

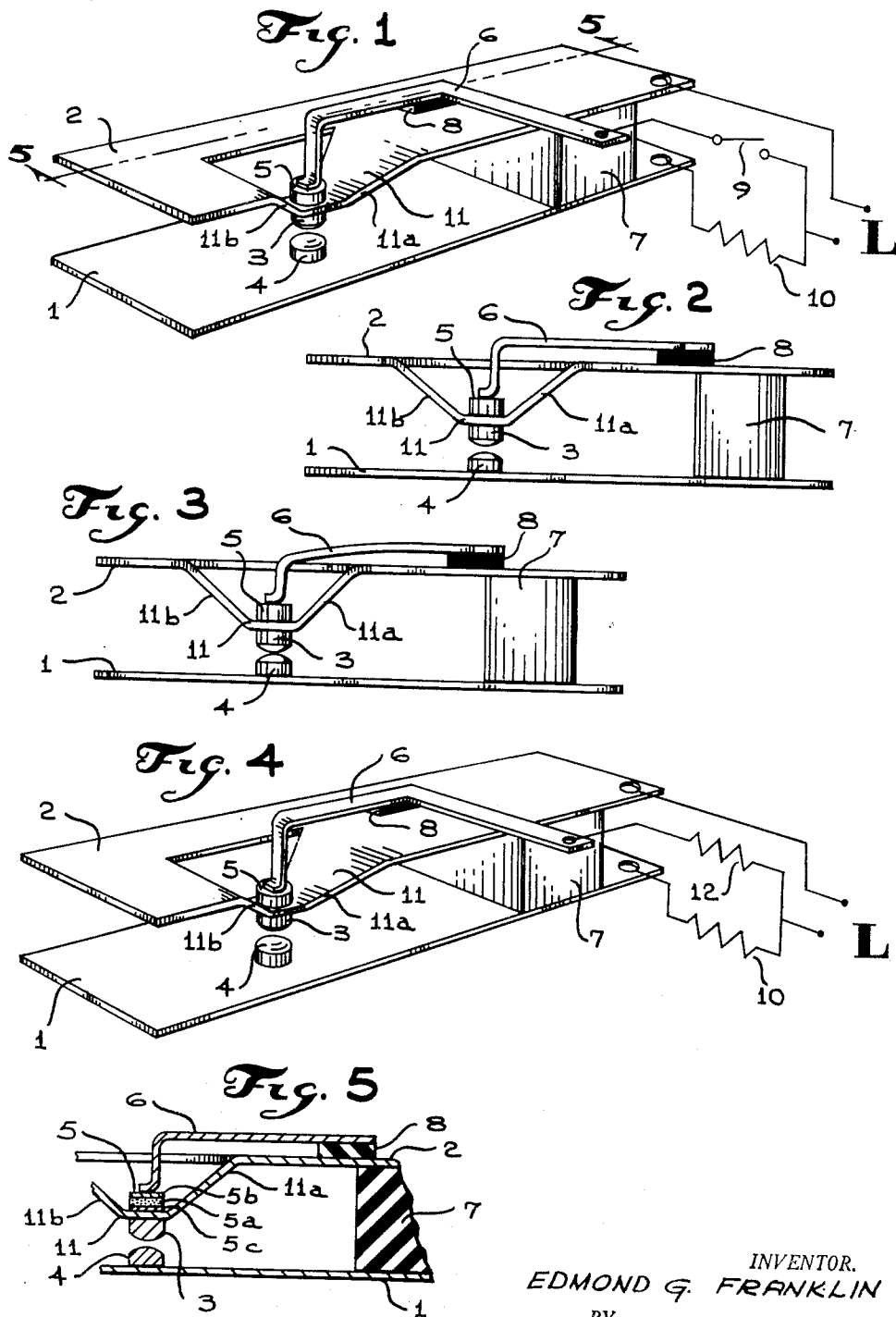
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REMOTE CONTROLLED THERMAL RELAY

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REMOTE CONTROLLED THERMAL RELAY

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4 Claims. (Cl. 200—122)

This invention relates in general to electric relays and pertains more particularly to a relay of the thermal variety.

One object of the invention is to provide a thermally actuated relay requiring only a small amount of electric power to control a much larger quantity, it being contemplated that the small amount of power be converted into heat and the heat in turn utilized to lengthen a readily expandable bridge member on which one of the load current carrying contacts is mounted. The bridge member is so designed that its expansion will cause its contact to engage another contact to complete a circuit through the electrical load requiring the larger amount of power for its operation. For example, the control power may, when following the teachings of the invention, be of the order of five watts, whereas the load power can be in the neighborhood of 1,000 watts or even more.

Another object of the invention is to provide a relay which is entirely reliable in its operation and which will have an exceptionally long life expectancy. In this connection, it is within the purview of the invention to provide a thermal relay in which there are employed no pivotally connected parts. Further, the parts are so arranged that undue stress or strain will never happen, all of which contribute to the long life of the relay.

A further object of the invention is to provide a relay of the foregoing type that may be of miniature proportions, the actual size being governed primarily by the amount of power to be controlled and the voltage thereof.

Still further, another object is to provide a relay that can be inexpensively fabricated from ordinary sheet stock at a less than competitively low figure, it is believed.

Yet another object resides in the provision of a thermal relay that possesses a fine degree of sensitivity, a sensitivity of such degree that the relay lends itself readily to installation in heating circuits, such as those where a thermistor is the temperature responsive element.

Still another object of the invention is to provide a relay having desirable cycling delay characteristics.

Other objects will be in part obvious and in part pointed out more in detail hereinafter.

The invention accordingly consists in the features of construction, combination of elements and arrangement of parts which will be exemplified in the construction hereafter set forth and the scope of the application of which will be indicated in the appended claims.

In the drawings:

Figure 1 is a perspective view of a thermal relay forming the subject matter of the instant invention shown connected in circuit with a manually operable switch;

Figure 2 is a side elevational view showing the relay contacts in a separated position;

Figure 3 is a view corresponding to Figure 2 but with the relay contacts in engagement;

Figure 4 is a view similar to Figure 1 but showing a thermistor substituted for the manually actuated switch of the earlier figure; and

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Figure 5 is an enlarged fragmentary sectional view taken in the direction of line 5—5 of Figure 1.

Referring first to Figures 1, 2, 3, and 5, the relay there selected for the purpose of exemplifying the invention comprises a pair of switch blades 1 and 2 vertically spaced one above the other. The upper switch blade 2 carries an electrical contact 3, the particular means by which this contact is supported being referred to hereinafter. The lower switch blade 1, on the other hand, supports a contact 4 attached directly to said blade.

In order to control relatively large amounts of power with a very small amount, provision is made for the employment of an auxiliary heating element designated in its entirety by the reference numeral 5. More will be said later on concerning the preferred construction of this heating element. However, from the drawing it will be observed that the heating element 5 is affixed to the free end of a thermal strip 6 having a substantially L-shaped configuration when viewed in side elevation (Figures 2 and 3). The switch blades 1 and 2 are electrically insulated one from the other by reason of a block of suitable dielectric material 7 and the terminal strip 6 is likewise insulated from the switch blade 2 by a much smaller piece of insulation labelled 8.

The terminal strip 6 has in circuit therewith a switch unit 9 which may be manually or automatically actuated, and lead connections extend from the switch unit 9 in opposite directions so that the switch unit may be suitably connected to a source of electric power designated by the letter L. To connect the other side of the heating element to the source of power L another conductor member extends from the switch blade 2 to said source of power. Thus in order to energize the heating element 5 only the switch 9 need be moved into a closed position.

Since it is contemplated that the relay control a relatively large amount of power such as would be required by a main heating element 10, the lower switch blade 1 is connected in circuit with this main heating element 10, the upper switch blade 2, of course, acting as part of the return path for the circuit involving the element 10. Thus it will be seen in the illustrated embodiment that the heating element 10 constitutes a load to which the relay is intended to supply power.

From the drawing it will be discerned that the upper switch blade is fabricated so that a downwardly projecting bridge 11 is formed. The bridge may be produced by a simple stamping and bending operation so that the bridge in effect constitutes two inclined struts 11a and 11b, the neighboring ends of such struts being joined together whereas the opposite ends are integrally connected with the main portion of the switch blade 2. The one primary criterion that is imposed upon the structure of the bridge member 11 resides in the fact that these struts should be readily expandable when subjected to heat from the heating element 5 so that each strut 11a and 11b will expand sufficiently in a lengthwise direction, in this way urging the contact 3 carried thereby downwardly into engagement with the other contact 4. Conversely, the struts 11a and 11b must contract enough when the heating element 5 is deenergized so that the contact 3 will be withdrawn from its cooperable contact 4 to break the circuit.

It is, however, within the purview of the invention to correlate the cross section of the struts 11a and 11b with the amount of current intended to pass therethrough so that when the contacts 3 and 4 meet, then the electrical resistance produced by the afore-mentioned correlation will produce additional heat which will cause further expansion of the struts 11a and 11b over and above that received from the auxiliary heating element 5. This results in what may be termed a "cycling delay" for upon the flow of current through the struts the additional or incremental expansion causes an increase in the pressural

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engagement of the contacts, thus quickly establishing an improved and firmer electrical contact. On the other hand, upon interruption of current caused by deenergizing the auxiliary heating element 5, the gap between contacts will rapidly increase due to the incremental contraction attributable to the loss of current which earlier caused the extra expansion of the struts. Needless to say, though, the heat from the load current passing through the struts must not be so great as to hold the contacts 3 and 4 together after the heat from the auxiliary element 5 has been removed.

While up to this point the auxiliary heating element 5 has been referred to only generally, from Figure 5 it can be seen that a preferred structure for the heating element 5 consists in utilizing a carbon resistor 5a having upper and lower metallized surfaces 5b and 5c. By so selecting and constructing the heating element 5 it will be appreciated that the upper metallized surface 5b can be soldered directly to the downwardly extending end of the terminal strip 6 and the lower metallized surface 5c may be merely urged into intimate contact with the upper side of the bridge member 11 by virtue of having the terminal strip 6 formed from metal having resilient characteristics. In this way the inherent resiliency of the terminal strip 6 is instrumental in forcing the auxiliary heating element 5 downwardly into electrical contact with said bridge member.

Thus it will be observed that when the switch 9 is closed current from the source L will course through the switch, the terminal strip 6, the heating element 5, the bridge 11, the switch blade 2, and thus back to the other side of the power source L. The energization of heating element 5 generates sufficient heat so that the heat is conducted from this heating element into the bridge 11 thereby causing the struts 11a and 11b to expand longitudinally, which expansion results in the contact 3 being moved downwardly from the position depicted in Figure 2 into the position pictured in Figure 3. Of course, it will be realized that the spacing of the contacts 3 and 4 shown in Figure 2 is somewhat exaggerated and so is the expansion that takes place in moving the contact 3 downwardly into engagement with the lower contact 4 as illustrated in Figure 3. Also, it will be recognized that the particular spacing will be governed to an appreciable extent by the voltage involved and the particular dimensions of the switch blades 1, 2 and the bridge member 11 will be dictated largely by the current to be carried by these members. As hereinbefore stated, the bridge member 11 should be of such dimensions that it will not expand to such an extent by reason of heat generated by the current flowing therethrough that the contacts will remain closed when the auxiliary heating element 5 is deenergized. If this were not the situation, then quite obviously once the contacts 3 and 4 are closed too much expansion from the current coursing through the struts 11a and 11b would be instrumental in expanding these struts sufficiently so that when the heating element 5 is deenergized the struts would not contact due to the removal of such source of heat and the contacts 3 and 4 would remain closed when they actually should move to open position. Of course, some expansion from the load current is of benefit as explained earlier.

Considering the system shown in Figure 4, it is to be kept in mind that this circuitry is identical with that of Figure 1 with the exception of the substitution of a thermistor 12 for the switch 9, a thermistor having a positive temperature coefficient of resistance such as that possessed by nickel wire. Also in this situation the thermistor 12 is in heat transfer relation with the load device 10 and as earlier stated, the load device 10 is a heating element. The heating element 10 thus transmits heat to the thermistor 12 and the change in the resistance of the thermistor is responsible for increasing the power supplied to the auxiliary heating element 5 when the heat received from the main heating element 10 requires an increase. Like

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the earlier described embodiment the energization of the heating element 5 generates sufficient heat so that the contacts 3 and 4 are closed. In this particular embodiment the closure of the contacts 3 and 4 takes place when the heating element 10 requires energization. Once the heating element 10 has been energized for a sufficient length of time then the transfer of heat from this heating element to the thermistor 12 will cause the resistance of the thermistor 12 to increase sufficiently so as to reduce the current passing through the heating element 5 with the concomitant result that the heat from the heating element 5 is reduced. This reduction in heat, of course, allows the struts 11a and 11b to contract, raising or withdrawing the upper contact 3 from engagement with the lower contact 4, thus breaking the circuit to the load device 10.

Of course, the load device 10 need not be an electrical heating element but might be an electric motor or some other electric contrivance. Also, from the foregoing description, it will be manifest that a relatively large amount of power can be adequately controlled with only a small amount of power. For example, the control power may be of the order of only five watts whereas the controlled power can be in the neighborhood of 1,000 watts or even more if need be. Further, it will be understood that the switch 9 and in some instances the thermistor 12 may be remotely located with respect to the load device and also the thermal relay, thereby making it possible to control the power passing through the load device from a point a considerable distance away.

As many changes could be made in the above construction and many apparently widely different embodiments of the invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the language used in the following claims is intended to cover all of the generic and specific features of the invention herein described and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

I claim:

1. A thermal relay comprising a pair of cooperable contacts, an electrically conductive element, means mounting one of said contacts for movement relative to said element and relative to the other of said contacts, said means including a pair of inclined struts joined together at one end and joined to said element at their other ends, said one contact being affixed to said struts at their neighboring ends, and electric heating means disposed adjacent said struts, said struts being capable of sufficient lengthwise expansion from the heat produced by the heating means when said heating means is energized with a relatively small amount of power so as to cause said one contact to engage said other contact to establish a conductive path via said struts and contacts, whereby said contacts are conditioned for the passage of a relatively large amount of power compared with the power required to energize said heating means, and the cross section of said struts being limited with respect to the current intended to flow therethrough so that additional expansion is effected by reason of such current flow.

2. A thermal relay comprising a pair of cooperable contacts, a pair of vertically spaced electrically conductive elements, one of said elements having an integral pair of inclined struts joined together at one end and joined to said one element at their other ends, said one contact being affixed to said struts at their neighboring ends and said other contact being affixed to said other conductive element, electric heating means disposed adjacent said struts, an electrical terminal member connected to said heating means, said heating means contacting said struts to include said heating means in circuit with said terminal member and said struts, said struts being capable of suffi-

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cient lengthwise expansion from the heat produced by the heating means when said heating means is energized with a relatively small amount of power so as to cause said one contact to engage said other contact to establish a conductive path via said struts and contacts, whereby said contacts are conditioned for the passage of a relatively large amount of power compared with the power required to energize said heating means.

3. A thermal relay comprising a pair of cooperable contacts, a pair of vertically spaced electrically conductive elements, means carried by one of said elements mounting one of said contacts for relative movement between said elements, said means including a pair of inclined struts joined together at one end and joined to said one element at their other ends, said one contact being affixed to said struts at their neighboring ends and said other contact being affixed to said other conductive element, electric heating means disposed adjacent said struts, a resilient metallic L-shaped strip having one end anchored to said one conductive element, electric heating means carried at the other end of said strip, the resiliency of said strip

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biasing said heating means into engagement with said struts and said struts being capable of sufficient lengthwise expansion from the heat produced by the heating means when said heating means is energized with a relatively small amount of power so as to cause said one contact to engage said other contact to establish a conductive path via said struts and contacts, whereby said contacts are conditioned for the passage of a relatively large amount of power compared with the power required to energize said heating means.

4. A thermal relay in accordance with claim 3 in which said heating means includes a carbon resistor, said L-shaped strip serving as one terminal therefor and said struts serving as the other.

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