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3,274,359

THERMAL RELAY

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Fig. 1

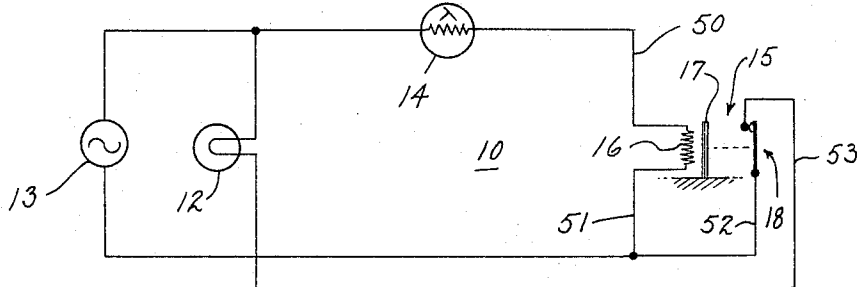


Fig. 2

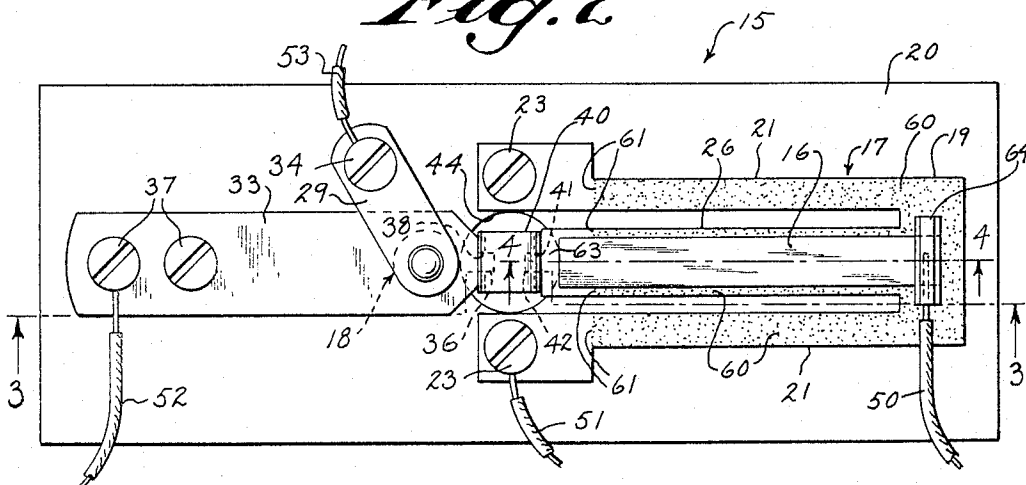


Fig. 3

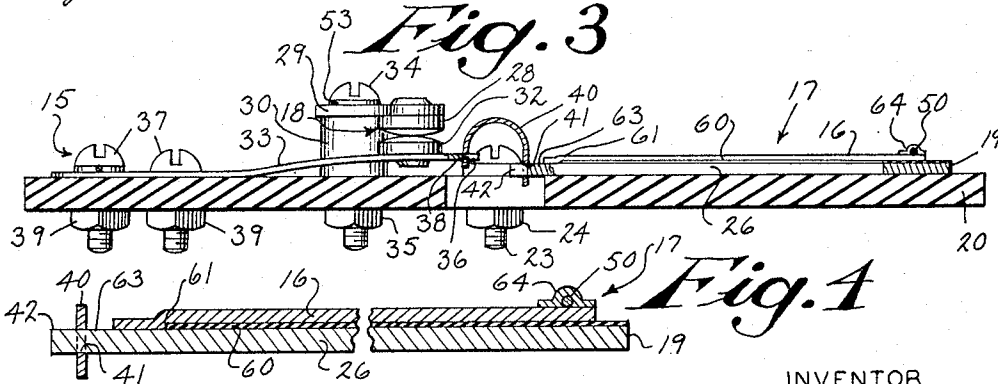


Fig. 4

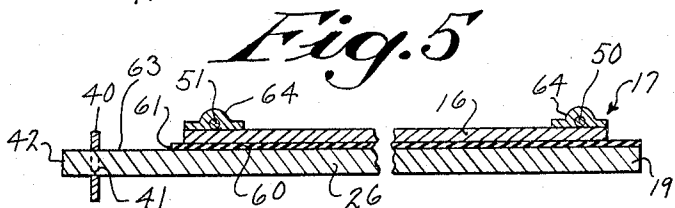
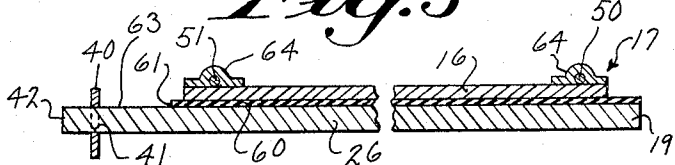


Fig. 5



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THERMAL RELAY

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2 Claims. (Cl. 200—122)

This invention relates to thermal relays and, more particularly, to a new and improved thermal relay which has particular, but not exclusive, application to light sensitive switches.

One type of prior art thermal relay employs a heater resistor and a bimetallic element. In such relays, the heater consists of a fine insulated resistance wire which is wound around the bimetallic element. When the requisite current flows through the resistance wire, the bimetallic element deflects sufficiently to open or close the relay contacts. The resistance windings of such prior art thermal relays were unsatisfactory because they were costly to manufacture, structurally weak and susceptible to surge voltages.

It is an object of the invention to provide a new and improved heater resistor element for thermal relays.

Another object of the invention is to provide a heater resistor element for thermal relays which is rugged, easily manufactured, relatively inexpensive and can withstand relatively large surge voltages.

A further object of the invention is to provide a heater resistor element for thermal relays which provides greater efficiency to allow greater contact size and separation.

A further object of the invention is to provide a heater resistor for the bimetallic element of a thermal relay wherein the heater resistor comprises a resistance coating intimately bonded to the surface of the bimetallic element and at least a portion of which is insulated from the element by an intervening coating of insulation.

These and other objects and advantages of the instant invention will become more apparent from the detailed description thereof taken with the accompanying drawings wherein:

FIG. 1 is a circuit diagram schematically illustrating a photocontrol device in which the thermal relay according to the instant invention is usable;

FIG. 2 is a top plan view of the thermal relay according to the instant invention;

FIG. 3 is a view taken along lines 3—3 of FIG. 2;

FIG. 4 is a view taken along lines 4—4 of FIG. 2; and

FIG. 5 shows a modified form of the instant invention.

Referring now to the drawings in greater detail, FIG. 1 shows the circuitry of a photocontrol device 10 operative to connect a lamp 12 being controlled to an energy source 13. The photocontrol 10 includes a photo-cell 14 consisting of a photo-sensitive resistance material, such as cadmium sulfide, which is characterized by an inverse illumination-resistance characteristic.

The thermal relay 15 includes a heater resistor element 16 connected by conductors 50 and 51 in series with the photo-cell 14 and the combination connected across the energy source 13. In addition, thermal relay 15 includes a bimetallic element 17 which is disposed in close thermal association with the resistor 16 and is operative when deflected to open contacts 18 to disconnect conductors 52 and 53 and, hence, the lamp 12 from the source 13.

The thermal relay 15 is shown in greater detail in FIGS. 2, 3 and 4 to include a non-conductive base 20 of any suitable insulating material such as Bakelite. The bimetallic element 17 has a generally E-shaped configuration consisting of a pair of generally parallel outer legs 21 which are each affixed by bolts 23 and nuts 24 to the base 20. The bimetallic element 17 also includes a center leg 26 which extends from a common end 19 in parallel with the

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outer legs 21. As those skilled in the art will appreciate, ambient temperature compensation is provided by the tendency of the common end 19 to deflect upwardly due to ambient heating in counteraction to ambient temperature deflection of the center leg 26.

With references to FIGS. 2 and 3, the contact assembly 18 is shown to include a fixed contact member 28 mounted at one end of a conductive terminal 29 which is affixed in spaced relation above the base 20 by a stud 30. A bolt 34 secured by a nut 35 affixes terminal 29 and stud 30 and also serves to connect conductor 53 to terminal 29.

The contact assembly 18 also includes a movable contact member 32, which is carried at one end of a snap-acting leaf spring member 33 disposed in substantial alignment with the central leg 26 of the bimetallic element 17. The other end of member 33 is fixedly mounted on the base 20 by screws 37 and bolts 39. The contact or free end of member 33 also has a tip 36 which engages a notch 38 in one side of a C-shaped spring member 40 which has a corresponding notch 41 in its opposite side for engagement by a tip 42 carried on the free end of the central leg 26 of the bimetallic element 17. An aperture 44 may be provided in the base 20 to allow unrestricted movement of spring 40. It can thus be seen that the C-shaped spring 40 couples the free end of the central leg 26 of bimetallic element 17 to the free end of the snap-acting spring member 33.

The fixed end of conductive spring member 33 is shown connected to the conductor 52 so that when the bimetallic element 17 is relaxed as shown in FIG. 3, the spring member 33 will hold the movable contact 32 in engagement with the fixed contact 28 to connect conductors 52 and 53 whereby the lamp 12 (see FIG. 1) will be energized. When the bimetallic element 17 deflects upwardly, the right side of the spring 40 will move downwardly, as viewed in FIG. 3, to produce a downward force on the free end of spring member 33. When this biasing force reaches a predetermined value to overcome the spring force of the member 33, the free end of the spring member 33 will be snapped downwardly to disengage the contacts 28 and 32.

One side of the bimetallic element 17, according to the instant invention, is shown in FIGS. 2 and 4 to be substantially covered by electrical insulation 60. This insulation extends from the common end 19 toward the opposite end up to a line designated by the reference numeral 61 and may consist of an aluminum oxide film or coating which is formed by anodizing this portion of the element 17. It is also contemplated that the insulation 50 could be provided by applying an insulating film such as a nonconductive epoxy.

The heater resistor element 16 is shown to consist of an elongate coating of electrical resistance material which is applied to the central leg 26 of the element 17 and which extends from the common end 19 past the edge 61 of the insulating film and onto the uninsulated free end 63 of said central leg. The resistance element 16 may consist of any suitable resistive material such as a mixture of graphite, metal particles and thermo-setting resin, which is applied by spraying or silk screening. A suitable resistance material has been found to be FH-441 conductive coating of the Atchison Colloids Company, which has a resistance of .20 ohm per inch plus or minus 20% at 75° F.

As seen in FIG. 4, the electrical insulation 60 electrically separates the resistance heater 16 from the bimetallic element 26 except for the extreme free end 63. The conductor 50 is connected to the heater resistor 16 in any suitable manner such as by a coating 64 of conductive epoxy. As seen in FIGS. 2 and 4, the conductor 50 engages the heater resistor 16 adjacent the common end 19 of the bimetallic element 17, while the conductor

51 is connected to an uninsulated portion of one of the outer legs 21. The current path between conductors 50 and 51 is, therefore, through substantially the entire length of the resistance heater element 16 from conductor 50 to the uninsulated end 53 and then through the bimetallic element of the conductor 51.

It is also contemplated that the heater resistor 16 can be entirely insulated from the bimetallic element leg 26 by the insulation 60 as shown in FIG. 5. In this case the conductors 50 and 51 are connected to the opposite ends of the resistance 16 so that no current flows through the bimetallic element 17.

Referring again to FIG. 1, it will be appreciated that when the level of ambient illumination is low, the photocell 14 will have a relatively high resistance so that the current flowing through heater resistor 16 will be insufficient to open contacts 18 and the lamp 12 will be energized. When the level of ambient illumination rises to the threshold operating level of control 10, the resistance of photocell 14 will have fallen to the point where the current flowing in heater resistor 16 is sufficient to produce the required deflection in the central bimetallic leg 26 to open contacts 18 and de-energize the lamp 12.

It can be seen that because the insulation 60 consists of a thin film or coating on the bimetallic element leg 26 and because the resistance 16 also consists of a film or coating on the insulation 60, there is in effect intimate engagement between said resistance and leg over a substantial area. As a result, there is a relatively high order of heat transfer efficiency therebetween which is not greatly diminished by the insulation 60. This provides greater element deflection so that larger switch contacts may be employed and a greater contact separation is possible so that the switch can handle relatively larger currents.

In addition, because the heater resistor 16 is a thin strip of resistive material, it is not easily damaged and can withstand relatively high surge voltages.

While the thermal relay, according to the instant invention, has been described with relation to one type of control device and, further, while the resistance element is discussed in relation to one particular type of bimetallic element, it is not intended to be limited thereby but only by the scope of the appended claims. For example, the bimetallic element may take any conventional form other than a flat member such as bars, bent or curved members or coils.

I claim:

1. A thermal relay including a flat elongated generally E-shaped bimetallic element having three adjacent disposed substantially parallel legs, one end of each of said legs being joined by a common end portion, a first coating covering a substantial elongate portion of one surface of the central one of said legs and extending from said one end to a terminal position short of the other end thereof, said first coating comprising an electrical insulating material, a second elongate coating disposed on said central leg and consisting of electrical resistance material, said second coating being disposed on said first coating and extending from the one end of said central leg past said terminal position and onto the other end of said element for electrically engaging said element, said first coating electrical insulating the remainder of said resistance coating from said element, first electrical terminal means electrically connected to said resistance coating adjacent said one end, and second electrical terminal means connected to the other end of one of the outer ones of said legs.

2. The thermal relay set forth in claim 1 and including base means, the other ends of each of the outer legs of said element being affixed to said base portion, switch means mounted on said base means and including a fixed contact member and a moveable contact member, and resilient means connected to the other end of said central leg and to said moveable contact member so that said moveable contact member will be moved between open and closed positions relative to said fixed contact member upon deflection of said central leg.

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