May 13, 1930. A. ESCHER 1,758,787

THERMOSTAT

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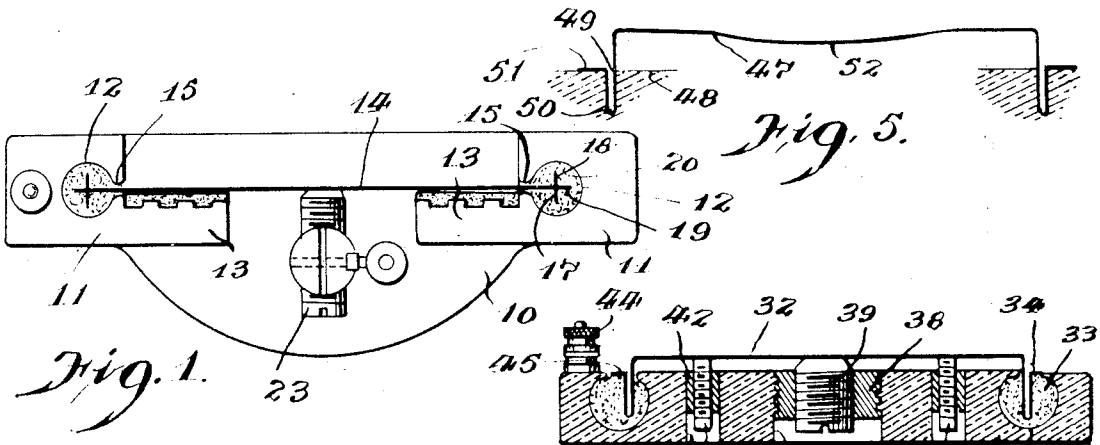


Fig. 1.

Fig. 5.

Fig. 3.

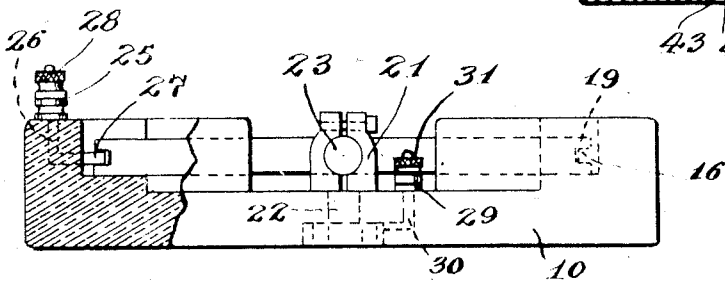


Fig. 2

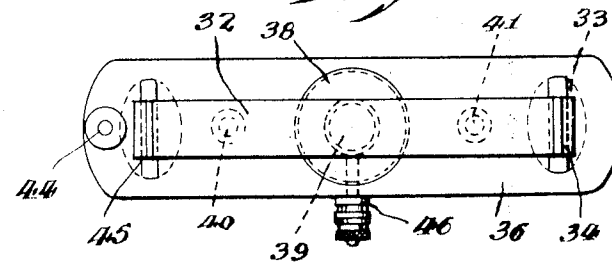


Fig. 4.

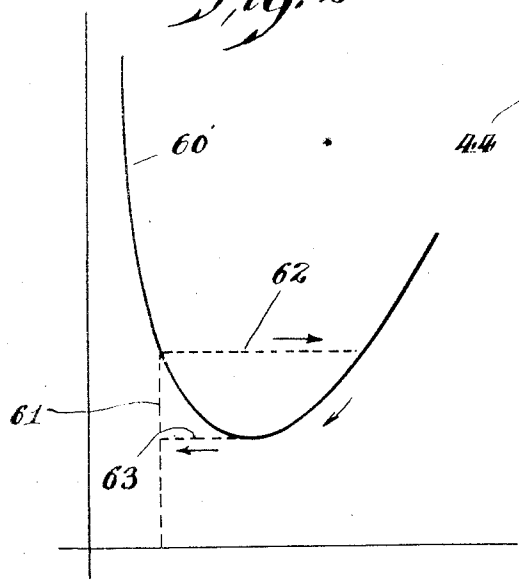


Fig. 6.

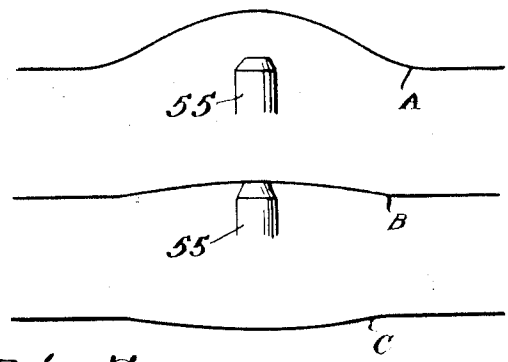


Fig. 7.

WITNESS

Chr. Nielsen

INVENTOR

Arnold Escher.

BY Munn & Co.

ATTORNEYS

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UNITED STATES PATENT OFFICE

ARNOLD ESCHER, OF RALEIGH, NORTH CAROLINA

THERMOSTAT

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This invention relates to thermostats and has for its object the provision of a device in which a single strip of resilient material is initially bent and maintained under a predetermined stress so that when the strip is heated it will suddenly buckle due to the storing of the termal expansion energy and thus instantly break the circuit.

A further object of the invention is the provision of a thermostat forming part of an electrical circuit and which is adapted to suddenly interrupt the electrical circuit by an instantaneous buckling of a single strip of metal away from a contact, the buckling being caused by initially maintaining the strip in a predetermined position so that said strip will be urged towards the buckling position.

Another object of the invention is the provision of a thermostat forming part of an electric circuit which is adapted to suddenly interrupt the circuit by an instantaneous buckling of the single strip of metal away from the contact, which has its ends fixed against movement on a base member having a different coefficient of expansion than the metal strip; the base having a smaller coefficient of expansion than the resilient strip, buckling out will happen after a certain temperature increase, said strip clicking back instantly at a lower temperature but where the base has a higher coefficient of expansion than the strip buckling out will happen after a certain temperature drop while the strip will snap back into place after a following increase of temperature.

This invention will be best understood from a consideration of the following detailed description, in view of the accompanying drawings forming a part of the specification; nevertheless it is to be understood that the invention is not confined to the disclosure, being susceptible of such changes and modifications which shall define no material departure from the salient features of the invention as expressed in the appended claims.

In the drawings:

Figure 1 is a plan view of a preferred form of my invention.

Figure 2 is a side view partly in section of the device shown in Figure 1.

Figure 3 is a horizontal longitudinal section of a modified form of the thermostat.

Figure 4 is a plan view of the form shown in Figure 3.

Figure 5 shows more or less diagrammatically a modified form of the mounting of the thermostatic strip.

Figure 6 shows a curve which is characteristic of an equation of any given rod and its performance under temperature changes.

Figure 7 shows more or less diagrammatically the various positions of a rod or strip from its initially flexed position to position at a predetermined temperature.

In carrying out the invention a strip of metal of any predetermined cross sectional area is provided and which has a definite degree of resiliency so that the rod may be initially flexed in order to place it under a stress so that when it is heated it will be suddenly buckled and snapped away from the contact to break an electric circuit which has one terminal connected with the rod or strip and the other terminal connected with the contact. The contact is normally adjustable and may be employed to create the flexure on the rod. The base upon which the strip is mounted should be made of a material having a lower coefficient of expansion than the rod so that at a certain temperature increase the spring will buckle out and release the rod from the contact to break the circuit. The cooling of the rod will cause the clicking or snapping back of the rod against the contact member to close the circuit. The rod is made of such material and is so initially stressed when mounted that the buckling and snapping back will be instantaneous in order to prevent sparking between the contact point and the rod. If the base is of a higher coefficient of expansion than the rod buckling will take place after a certain temperature drop and will snap back into position in engagement with the contact after the temperature has been increased. The rod, its flexure and stress also may be such, that after buckling out at a certain temperature it will not return to produce contact at normal temperature but a force is to be applied to push it back.

Referring more particularly to Figure 1

the base member 10 is shown formed of porcelain having elevated portions 11 forming posts at its ends which are provided with recesses 12. The space between the extensions 13 and the rod 14 may be filled with cement or similar substance, sticking to extension 13 but not bonding to 14. This method of cementing prevents other buckling curves than desired under conditions where such might be the case due to the bending, stress and temperature of the rod. The posts 11 have extensions 13 extending longitudinally of the base and towards each other but normally spaced from a thermostatic rod 14.

The sockets 12 are shown cylindrical in shape and a channel 15 passes through the wall of the post 11 and connects the sockets 12 to the exterior. The ends of the rod 14 as shown in Figure 2, are cut away as at 16 to provide laterally projecting lugs 17 which cooperate with the ends 19 of the rod 14 to lock with a cement or solder 20 which is placed in the sockets 12 so that the lugs 18 and 19 and a portion of the length of the bar 14 adjacent its outer end will be imbedded in the cement for securely locking the ends of the rod in position and for maintaining said rod under a predetermined stress.

A clamping post 21 has its lower end, as shown at 22, located in a passage or recess in the bottom of the base member 10 and a nut or cement may be employed for securing the inner end 22 of the clamping post 21 in position on the base member 10. The post is provided with an internal passage into which is threaded a contact member 23. By reason of the threads on the contact 23 and the internal threads in the passage in the clamping post 21, the screw contact member 23 may be adjusted towards or away from the rod 14 so that the rod may be flexed and maintained under a predetermined stress.

A binding post 25 is mounted on the base member 10 and has an extension 26 connected, as shown at 27, with one end of the rod 14 so that when the terminal of a circuit is connected by means of the nut 28 to the binding post 25 the rod 14 will form part of the circuit. A second binding post 29 is mounted on the base member 10 and is provided with an extension 30 forming a conductor which is connected with the inner end 22 of the post 21. When the other terminal of the circuit is connected by means of the nut 31 to the binding post 29 the circuit will be complete as long as the contact screw 23 engages the rod 14.

Referring to Figures 3 and 4 the ends of the thermostatic bar 32 are mounted in a cement composition or solder 33. The bent extension 34 is formed by bending the end of the bar upon itself before the cement is applied and formed into shape. The cemented ends are inserted into the sockets 35 in the base member 36. The base member is provided with a threaded passage 37 in which is screwed a nut 38 having a central threaded passage to receive the threads of the screw contact member 39, the outer free end of the contact member being normally engaged by the thermostatic bar 32. In such cases where the flexing of the thermostatic bar 32 will tend to buckle the bar in opposite directions set screws 40 and 41 are mounted for adjustment in nuts 42 in recesses 43 for engaging the thermostatic bar at spaced points and for maintaining a proper position of the bar before and at the moment of buckling. The set screws will hold the rod only before and at the moment of buckling, where the stresses are highest; as soon as the desired full-length buckling happens the stress decreases and there is no danger of reversed buckling and the rod will move outwards over its whole length separating from members 40 and 41. The binding post 44 is connected at the securing end 45 of the bar 32 while a binding post 46 is in electrical communication with the screw contact member 39. Thus it will be readily seen that the thermostat may be connected to a circuit by attaching one terminal of the circuit to the binding post 44 while the other terminal is connected to the binding post 46.

A flexible mounting as shown in Figure 5 is provided from the ends of the thermostatic bar 47 since the base member 48 is provided with slots 49 in which are inserted the bent portions 50 of an end of the bar 47. The bent portions of the ends of the bars are spaced from each other with the outer extreme end of the bar, as shown at 51, in flat engagement with a face of the base member 48. The intermediate portion 52 of the bar 47 is normally flexed so that when the device is heated the rod will buckle out as described previously.

Referring more particularly to Figure 6 the vertical ordinates represents the temperature increase and decrease, depending upon base, and the horizontal abscissæ represent the deflection of the rod. Curve 60 represents in orthogonal coordinates the relation between temperature and deflection at the moment of buckling, given by a characteristic equation for any particular rod. Line 61 represents the temperature change for a given position or abscissa of the contact point, and 62 represents the sudden buckling out at a fixed temperature. The numeral 63 designates the clicking back.

Referring more particularly to Figure 7 the three diagrammatic positions of the rod illustrate the procedure or physical treatment by which the bar obtains the peculiar properties that are one object of this invention as described hereafter. or illustrated in Figure 6. Line C is the initial position of the rod, following approximately a sinoidal curve, between two waves. This will preferably be

the shape of the rod in its unstressed state, when no exterior forces act on it, and the process of fastening then must be such that it maintains the same shape after being fastened. Or else the unstressed rod may be of any shape, being bent while fastening it to the base in such a manner that after being fastened and released it will have the desired shape C.

After this the rod is deflected into position B, by means of forces applied in the plane of deflection, generally produced by advancing the contact screw 55 and the set screws if any. For simple rods as illustrated in Figure 1, the curvature of the rod in position B will be to the opposite side than in position C. For rods, bent as shown in Figure 5, the curvature may still be to the same side as in C, but nearer to the straight line.

Provided the initial flexure and the subsequent bending are of a predetermined amount, depending upon the physical properties of the rod, the latter in position B will be in such a state of internal stress, that at a given temperature its equilibrium becomes unstable and it will suddenly buckle out into position A (62). If afterwards the change of temperature reverses, that is, if there was an increase that produced the buckling there will be a decerase afterwards and the contrary, the rod will gradually move back and from a certain point at a given temperature will suddenly click back into position B (63).

It will be borne in mind that the resiliency of the thermostatic bars and their cross sectional area will affect the temperature changes of the device and the thinner the bar the more quickly it will be affected at lower temperatures and the time for buckling to interrupt the circuit may be determined either by providing a bar of proper thickness and resiliency or by adjusting the screws 40 and 41 on the contact screw 33 or 39 to vary the stress on the bars from the initial stress employed for causing a limited flexure of the bars, or by using a rod as shown in Figure 5 or a rod as shown in Figure 1.

What I claim is:

1. In a thermostat, a thin strip formed of monometallic material and having its ends fixed in position and maintained under a slight stress so that when the strip is heated to a predetermined degree said strip will suddenly buckle, and a contact for maintaining the strips under a slight stress.

2. In a thermostat, a resilient strip formed of monometallic material and having its ends fixed in position, said strip being flexed so that when the strip is heated to a predetermined degree the strip will suddenly buckle and means for maintaining the strip flexed.

3. In a thermostat, a resilient strip formed of monometallic material and having its ends fixed in position, said strip being flexed so that when the strip is heated to a predetermined degree the strip will suddenly buckle, and means for maintaining a predetermined flexure of the strip.

4. In a thermostat, a thin strip formed of monometallic material and having its ends fixed in position and maintained under a slight stress so that when the strip is heated to a predetermined degree said strip will suddenly buckle, and adjustable means for maintaining the strip flexed.

5. In a thermostat, a resilient strip formed of monometallic material, means for securing the ends of the strip against movement and the strip under stress, and means engaging the strip and adapted to be adjusted for varying flexure of the strip so that when said strip is heated to a predetermined temperature the strip will suddenly buckle.

6. In a thermostat, a resilient strip formed of monometallic material means for securing the ends of the strip against movement, and the strip under stress, and means engaging the strip and adapted to be adjusted for varying flexure of the strip so that when said strip is heated to a predetermined temperature the strip will suddenly buckle, said securing means having a different coefficient of expansion than the strip.

7. A thermostat comprising a base member provided with spaced sockets, a flexed strip having its ends mounted in the socket, said strip being formed of monometallic material, a contact member having a free end engaging the strip, a mounting for the contact member permitting adjustment of the contact member towards or away from the strip, said strip when heated to a predetermined temperature being suddenly buckled and instantly released from the contact member.

8. In a thermostat, a thin monometallic strip having its ends fixed in position and maintained under a slight stress so that when the strip is heated to a predetermined degree said strip will suddenly buckle, said strip being adapted to instantly click back into normal position at a predetermined temperature and means for maintaining the strips under a slight stress.

9. In a thermostat, a thin bar formed of monometallic material and maintained under stress so that at a given temperature a predetermined amount of energy stored in the bar will cause actuation of the bar, and means for maintaining the bar under stress.

10. In a thermostat, a thin bar of monometallic material maintained under stress so that at a given temperature a predetermined amount of energy in the bar will be released, means connected with the bar adapted to be actuated when the energy is released, and means for maintaining the bar under stress.

11. A thermostat comprising a flexible strip formed of homogeneous resilient metal, a base member having a different coefficient of expansion than the flexible strip, means for

securing the ends of the strip to the base member, a contact member adjustable at right angles to the strip, said contact member flexing the strip from the opposite side of the initial curvature and fixed in a predetermined position, said strip when heated to a predetermined temperature being adapted to be suddenly buckled and instantly released from the contact member.

12. A thermostat comprising a flexible strip of metal formed of homogeneous resilient material, said strip in its unstressed state having a slight curvature to one side of a line passing through the ends of the strip, a base member having a different coefficient of expansion than the strip, means for connecting the ends of the strip to the base member, means for maintaining the strip of metal curved, the temperature stresses, due to the difference of the coefficients of expansion between the base and the strip compressing said strip until at a given temperature and also due to its initial curvature said strip will suddenly buckle, the strip being adapted to suddenly click back into its normal inoperative position when the temperature of the strip has fallen below a predetermined degree.

13. A thermostat comprising a flexible strip of homogeneous resilient material, means for securing the ends of the strip against movement, said strip being curved along its length and bent outwardly from a line passing through the fastened ends of said strip, the strip having a different coefficient of expansion from the means which fasten the ends of the strip, a contact normally engaging the strip, said strip adapted to be suddenly buckled at a predetermined temperature for releasing the strip from the contact, said strip being adapted to click back into engagement with the contact when the temperature of said strip falls to a predetermined degree.

14. In a thermostat, a flexible member of resilient material having a constant coefficient of heat expansion, said member when no external forces are acting upon the same having a slight curvature to one side, a base having a different coefficient of expansion, the flexible member being fastened to the base member in such a manner that the flexible member will be urged to one side of its normal straight position, said base member holding the flexible member under a predetermined deflection, said initial curvature and final deflection being of such an amount that said flexible member will snap away from its normal position when heated and click back when the temperature has been reduced.

15. In a thermostat, a strip of metal formed of homogeneous material and having a flexible portion, a base having a different coefficient of heat expansion than the metal strip, said metal strip being initially curved to one side of its normal length and subsequently urged towards the opposite side, said base member laterally supporting the strip of metal in a predetermined position so that at given temperatures the flexible portion will affect sudden changes in the shape of the metal.

16. In a thermostat, a flexible member formed of any resilient homogeneous material, a support having a different coefficient of heat expansion than the flexible member and connecting opposite points of the flexible member in such a manner that any temperature changes will set up stresses in said member, said flexible member being initially curved to one side of a line passing through the connected points of the support for the flexible member so that subsequent deflection to the opposite side of said line will be such that under the longitudinal stresses introduced by temperature changes said flexible member will affect sudden displacement of finite amounts.

ARNOLD ESCHER.