

Aug. 25, 1970

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3,525,967

SAFETY SWITCH ARRANGEMENT FOR ELECTRICAL RESISTANCE HEATERS

Filed July 25, 1968

FIG. 2

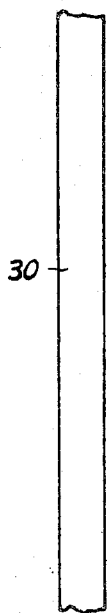
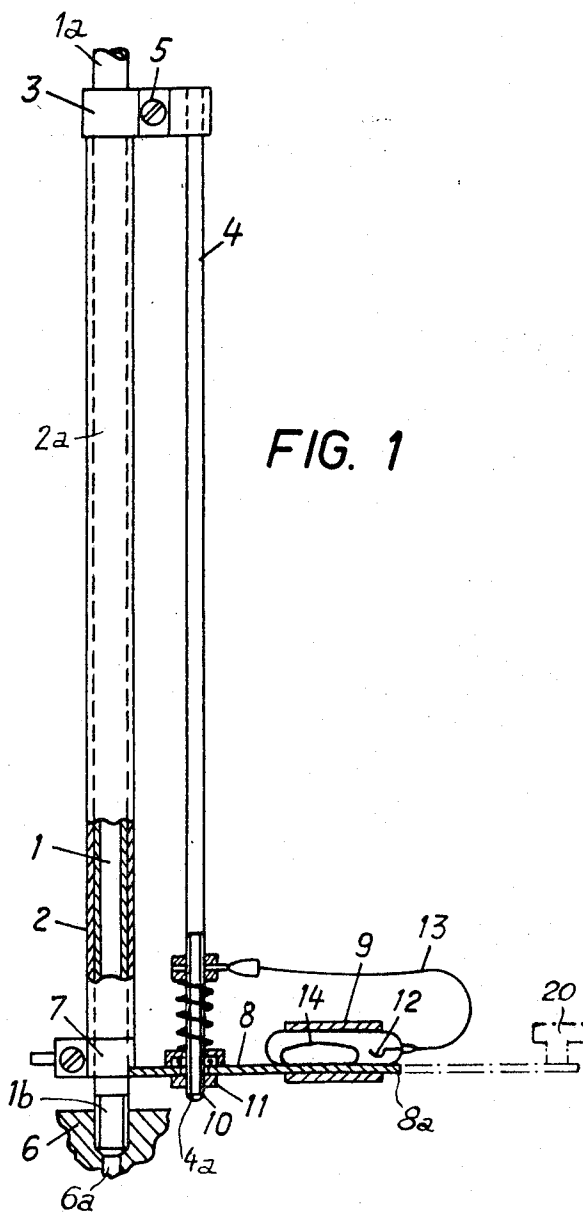


FIG. 1



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SAFETY SWITCH ARRANGEMENT FOR ELECTRICAL RESISTANCE HEATERS

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Filed July 25, 1968, Ser. No. 747,659

Claims priority, application Switzerland, July 28, 1967,
10,732/67

Int. Cl. H01h 37/48, 37/72

U.S. Cl. 337-141

8 Claims

ABSTRACT OF THE DISCLOSURE

A safety switch arrangement for electrical resistance heaters comprising tube means, the length of which varies as a function of temperature. A heat generating element is arranged at one side of the tube means and a heat absorbing medium is disposed at the other side thereof. Further, means are provided for fixedly retaining one end of the tube means. A member, such as a switch or transducer or the like, actuated in response to changes in the absolute length of said tube means is operably associated with the other free end of such tube means. The changes in the absolute length of the tube means constitute a measure for the generation of heat and the transmission of heat. Transmission means cooperate with the tube means and the actuated member, said transmission means and said actuated member being situated at the same side of said heat generating element.

BACKGROUND OF THE INVENTION

The present invention relates to an improved safety switch arrangement for electrical resistance heaters of the type incorporating an elongate carrier or support for the heating wires or the heating layer.

One problem associated with electrical resistance heaters is the prevention of overheating and, therefore, damage or destruction of the heater.

While there are, of course, known to the art, bi-metallic switches for protecting heaters and the like, they have the drawback that they are very slow to respond and, therefore, generally are not capable of providing effective protection.

SUMMARY OF THE INVENTION

Accordingly, it is a primary object of the present invention to provide an improved safety switch arrangement for electrical resistance heaters which effectively overcomes the aforementioned drawbacks.

A further, more specific object of the present invention relates to an improved safety switch arrangement for resistance heaters which is quick to respond, thereby ensuring for effective protection of the heater unit.

Still a further important object of the present invention relates to an improved safety switch arrangement for electrical heaters which is relatively simple in construction, economical to manufacture, extremely reliable in operation, and provides positive protection for the associated heater structure.

Now, in order to implement these and still further objects of the invention which will become more readily apparent as the description proceeds, the inventive safety switch arrangement for electrical resistance heaters is manifested by the features that, there is provided a support which is rigidly fixed at one end and the other end of which is operably associated with an electrical switch in such a manner that changes in the length of the support, owing to heating thereof, cause actuation of a switch.

Consequently, there is provided a simple safety switch arrangement which responds directly to the heat to which the material of the support of the heater is subjected, so that any overheating is extensively prevented.

BRIEF DESCRIPTION OF THE DRAWING

The invention will be better understood and objects other than those set forth above will become apparent when consideration is given to the following detailed description thereof. Such description makes reference to the annexed drawing wherein:

FIG. 1 depicts, partly in cross-section, an exemplary embodiment of inventive safety switch arrangement; and

FIG. 2 is a fragmentary schematic view of a beam or blade spring which can be used in the arrangement of FIG. 1 instead of the rod member thereof.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Describing now the drawing, there is provided a thin-walled glass tube 1 which is equipped at its outer surface with an electrical resistance heating element 2. In the exemplary depicted embodiment, this electrical resistance heating element 2 possesses the form of a uniform electrically conductive jacket or covering 2a. Instead of using a covering 2a, it also would be possible to wind upon the tube 1 a conventional helical or screw-like winding of a resistance wire. A suitable liquid or fluid medium which is to be heated is conducted through the inside of the hollow glass tube 1, so that this tube 1 serves as a through-pass heater. At the upper end 1a of the glass tube 1, there is mounted a clamp clip or ring 3 which is fixedly secured to the tube 1 and serves for the attachment of a rod member 4. As best shown in the drawing, this rod member 4 extends in parallelism with the tube 1 and is spaced somewhat therefrom. The actual clamping action is achieved by means of a suitable screw 5 or similar fastening expedient. The lower end 1b of the tube 1 is rigidly retained in a housing 6 or other type of suitable member.

The fluid medium to be heated is delivered from the housing 6, through the agency of a suitable opening 6a, into the tube 1, leaving the latter at the upper region thereof. A further clamping clip or ring 7 is located at the region of the housing 6. A resilient arm member 8 extends from this clamp ring 7 transverse to the longitudinal axis of the tube 1. The outer free end 8a of the resilient arm member 8 carries a mercury tilt switch 9. The lower end 4a of the rod member 4 is provided with threading 10 upon which is threaded a threaded nut member 11 bearing against the underside of the resilient arm member 8. A wire loop 13 depends from a contact 12 provided at the mercury tilt switch 9. This wire loop 13 is electrically coupled with the heater unit. Thus, when the mercury drop or bead 14 comes into contact with this contact 12 the electrical current circuit for the heater unit is closed, and in the reverse manner, when the mercury bead 14, during inclined position of the arm member 8, is not in contact with the contact 12, then this current circuit is interrupted. Naturally, suitable electrical insulating material or means is provided in order to conduct the flow of current in the desired direction and to protect against contact with current-conducting components.

Now if the heating unit 2 is switched in and thermal energy or heat transmitted to the tube 1 and, therefore to its contents, then the tube 1 tends to expand in its lengthwise direction, so that the clamp member 3 moves somewhat toward the top, therefore entrains the movement transmitting-rod member 4. As a result, the movement of the rod member 4 is transmitted via the nut mem-

ber 11 to the horizontal transmission arm member 8 and, therefore, to the mercury tilt switch 9. The resilient arm member 8 tends to bend through somewhat owing to the displacement of the rod member 4. As soon as this upward movement of the arm member 8 has assumed a certain value, then, the mercury drop or bead 14 comes out of contact with the contact 12, so that the supply of current for heating purposes is interrupted. When the tube 1 has cooled, then there occurs a movement of the arm member 8 in the opposite direction, whereupon the mercury switch 9 is again switched in. By appropriately rotating the threaded nut member 11 it is possible to adjust the response temperature of the mercury switch 9. The length of the tube member 1 should at least amount to 30 times its maximum width.

As will be best recognized by referring to the drawing, the spaced arrangement of the rod member 4 with respect to the tube 1 brings about a so-called displacement transmission or displacement advantage in that the path of displacement of the single arm-lever member 8 at its free end 8a is greater than at the location of its attachment, which could also be a pivotal attachment.

Moreover, instead of using a tiltable mercury switch, it would be possible to use a different type of switch, for instance a microswitch, or some other suitable type of transducer. Furthermore, it would be possible to arrange the switch at the upper end of the tube and, at this location for instance, to actuate such through the agency of a double-arm lever member with markedly different lengths of the lever arms.

In this manner, it is possible to provide a safety switch arrangement for the heating unit which is independent of any possible calcification of the tube 1, in that it directly responds to the heating of this tube, and therefore, at the same time, acts as a safety switch for dry operation of the heating unit, in other words, without any fluid medium moving therethrough. Since the mass of the small tube 1 which is to be heated is relatively small, the switching inertia or response time is also small.

It is also possible to construct the arm member 8 longer and to provide at the free end 8a of this arm member 8 a manual actuation lever or knob 20, as shown in phantom lines in FIG. 1, thereby enabling the performance of a switching-in operation manually. The switching-out operation then occurs automatically as a function of the heating of the tube member 1, since the mercury tilt switch 9 is arranged in the current circuit of the heater unit 2 or influences such through the agency of intermediate elements.

A further embodiment of the invention resides in the fact that instead of using a tube as the support or carrier for the heating windings, there is employed a solid rod, whereby this apparatus then may be used as a room heating device, as an immersion rod or the like.

Furthermore, it would be possible to arrange the rod member 4 such that it does not extend in juxtaposition parallel to the rod or tube carrying the heating winding, rather that it is either arranged internally of the tube member 1 or, however, is constructed as a larger size tube which extends about the rod or tube and, therefore, about the heating device, whereby then the lower end is used in analogous manner for actuating a switch or the like.

A further variant of the throughpass heater unit resides in manufacturing the tube 1 itself from a material which during the passage of current heats up to a desired degree, such as would be achieved by forming the tube 1 itself of a suitable current conducting electrical resistance material.

Finally, it also would be possible to construct the rod member 4 such that it is not flexurally stiff or rigid, rather is constructed in the form of a flat spring 30 (FIG. 2) which is rigidly connected or supported at its lower end and which bends through when it is in cold condition. A switching pin or a microswitch or the like would then

bear approximately at the center against this bent or flexed flat spring 30, which would then actuate such switch as soon as, during a predetermined or impermissible heating, the upper attachment location for this spring, due to expansion of the tube 1, is displaced toward the top, and consequently the bending through of the blade or leaf spring becomes smaller. In so doing, with a given change in the length of the tube, the thus resulting change of the bending through is greater, so that in this manner a transmission ratio is obtained which provides a sufficient switching path for the switch.

In the event that a suitable amount of space is available, the spring 30 or the rod member 4 generally could, instead of depending downwardly from the clamping ring or member 3, also depend upwardly, whereby then the increase of the bending through of the spring can be utilized for actuating the switch.

Since there is used the change in length of that body member, that is, the tube which is directly in contact with the heat absorbing medium, as the measurement magnitude or value, there is obtained a determination of the production of heat and the delivery of thermal energy which is exact, sensitive and free of delay. As a result, it is also possible to increase by a factor of 3 to 4 the heating load of the tube per surface area, which normally amounted to approximately 10 to 15 watts/cm.².

If there occurs a change in the transmission or delivery of heat, for instance because of soiling, calcification, an absence of the medium, or because of changes in the production of heat, then the tube member accordingly changes its lengthwise expansion, and the switch responds as soon as it has reached the critical lengthwise elongation, completely independent of the reason why such body member has reached such critical lengthwise expansion.

It should be apparent from the foregoing detailed description that the objects set forth at the outset to the specification have been successfully achieved.

Accordingly, what is claimed is:

1. A safety switch arrangement for electrical resistance heaters comprising: heater tube means defining a through flow passage for conducting a heat-absorbing medium to be heated therein, the length of said tube means being temperature dependent wherein changes in the absolute length of said tube means constitute a measure of the generation and transmission of heat; heat generating element means disposed about the outside of said tube means for heating said tube means and the heat-absorbing medium conducted therein; means for fixedly retaining one end of said tube means; a rod member extending substantially parallel to and at a distance away from the outside of said tube means; means for fixedly securing one end of said rod member to the free end of said tube means; a lever arm means attached to said tube means and disposed substantially transverse to the longitudinal axis thereof; means coupling said rod member to said lever arm means whereby changes in length of said tube are transmitted by said rod member to said lever arm means; said lever arm means being actuated by said rod member as a function of the change of length of said tube means; and switch means operably associated with said lever arm means and connected to said heat generating element means, said switch means thereby being actuatable in accordance with changes in the absolute length of said tube means to control said heat generating element means.

2. A safety switch arrangement for electrical resistance heaters as defined in claim 1, wherein said heat generating element means comprises heater windings.

3. A safety switch arrangement for electrical resistance heaters as defined in claim 1, wherein said tube means is formed of a current conducting electrical resistance material.

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4. A safety switch arrangement for electrical resistance heaters as defined in claim 1, further including manually operable means operably connected with said lever arm means.

5. A safety switch arrangement for electrical resistance heaters as defined in claim 4, wherein said manually operable means comprises a manually actuated knob.

6. A safety switch arrangement for electrical resistance heaters as defined in claim 1, wherein said lever arm means is pivotably mounted to said tube means.

7. A safety switch arrangement for electrical resistance heaters as defined in claim 1, wherein said lever arm means is resilient and is fixedly mounted at one end thereof to said tube means.

8. A safety switch arrangement for electrical resistance heaters as defined in claim 1, wherein said switch means comprises a mercury tilt switch.

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