

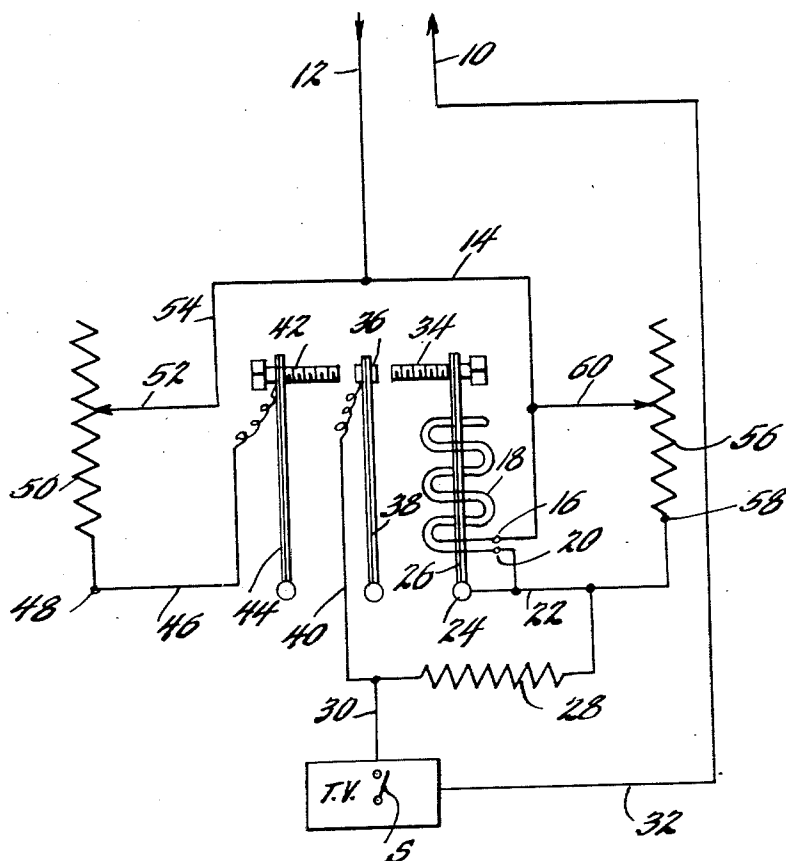
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THERMALLY CONTROLLED RETARDED RELAY

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THERMALLY CONTROLLED RETARDED RELAY

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This invention relates to retarded relays of the thermally controlled type, especially adapted for applying a time controlled reduced starting voltage to electric appliances, such as radios, television sets, electric motors, etc.

One object of the invention is to provide a retarded relay of the character indicated which dispenses with the use of electromagnets and relies for its operation entirely upon thermally responsive elements so arranged as to be independent of ambient temperature variation.

Another object is to provide a relay of the character indicated which can be accurately adjusted for different time intervals of retardation.

A further object is to provide, in a relay of the character indicated, a circuit arrangement whereby an initial starting current of the required strength may be obtained for the heater for the thermally responsive element and that current, after a predetermined time interval, automatically reduced to a lesser amount just sufficient to maintain the heater in its heated condition.

A still further object is to provide a thermally controlled retarded relay whereby the same delay may be obtained for a wide range of loads without requiring adjustment of the thermostat contacts.

The various further objects and advantages will appear from the following detailed description and the features of novelty will be particularly pointed out in the claims.

In the accompanying drawing, the figure illustrates diagrammatically an electric circuit of a preferred embodiment of this invention.

Referring in detail to the drawing, my improved thermally retarded relay is illustrated as applied to an electric appliance, such as a television set TV, provided with its usual starting switch S. One terminal of the set may be connected directly to one side 10 of the power line 10, 12, while the other terminal is connected to the other side 12 of the power line through my novel thermally retarded relay.

For applying a reduced starting voltage to the set TV, the side 12 of the power line is connected by wire 14 to one terminal 16 of a non-inductively wound heater coil 18, the other terminal 20 of the heater coil being connected by wire 22 to the stationary extremity 24 of bi-metallic strip 26, about which the heater coil 18 is wound. Wire 22 is further connected to one terminal of a resistor 28, the other terminal of resistor 28 being connected to one of the lead-in wires 30 of the electric appliance, indicated for example as television set TV. The other lead wire 32 of the appliance may be connected directly to the other side 10 of the power line.

From the circuit thus far described it is clear that, when the switch S of the TV set is closed, a reduced voltage will be applied to the set by reason of the voltage drop through series resistance 28 and the heater coil 18 in series with said resistor leading to the side 12 of the power line. Immediately upon closing of the circuit by switch S the current passing through heating coil 18 will cause it to heat up, thus causing bi-metallic strip 26 to become

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heated. The heating of bimetallic strip will cause it to flex to the left until, after a predetermined time interval, its movable extremity, carrying a manually adjustable contact 34, makes contact with contact element 36 disposed at the movable extremity of a second bi-metallic thermostat strip 38. Contact 36 is connected by a flexible wire 40 to lead-in wire 30 of the electrical appliance TV. Thus it is seen that, after the predetermined interval required to heat up bi-metallic thermostat strip 26 sufficiently for it to expand until it makes contact with contact 36, the resistor 28 is shunted by wire 22, connected to stationary terminal 24, bi-metallic 26, contacts 34, 36, and wire 40 connected to lead-in wire 30 of TV. This by-passing of the current around resistor 28 permits more current to pass through heater coil 18, causing it to heat up to higher temperature and thus imparting additional heat to bi-metallic 26, causing its movable extremity to bend further, carrying along with it contact 34 and contact 36 of bi-metallic 38, flexing the latter until contact 36 makes contact with manually adjustable contact 42 of bi-metallic strip 44. Contact 42 is connected by a flexible wire 46 to terminal 48 of variable resistor 50. The movable contact 52 of variable resistor 50 is connected by wire 54 connected to wire 14 leading to side 12 of the power line.

From the above connections it is seen that after the predetermined interval of time above referred to required to heat up bi-metallic strip 26, the heating of the latter is increased by the increased current through heating coil 18, until strip 26 expands sufficiently to carry contact 36 along with contact 34 so as to make contact finally with contact 42. In this way variable resistor 50 is brought into the circuit to shunt around heater coil 18. This shunting of the heater coil accomplishes two purposes—

firstly, it puts the full required voltage upon the electrical appliance TV, after the required interval required to permit the set to gradually heat up; and secondly, it reduces the amount of current through the heater coil to an amount just sufficient to maintain its heat. This heat maintaining current is considerably less than the current required to initially bring the heater coil and bi-metallic 26 up to the required temperature to secure the necessary movements of the contacts as above described.

For the purpose of obtaining a quick adjustment of the current through the heater coil 18 in accordance with the amount of load imposed on the circuit by the electric appliance, a variable resistor 56 is connected to shunt around heater coil 18, the stationary terminal 58 of variable resistor 56 being connected to wire 22 and the adjustable terminal 60 being connected to wire 14. Thus the initial heating current taken by heater coil 18 can be adjusted to the required amount by adjusting movable contact 60 of variable resistor 56, while the final heat-maintaining current is adjusted by movable contact 52 of variable resistor 50.

If it should be required to vary further the retardation of the time of the final closing of the circuit to apply the full voltage to the electric appliance the manually adjustable contacts 34 and 42 may be adjusted, so as to vary the amount of expansion of bi-metallic strip 26 required to complete contact with contacts 36 and 42. This makes my thermal relay capable of application for regulation of appliances having a wide range of loads.

In order to render my improved thermal relay independent of ambient temperature variation, the three bi-metallic strips 26, 38 and 44 have their high expansion sides facing in the same direction and are equally responsive to ambient temperature variation. Thus, no matter what the outside temperature may be, all of the three bi-metallics will be equally affected thereby, and the relative positions of the movable extremities thereof will not be varied by such temperature variation.

It will thus be seen that I have provided a retarded relay of the thermally controlled type which: dispenses entirely with the use of electromagnetically operated circuit closing elements; may be adjusted to secure exactly any required degree of retardation for a wide range of loads; is unaffected by ambient temperature variation; uses a minimum of heating current in prolonged operation; and is composed of few inexpensive parts, reliable in operation, and easy to assemble.

Having described my invention, I claim:

1. A thermal relay for applying time controlled reduced starting voltages to electric appliances, comprising a series of three adjacent bi-metallic thermostatic strips having their high expansion sides facing in the same direction and their movable extremities bearing contacts normally serially spaced from one another; a resistance heater element adjacent the first of said strips adapted to be connected to one side of a power line; means for manually regulating the heating current in said heater element; connections including a resistor adapted for inserting said heater element in series with the electric appliance to be controlled; the stationary end of said first bi-metallic strip being electrically connected to a junction between said heater and one end of said resistor; a contact on said second strip being electrically coupled to the other end of said resistor, one terminal of said electric appliance being adapted for direct manual connection to the other side of the power line; the contacts of the movable ends of said first and second bi-metallic strips being adapted to make contact with one another after a timed interval subsequent to the closing of the power line circuit through said electric appliance in series with the heater element, the heating of the first metallic strip by said heater causing movement of the movable end of said first bi-metallic strip and short-circuiting said resistor; the increased current through said heater causing further timed movement of the contact of the first bi-metallic strip, urging the contact of the second bi-metallic into contact with the movable contact of said third bi-metallic; said third bi-metallic contact being connected through a second resistor to one side of the power line; said second resistor shunting said heater element to reduce the heating current therethrough and placing the full required potential upon the appliance after a timed interval subsequent to the manual closing of the power line.

2. A thermal relay as defined in claim 1, including means for adjustably varying the spacing between said movable contacts.

3. A thermal relay as defined in claim 1, wherein said current regulating means is a variable resistor shunting said heater element and in series with said appliance.

4. A thermal relay as defined in claim 1, wherein said second mentioned resistor is manually variable.

5. A thermal relay as defined in claim 4, wherein said current regulating means is another manually variable resistor shunting said heater element and in series with said appliance.

6. A thermal relay as defined in claim 1, wherein said three bi-metallic strips render the timing of the relay independent of variation in ambient temperature.

7. A thermal relay including a series of three bi-metallic strips having their high expansion sides facing in the same direction; the movable extremities of said

strips bearing contacts normally spaced from one another but adapted to make serial contact with one another upon movement of the movable extremity of the first bi-metallic strip of the series; an electric heater element for the first bi-metallic strip; a resistor connected between said heater element and the power line adapted to include in series said electric appliance upon manual closing of the circuit to apply a reduced voltage to said appliance for a predetermined time including the time of movement of the movable contact of said first bi-metallic strip to make contact with the second bi-metallic strip; connections between said second bi-metallic strip and said appliance, said resistor and heater for short circuiting said resistor, thereby increasing the impressed voltage on said appliance and increasing the current through said heater when said first bi-metallic makes contact with said second bi-metallic; and connections between said movable contact of said third bi-metallic strip with the power line for placing the full required voltage upon the electric appliance and including means for shunting the heater element sufficiently to reduce its heating current after the three movable contacts have completed contact with one another by continued timed movement of the movable end of the first bi-metallic strip after making contact with said second bi-metallic strip.

8. A thermal relay as defined in claim 7, including means for manually adjusting the spacing of said first and second movable contacts.

9. A thermal relay as defined in claim 8, including means for manually adjusting the spacing of said second and third contacts.

10. A thermal relay as defined in claim 9, wherein said three bi-metallic strips render the timing of said relay independent of ambient temperature variation.

11. A thermal relay for applying time controlled reduced starting voltages to an electric appliance comprising an electric circuit including a bimetallic thermostatic strip, a resistance heater element adapted to be placed in series with said appliance disposed adjacent said thermostatic strip; means for applying a reduced starting voltage to said appliance including a resistor disposed in series with said resistor heater; means operated by the expanding movement of said bimetallic strip due to the heating thereof for short circuiting said resistor so as to apply an increasing voltage to said appliance and increased heating current to said resistance heater, causing further movement of said bimetallic; and means operated by said further movement of said bimetallic strip for applying maximum voltage to said appliance, said last mentioned means including means for shunting said resistance heater so as to reduce the heating current thereof to a degree just sufficient to maintain the bimetallic strip substantially in its extreme position of movement.

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