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CONTROL DEVICE WITH IMPROVED THERMAL OPERATING MEANS

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FIG. 2.

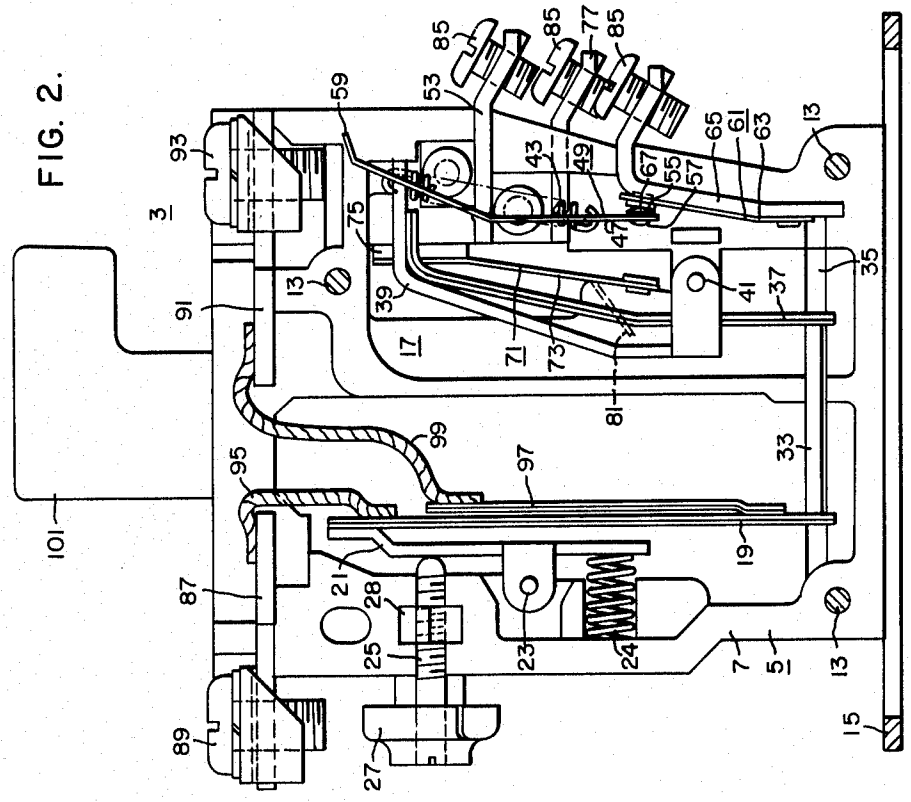
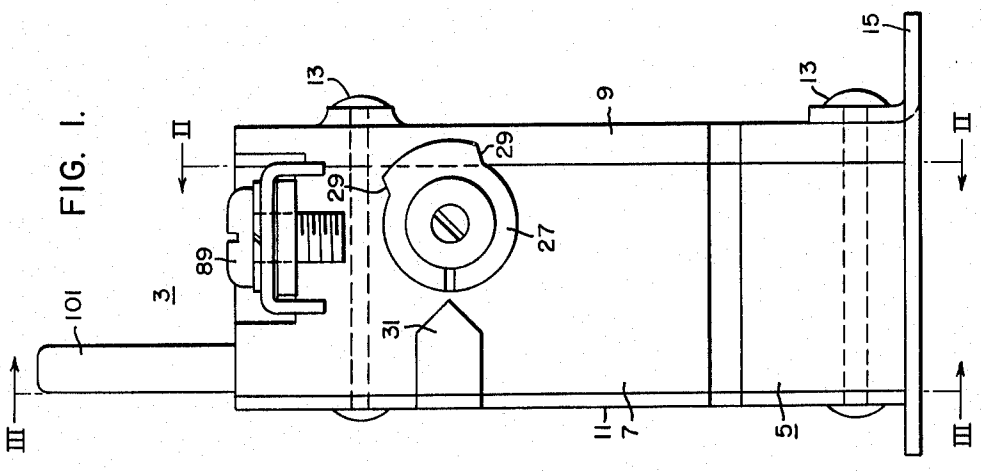


FIG. 1.



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CONTROL DEVICE WITH IMPROVED THERMAL OPERATING MEANS

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FIG. 4.

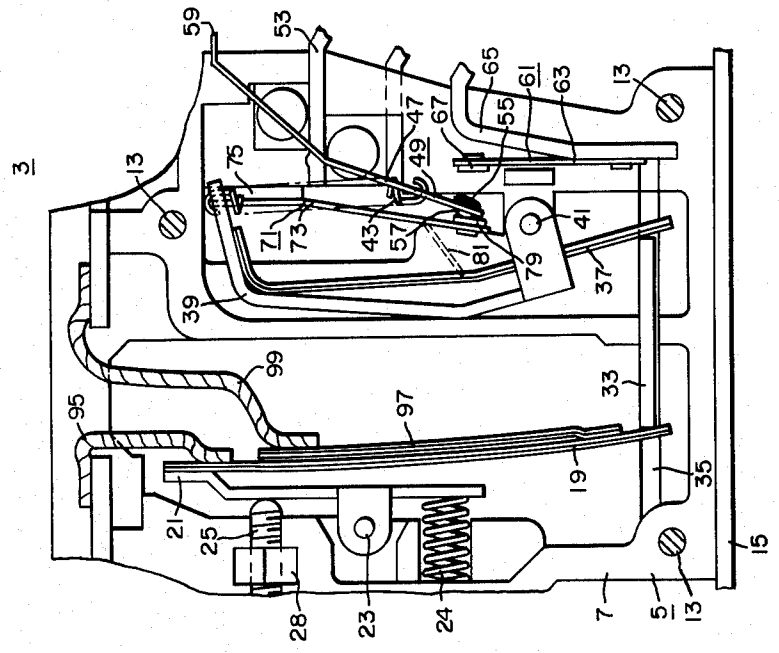
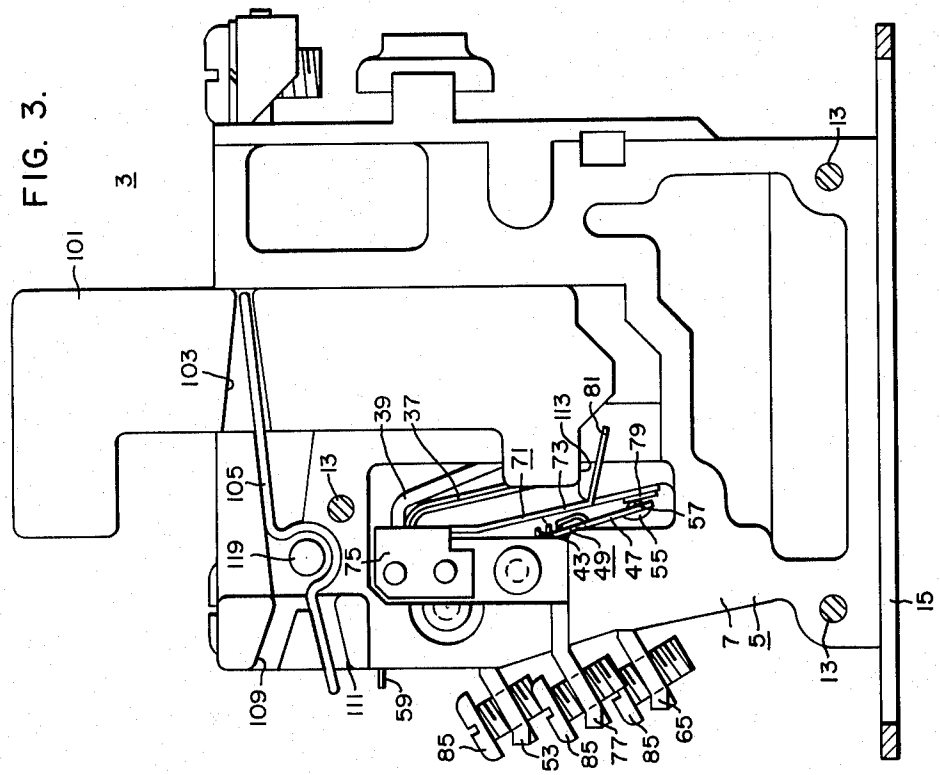


FIG. 3.



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CONTROL DEVICE WITH IMPROVED THERMAL OPERATING MEANS

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FIG. 7.

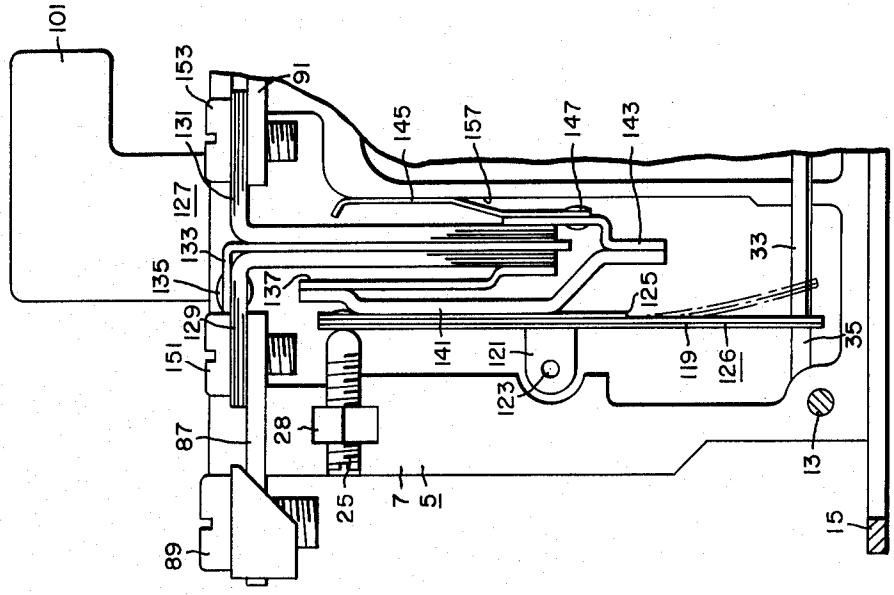


FIG. 8.

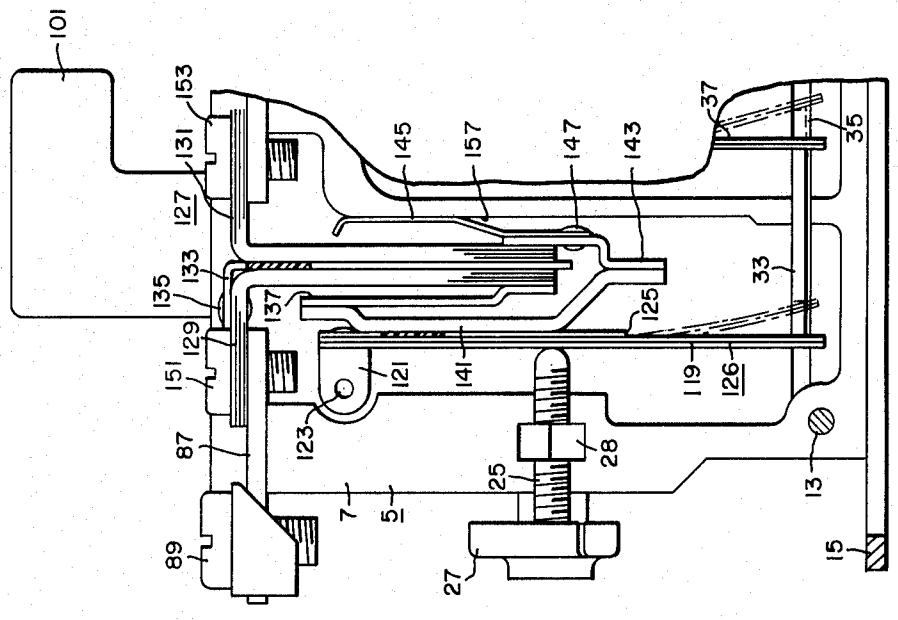


FIG. 5.

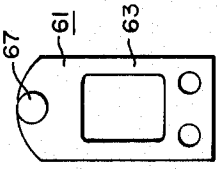
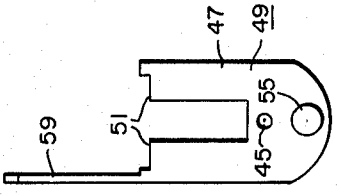


FIG. 6.



United States Patent Office 3,257,526
Patented June 21, 1966

3,257,526

CONTROL DEVICE WITH IMPROVED THERMAL OPERATING MEANS

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Filed July 16, 1964, Ser. No. 383,033
12 Claims. (Cl. 200—122)

This invention relates generally to electric control devices and more particularly to electric control devices of the type comprising automatic thermal operating means.

In the electric control art, it is desirable at certain installations to be able to effect automatic thermal operation of a control device upon the occurrence of a relatively low overload current. One way of achieving low current automatic thermal operation is to provide a heater element that comprises a very low mass of resistance material so that when an overload current occurs, the temperature of the heater element increases very rapidly to an operating temperature. As the thermal reacting quality of the heater element is increased, however, the ability of the heater element to withstand higher currents is reduced, so that in many cases the most effective heater element will be most likely to burn out under overload or short circuit conditions.

An object of this invention is to advance the art by providing an electric control device having improved and effective relatively low-current thermal operating means.

Another object of this invention is to provide a novel electric control device having improved bimetal actuating means.

A further object of this invention is to provide an improved thermal overload relay with fast-trip bimetallic actuating means.

A more general object of this invention is to provide an improved electric control device having increased reliability and versatility.

The invention, both as to structure and operation, together with additional objects and advantages thereof, will be best understood from the following detailed description when read in conjunction with the accompanying drawings.

In said drawings:

FIGURE 1 is an end elevational view of a relay constructed in accordance with principles of this invention;

FIG. 2 is a sectional view taken generally along the line II—II of FIG. 1;

FIG. 3 is a sectional view taken generally along the line III—III of FIG. 1 with the parts being shown in an operating position that is different from the position shown in FIG. 2;

FIG. 4 is a partial view similar to FIG. 2 illustrating the relay of FIG. 2 with the parts in a different operating position;

FIG. 5 is an elevational view of the stationary contact structure seen in FIG. 2;

FIG. 6 is an elevational view of the movable contact structure seen in FIG. 2;

FIG. 7 is a partial sectional view similar to FIG. 2 illustrating a different embodiment of the invention; and

FIG. 8 is a view similar to FIG. 7 illustrating still another embodiment of the invention.

Referring to the drawings, and particularly to FIGS. 1–4, there is shown therein an electric control device 3 of the type known in the art as an ambient temperature compensated thermal overload relay. The relay 3 comprises a housing 5 of molded insulating material that comprises a center part 7, a front cover 9 and a back cover 11 (FIG. 1). The parts 7, 9 and 11 of the housing 5 are secured together by means of three rivets 13. The housing 5 is fixedly secured to a suitable supporting base 15.

A control mechanism 17, which is supported inside the housing 5, comprises an actuating bimetal member 19 (FIGS. 2 and 4) that is welded or otherwise suitably secured at the upper end thereof to a support 21. The support 21 is pivotally mounted in the housing 5 by means of a pivot pin 23. A spring 24 is disposed between part of the housing 5 and the lower part of the support 21 to bias the support 21 and bimetal 19 in a counterclockwise (FIG. 2) direction about the pivot 23. Counterclockwise movement of the support 21 and bimetal 19 about the pivot 23 is limited by engagement of the support 21 with an adjusting screw 25. An insulating knob 27 is disposed at the outer end of the adjusting screw 25 to provide for manual operation of the screw 25 in order to permit adjustment of the position of the support member 21 and actuating bimetal 19 within the housing. The screw 25 is threaded into a nut 28 that is fixedly supported in the housing 5. Thus, the screw 25 moves in and out of the stationary nut 28 to the various adjusted positions thereof. Surfaces 29 (FIG. 1) are provided on the adjusting knob 27 to engage opposite sides of a stop 31 in order to limit rotation, in both directions, of the adjusting knob to thereby prevent over-adjustment of the initial position of the support 21 and actuating bimetal 19.

The lower free end of the bimetal 19 engages one end of an insulating thrust transmitting member or slider 33 that is slidably supported in the housing 5 in a track 35 that is molded integrally with the housing. The other end of the slider 33 engages the lower or free end of a compensating bimetal 37 that is fixed at its other end to a support 39. The support 39 is pivotally supported in the housing 5 on a pivot pin 41.

An overcenter spring 43 is supported at one end in an opening in the support 39 and at the other end in an opening 45 (FIG. 6) in the bight portion of a generally U-shaped part 47 of a movable contact structure 49. The leg portions 51 (FIG. 6) of the movable contact arm 47, engage in suitable notches in a terminal conducting strip 53 (FIG. 2) to pivotally support the movable contact arm 47 on the terminal conductor 53. Contacts 55 and 57 are secured to the opposite sides of the movable contact arm 47. An extended portion 59 of one leg of the movable contact arm 47 serves as an indicator that protrudes from the housing 5 (FIG. 4) to provide a visual indication that the relay has been operated.

In operation, the movable contact arm 47 cooperates with a relatively stationary contact structure 61 (FIG. 5). The relatively stationary contact structure 61 comprises a resilient contact arm 63 that is fixedly supported at the lower end thereof to a terminal strip 65 (FIGS. 2 and 4). A contact 67 is fixedly secured to the contact arm 63.

In operation, the movable contact arm 47 also cooperates with another relatively stationary contact structure 71 (FIGS. 2 and 4). The relatively stationary contact structure 71 comprises a contact arm 73 that is secured to a conducting member 75 that is connected to a terminal strip 77. A contact 79 is secured to the free end of the contact arm 73. An extension 81 is provided on the contact arm 73 to permit resetting of the relay in a manner to be hereinafter specifically described.

Terminal screws 85 are provided at the outer ends of the conducting strips 53, 65 and 77 to permit connection of the relay in circuits to be controlled by the relay.

The controlling circuit of the relay 3 comprises a conducting strip 87 having a terminal connector 89 at its outer end, and a conducting strip 91 having a terminal connector 93 at its outer end. The conducting strips 87 and 91 are suitably supported in molded formations in the insulating housing 5. When the relay is connected

in an electric circuit, the controlling circuit extends from a conductor that would be electrically connected to the conducting strip **87** by means of the terminal connector **89**, through the conducting strip **87**, a flexible conductor **95** that is secured at one end to the strip **87** and at the other end to the bimetal **19**, the bimetal **19**, a bimetal **97** that is welded or otherwise suitably secured at the lower end thereof to the bimetal **19**, a flexible conductor **99** that is secured at one end to the bimetal **97** and at the other end to the conducting strip **91**, the conducting strip **91**, to a conductor that would be connected to the conducting strip **91** by means of the terminal connector **93**.

An insulating reset rod **101**, having a notch **103** (FIG. 3) therein, protrudes from the housing **5**. An adjusting spring **105** (FIG. 3) is supported on the housing **5** with one end thereof being disposed in the notch **103** and the other end protruding from the housing **5**. One end of the adjusting spring **105** can be disposed either in a slot **109** or a slot **111** which slots are formed in the molded housing **5** during the molding operation of the housing. When the spring **105** is positioned in the slot **111**, the relay is set for a hand resetting operation, and when the spring **5** is in the slot **109**, the relay is set for an automatic resetting operation.

The operation of the relay **3** is as follows:

The relay is shown in FIG. 2 with the parts thereof being in the positions that they would be in when the current flowing through the controlling circuit is below a predetermined value. With the parts so positioned, the contact **55** of the movable contact structure **49** is in engagement with the relatively stationary contact structure **67**. The spring **43** biases the movable contact structure **49** into the position shown in FIG. 2. It is to be noted that the controlling circuit passes through the actuating or operating bimetal **19**, to generate heat in the bimetal **19**, and also through the bimetal **97** that is mounted in a generally parallel relationship and in close proximity to the actuating or operating bimetal **19**. Thus, heat that is generated in the bimetal **97** is radiated to heat the actuating or operating bimetal **19**. When the current flowing through the controlling circuit reaches a predetermined value, the bimetal **19** will be heated to such an extent that the bimetal **19** will deflect to an operating position (FIG. 4). During this deflecting movement of the bimetal **19**, the lower end thereof moves the slider **33** to the right from the position seen in FIG. 2 to the position seen in FIG. 4. During this movement, the slider **33** moves against the lower end of the compensating bimetal **37** to move the compensating bimetal **37** and the support **39** in a counterclockwise direction about the pivot **41** to the position seen in FIG. 4. This movement of the support **39** carries the spring **43** to an overcenter position to the left of the movable contact arm **47** whereupon the spring **43** operates with a snap action to move the movable contact arm **47** to the position seen in FIG. 4 wherein the contact **57** engages the relatively stationary contact **79** on the contact arm **71**. The parts **39**, **43** and **49** are so positioned (FIG. 4) that the spring **43** holds the movable contact arm **47** in the actuated position and these parts will remain in the actuated position even after the bimetals **19**, **97** cool and deflect back to the relatively straight positions seen in FIG. 2. Since the slider **33** is not secured to the bimetals **19** and **37**, the straightening cooling deflection of the bimetal **19** will not affect the actuated positions of the parts **39**, **43**, **49**. The relay is reset back to the initial position seen in FIG. 2 by manual depression of the reset rod **101** during which movement a shoulder portion **113** (FIG. 3) on the rod **101** engages the extension **81** of the relatively stationary contact arm **73** flexing the resilient contact arm **73** to move the movable contact arm **47** counterclockwise (FIG. 4) to move the contact arm **47** and spring **43** to a position where the spring **43** is overcentered with respect to the contact arm **47** whereupon the spring **43** operates to move the contact arm **47** into engagement with the relatively stationary contact **67** flexing the resilient stationary contact **61** back to the position seen in FIG. 2 until the back portion of the contact **67** engages the terminal strip **65** to stop the parts in the position disclosed in FIG. 2. This movement also moves the compensating bimetal **37** and support **39** in a clockwise direction about the pivot **41** from the actuated position seen in FIG. 4 to the initial position seen in FIG. 2. The parts will remain in the initial position seen in FIG. 2 until the relay is again actuated by means of an overload current through the controlling circuit.

When it is desired to have the relay **3** reset automatically after it has been actuated, the end of the spring **105** (FIG. 3) is removed from the slot **111** and moved up into the slot **109**. This pivots the spring **105** about a molded pivot **119** during which movement the inner end of the spring **105** operates in the slot **103** to move the reset rod **101** to a lower position and automatic resetting. When the parts are in the automatic resetting position and the relay is thermally actuated by flexing of the bimetal **19**, the shoulder **113** will engage the extension **81** (FIG. 3) on the stationary contact arm **73** to maintain the stationary contact arm **73** in such a position that the stationary contact **79** will engage the movable contact **57** to limit movement of the parts **39**, **43**, **47** such that the spring **43** will be so positioned that the spring **43** will bias the movable contact arm **47** into closed position and at the same time the spring **43** will bias the support **39** and compensating bimetal **37** in a clockwise direction about the pivot **41** back toward the initial (FIG. 2) position. The parts will be retained in this actuated position so long as the bimetal **19** is flexed holding the slider **33** to the right (FIG. 4) to hold the compensating bimetal **37**, support **39**, spring **43** and contact arm **37** in the actuated position. However, when the bimetal **19** cools the lower end thereof will deflect back to the left to the position in which it is shown in FIG. 2 to no longer restrain the slider **33** in the FIG. 4 position whereupon the spring **43** will automatically move the bimetal **37** and support **39** clockwise such that the line of action of the spring **43** will be moved overcenter to the right of the contact arm **47** to thereby snap the contact arm **47** back to the initial position in which position the contact **55** engages the contact **67** biasing the flexible contact arm **63** into engagement with the conducting strip **65** as is shown in FIG. 2. The parts will thereafter remain in the initial (FIG. 2) position until the relay is again actuated by an overload current. Thus, the relay can be set for either a hand resetting operation or a manual resetting operation by merely positioning the spring **105** (FIG. 3) in one of the slots **111** (hand resetting) or **109** (automatic resetting).

As was hereinbefore set forth, the relay can be adjusted by rotation of the knob **27**. This movement rotates the screw **25** to move the screw lengthwise to rotate the support **21** and bimetals **19**, **97** about the pivot **23**. This adjustment will control the rating of the relay by controlling the amount of work or deflecting movement of the actuating bimetal **19** that is necessary in order to effect movement of the overcenter spring **43** to an overcenter position. The stop **31** (FIG. 1) engages the surfaces **29** on the knob **27** to limit rotation of the knob **27**. Thus, the amount of adjustment is limited to the adjustment that can be effected within less than one revolution of the knob **27**. Indicating marks may be placed on the knob **27** to provide a visual indication of the amount of adjustment.

The bimetal **37** compensates for movement of the actuating bimetal **19** in response to changes in ambient temperature. The high expansion sides of both the actuating bimetal **19** and the compensating bimetal **37** are on the left as seen in FIG. 2 so that the compensating bimetal **37** will flex in the same direction as the actuating bimetal **19**. Thus, when the bimetal **19** deflects to the right

(FIG. 2) in response to a rise in the ambient temperature, the compensating bimetal **37** will deflect an equal amount to the right without effecting any significant movement of the support **39**, spring **43** and contact arm **47**. Thereafter, if the ambient temperature drops and the actuating bimetal **19** deflects back to the left, the compensating bimetal **37** will deflect back to the left without effecting any significant movement of the support **39**, spring **43** and contact arm **47**. Thus, the compensating bimetal **37** compensates for movement of the actuating bimetal **19** in response to changes in ambient temperature.

As can be seen in FIG. 2, other than at the lower end thereof where the bimetal **97** is bent-over and welded or otherwise secured to the bimetal **19**, the heating bimetal **97** is disposed parallel to the actuating bimetal **19** in spaced close proximity to the bimetal **19** so that the heat radiated from the heating bimetal **97** will operate to deflect the actuating bimetal **19**. Thus, the actuating bimetal **19** is heated by means of the heat generated by the current flowing through the bimetal **19**; by means of the heat radiated from the current carrying heating bimetal **97**; and by means of the heat conducted from the current carrying heating bimetal **97** at the lower end where the bimetal **97** is bent-over and brazed; welded or otherwise secured to the bimetal **19**. The high expansion sides of both the actuating bimetal **19** and the heating bimetal **97** are on the left as seen in FIGS. 2 and 4. The bimetals **19** and **97** are selected such that under operating conditions the closely spaced parallel relationship between the bimetals will be maintained even when the bimetals flex (FIG. 4) to actuate the relay. Thus, the heating bimetal **97** can be mounted on the actuating bimetal **19** in a closely spaced parallel relationship with the actuating bimetal **19** and the heating bimetal **97** will not interfere with the flexing action of the actuating bimetal **19**. Moreover, the heating bimetal **97** will efficiently radiantly heat the actuating bimetal **19** not only because of the close initial spacing between these bimetals; but also because this close spacing is maintained even as the bimetals flex to the operating position seen in FIG. 4. Thus, a fast low-current thermal actuating means is provided to actuate the relay **3**.

If desired, a thin sheet of mica or other suitable electrical insulating and good heat conducting material could be mounted between the bimetals **19** and **97** except where the bimetal **97** is secured to the bimetal **19** in electrical contact with the bimetal **19**.

The relay **3** can be connected to control either a normally open or a normally closed circuit. When it is desired to control a normally closed circuit, the conductors of the controlled circuit are connected to the common terminal conductor **53** and to the terminal conductor **65**. When the relay is so connected, and when the relay is in the initial or normally closed position (FIG. 2), the controlled circuit passes from the common terminal conductor **53**, through the movable contact arm **47**, the contact **55**, the contact **67**, the relatively staionary contact arm **63** to the terminal conductor **65**. When the relay is actuated by an overload current above the predetermined value in the manner previously described, the parts will be operated to the open circuit position seen in FIG. 4. Thereafter, the relay would be reset either automatically or manually back to the initial or closed circuit position seen in FIG. 2 in the same manner hereinbefore described.

If it is desired to control a normally open circuit by means of the relay **3**, the conductors of the controlled circuit are connected to the common terminal conductor **53** and to the terminal conductor **77**. Thus, the initial (FIG. 2) position of the relay would be normally open and upon actuation of the relay to the position seen in FIG. 4, a circuit would be made from the conducting strip **53** through the movable contact arm **47**, the contact **57**, the contact **79**, the contact arm **73**, the conducting tab **75** to the terminal conductor **77**. Thereafter, the relay would be reset either automatically or manually back to the initial or open circuit position seen in FIG. 2 in the same manner hereinbefore described.

Two different embodiments of the invention are shown in FIGS. 7 and 8. In these two embodiments, the parts comprising the slider **33**, and those parts that are actuated by movement (to the right, FIGS. 2 and 4) of the slider **33** are the same as the parts, previously described with reference to FIGS. 1–6. Thus, only the thermal actuating means and those parts of the relays of FIGS. 7 and 8 that are different will be specifically described. Only the new or substantially different parts are identified by reference characters not found in FIGS. 1–4.

Referring to FIG. 7, an operating bimetal **119** is welded or otherwise suitably secured intermediate the ends thereof to a support **121** that is pivotally supported on the housing **5** by means of a pivot pin **123**. The adjusting screw **25** engages the upper end of the bimetal **119**. A thin sheet of mica or other suitable electrical insulating and good heat conducting material **125** is suitably secured to the bimetal **119** on the right-hand (FIG. 7) side of the bimetal **119**. The bimetal **119** and insulating member **125** comprise an actuating structure **126** supported on the support **21**. The bimetal **119** does not carry the current of the controlling circuit. The bimetal **119** is heated by means of a removable heating structure indicated generally at **127**. The heating structure **127** comprises a first laminated conductor **129** and a second laminated conductor **131**. An electrical insulating member **133** is riveted at **135** to the conductor **129**. The insulating member **133** is disposed between the conductors **129** and **131**. A conductor **137** is welded or otherwise suitably secured at the lower end thereof to the conductor **129** and at the upper end thereof to a heating conductor **141**. A conductor **143** is welded or otherwise suitably secured to the lower end of the heating conductor **141** and at the upper end thereof to the conductor **131**. A resilient spring member **145** is riveted at **147** to the conductor **143**. The removable heating structure **127** is removably connected in the controlling circuit by means of a screw **151** that connects the conductor **129** to the conductor **87** and a screw **153** that connects the conductor **131** to the conductor **91**. The heating structure **127** can be replaced with a different heating structure in order to change the rating of the relay. As is seen in FIG. 7, the actuating structure **126**, comprising the bimetal **119** and the insulating member **125**, is pivotally supported intermediate the ends thereof by means of the support **121** that is pivotally supported at **123**. When the heating structure **127** is moved down into the position disclosed in FIG. 7, the spring member **145** biases against a surface **157** that is molded integral with the housing part **7** to flex the spring **145** and thereby bias the heating structure **127** into engagement with the actuating structure **126**. The heating structure **127** must flex laterally (FIG. 7) in order to permit the biasing action of the spring **145** to operate to bias the heater **141** against the actuating structure **126**. The heating structure **127** must be rigid enough to enable the structure to be forced down into the position seen in FIG. 7 wherein the spring **145** is flexed against the surface **157**. Thus, the insulating member **133** is a flat member that will flex laterally (to the right and left as seen in FIG. 7) and the conductors **129** and **131** are laminated members that will flex laterally (to the right and left as seen in FIG. 7); but the members **133**, **129**, **131** are rigid enough longitudinally to transmit a downward (FIG. 7) thrust such that the heating structure **127** can be forced into and out of the mounted position by means of a manual force applied at the top (FIG. 7) of the structure. The conductors **141**, **137** and **143** are rigid conductors. This biasing action is permitted because, when the adjusting screw **25** is in the adjusted position, the screw **25** and the pivot **23** are spaced stationary stops that prevent rectilinear movement, to the left (FIG. 7), of the actuating structure **126**. Thus, the heater member **141** is spring biased against the actuating structure **126** between the

pivot **123** and the adjusting screw **25**. Specifically the heater member **141** is biased against the insulating member **125** that is supported on the bimetal **119** so that the heater member **141** will be constantly maintained in close proximity to the bimetal **119** even during a tripping operation and even when the initial position of the pivotally supported bimetal **119** is adjusted by rotation of the adjusting screw **25**.

The controlling circuit through the relay of FIG. 7 extends from a conductor that would be connected to the conducting strip **87** by means of the terminal connector **89**, through the conductor **129**, the conductor **137**, the heating conductor **141**, the conductor **143**, the conductor **131**, the conducting strip **91**, to a conductor that would be connected to the conducting strip **91** by means of the terminal **93** seen in FIG. 2. Upon the occurrence of a current above a predetermined value through the controlling circuit (FIG. 7), the heat generated in the heating conductor **141** will be conducted through the mica **125** to heat the bimetal **119** whereupon the bimetal **119** will flex moving the lower or free end thereof from the position in which it is shown in full lines to the position in which it is shown in dot-dash lines to move the slider **33** to the right to effect an automatic operation of the relay contact structure in the same manner hereinbefore described.

The relay disclosed in FIG. 8 is the same as the relay disclosed in FIG. 9 except that the pivotal support **121**, **123** of the bimetal **119** has been moved to be positioned at the upper end of the bimetal **119** and the adjusting screw **25** has been moved downward to engage the bimetal **119** at a point intermediate the ends of the bimetal **119**. Otherwise, the structure and operation of the relay disclosed in FIG. 8 is the same as that disclosed in FIG. 7.

The calibrating screw **25** is shown in FIG. 7 without an adjusting knob on the external end thereof. It can be understood that the calibrating screw **25** could be extended outward and an insulating adjusting knob similar to the knob **27** (FIG. 8) could be mounted on the outer end of the screw **25**. As shown in FIG. 7, the screw **25** is operated by means of a screwdriver or other suitable tool.

From the foregoing, it can be understood that there is provided by this invention an improved electric control device with an improved and effective relatively low-current and fast-operating thermal operating means. In the first embodiment, the actuating bimetal is heated by means of the heat generated by the current flowing through the bimetal; by means of the heat radiated to the actuating bimetal from the current carrying heating bimetal; and by means of the heat conducted to the actuating bimetal from the heating bimetal at the area where the heating bimetal is secured to the actuating bimetal. The bimetals are closely spaced and they are selected such that under operating conditions the closely spaced parallel relationship between the bimetals will be maintained even when the bimetals flex to actuate the relay. Thus, the heating bimetal can be mounted on the actuating bimetal in a closely spaced parallel relationship with the actuating bimetal and the heating bimetal will not interfere with the flexing action of the actuating bimetal. Moreover, the actuating bimetal will be efficiently heated by heat radiated from the actuating bimetal not only because of the close initial spacing between these bimetals; but also because this close spacing is maintained when the bimetals flex to actuate the relay. Moreover, with the heating bimetal supported on the actuating bimetal, the initial position of the actuating bimetal is adjustable without disturbing the above-set-forth relationship between these bimetals.

In each of the other two embodiments, a removable current-carrying heater structure is spring biased against a pivotally supported adjustable actuating structure such that a heating member is maintained in closed proximity to an actuating bimetal member even when the actuating bimetal member flexes to actuate the control device and regardless of the adjusted position of the actuating bimetal member.

While the invention has been disclosed in accordance with the provisions of the patent statutes, it is to be understood that various changes and modifications may be made without departing from the spirit and scope of the invention.

We claim as our invention:

1. An electric control device comprising a pair of cooperable contacts operable between two positions, thermal actuating means comprising a first elongated bimetal, a second elongated bimetal supported in proximity to said first bimetal in a generally parallel relationship with said first bimetal, means for connecting said second bimetal in the circuit of said control device whereby said second bimetal serves as a heater member to heat said first bimetal, upon the occurrence of a current above a predetermined value through the circuit of said control device said bimetals deflecting in the same direction such that the spacing between said bimetals remains substantially the same, and connecting means operatively connecting said thermal actuating means with said contacts such that upon said deflection of said bimetals said bimetals will operate through said connecting means to effect automatic operation of said contacts from one to the other of said positions.

2. An electric control device comprising a pair of cooperable contacts operable between two positions, thermal actuating means comprising a first elongated bimetal part and a second elongated bimetal part disposed in close proximity to said first bimetal part in a generally parallel relationship with said first bimetal part, means connecting said first bimetal part and said second bimetal part in electrical series with each other in the circuit of said control device, upon the occurrence of a current above a predetermined value through said circuit said bimetal parts deflecting in the same direction such that the relative spacing between said bimetal parts remains substantially the same, and connecting means operatively connecting said thermal actuating means with said contacts such that upon said deflection of said bimetal parts said bimetal parts will operate through said connecting means to effect operation of said contacts from one to the other of said positions.

3. An electric control device comprising a pair of cooperable contacts operable between two positions, thermal operating means comprising a first bimetal having an upper end and a lower end, a second bimetal having an upper end and a lower end, means mounting said second bimetal at the lower end thereof on the lower end of said first bimetal, means for connecting the upper ends of said first and second bimetals in an electric circuit, said second bimetal through the length thereof being in close proximity to said first bimetal with the high expansion side of said second bimetal facing the low expansion side of said first bimetal whereby said bimetals will deflect in the same direction, and upon occurrence of a current above a predetermined value through the circuit of said control device said bimetals deflecting with the relative spacing between said bimetals remaining substantially the same, and connecting means operatively connecting said thermal actuating means with said contacts such that upon deflection of said bimetals to an actuating position said bimetals will operate through said connecting means to effect operation of said contacts from one to the other of said positions.

4. An electric control device comprising a pair of cooperable contacts operable between two positions, thermal operating means comprising a first elongated bimetal having an upper end and a lower end, means supporting said first elongated bimetal at the upper end thereof on a support member, a second elongated bimetal having an upper end and a lower end, means supporting said second bi-

metal at the lower end thereof on the lower end of said first bimetal with the main portion of said second bimetal being disposed in a generally parallel relationship with said first bimetal and in close proximity to said first bimetal, the high expansion side of said second bimetal being adjacent the low expansion side of said first bimetal whereby said bimetals will deflect in the same direction, means connecting said first and second bimetals at the upper ends thereof in an electric circuit whereby said first and second bimetals are disposed in electrical series in said circuit, an operating mechanism, means for operatively connecting said thermal operating means in proximity to the lower ends of said bimetals to said operating mechanism, upon the occurrence of a current above a predetermined value through said circuit said first and second bimetals deflecting such that the relative spacing therebetween remains substantially the same and said deflection operating through said connecting means to operate said operating mechanism to thereby operate said contacts from one to the other of said positions.

5. An electric control device comprising a pair of cooperable contacts operable between two positions, thermal operating means comprising a first elongated bimetal having an upper end and a lower end, means supporting said first elongated bimetal at the upper end thereof on a support member, a second elongated bimetal having an upper end and a lower end, means supporting said second bimetal at the lower end thereof on the lower end of said first bimetal with the main portion of said second bimetal being disposed in a generally parallel relationship with said first bimetal and in close proximity to said first bimetal, the high expansion side of said second bimetal being adjacent the low expansion side of said first bimetal whereby said bimetals will deflect in the same direction, means connecting said first and second bimetals at the upper ends thereof in an electric circuit whereby said first and second bimetals are disposed in electrical series in said circuit, an operating mechanism, means for operatively connecting said thermal operating means in proximity to the lower ends of said bimetals to said operating mechanism, upon the occurrence of a current above a predetermined value through said circuit said first and second bimetals deflecting such that the relative spacing therebetween remains substantially the same and said deflection operating through said connecting means to operate said operating mechanism to thereby operate said contacts from one to the other of said positions, and means for adjusting the initial position of said bimetals to vary the amount of deflecting of said bimetals that is necessary to effect operation of said contacts.

6. An electric control device comprising a pair of cooperable contacts operable between two positions, an actuating structure comprising a bimetal member, heater means, means biasing said heater means against said actuating structure into an abutting heat conducting relationship with said actuating structure, upon the occurrence of a current through said control device above a predetermined value said heater means operating to heat said bimetal such that said bimetal deflects to effect operation of said contacts from one to the other of said positions.

7. An electric control device comprising a housing having an opening therein, a control mechanism supported within said housing and comprising a pair of cooperable contacts operable between two operating positions, an actuating structure comprising a bimetal member, means supporting said actuating structure in said housing, a current carrying heater structure removably mounted in said housing at said opening, means for connecting said current carrying heater structure in an electric circuit, means biasing said heater structure against said actuating structure into an abutting heat conducting relationship with said actuating structure, and upon the occurrence of a current through said circuit above a predetermined value said heater structure heating said bimetal member and said bimetal member deflecting to effect operation of said contacts from one to the other of said positions.

8. An electric control device comprising a housing having an opening therein, a control mechanism supported within said housing and comprising a pair of cooperable contacts operable between two positions, an actuating structure comprising a bimetal member and a heat-conducting insulating member, means supporting said actuating structure within said housing, a current-carrying heater structure removably mounted within said housing at said opening, means for connecting said heater structure in an electric circuit, said heater structure comprising a spring member, said heater structure being disposed within said housing with said spring member engaging a stationary surface to spring charge said spring member to thereby bias said heater structure against said heat-conducting insulating member and to bias said heat-conducting insulating member against said bimetal member to thereby provide a good heat-transfer relationship from said heater structure through said heat-conducting insulating member to said bimetal member, and upon the occurrence of a current above a predetermined value through said circuit said heater structure heating said bimetal member and said bimetal member deflecting to effect operation of said contacts from one to the other of said positions.

9. An electric control device comprising a pair of cooperable contacts operable between two positions, an elongated actuating structure comprising an elongated bimetal member, means pivotally supporting said actuating structure intermediate the ends thereof, stop means in proximity to a first end of said actuating structure, heater means, means biasing said heater means against said actuating structure into an abutting heat conducting relationship with said actuating structure intermediate said pivotal support and said first end, upon the occurrence of certain overload current conditions said heater structure heating said bimetal member and said bimetal member deflecting to effect operation of said contacts from one to the other of said positions.

10. An electric control device comprising a housing having an opening therein, a control mechanism supported within said housing and comprising a pair of contacts operable between two positions, an elongated actuating structure supported within said housing, said elongated actuating structure comprising an elongated bimetal member, a first stop means in proximity to a first end of said elongated actuating structure on a first side thereof, a second stop means intermediate the ends of said elongated actuating structure on said first side thereof, a current carrying heater structure supported in said housing at said opening, means for connecting said heater structure in an electric circuit, said heater structure being disposed on the side of said actuating structure that is opposite said first side, means biasing said heater structure against said actuating structure into an abutting heat conducting relationship with said actuating structure intermediate said first and said second stop means and at said second side of said actuating structure, and upon the occurrence of a current above a predetermined value through said circuit said heater structure operating to heat said bimetal member and said bimetal member deflecting to effect operation of said contacts from one to the other of said positions.

11. An electric control device comprising a housing having an opening therein, a control mechanism supported within said housing and comprising a pair of cooperable contacts operable between two operating positions, an elongated actuating structure comprising an elongated bimetal member, fixed-pivot support means pivotally supporting said elongated bimetal member within said housing intermediate the ends of said elongated bimetal member, an adjustable stop in proximity to a first end of

said bimetal member on the first and supporting side of said bimetal member, a removable current-carrying heater structure supported within said housing at said opening and comprising a spring member engaging a stationary surface within said housing to bias said heater structure toward said bimetal member into an abutting heat conducting relationship with said actuating structure on the side of said bimetal member that is opposite said first side and between said support and said first end of said bimetal member, an electrical insulating member between said bimetal member and said heater structure, means connecting said heater structure in an electric circuit, and upon the occurrence of a current above a predetermined value through said circuit said bimetal member deflecting and the end thereof that is opposite said first end moving to effect operation of said contacts from one to the other of said positions.

12. An electric control device comprising a housing having an opening therein, a control mechanism supported within said housing and comprising a pair of cooperable contacts operable between two operating positions, an elongated bimetal member within said housing, fixed-pivot support means on a first side of said bimetal member pivotally supporting said bimetal member at a first end of said bimetal member, an adjustable stop on said first side of said bimetal member intermediate the ends of said bimetal member, a current carrying heater structure removably mounted in said housing in proximity to said opening, means for connecting said current carrying heater structure in an electric circuit, said heater structure comprising spring means biasing said heater structure against said bimetal member into an abutting heat conducting relationship with said actuating structure on the side of said bimetal member that is opposite said first side and between said adjustable stop and said support means, an electrical insulating member disposed between said bimetal member and said heater structure, and upon the occurrence of a current above a predetermined value through said electric circuit said heater structure operating to heat said bimetal member whereupon said bimetal member deflects and the end thereof that is opposite said pivotally supported end moves to effect automatic operation of said contacts from one to the other of said positions.

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