. This plate is normally secured on the lug by a set-screw 53 which passes through a slot 54 formed in

the plate and the spring. The set-screw rigidly secures the spring at all times except when it is desired to adjust or regulate its tension. An adjusting screw 33 passing through the member 31 and engageable with the end of the lug is employed for this purpose. A rise or fall in temperature will cause the tube A to expand or contract lengthwise a greater distance than the spring B and will thus cause it to either be compressed or extended, as the case may be. This movement of the spring B is in the present instance transmitted to the pivotally mounted switch lever 24 by means of a link 34, which extends through a slot formed in the lever 24 on one side of the pivot 25. A pin 35 secured in the upper end of the link engages the upper side of the lever when the spring is extended and will thus cause the lever to rock about the pivot 25 in the direction of arrow *c*, causing the coöperating contacts 17—21, 18—22, and 19—23 to break in unison or in successive order, and similarly the contacts 9—27, 10—28 and 11—29 to break in unison or in successive order.

The contraction of the tube as previously described causes compression of the spring B and consequently moves the link 34 in an upward direction through the slotted lever. The pin 25 will then move away from the lever and will permit this to assume its normal position, shown in Fig. 1, which is controlled by a counter-weight 38. The movement of the pin 35 away from the lever permits the counter-weight to rock the lever about the pivot 25, thus closing one or more circuits when the contacts engage.

A thermostat constructed as here shown is capable of accurately regulating the temperature of either liquids or fluids. To describe its operation, we may consider it as connected with an electric water heater provided with six separate heating elements. Each end of the switch lever is in this instance provided with three sets of contact members and as six separate heating elements are employed in the water heater, it is only necessary to connect the respective terminals of the contacts with the respective heating elements. With the drop head contacts adjusted to close the circuits in successive order, it can easily be seen that when first starting the heater, all contacts will be closed, the current will thus pass through the several heating elements and permit these to raise the temperature of the water to for instance 180°. The moment this point is reached it is possible to so adjust the thermostat that a slight movement of the switch lever will first open one set of contacts, thus cutting out one heating element. If the temperature of the water still rises two, three, four or more heating elements may be cut out, leaving only one or two elements in operation, to make up for losses by radiation. In other words, maintaining the temperature of the water constant without cutting in or out all heating elements in unison.

The thermostat proper when employed for the purpose of regulating the temperature of heaters is preferably positioned at a point where the water will surround the tube A, thus permitting any slight variation in temperature to immediately effect the thermostat. The provision of the adjusting screw 33 provides one means whereby the thermostat may be adjusted, as it permits the tension in the spring B to be increased or decreased to suit various conditions. Further adjustment may be made by operating either adjusting screw 8′ or 16 and still further adjustment may be made by adjusting the position of the several drop head contacts. Accurate control of the temperature of liquids or fluids may thus be assured by the use of the single thermostat here shown. The arrangement of the spring with relation to the expansible tubular element A of the switch lever 24 prevents cramping or distortion of any of the parts of the mechanism when subjected to either extreme high or low temperatures. This can readily be understood from the following explanation:

If the thermostat is subjected to extreme low temperature contraction of the tube A will take place, the spring B will then be compressed and the link with connected pin 35 lifted in an upward direction; the pin will thus move away from the switch lever the moment the contacts are closed and it is thus prevented from transmitting any force to said parts. Extreme high temperature will cause expansion of the tube and cause the spring B to become extended. The movement of the link and pin will then be in a downward direction and will then cause the contacts to separate. No strain is thus placed upon the contacts at any time, nor is any strain transmitted to either of the thermally sensitive elements or the switch lever operated thereby. The greatest pressure that can possibly be applied to the contacts is that caused by the weight of the counterbalance 38, which may be adjusted by moving this in or out on the lever 24. The closing of the electric circuits is in this instance accomplished by a drop in temperature. This causes the link and pin to move away from the lever and permits this to descend by gravity against the contacts, thus closing the circuits through same. Increase of temperature beyond a predetermined degree will cause the tube A to expand and the spring B to become extended. Positive force of relatively large magnitude is thus applied directly to the lever to separate the contacts, thus obtaining an ideal condition, as it sometimes happens that the contact points become fused and stick.

The several difficulties common to ther-

mostats are not contained in the present device. The cramping of the contacts and consequent distortion or fatigue of the expanding members of the thermostat are entirely eliminated. The provision of a plurality of contacts adapted to be opened or closed either in unison or successive order permits the single thermostat to handle relatively high current values, for instance it is possible to use the current flow of two amperes or more through each set of contacts. This makes the final output comparatively large. The limited current rating of other than relay types makes most forms of thermostats unsuitable for the large current values required for treating large volumes, the only remedy being the use of several separate thermostats, which complicates the wiring, and furthermore, increases the difficulty of perfect adjustment.

For the purpose of permitting the contacts to be snapped apart or quickly separated when a circuit carrying a greater current flow than possible with slowly opening contacts is to be opened, the following arrangement may be employed:

Suitably secured on the lower end of each drop head contact is a permanent magnet 40 and formed around the opposite contact terminals are ring-shaped armature members 41. The contact mounted interior of the armature is preferably yieldably mounted. This is secured by providing a collar 42 between which and the lower end of the slot is interposed a spring 43. The closing of the contacts here shown permits the magnet 40 to positively grip the armature and secures the contacts against movement until a certain pressure is applied to the drop head, which is sufficient to overcome the magnetic pull.

The contacts are, as previously described, separated when the spring B is extended. Considerable vertical force must, therefore, be exerted upon the drop heads before the force of attraction of the magnets shall have been neutralized. The moment, however, that this equilibrium or equalization of forces is obtained, it can readily be seen that the contacts will be quickly snapped apart or separated, thus preventing flashing or burning of the contacts, which is so destructive to the accurate operation and adjustment of thermostat contacts.

The materials and finish of the several parts of the thermostat may otherwise be such as the judgment and experience of the manufacturer may dictate.

We wish it understood that various changes in form, proportions and minor details of construction may be resorted to within the scope of the appended claims and that we do not wish to limit ourselves to the specific design and construction here shown.

Having thus described our invention, what we claim and desire to secure by Letters Patent is—

1. A thermostat consisting of an expansible tubular member, a leaf spring secured within the tube adapted to be compressed or extended by the tube, and a pivotally mounted lever within the tube adapted to be rocked by a counter-weight in one direction and by the spring in the opposite direction, said lever adapted to close or open a pair of contacts controlling an electric circuit.

2. A thermostat comprising an expansible tube, a spring member in the tube having one end rigidly secured and the opposite end adjustably secured, and a lever pivotally mounted in the tube adapted to be rocked by the movement of the spring when the tube is expanded or contracted, said lever adapted to open or close a pair of contacts controlling an electric circuit.

3. A thermostat consisting of an expansible tubular member, a leaf spring secured within the tube and adapted to be compressed or extended by the tube, a pivotally mounted lever within the tube, and means for transmitting movement of the spring to rock the lever.

4. A thermostat consisting of an expansible tube, a spring member adapted to be compressed or extended by the tube, a lever pivotally mounted in the tube adapted to be rocked by the spring when the tube is expanded or contracted, a plurality of stationary contacts mounted adjacent one end of the tube, and a plurality of alined cooperating contacts carried by the lever and freely movable in a vertical direction.

5. A thermostat consisting of an expansible tube, a spring member adapted to be compressed or extended by the tube, a lever pivotally mounted in the tube adapted to be rocked by the spring when the tube is expanded or contracted, a plurality of stationary contacts mounted adjacent one end of the tube, a plurality of alined coöperating contacts carried by the lever and freely movable in a vertical direction, and means for adjusting the vertical movement of each individual contact carried by the arm.

6. A thermostat comprising an expansible tube, a spring member extending through the tube and having both ends secured thereto, to permit the spring to become compressed or extended by the expansion or contraction of the tube, a lever extending through the tube, a pivot member for the lever, approximately central thereof, a link connection formed between the spring and the lever, and a plurality of contact members positioned at both ends of the lever adapted to be opened or closed by the lever.

7. A thermostat comprising an expansible tube, a spring member extending through the tube and having both ends secured there-

to to permit the spring to become compressed or extended by the expansion or contraction of the tube, a lever extending through the tube, a pivot member for the lever, approximately central thereof, a link secured at one end to the spring and having its opposite end extending through a slot formed in the lever on one side of the pivot, a pin in the link engageable with the lever when the spring is extended, and a plurality of contact members positioned at both ends of the lever adapted to be opened or closed by the lever.

8. A thermostat comprising an expansible tube, a spring member extending through the tube and having both ends secured thereto to permit the spring to become compressed or extended by the expansion or contraction of the tube, a lever extending through the tube, a pivot member for the lever, approximately central thereof, a link secured at one end to the spring and having its opposite end extending through a slot formed in the lever on one side of the pivot, a pin in the link engageable with the lever when the spring is extended, a plurality of stationary contact members on one end of the lever, a plurality of vertically movable contacts on the opposite end of the lever, a plurality of stationary contacts mounted adjacent one end of the tube in alinement with the vertically movable contacts on the lever, and a plurality of vertically movable contacts mounted adjacent the opposite end of the tube in alinement with the stationary contacts on the lever.

9. A thermostat comprising an expansible tube, a spring member extending through the tube and having both ends secured thereto to permit the spring to become compressed or extended through the tube, a pivot member for the lever, approximately central thereof, a link secured at one end to the spring and having its opposite end extending through a slot formed in the lever on one side of the pivot, a pin in the link engageable with the lever when the spring is extended, a plurality of stationary contact members on one end of the lever, a plurality of vertically movable contacts on the opposite end of the lever, a plurality of stationary contacts mounted adjacent one end of the tube in alinement with the vertically movable contacts on the lever, and a plurality of vertically movable contacts mounted adjacent the opposite end of the tube in alinement with the stationary contacts on the lever, and means for adjusting the vertical movement of each individual contact carried by the arm and mounted adjacent the tube.

10. A thermostat comprising a tubular expansible member, a leaf spring adjustably secured within the tube adapted to be compressed or extended by said tube, a pivotally mounted lever within the tube, and means for transmitting movement of the spring to rock the lever.

11. A thermostat consisting of a tubular expansible member, a leaf spring secured at each end within said tube adapted to be compressed or extended by said tube, a lever pivotally mounted within the tube adjacent to the spring, means for transmitting movement of the spring to rock the lever, means actuated by said lever for opening or closing an electric circuit, and means for adjusting the leaf spring to increase or decrease the tension thereof.

12. A thermostatic switch comprising a pivotally mounted lever, an expansible member, means for transmitting the contracting or expanding movement of said member to rock the lever, a plurality of stationary contacts adjacent to one end of the lever, a plurality of alined coöperating contacts carried by the lever, said contacts being freely movable in the lever in a vertical direction, a flexible conductor connected to each movable contact, a conductor connected to each stationary contact, and means for passing a current through the conductors when the contacts are closed.

13. A thermostatic switch comprising a pivotally mounted lever, an expansible member, means for transmitting the contracting or expanding movement of said member to rock the lever, a plurality of stationary contacts adjacent to one end of the lever, a plurality of alined coöperating contacts carried by the lever, said contacts being freely movable in the lever in a vertical direction, a flexible conductor connected to each movable contact, a conductor connected to each stationary contact, means for passing a current through the conductors when the contacts are closed, and means for adjusting the vertical movement of each individual contact carried by the lever.

In testimony whereof we have hereunto set our hands in the presence of two subscribing witnesses.

HARRY A. MULVANY.
HARRY E. KENNEDY.

Witnesses:
JOHN H. HERRING,
THOS. CASTBERG.