Jan. 4, 1966 E. G. SALEM 3,227,842

TEMPERATURE-ACTUATED CIRCUIT BREAKER

Filed Nov. 3, 1961

fig-1

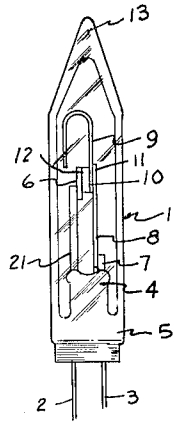


fig 2

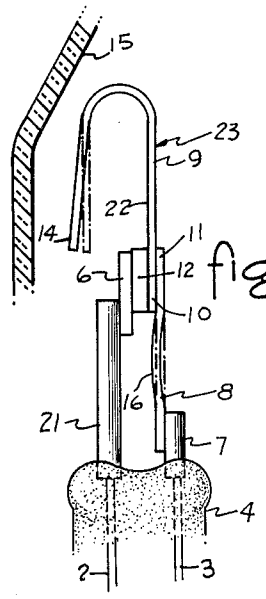


fig-3

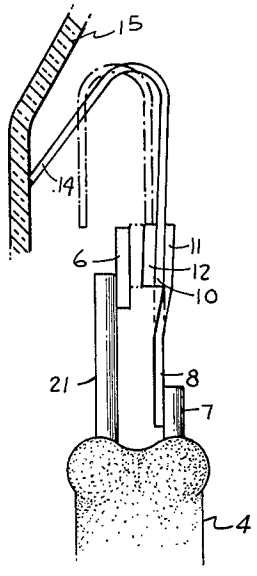
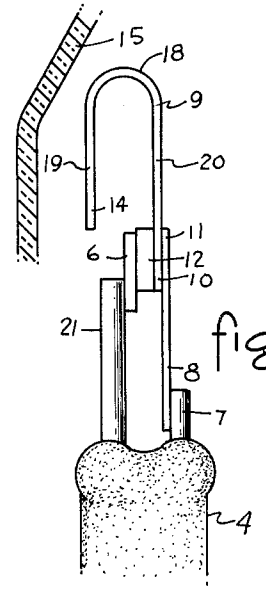


fig-4



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TEMPERATURE-ACTUATED CIRCUIT BREAKER

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This invention relates to electrical circuit breakers, and particularly to those which are actuated by a change in the ambient temperature, automatically opening at one temperature and closing at another. The opening and closing are generally called "tripping" and "resetting," respectively.

Such devices can be used in electrical motors to break the circuit when the temperature of a critical part becomes too great. Such temperature actuated breakers are especially useful in motors which have only a small difference in current between normal operation and operation with the rotor locked. In the latter condition, the current may be only slightly different from the normal current, but the temperature of the field windings may be increased to the danger point, because the ventilation is reduced when the rotor is stationary. The ventilation usually comes from fan blades operated from the rotor.

In order to function effectively, the breaker should have an appreciable differential, or lag, between the trip and reset temperatures. A differential of 4° C. is generally satisfactory to insure that the breaker remains open for a reasonable period before it closes again. If the differential is to small, the contacts will continually open and close in rapid sequence, thereby shortening the life of the breaker and allowing the temperature of the motor to rise higher than might be desirable. With a long differential, the breaker will remain open long enough for the motor to cool appreciably between each trip and reset.

Such temperature differentials have previously been obtained by the use of the "snapping" type of breaker, actuated by a bimetallic element which has one stable position when cold, and another when hot, and snaps from one position to the other at a particular temperature. The snapping temperature is different on heating than on cooling, thereby providing the differential.

The snapping type of breaker is expensive and difficult to use in a small space.

I have discovered that the differential can also be obtained by attaching one end of a U-shaped bimetallic strip to another bimetallic strip carrying one of a pair of contacts, the other end of the U-shaped piece being free, and enclosing the breaker in a container with the free end of the bimetal in position to touch the wall of the container when its temperature rises, just before the contacts open.

The second-mentioned bimetal can be fairly straight, the contact at its end being normally closed to another contact when the ambient temperature is below the value at which the contacts are to open. This bimetal carries current, the U-shaped bimetal does not.

The container can be a sealed glass tube, filled with a light gas such as hydrogen or helium, when it is desired to make the device extremely sensitive in its response to temperature changes. The convection currents in the gas will insure that the bimetal will be quickly cooled or heated by the surroundings outside the container.

The same bimetal structure can be used in a container of different material if desired, but the use of glass provides a device which is insulated from its environment, except at its lead-in wires, and the glass tube can be inserted directly into an electrical winding whose temperature is to be controlled. The use of a container of glass also facilitates the use of the device for controlling

the temperature of liquid media since its portions other than those near the lead-in wires can be inserted directly into the liquid. The device is thus especially useful in coffee percolators and the like, and in many other devices requiring temperature or current control.

Because the circuit breaker of my invention is actuated by a change in ambient temperature, a smaller number of types can be used than would be necessary with a breaker actuated mainly by current passage. Many motors which are of different current ratings have the same temperature rating, and so the same breaker can be used with them.

Other objects, advantages and features of the invention will be apparent from the following specification taken in conjunction with the accompanying drawing, in which:

FIG. 1 is a side view of a device according to the invention;

FIG. 2 is a cut-away view showing the device when it is passing current but not hot enough to open its contacts;

FIG. 3 is a similar view showing the device when it is heated by an increase in ambient temperature; and

FIG. 4 is a similar view showing the device on reclosing its contacts.

In FIG. 1, the hermetically sealed glass envelope **1** has the two lead-in wires **2**, **3**, sealed through it at one end, preferably through a press **4** in stem **5**, which closes the end of said envelope by a pinch seal. A support wire of metal, for example, of nickel extends from lead-in wire **2** above the press **4**, to support contact **6** and be in electrical contact therewith and with the lead-in wire **2**.

A short support wire **7** extends from lead-in wire **3** out of the top of stem **4**, the support wire **7** being set into the stem for a short distance, as is customary with such wires in stems. The support wire **7** is connected electrically to lead-in wire **7**. The bimetal strip **8** extends from support wire **7**, to which it is welded into the tube **1** in a general direction along, or parallel to, the longitudinal axis of said tube, and is substantially straight when at normal ambient temperature, with no current flowing through it.

The U-shaped bimetal **9** has one leg longer than the other, and the end **10** of the longer leg is welded to the otherwise free end **11** of the straight bimetal strip **8**. A contact **12** is welded to the same end **10**, so that the end **11** of straight bimetal **8** is welded to one side of end **10**, and the contact **12** to the other side, the contact **12** being, of course, in register with fixed contact **6** and normally closed to it.

The envelope is evacuated and filled with helium to a pressure of about 700 mm. of mercury, in the manner customary in the lamp art, the end **13** of the bulb acting as an exhaust tube during that procedure, and being then hermetically sealed off, as it is shown in FIG. 1.

In operation, the passage of current through the bimetal strip **8**, when the contacts **6** and **12** are closed and the lead-in wires connected in series with a voltage source and the device to be protected, heats said strip, causing it to bow inwardly somewhat and increase the pressure holding contacts **6**, **12**, together. When the ambient temperature rises sufficiently, as it would do if the temperature of the device in contact with the envelope **1** rises to an undesired value, the U-shaped bimetal **9** bends so that its free end **14** touches the glass wall **15** of tube **1** and the contacts **6**, **12** open, as shown in FIG. 3. On cooling, the device returns to a position with the contacts **6**, **12** closed as in FIG. 1 and the cycle is repeated until the difficulty is repaired or the power shut off. When the latter occurs the switch returns to the position of FIG. 1, as shown in FIG. 4.

In the device described, the two bimetal strips **8**, **9** were welded together with the high expansion side **16** of bimetal **8** and the high expansion side **22** of the long end of U-shaped bimetal **9** on the same side of the centerline of bimetal **8**; that is both strips face in the same direction. In other words, the high expansion side **16** of bimetal **8** is welded to the low-expansion side **23** of bimetal **9**.

By "high expansion" side, of course, we mean the side made of material of a higher coefficient of expansion than that of the other, or "low expansion" side. A bimetallic strip is an integrally bonded combination of a low expansion piece and a high expansion piece.

In one specific embodiment of the invention, the bimetal strip **8** was of the kind known as Chace 4800 about .012 inch thick, ⅛ inch wide and about 5/16 inch long, and the U-shaped bimetal **9** was of the type known as Chace 6400, .010 inch thick 1/16 inch wide and 0.340 inch from the outside edge of its end **10** to the middle **18** of the U. The strip was bent to a radius of 0.047 inch in the vicinity of the middle **18**, and the inside distance between the parallel legs **19** and **20** was about 0.09 inch. The short leg **19** was 0.247 inch from the outside edge of end **14** to the projection of the middle **18** into the plane of the leg.

The short bimetal strip **8** was about ⅛ inch wide and 5/16 inch long, made of .012 inch thick bimetal strip. Contacts **6**, **12** were each 0.023 inch thick, 0.092 inch wide and 0.125 inch long, placed with their longest dimensions at right angles to each other. The other contact **6** was of the same thickness and width, and 0.125 inch long, the portion extending above support wire **21**, extending from lead-in wire **2** and set slightly into the top of press **4**, being about 0.068 inch.

The support wires are 0.030 inch diameter nickel, and the lead-in wires **2**, **3** of .020 inch diameter dumet wire.

The sealed envelope was so-called "T–2" tubular bulb which had an inside diameter of about 0.230 inch.

When the device is not to be in an envelope heated during manufacture so that it reaches a temperature above normal operating temperature, the high-expansion and low-expansion sides of the bimetal strip **8** can be in the reverse position to that already described, or the strip can even be of a single material, such as Phosphor bronze, instead of bimetal. In cases where an outside envelope is not used, a flat stop can be placed in position so that the free end of the U-shaped bimetal will bear against it when heated.

Other modifications of the invention will be apparent

to a person skilled in the art, from a reading of the present specification, without departing from the spirit and scope of the invention.

I claim:

1. A temperature-actuated circuit breaker comprising a hermetically sealed envelope, a wire sealed therethrough and electrically connected to a fixed contact, another wire sealed therethrough and electrically connected to a bimetal strip, a U-shaped bimetal strip mechanically connected to said first-mentioned bimetal strip at one end of the U-shaped strip, the other end of said U-shaped strip being normally free to move toward the inside wall of said envelope to meet the same, and a contact movable with said first-mentioned bimetal strip and normally closed to said fixed contact.

2. The circuit of claim **1**, and a filling of helium in said envelope.

3. A temperature-actuated circuit breaker comprising a hermetically sealed envelope, a wire sealed therethrough and electrically connected to a fixed contact, another wire sealed therethrough and electrically connected to a metal strip, a U-shaped bimetal strip mechanically connected to said metal strip at one end of the U-shaped strip, the other end of said U-shaped strip being normally free to move toward the inside wall of said envelope to meet the same, and a contact movable with said bimetal strip and normally closed to said fixed contact.

4. The circuit breaker of claim **3**, and a filling of helium in said envelope.

5. A pair of cooperating contacts, one at least being attached to a flexible metal strip, a U-shaped bimetal strip attached at one of its ends to said metal strip, and a stop for limiting the motion of the other end of said U-shaped bimetal strip.

6. The combination of claim **5**, in which the stop is an envelope containing the U-shaped bimetal strip.

References Cited by the Examiner

UNITED STATES PATENTS

1,851,657	3/1932	Appelberg	200—113
2,530,059	11/1950	Hood	200—138
2,742,547	4/1956	Tsai	200—113
2,769,876	11/1956	Macemon et al.	200—113
2,785,278	3/1957	Peterson	200—138
2,820,870	1/1958	Noksu	200—113

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