May 9, 1933. E. C. RANEY 1,907,666

THERMIC SWITCH

Filed Aug. 9, 1929

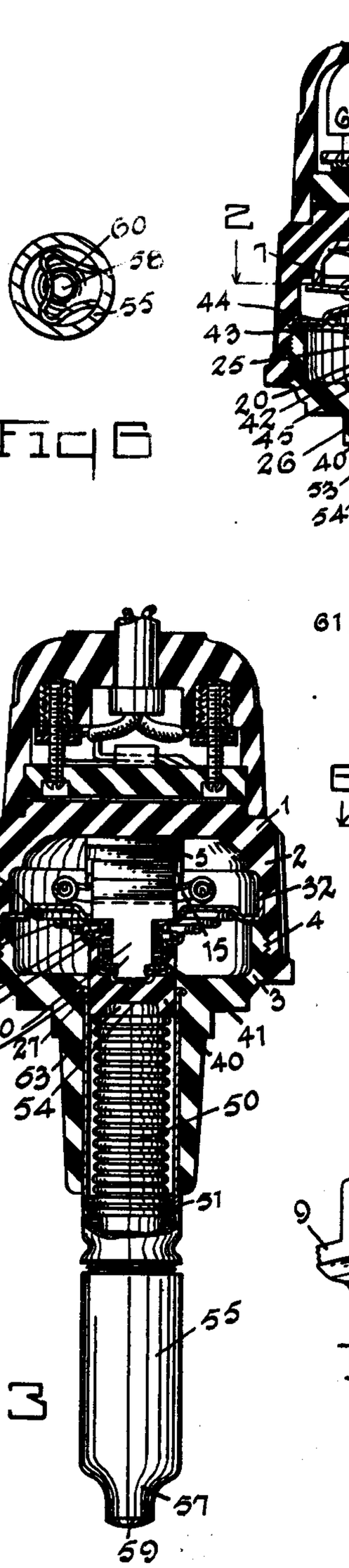

Fig 6

Fig 3

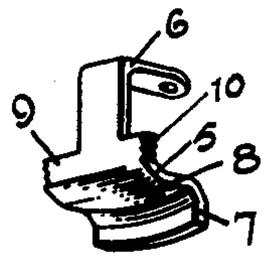

Fig 5

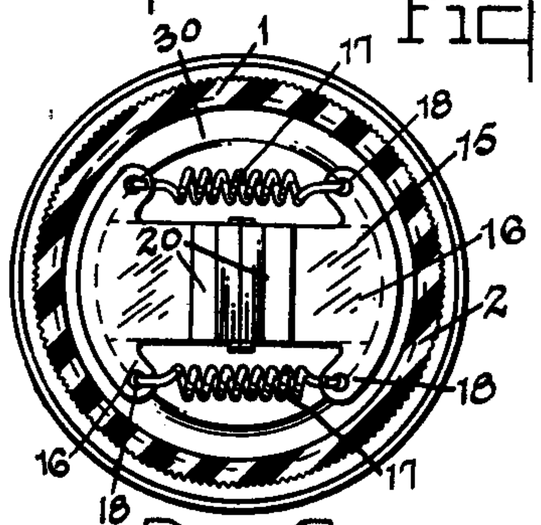

Fig 1

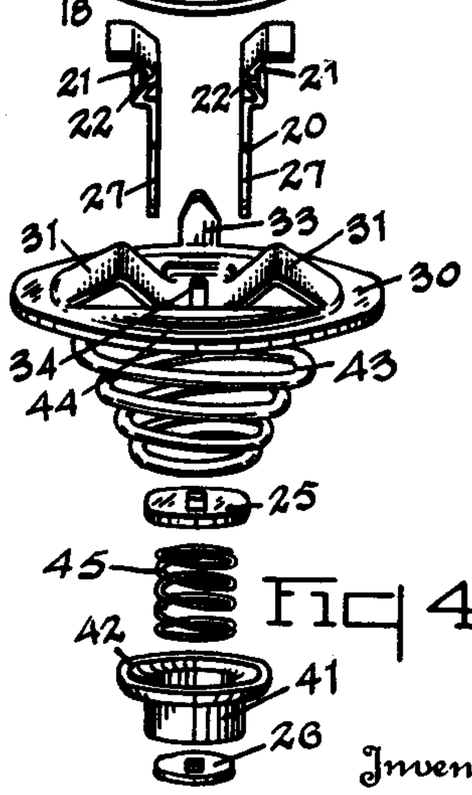

Fig 4

Fig 2

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THERMIC SWITCH

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The invention particularly provides a thermic switch that may be formed of parts that may be made at a low cost of production and set for efficient operation of the switch at definite temperatures.

The invention may be contained in switches that vary in their details and, to illustrate a practical application of the invention, I have selected a switch containing the invention as an example of the various embodiments of my invention and shall describe it hereinafter. The particular structure selected, as an example, is shown in the accompanying drawing.

Fig. 1 illustrates a vertical section of the switch. Fig. 2 is a view of a section taken on the plane of the line 2—2 indicated in Fig. 1. Fig. 3 illustrates a vertical section of a part of the switch taken on a plane at right-angles to the plane of the section of Fig. 1. Fig. 4 is a composite view of parts of the switch, indicating the assembly of such parts. Fig. 5 is a perspective view of a fixed contact of the switch. Fig. 6 is a view of a section taken on the plane of the line 6—6 as indicated in Fig. 1.

The instrument illustrated in the drawing is provided with a head of insulating material that contains the switch, and a stem, that is connected to the head, which contains the thermic material that operates the switch. The head 1 is formed of two parts 2 and 3 that may be interconnected by means of the threaded portions 4. The fixed contacts 5 of the switch are provided with the electric terminals 6 for connecting the fixed contacts with an external circuit. The fixed contacts 5 are provided with curved flange portions 7 that extend substantially at right-angles to the body portions 8 of the fixed contacts. The flanged portions are curved on a center located substantially in the axis of the instrument. The edges of the flanged portions 7 form the contacting areas of the switch. Each contact 5 is also provided with a portion 9 that extends substantially parallel to the direction in which the flange 7 extends, but in a direction opposite to that in which the flange extends from the body portion of the fixed contact. The portion 9 is embedded in the end wall of the part 2 of the head. The portion 9 has at its end edges a plurality of serrations 10 which securely lock the fixed contact in the insulating material of which the head is formed. The terminals 6 are formed narrower than the contacts 5. They protrude from the head whereby the terminals may be inserted in the end of a plug for connecting the switch to an external circuit.

The movable contact 15 of the switch is formed of a pair of plates 16 that are connected together for pivotal movements one relative to the other. Preferably, the contiguous ends of the plates 16 are located in recesses of a part of a switch actuating member and springs 17 are connected to ears 18 located at the outer corners of the plates 16. The springs 17 operate to produce a thrust or pressure components in the planes of the plates 16 towards each other and lateral components that tend to angularly move the plates 16 relative to each other. Contacting pressure between the outer ends of the plates 16 and the arcuate edges of the fixed contacts 5 is produced when the lateral components are in one direction and when the lateral components are in the opposite direction the plates 16 move from the fixed contacts 5. Preferably, the end edges of the plates 16 are curved and the ears 18 protrude from the corners of the plates in the line of the curvature of the end edges. The length of the fixed contacts 5 are substantially the same as the length of the curved edges of the plates 16 between the ears, whereby a compact arrangement of the parts is provided for locating the switch within a cylindrical head which has a relatively small diameter and yet provides a large contact area between the contacts of the switch.

The movable contact 15 is connected to an actuating member by means of a pair of sheet metal strips 20. The strips 20 have portions bent to form V-shaped channel portions 21 having a length substantially the same as the width of the body portions of the plates 16. The ends of the channel portions 21 are provided with lugs 22 that protrude from the ends of the V-shaped

channels 21 and are bent so as to cover or enclose the corners of the inner ends of the plates 16 when they are inserted in the V-shaped channels. The strips 20 are so placed that the channel openings of the strips extend in opposite directions. They are secured in this position, when assembled, by means of a pair of discs 25 and 26. Preferably, the strips 20 are provided with tongues 27 having a width narrower than the body portion of the strips 20 and the discs 25 and 26 are provided with slots that fit the tongues 27 when they are placed side by side, so that when the discs 25 and 26 are forced over the tongues 27, they will securely bind the strips 20 together.

The movable contact 15, together with its connecting member, is supported for movements relative to a plate 30 that is secured in the head 1 between the parts 2 and 3 of the head. The plate 30 is die pressed to shape and there is formed in the plate 30 raised V-shaped portions 31. For purposes of securing the plate 30 in position, and insuring registration of the protruding portions 31 of the plate 30, relative to the fixed contacts, the part 2 of the shell may be provided with a suitable recess 32 and the plate 30 may be provided with a tongue 33 that substantially fits the recess 32. The plate 30 is also provided with a slot 34 that is located between, and extends parallel to, the ridges 31. The slot 34 has a size substantially the same as that of the cross section of the strips 20, when they are placed back to back, to permit free movements of the strips 20 through the slot 34 of the plate 30.

The plate 30 is located in a plane substantially parallel to the plane of the contact edges of the fixed contacts 5. This locates the plane of the tops of the ridges parallel to the plane of the contacts and preferably the parts are so formed that these planes are in close proximity to each other and the ridges are placed close to the axis of the instrument or about midway between the axis of the instrument and the fixed contacts. The tops of the ridges 31 are therefore located intermediate the points of connection of the ends of the springs with the plates 16 and the inner ends of the plates and comparatively close to the axis of the instrument. In the operations of the movable contact 15, by the springs 17, the protruding ridges 31 of the plate 30 coact to produce a wide opening of the contacts and an early closing of the contacts in the movement of the actuating member that operates the switch through the connecting member formed by the strips 20. When the inner ends of the plates pass through the plane of the fixed contacts, the outer ends of the plates will be moved away from the fixed contacts and so as to strike the ridges 31 of the plate 30. The points of connection of the ends of the springs 17 being located on the outside of the ridges, the springs tend to draw the outer ends of the plates towards each other as the plates pivot on the tops of the ridges 31. In the reverse movement of the actuating member, the plates will tilt on the ridges 31, moving the outer ends of the plates 16 towards the contact edges of the fixed contacts by a relatively short movement of the connecting strips 20, and until the inner ends of the plates 16 pass through the plane of the ridges. The springs 17 will then produce a contacting pressure component as between the fixed contacts and the movable contact.

The switch is operated by the expansion and contraction of a thermic element, the expansion movements operating on the movable contact member to break the circuit through the contacts and a compression spring operating on the movable contact, as the element contracts, to complete the circuit through the contacts. A thimble 40, formed of insulating material, is located in an opening formed in the end wall of the part 3 of the shell 1 and is reciprocally movable therein. A cup 41 is located in the thimble 40. The cup 41 has a flange 42 that rides on the edge of the thimble 40. The flange is skirted to provide a recess for receiving the end of a convolute spiral spring 43 located between the flange 42 and the plate 30. The plate 30 has a centrally raised portion to form a seat 44 for the larger end of the convolute spring 43. The convolute spring enables relatively free movement of the turns of the spring and causes the return movements of ends of the plates 16.

The bottom of the cup 41 is located in spaced relation to the bottom of the thimble 40 and a compression spring 45 is located within the cup 41 and intermediate the disc 25 and the bottom of the cup. The lower ends of the strips 20 extend through a slot formed in the bottom of the cup and the disc 26 is located beneath the bottom of the cup 41 and is movable between the limits provided by the bottom of the cup 41 and the bottom of the thimble 40. When, therefore, the thimble 40 is moved by the expansion of the thermic element, it compresses the spring 45 against the vertical component induced at the inner ends of the plates 16 by the tension of the springs 17. The spring 45 is compressed until the disc 26 engages the bottom of the thimble 40. Continued upward movement of the thimble 40 moves the strips 20 and the inner ends of the contact plates 16 until the lateral component induced by the spring 17 is less than the pressure produced by the spring 45. At this point the lateral component, however, is sufficiently great for a good contact pressure

between the contacts of the switch. The lateral component at the outer ends of the contact plates 16, which is the pressure applied at the ends of the movable contact against the fixed contact, is greater than the lateral component at the inner ends of the plates by reason of the relative location of the connecting points of the springs 17. When this contact pressure diminishes to a certain point, which, however, is still sufficiently great to maintain a good contact pressure, the spring 45 will cause the inner ends of the plates to snap through the plane of the contact edges of the contacts 5 and the lateral components of the spring 17 will be reversed which will operate to raise the disc from the bottom of the thimble 40 and to separate the contacts as the central portions of the plates strike the ridges 31 of the plate 30. When the thermic element contracts, the thimble 40 is moved downwardly by the spring 43 and the inner ends of the plates 16 will immediately move downwardly by reason of the interengagement of the disc 26 on the bottom of the cup 41. The contact plates tilt on the ridges 31 and quickly raise the outer ends of the plates above the plane of the tops of the ridges 31 and reverse the lateral components produced by the springs 17, to cause a quick connection by a very short reverse movement of the inner ends of the plates 16.

The spring 43 operates to maintain the thimble 40 in contact with a sheet metal bellows 50 located in a metal sleeve 51 that protrudes from the end wall of the part 3 of the shell 1. The sleeve 51 is provided with outwardly turned ears 52 which anchor the sleeve 51 in the insulating material of the shell 1. The thimble 40 is located in one end of the sleeve 51 and is moved therein by the expansion bellows 50 or the spring 43 when the bellows contracts. Preferably, the thimble 40 is provided with a recess 54 for receiving the tip 53 of the expansion bellows which operates to maintain the upper end of the bellows in axial alignment in the instrument.

The lower end of the bellows 50 is connected to a shell 55. The interior of the bellows 50 communicates with the interior of the shell 55 and the two are filled with a suitable thermic material that has, preferably, a large coefficient of expansion. Fluids, such as water or mixtures of liquids, or plastics, that melt or solidify at substantially definite temperatures, may be used. Preferably materials, or mixtures of materials, are used that at definite temperature points have increasing coefficients of expansion. The points at which their physical condition changes may be varied by forming mixtures of definite proportions of the materials, in the manner well known in the art. In the particular form of construction shown in the drawing, the bellows 50 and the shell 55 are filled with a mixture of water and alcohol in a desired proportion. The water and alcohol mixture is particularly advantageous by reason of the fact that it affords a reliable and definite expansion point at which the movable contact may be operated and thus insures certainty of operation at the same point in the succeeding operations of the refrigerating apparatus controlled by the switch. In the operation of refrigerating apparatus, the water will freeze and portions of the frozen ice will subsequently melt to cause corresponding changes in movement of the movable contact by the movement of the bellows containing the mixture, which will produce a reliable operation of the switch when a definite portion of the water has changed physically. Consequently, the switch will, in its repeated operation, always operate at the same thermic or temperature point. The bellows 50, being located within the sleeve 51, it is, by reason of the air space between the bellows and the sleeve, shielded to a certain extent from the transmission of heat therefrom, while the shell 55 is in a more direct heat conductive relation, with reference to exterior bodies and, consequently, heat is more readily transmitted to and from the shell 55 than to and from the bellows. The shell 55 is not only connected to the bellows 50, but is also connected to the end of the sleeve 51. Preferably, the ends of the sleeve 51 and the shell 55 are threaded to enable adjustment of the bellows with reference to the movable contact in order to bring about operation of the switch at the desired times. Thus the material within the bellows and the shell may be, if desired, raised or lowered to the desired temperature at which the switch is to be opened and, upon insertion of the bellows within the sleeve 51, the shell may be threaded into the sleeve 51 until the switch is tripped open, whereupon the shell and the sleeve may be secured in this adjusted relation by either soldering or reaming, or any other suitable interlocking means. In the form shown, the shell is provided with a channel 56 and the end of the sleeve 51 is spun or forced into the channel 56 so as to seal and interlock the sleeve 51 to the end of the shell 55 in this adjusted relation.

The thermic material is introduced into the bellows and the shell 55 through the contracted end 57 that is closed by means of the plug 58. Solder 59 may be placed on the end of the shell so as to cover and seal the end of the shell.

The end 57 of the shell 55 is tapered so as to form between the plug 58 and the surfaces of the tapered end, a space for the thermic material that conforms to a cylindrical punch having a central opening and a

sharp knife edge. The part that conforms to the knife edge is located intermediate the flaring inner surface of the tapered wall of the end 57 and the surface of the plug 58 which protrudes well into the interior of the shell. The thermic material that thus surrounds the plug, and located within the tapered wall, is surrounded by and contains within itself a relatively large amount of metal which has high heat conductivity and, since the material between these highly conductive parts is thinned down to a sharp edge or line, the temperature of the thermic material at this point will be substantially the same as that of the outside atmosphere contiguous to the tip of the shell and, by reason of the tapered walls or flaring surfaces that extend from a line on the said surfaces, crystallization or solidification will readily set up in such a chamber or space and thus bring about prompt solidification or crystallization in the body of the shell.

The shell 55 is also provided with a heat distributor for conducting and transmitting the heat from the wall of the shell throughout the material located in the central portion of the shell. A sheet metal corrugated member 60, having a length substantially the same as the shell, is located therein. It has portions in contact with the surface of the wall of the shell and portions located in proximity to the axis of the shell whereby heat will be readily transmitted through the member to and from the wall of the shell into that portion of the material located well within the shell and more or less remote from the wall of the shell. Preferably, the heat conductor 60 is provided with a plurality of tapered tongues 61 that extend towards the bellows 50 which reduces the conductivity of the member at the end of the shell that is connected to the bellows. This provides a means that insures the solidification of the thermic material within the shell 55 in advance of solidification of the material within the bellows 50. The bellows is also shielded by the sleeve 51, while the shell 55 is provided with heat conductive walls and the interior member 56 aids in the ready absorption or transmission of heat from the thermic material in the shell and the early crystallization and solidification of the thermic material therein. The expansion occurring thereby is transmitted to the non-solidified material in the shell and bellows which causes the bellows to expand and eventually operate the switch.

I claim:

1. In a switch, a pair of fixed contacts, a pair of movable plates adapted to make contact with the fixed contacts at their ends, a pair of sheet metal members having V-shaped channel parts for receiving the ends of the plates for maintaining the ends of the plates in position, a pair of springs for producing an end thrust of the plates against the bottoms of the channels of the said sheet metal members to force the said sheet metal members against each other.

2. In a switch, a pair of fixed contacts, a movable contact comprising a pair of plates, a pair of sheet metal members having V-shaped channels at its end for receiving ends of the plates for moving the said ends of the plates through the plane of the contacting surfaces of the said fixed contacts and to force the said sheet metal members against each other.

3. In a switch, a pair of fixed contacts, a movable contact formed of a pair of plates, a pair of springs connected to end portions of the plates for producing an endwise thrust in the plates towards each other and lateral components towards and away from the fixed contacts, a third plate formed of sheet metal, the said third plate having ridges struck up therefrom, a channel member for receiving the inner ends of the first named plates and movable through the said third plate for moving the inner ends of the first named plates across the plane of the contacting surfaces of the said fixed contacts and the plane of the tops of the said ridges.

4. In a switch, a pair of fixed contacts, a movable contact formed of a pair of plates, a pair of springs connected to end portions of the plates for producing an endwise thrust in the plates towards each other and lateral components towards and away from the fixed contacts, a third plate formed of sheet metal, the said third plate having ridges struck up therefrom, the said last named plate having a recessed portion, a movable member having a skirt portion and a convolute spring located intermediate the skirt portion and the recessed portion of the second named plate, a channel member operatively connected to the movable member and to the inner ends of the first named plates for moving the said plates through the plane of the contacts and the plane of the ridges.

5. In a switch, a pair of fixed contacts, a movable contact comprising a pair of plates adapted to electrically connect the fixed contacts, a pair of springs connected to end portions of the plates for producing an end thrust in the plates towards each other and lateral pressure components towards and away from the contacts, a movable member for actuating the inner ends of the plates and comprising a cup, a channeled member for receiving the inner ends of the plates and extending through the bottom of the cup, a spring located intermediate the bottom of the cup, and connected to the channel member for moving the inner ends of

the plates through the plane of the fixed contacts.

6. In a switch, a pair of fixed contacts, a movable contact comprising a pair of plates adapted to electrically connect the fixed contacts, a pair of springs connected to end portions of the plates for producing an end thrust in the plates towards each other and lateral pressure components towards and away from the contacts, a movable member for actuating the inner ends of the plates and comprising a cup, a channeled member for receiving the inner ends of the plates and extending through the bottom of the cup, a spring located intermediate the bottom of the cup and connected to the channel member for moving the inner ends of the plates through the plane of the fixed contacts, a third plate formed of sheet metal and having ridges struck up therefrom, the ridges located intermediate the line of movement of the inner ends of the plates and the ends of the plates, the last named plates having a recess for yieldingly resisting the movement of the cup, and a convolute spring having an end portion for fitting the said recess, the said clup having a skirt portion for receiving the other end of the convolute spring.

7. In a switch, a pair of fixed contacts, a movable contact comprising a pair of members adapted to electrically connect the fixed contacts, a pair of springs connected to the end portions of the members for producing an end thrust in the members towards each other and lateral pressure components towards or away from the contacts, a plate having a pair of ridges, the plane of the ridges being located parallel to and in close proximity to the plane of the said fixed contacts, the ridges being located opposite the points between the contacts and in close proximity to the line of movement of the inner ends of the members, a movable thermic element responsive in its movements to changes of temperature, means for interconnecting the thermic element with the inner ends of the said members and comprising a pair of channeled strips for receiving the inner ends of the members, and a cup connected to the strips, the cup and strips having means for producing limited free movements of the strips relative to the cup, a compression spring connected to the strips and to the cup for yieldingly resisting the movement of the strips relative to the cup, a compression spring located intermediate the cup and the plate for causing return movements of the inner ends of the members upon return movement of the thermic element.

In witness whereof I have hereunto signed my name to this specification.

ESTEL C. RANEY.