March 17, 1970 W. W. CHAMBERS 3,501,718

RAPID OPENING TIME-DELAY RELAY

Filed Sept. 30, 1968

FIG. 1

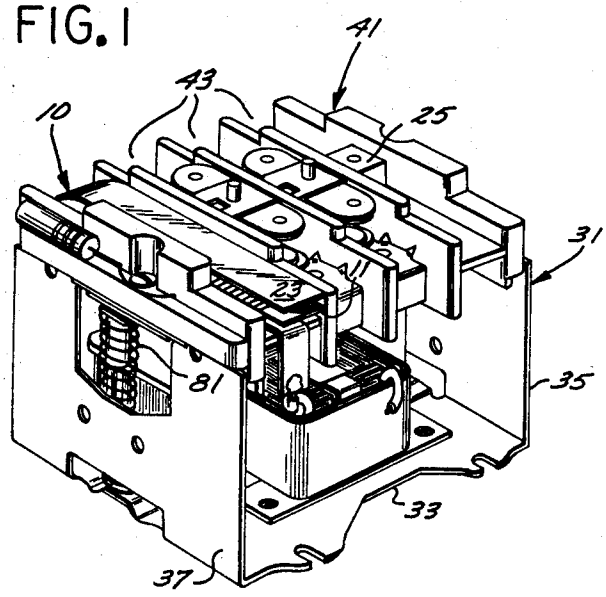


FIG. 4

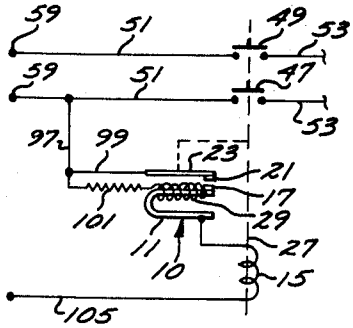


FIG. 2

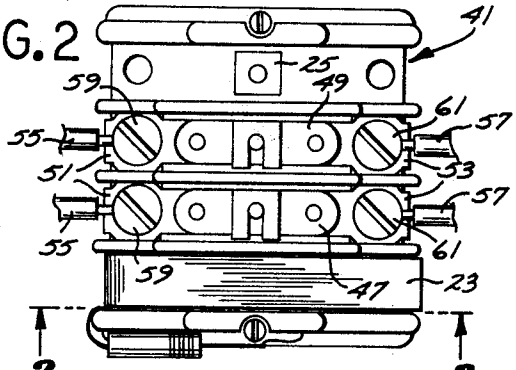


FIG. 3

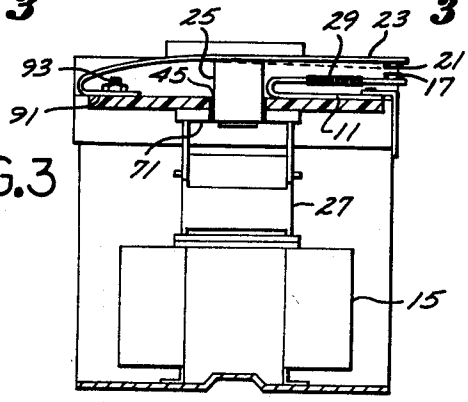
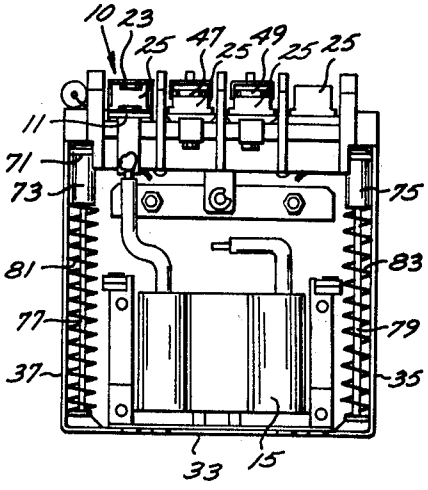


FIG. 5



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RAPID OPENING TIME-DELAY RELAY

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U.S. Cl. 335—66 6 Claims

ABSTRACT OF THE DISCLOSURE

A rapid opening time-delay relay, biased to its open position, and including a frame mounting one end of a thermostatic blade which carries a first electrical contact on its free end. A second electrical contact is arranged in adjacent spaced relation with the first contact, is mechanically coupled to the relay armature, and is movable into engagement with the first contact upon energization of the relay. A heat motor is disposed in heat exchange relationship with the thermostatic blade and is adapted for connection in parallel circuit with the second contact whereby, when power is applied to the relay, the blade is heated and flexed to engage the first and second contacts. This causes current in the circuit to bypass the heat motor and energize the relay winding to close the relay. Since the second contact is coupled to the relay armature, energization of the relay maintains the first and second contacts in engagement, both during and after cooling of the blade.

BACKGROUND OF THE INVENTION

Field of the invention

The present invention relates generally to electrical relays which provide a time-delay after application of power before they close and, more particularly, to delayed-closing relays which open rapidly when power is removed therefrom.

Description of prior art

Prior are time-delay relays generally include a plurality of pairs of electrical contacts carried on thermostatic blades and cooperatively arranged to perform the time delay function upon application of power to the relay. Such relays are unsatisfactory for certain applications because they are slow to open when power is removed therefrom. For example, time delay circuitry has been proposed which includes a relay armature coupled with a movable contact which is alternately engageable with first and second stationary contacts. The first contact is in circuit with a heat motor disposed adjacent thermostatic elements for driving the relay armature, and the second contact is in circuit with the relay coil. When power is applied to the relay, the heat motor is energized to heat the thermostatic elements and move the armature to break the circuit through the heat motor and close the circuit through the relay winding to maintain the relay actuated while the thermostatic elements cool whereby when power to the relay is discontinued the relay will open rapidly. A time delay circuit of this type is shown in U. S. Patent No. 2,484,112. However, time-delay relays of this type have the disadvantage that the thermostatic elements must be relatively large to control the relay armature and consequently are relatively expensive to manufacture.

SUMMARY OF THE INVENTION

The time-delay relay of present invention is characterized by a first electrical contact carried on the free end of a thermostatic blade and connected in series with the coil of the relay. A second contact is adapted for

connection in parallel with a heat motor disposed in heat exchange relationship with the thermostatic blade and is operatively coupled with the armature of the relay for movement into engagement with the second contact when the relay is energized. Application of power to the relay energizes the heat motor to heat and flex the thermostatic blade to engage the first and second contacts thereby causing current in the circuit to bypass the heat motor and energize the relay. While the relay is actuated, the first and second contacts are maintained in engagement irrespective of cooling of the blade. Consequently, when power is lost, the relay will open rapidly regardless of the heated or cooled state of the thermostatic blade.

Other objects and features of the present invention will become apparent from a consideration of the following detailed description when taken in conjunction with the accompanying drawing.

DESCRIPTION OF THE DRAWING

FIG. 1 is a perspective view of a time-delay relay embodying the present invention;

FIG. 2 is a top view of the relay shown in FIG. 1;

FIG. 3 is a vertical sectional view taken along the line 3—3 of FIG. 2;

FIG. 4 is an electrical schematic diagram of the time-delay relay shown in FIG. 1; and

FIG. 5 is a front view of the relay shown in FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 3, the time-delay relay of the present invention includes a delay switch, generally designated **10**, having a U-shaped bimetallic blade **11** connected in series with a coil **15** and carrying a first electrical contact **17** on its free end. A second electrical contact **21** is carried on the free end of a leaf spring **23** which tends to urge the second contact **21** downwardly into engagement with the first contact **17**. The spring **23** is flexed upwardly when the relay is deenergized, by an upstanding piston **25** (FIG. 3) carried from an armature **27** of the relay. A coil of resistance wire **29** is wound on the thermostatic blade **11** to form a heat motor, and is adapted for connection in parallel circuit with the second contact **21**. Thus, when power is applied to the relay, the motor **29** heats the thermostatic blade **11**, which moves the first contact **17** upwardly into engagement with the second contact **21**. This circuit bypasses the motor **29** and energizes the relay coil **15** to pull the armature **27** downwardly to the broken line position shown in FIG. 3. In the energized conditon of the coil **15** the contacts **17** and **21** are maintained in engagement irrespective of cooling of the blade **11**. In this regard, cooling of the blade **11** moves the first contact **17** downwardly into a position out of engagement with the second contact **21** when the relay is de-energized and the armature **27** bends the free end of the spring **23** upwardly. This assures rapid opening of the relay without the necessity of waiting for the blade **11** to cool after power to the relay has been discontinued.

The relay of the present invention includes a frame **31** having a base **33** and oppositely disposed, upstanding, side walls **35** and **37**. Secured between the upper extremities of the side walls **35** and **37** is a top wall **41** having a plurality of forwardly and rearwardly disposed, coextensive channels **43** therein. As best seen in FIG. 3, a plurality of apertures **45** are formed intermediately in the channels **43** for receiving the respective plungers **25** carried on the armature **27**. Referring to FIG. 5, it is noted that the plunger **25** on the right-hand side of the relay is not utilized in the particular embodiment shown.

Forwardly and rearwardly extending contact strips **47** and **49** are supported on the middle two plungers **25** and have their opposite ends disposed over terminals **51** and **53** (FIG. 2), respectively. The terminals **51** and **53** have electrical leads **55** and **57** connected therewith by screws **59** and **61**, respectively.

Referring to FIG. 3, the armature **27** includes a top plate **71** on which the plunger **25** is carried and which forms on its opposite ends a pair of downwardly projecting posts **73** and **75** (FIG. 5). A pair of spring rods **77** and **79** are connected between the base **33** and the respective posts **73** and **75** to form spring guides. Compression springs **81** and **83** surround the respective rods **77** and **79** for biasing the armature **27** upwardly to normally maintain the contact strips **47** and **49** spaced above the terminals **51** and **53** and to project the plunger **25** upwardly against the leaf spring **23** to maintain the contacts **17** and **21** spaced apart.

Referring to FIG. 3, the leaf spring **23** is turned under at its left-hand end to form a mounting tab **91** which is secured to the top **41** by a nut and bolt assembly **93**.

Referring to FIGS. 4 and 5, the heat motor **29** and leaf spring **23** are connected in parallel and are each connected to one of the power terminals **51** by means of electrical leads **97**, **99**, and a voltage dividing resistor **101**. The thermostatic blade **11** is connected in series with the coil **15**, and the opposite end of the coil **15** is connected with a power lead **105**.

In operation, when there is no power supplied to the relay of present invention, it will remain open as shown in FIG. 4 with the delay switch **10** open. When power is applied to the relay the current passing through the lead **97**, resistor **101**, heat motor **29**, thermostatic blade **11**, and relay **15** is sufficient to heat the thermostatic blade **11**. However, the power is insufficient to actuate the relay coil **15**. After a predetermined time interval the thermostatic blade **11** becomes heated sufficiently to raise the contact **17** upwardly into engagement with the contact **21** thereby completing the parallel circuit through leads **97**, **99**, leaf spring **23**, thermostatic blade **11**, and relay coil **15** to energize such relay and pull the contact strips **49** and **47** downwardly onto the terminals **51** and **53**.

Actuation of the relay pulls the plunger **25** downwardly to enable the leaf spring **23** to assume the broken line position shown in FIG. 3, and thereby maintain the contacts **17** and **21** in engagement after the blade **11** has cooled. Closing of the contacts **17** and **21** also causes current to bypass the resistor **101** and the heat motor **29**, allowing the thermostatic blade **11** to cool and assume its relaxed position. Upon deenergization of the relay, the armature **27** is lifted upwardly by the compression springs **81** and **83** to push the left-hand plunger **25** (FIG. 5) upwardly against the leaf spring **23**. This raises the second contact **21** out of engagement with the first contact **17** and rapidly breaks the circuit through the coil **15**. Thus, when power is again applied, the thermostatic blade **23** is again heated to provide a time-delay before closing of the delay switch **10** and actuation of the relay.

From the foregoing, it will be apparent that the time-delay relay of the present invention provides a convenient and economical means for delaying application of power to an associated electrically operated system, and for rapidly opening the circuit to such system when power has been interrupted. A relay of this type is of particular importance where power is to be rapidly cut off from a device such as a water heater whose limit switch has been opened due to overheating. In cases of this type the relay of the present invention rapidly breaks the circuit to the heating elements to prevent further heating and overpressurization.

Various changes and modifications may be made with regard to the foregoing detailed description without departing from the spirit or the scope of the following claims.

I claim:

1. A rapid opening time delay relay comprising:
first and second electrical contacts arranged in adjacent, spaced apart relation;
a thermostatic blade mounting said first contact and adapted to flex upon heating and cooling to move said first contact into and out of engagement, respectively, with said second contact;
electrical resistance means disposed in heat exchange relation to said blade;
a relay armature and coil;
means coupling said armature to said second contact and operative upon energization of said coil to maintain engagement of said first and second contacts; and
electrical circuit means connecting said resistance means, said first contact and said coil in series, and connected to said second contact for shunting said resistance means upon engagement between said first and second contacts whereby application of current to said resistance means effects delayed engagement of said first and second contacts, and whereby said shunting enables subsequent rapid disengagement of said first and second contacts upon cooling of said resistance means and termination of said application of current to said second contact.

2. A rapid opening time-delay relay as set forth in claim **1** that includes:
a leaf spring cantileverally mounted from said frame and mounting said second contact on its free end, said armature being coupled medially with said spring.

3. A time-delay relay as set forth in claim **1** wherein:
said thermostatic blade is electrically conductive and is connected in series with said heat resistance means and said coil.

4. A time-delay relay as set forth in claim **2** wherein:
said leaf spring is formed to normally bias said second contact into engagement with said first contact and said armature mounts a plunger engageable with said leaf spring when said relay is de-energized to overcome the bias of said spring and maintain said first and second contacts spaced apart.

5. A time-delay relay as set forth in claim **3** wherein:
said leaf spring is electrically conductive and is connected in circuit with said second contact.

6. A time-delay relay as set forth in claim **5** wherein:
said thermostatic blade is electrically conductive and is connected in series with said electrical resistance means and said relay coil.

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U.S. Cl. X.R.

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