Aug. 25, 1936. W. K. HODGMAN, JR 2,051,853

THERMOSTATICALLY CONTROLLED SWITCH

Filed Nov. 30, 1934

Fig.1.

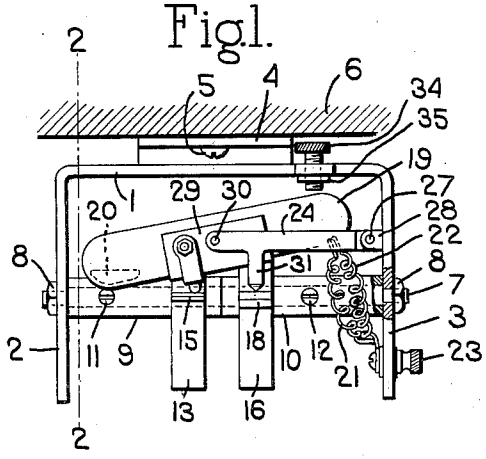


Fig.2.

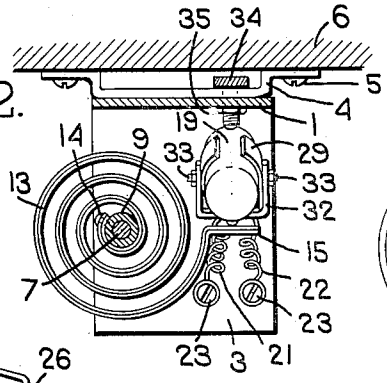


Fig.3.

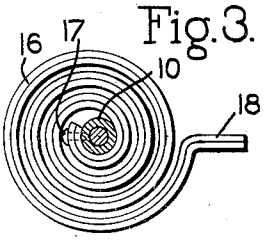


Fig.4.

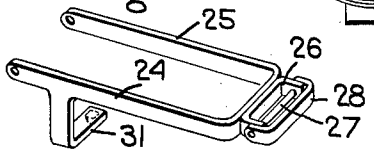


Fig.5.

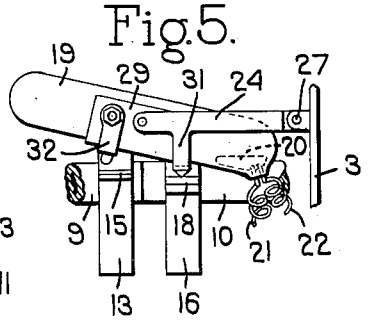


Fig.6.

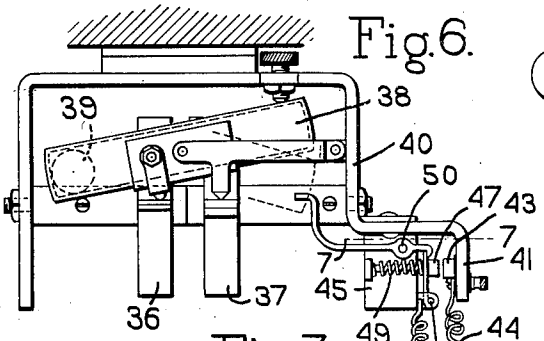
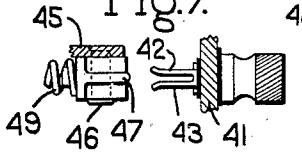


Fig.7.



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THERMOSTATICALLY CONTROLLED SWITCH

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8 Claims. (Cl. 200—138)

This invention relates to an electric circuit closing device operated thermostatically.

The object of the invention is to provide such a device which shall act to close the circuit either upon the occurrence of a sudden or abnormal rise in temperature or upon the attainment of a predetermined temperature, and in which the closing of the circuit shall be effected with an abrupt movement to cause a quick and positive electrical connection.

The nature and objects of the invention will appear more fully from the accompanying description and drawing and will be particularly pointed out in the claims.

The drawing illustrates two preferred embodiments of the invention of a type particularly designed for use as self-contained units in connection with the operation of fire extinguishing or alarm-giving electrically controlled systems.

In the drawing:

Fig. 1 is a front elevation of a unit embodying one preferred form of the invention.

Fig. 2 is a view in vertical cross section taken on the line 2—2 of Fig. 1.

Fig. 3 is an end elevation of one of the thermo-responsive elements shown in Fig. 1.

Fig. 4 is a detail in perspective of the guide arm and its supporting bracket shown in Figs. 1 and 2.

Fig. 5 is a view similar to Fig. 1 of a portion of the device with the parts in circuit closed position.

Fig. 6 is a front elevation of a unit embodying a second preferred form of the invention.

Fig. 7 is a view in cross section taken on the line 7—7 of Fig. 6 and on a larger scale.

It is frequently desirable in various electrically controlled systems, such, for example, as a sprinkler system installed for the extinguishment of a fire or, for example, as a system for giving an alarm, that means be provided which shall act to close the controlling electric circuit either when there is a sudden or abnormal rise in temperature or when a predetermined temperature has been reached. Such a device is desirably in a compact, unitary form and a number of such units are installed at various points throughout the building or other place protected by or furnished with the system. It is of the highest importance that if one of these units acts, it shall effect the closing of the circuit with absolute certainty, else the system cannot be depended upon and much of its value is lost. For example, in the case of the well-known sprinkler systems installed in buildings for the automatic extinguishment of fires, if a fire occurs in the vicinity of one of these units and either as the result of rapid combustion causes a sudden rise in temperature or as the result of gradual combustion causes a predetermined temperature to be attained and the thermo-responsive unit fails to close the circuit, great damage may result. The same thing is true if the system is to function simply for giving an alarm. In fact, whatever may be the purpose of the system, that purpose will not be secured if the circuit is not promptly and surely closed. It must be remembered also that such systems usually stand inactive for long periods of time and only on rare occasions are required to function. Consequently the contacts or terminals which must be closed to render the system effective become subject to more or less corrosion or other impairment.

The present invention has for its object to ensure that under the conditions set forth the closing of the circuit shall take place abruptly and with a quick, positive, and certain contact so that the effective operation of the system is ensured.

In that preferred embodiment of the invention shown in Figs. 1 to 5, inclusive, the device is of compact, unitary form employing a mercury switch controlled by two thermo-responsive elements and acting with an abrupt movement from open to closed circuit position to effect a quick and positive closing electrical connection between the contacts of the electric circuit.

The device as illustrated comprises a frame having a base 1 and depending side flanges 2 and 3. This base is shown as provided with a bracket 4 secured thereto and, in the case illustrated, this bracket is shown secured by screws 5 to the ceiling 6 of the building. A shaft 7 extends transversely between the flanges 2 and 3 and is secured at each end thereto by nuts 8 threaded to the ends of the shaft. Upon this shaft are mounted two sleeves 9 and 10 rotarily adjustable on the shaft and locked in adjusted position respectively by the set screws 11 and 12.

A thermo-responsive element 13 in the form of an open helix is secured at its inner end by the set screw 14 to the sleeve 9. This element is in the form of a bimetallic strip with its two components having different coefficients of expansion so arranged that as the temperature increases, the differential in expansion of the two strips will cause the forwardly bent free end 15 to rise and, conversely, as the temperature decreases, cause the end 15 to fall. A second thermo-responsive element 16 of generally similar construction and operation is secured at its inner end by the set screw 17 to the other sleeve

18 so that its forwardly projecting free end 18 rises and falls with the increase or decrease of temperature. These two thermo-responsive elements are similar except that 16 has a thermo-responsive movement slower than 13 to a sudden rise in temperature but both of these elements respond with substantially equal increments of movement to a gradual rise in temperature. This functioning of the two thermo-responsive elements is best secured by making both of the same materials but with the one shown at 16 of greater mass. This is secured in the form illustrated by making the element 16 much thicker than the element 13, as indicated by a comparison of Fig. 3 with the element shown in Fig. 2. It will thus be seen that these two thermo-responsive elements have a differential movement, the end 15 of the element 13 rising much faster than does the end 18 of the element 16 if the surrounding atmosphere has a sudden rise in temperature. This is due to the fact that owing to the greater mass of the element 16, it responds more slowly than does the element 13 to a change in temperature. But these elements are readily so proportioned that if the surrounding atmosphere rises gradually in temperature, they will both respond with substantially equal increments of movement so that the ends 15 and 18 will rise and fall substantially uniformly. A mercury switch shown as an elongated hollow closed body 19 of glass or suitable material containing a pool of mercury 20 is supported normally in an inclined position on the free ends 15 and 18 of the thermo-responsive elements. Two wires 21 and 22 are shown extending from binding posts 23 mounted in the flange 3 and to which binding posts the arms of the electric circuit to be controlled may be secured. These wires extend into the interior of the body 19 of the mercury switch and their free ends form two separated contacts which in this case constitute the terminals of the electric circuit and are maintained in a perfect and clean condition within the body 19. In the normal position of the switch the contacts are in the elevated end of the switch with the pool of mercury 20 in the opposite depressed end.

The mercury switch is preferably held in position mounted and guided for bodily vertical movement and arranged to permit a pivotal or rocking movement. For this purpose a guide arm construction shown separately in Fig. 4 is provided. This guide arm is of U-shape presenting the bifurcations 24 and 25 and at the base of the U has secured thereto a flanged portion 26 pivoted on the shaft 27 mounted in the bracket 28 secured to the flange 3. The mercury switch is pivotally mounted between and to the free ends of the bifurcations. This is conveniently secured by providing a saddle 29 in which the mercury switch rests and this saddle is pivoted at 30 in the ends of the bifurcations 24 and 25. A depending arm 31 on the bifurcation 24 is provided with a point resting on the end 18 of the thermo-responsive element 16, while a U-shaped element 32 is secured at 33 to the saddle 29 and provided with a point resting on the end 15 of the thermo-responsive element 13. The arc through which the pivot 30 moves about the center 27 is comparatively flat and of short extent so that for all intents and purposes the mercury switch when moved bodily up and down moves in a substantially vertical path.

A set screw 34 constituting a limiting stop is threaded into and thus adjustably mounted in the base 1 directly over the end of the mercury switch and is locked in adjusted position by the lock nut 35.

The operation of the device will now be apparent. Under normal conditions the parts stand in a position substantially as shown in Fig. 1 with the mercury switch supported on the free ends of the two thermo-responsive elements in an inclined position with the pool of mercury at the end opposite the contacts. If now a sudden rise in temperature of the surrounding atmosphere takes place, the thermo-responsive element 16 has a thermo-responsive movement much slower than 13. Consequently while the free ends 15 and 18 both rise to some extent, the end 15 rises more rapidly than the end 18, with the result that the mercury switch is rocked on its pivot 30 and when a predetermined amount of this differential movement takes place and the mercury switch reaches the horizontal, it is abruptly tipped into the opposite inclined position and the pool of mercury 20 is abruptly projected to the opposite end of the hollow body and in between the two contacts and effects a quick and positive electrical connection therewith, the parts assuming the position shown in Fig. 5. If, on the other hand, with the parts in the position shown in Fig. 1, a gradual rise in the temperature of the surrounding atmosphere takes place, the free ends 15 and 18 rise with a joint movement responding with substantially equal increments of movement to the rise in temperature and the mercury switch moves vertically upward in the inclined position illustrated. But its upper end then comes in contact with the set screw 34 and this set screw is so adjusted that when a predetermined temperature has been reached, the mercury switch is rocked by the joint upward movement of the supporting ends 15 and 18 coacting with the set screw 34 just past the horizontal. Thereupon, as before, the mercury switch is abruptly tipped into the opposite inclined position and the pool of mercury 20 abruptly projected to the opposite end of the hollow body and in between the two contacts and effects a quick and positive electrical connection therewith.

Another embodiment of the invention is shown in Figs. 6 and 7 and serves further to illustrate the broad principles of the invention. In this device the two thermo-responsive elements 36 and 37 correspond to the thermo-responsive elements 13 and 16 already described and are shown arranged and mounted in the same manner as before. The rocking switch element is also shown as having a similar elongated hollow closed body 38 as in the case of the mercury switch and mounted, supported and guided in the same manner as that previously described. While a pool of mercury may be employed in this construction, there is herein shown in place thereof a spherical weight 39. In this construction the electric contacts are mounted independently of the rocking member 38. The side flange 40 is shown as extended and offset at 41. On this flange is mounted a pair of contacts 42 and 43, both of which in this case are connected to a wire 44 which forms one terminal of the electric circuit. A bracket 45 depends from the offset portion of the flange 40 and has pivotally mounted thereon at 46 a knife 47 adapted to enter between and have a sliding positive engagement with both of the contacts 42 and 43. In this case a wire 48 connected to the knife forms the other terminal of the electric circuit. The knife is projected into engagement with the contacts by a powerful spring 49 and is held in

retracted open circuit position with the spring 49 compressed by a latching lever pivoted at 50 on the bracket 45 having one end hooked over the upper end of the knife and the other end standing beneath the end of the switch body 38 and in such a position that when the switch is rocked abruptly into the inclined position shown in dotted lines in Fig. 6, it will release the latch and cause the knife to have an abrupt movement being forced by the spring 49 quickly and positively into a sliding positive engagement with both of the contacts 42 and 43, thus effecting a positive electrical circuit closing connection.

It will thus be seen, as exemplified by the specific forms of the invention illustrated, that the pair of contacts may either constitute the two terminals of the electric circuit and the closing electric connection be effected by the element projected therebetween or the pair of contacts may, one or both, constitute one terminal and the projected element the other terminal, and the closing electric connection be effected by the projection of the elements therebetween. In any case, however, the action of the two thermo-responsive elements in response either to a sudden rise in temperature or in response to the attainment of a predetermined temperature is such as to effect an abrupt movement of the device from open circuit to closed circuit position and a quick and positive closing electrical connection with a pair of contacts thus ensuring with the highest degree of certainty the closing of the electric circuit and the functioning of the apparatus controlled thereby.

Having thus described the invention, what is claimed as new, and desired to be secured by Letters Patent, is:

1. An electric circuit-closing device comprising a pair of contacts, means having an abrupt movement from open circuit to closed circuit position and acting upon such movement to effect a quick and positive closing electrical connection with said contacts, and two thermo-responsive elements, one of which has a thermo-responsive movement slower than the other to a sudden rise in temperature and both of which respond with substantially equal increments of movement to a gradual rise in temperature, the said thermo-responsive elements acting upon a predetermined amount of differential movement in the former case and upon a predetermined amount of joint movement in the latter case to effect the abrupt closing movement of said means.

2. An electric circuit-closing device comprising a pair of contacts, an element having an abrupt movement from open circuit to closed circuit position and projected upon such movement in between the two contacts to effect a quick and positive electric circuit closing connection, and two thermo-responsive elements, one of which has a thermo-responsive movement slower than the other to a sudden rise in temperature and both of which respond with substantially equal increments of movement to a gradual rise in temperature, the said thermo-responsive elements acting upon a predetermined amount of differential movement in the former case and upon a predetermined amount of joint movement in the latter case to effect the abrupt closing movement of said element.

3. An electric circuit-closing device comprising a pair of contacts, a pivotally mounted mercury switch having an abrupt rocking movement from open circuit to closed circuit position in which the mercury is projected upon said movement in between the two contacts to effect a quick and positive electric connection therewith, and two thermo-responsive elements, one of which has a thermo-responsive movement slower than the other to a sudden rise in temperature and both of which respond with substantially equal increments of movement to a gradual rise in temperature, the said thermo-responsive elements acting upon a predetermined amount of differential movement in the former case and upon a predetermined amount of joint movement in the latter case to effect the abrupt closing movement of said switch.

4. An electric circuit-closing device comprising a pair of contacts, a knife having an abrupt movement from open circuit to closed circuit position and forced upon said movement into a sliding positive engagement with both of said contacts to effect a positive electrical connection therewith, and two thermo-responsive elements, one of which has a thermo-responsive movement slower than the other to a sudden rise in temperature and both of which respond with substantially equal increments of movement to a gradual rise in temperature, the said thermo-responsive elements acting upon a predetermined amount of differential movement in the former case and upon a predetermined amount of joint movement in the latter case to effect the abrupt closing movement of said knife.

5. An electric circuit-closing device comprising a pair of contacts, a mercury switch having an elongated hollow body into one end of which the pair of contacts extends and which contains a pool of mercury, two thermo-responsive elements, one of which has a thermo-responsive movement slower than the other to a sudden rise in temperature and both of which respond with substantially equal increments of movement to a gradual rise in temperature, the said thermo-responsive elements normally supporting the mercury switch in an inclined position with the mercury at the end opposite the contacts and acting upon a predetermined amount of differential movement in the former case and upon a predetermined amount of joint movement in the latter case to rock the switch past the horizontal and cause the mercury abruptly to be projected to the opposite end of the hollow body and in between the two contacts to effect a quick and positive electric connection therewith.

6. An electric circuit-closing device comprising the construction defined in claim 5, together with a guide arm mounted for vertical movement and pivotally connected to the mercury switch and acting to maintain the mercury switch in cooperative relation with the thermo-responsive elements.

7. An electric circuit-closing device comprising a pair of contacts, a knife having an abrupt movement from open circuit to closed circuit position and forced upon said movement into a sliding positive engagement with both of said contacts to effect a positive electrical connection, a rocking switch having an elongated hollow body containing a weight movable abruptly from one end to the other of the body when rocked from an inclined position past the horizontal, two thermo-responsive elements, one of which has a thermo-responsive movement slower than the other to a sudden rise in temperature and both of which respond with substantially equal increments of movement to a gradual rise in temperature, the said thermo-

responsive elements normally supporting the rocking switch in an inclined position and acting upon a predetermined amount of differential movement in the former case and upon a predetermined amount of joint movement in the latter case to rock the switch past the horizontal and cause the weight to move abruptly to the opposite end of the switch, the said movement of the weight acting to give an abrupt further rocking movement to the switch and thereby effect the abrupt movement of the knife from open circuit to closed circuit position.

8. An electric circuit-closing device comprising the construction defined in claim 7, together with a guide arm mounted for vertical movement and pivotally connected to the rocking switch and acting to maintain the rocking switch in cooperative relation with the thermo-responsive elements.

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