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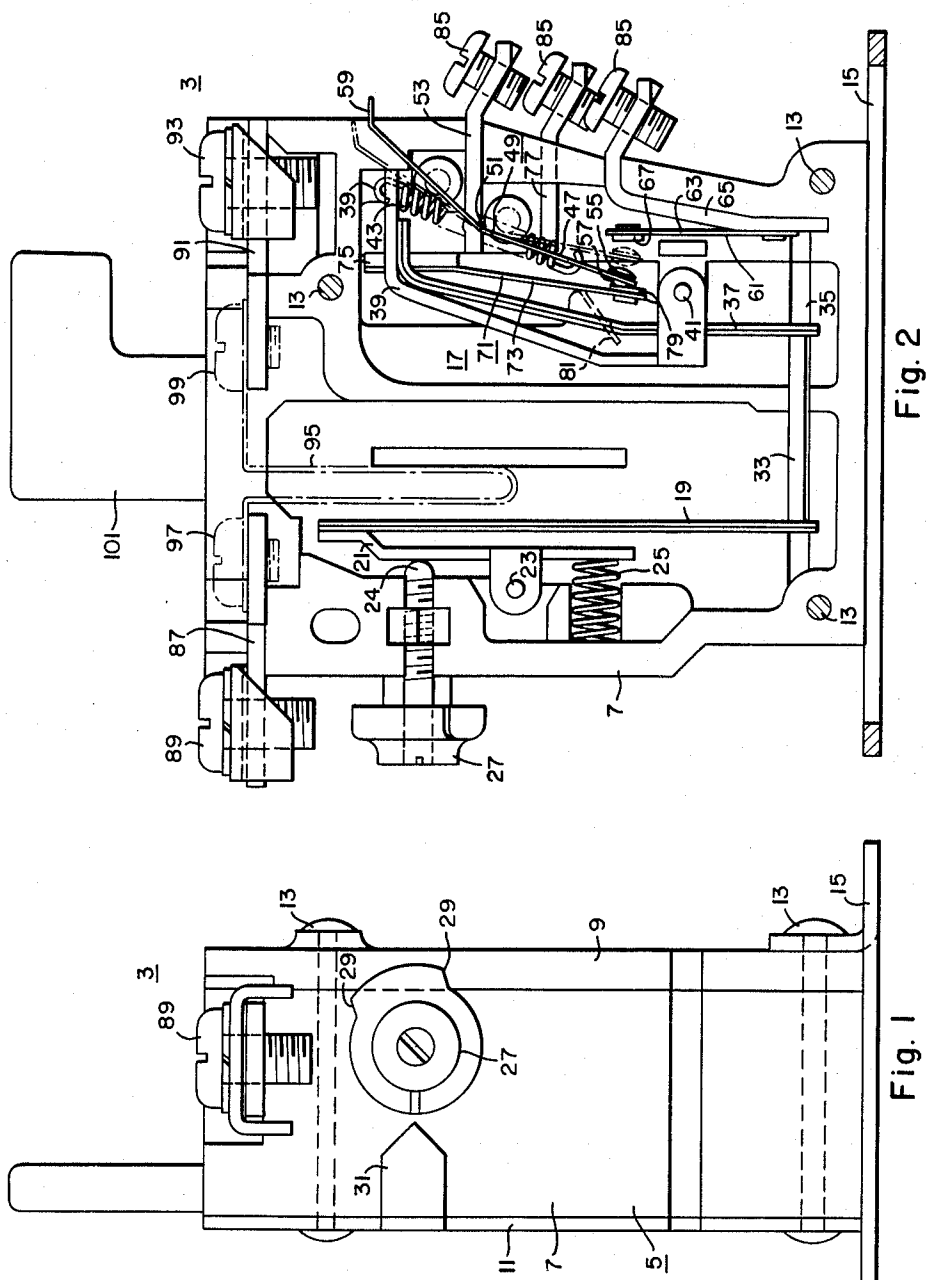
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3,213,243

THERMAL OVERLOAD RELAY WITH RESET MEANS

Filed June 21, 1962

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WITNESSES

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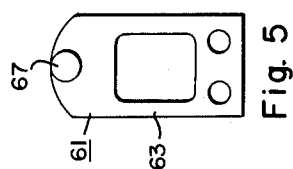
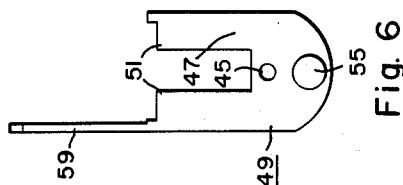
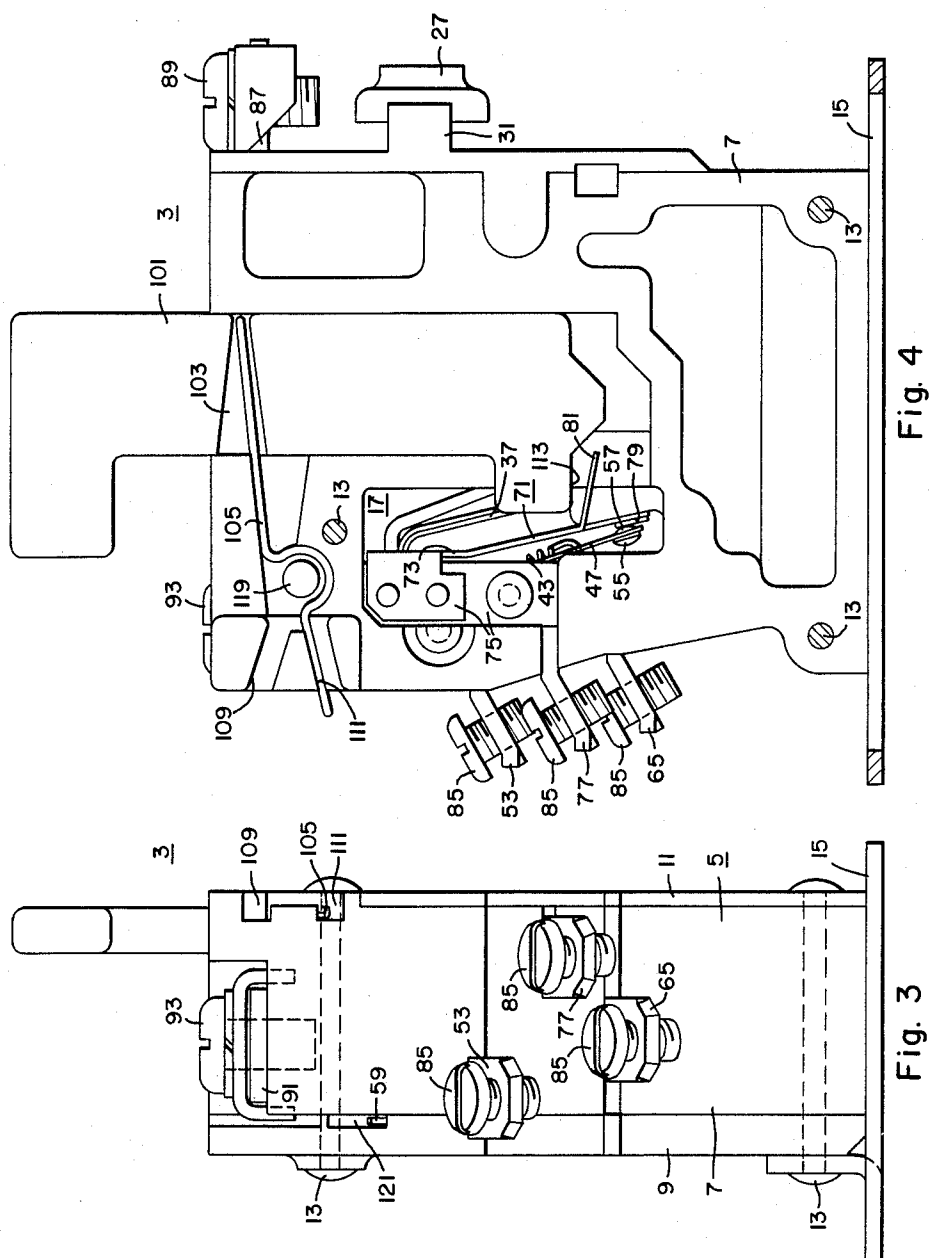
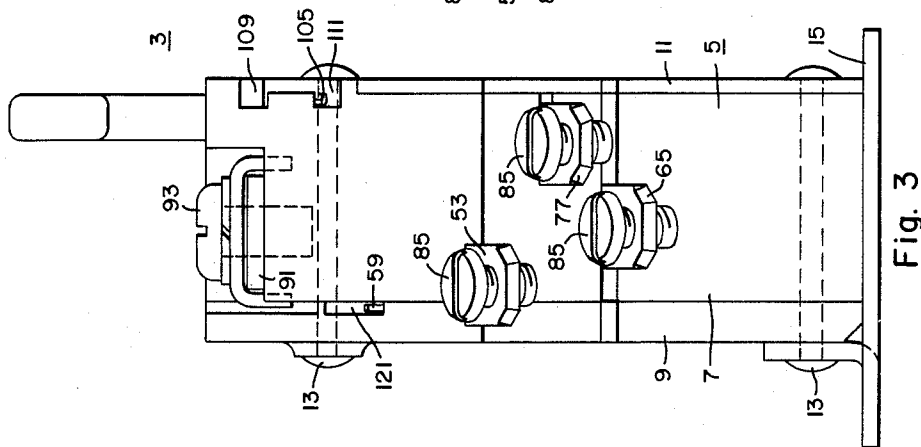
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THERMAL OVERLOAD RELAY WITH RESET MEANS

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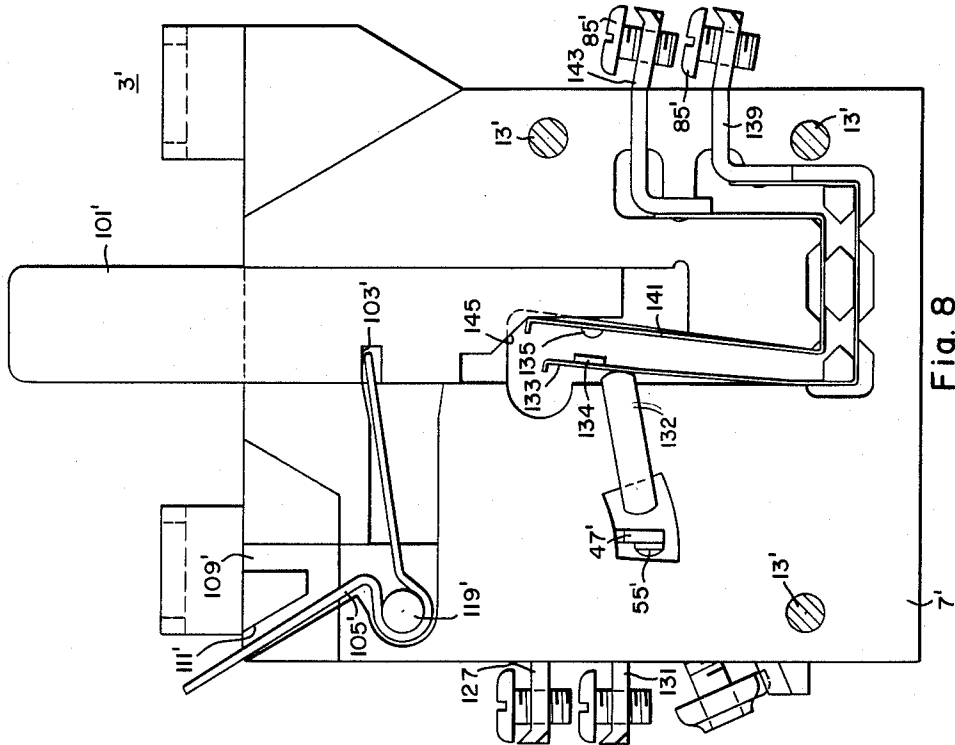
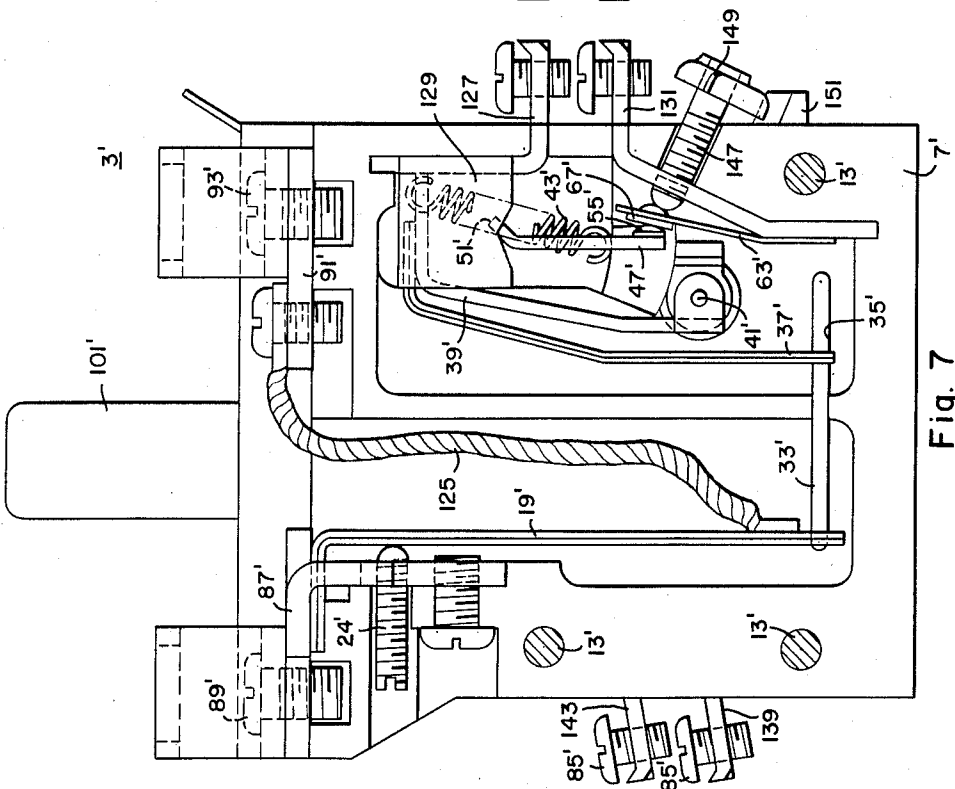
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THERMAL OVERLOAD RELAY WITH RESET MEANS

Filed June 21, 1962

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3,213,243 THERMAL OVERLOAD RELAY WITH RESET MEANS

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7 Claims. (Cl. 200—122)

This invention relates generally to electric control devices and more particularly to ambient temperature compensated thermal overload relays.

An object of this invention is to provide an improved electric control device for controlling either a normally open or a normally closed circuit.

Another object of this invention is to provide a thermal overload relay with improved means for resetting the relay after the relay has been automatically actuated.

Another object of this invention is to provide an improved thermal overload relay that is actuated from an initial position wherein a first set of two contacts is closed, to an actuated position to open the first set of contacts and close a second set of contacts, which relay is readily arranged to provide either manual or automatic operation back to the initial position.

A further object of this invention is to provide a relay in accordance with the immediately preceding object wherein a movable contact arm is common to both sets of contacts and the relay can be changed to control either a normally open or normally closed circuit merely by changing the external connection.

In accordance with another embodiment of this invention, an object is to provide an improved relay for controlling two separate and voltage-independent circuits.

A further object of this invention is to provide a thermal overload relay with improved means for adjusting the operating characteristics of the relay.

Another object of this invention is to provide an improved relay with improved means providing a visual indication that the relay has been actuated.

The invention both as to structure and operation, together with additional objects and advantages thereof, will be best understood from a study of the following detailed description of different embodiments thereof when the study is made 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 side elevational view, with the front cover removed, of the relay seen in FIG. 1;

FIG. 3 is an end elevational view of the relay seen in FIG. 1 taken from the end opposite the end shown in FIG. 1;

FIG. 4 is a side elevational view, with the back cover removed, of the relay seen in FIGS. 1-3;

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 FIGS. 2 and 4;

FIG. 7 is a view similar to FIG. 2 of a relay representing a different embodiment of the invention; and,

FIG. 8 is a view similar to FIG. 4 of the relay shown in FIG. 7.

Referring to the drawings, and particularly to FIGS. 1-6, there is shown therein an electric control device 3 of the type known in the art as an ambient temperature compensating overload relay. The relay 3 comprises a housing 5 of molded insulating material that comprises a central part 7, a front cover 9 and a back cover 11.

The parts 7, 9 and 11 of the housing 5 are secured together by means of three rivets 13. The housing 5 is supported on a suitable base 15. A control mechanism 17 is supported inside the housing 5 and comprises an actuating bimetal member 19 (FIG. 2) that is attached at one end to a support 21. The support 21 is pivotally mounted in the housing 5 by means of a pivot pin 23. A spring 25 biases the support 21 and bimetal 19 in a counterclockwise (FIG. 2) direction about the pivot 23, which movement is limited by engagement of the support 21 with an adjusting screw 24. 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. Surfaces 29 (FIG. 1) are provided on the adjusting knob 27 to engage opposite sides of a stop 31 in order to limit movement of the adjusting knob 27 to prevent overadjustment of the initial position of the actuating bimetal 19 and support 21.

The free end of the bimetal 19 engages one end of an insulating thrust transmitting member 33 that is slidably supported in the housing 5 in a track 35 molded integral with the housing. The other end of the thrust transmitting member 33 engages the free end of a compensating bimetal member 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 (FIG. 2) is supported, at one end, in an opening in the support 39, and, at the other end, in an opening 45 (FIG. 6) in 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 strip 53 (FIG. 2) to pivotally support the movable contact arm 47 on the terminal 53. Contacts 55 and 57 (FIGS. 2 and 6) are secured to 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, as will be hereinafter specifically described, protrudes from the housing 5 when the relay is set for a hand resetting operation and the relay has been actuated by operation of the control mechanism 17.

In operation, the movable contact arm 47 cooperates with a relatively stationary contact structure 61 (FIGS. 2 and 5). The relatively stationary contact structure 61 comprises a resilient contact arm 63 that is fixedly supported on a terminal strip 65. A contact 67 is suitably 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 tab 75 (FIGS. 2 and 4) which tab 75 is suitably secured in the housing and is connected to a terminal strip 77. A contact 79 (FIGS. 2 and 4) 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 3.

The controlling circuit of the relay 3 comprises a conducting strip 87 (FIG. 2) 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 housing 5. A replaceable heater member 95 is supported at one end, on the conducting strip 87 by means of a screw 97, and at the other end, on the conducting strip 91 by means of a screw 99.

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An insulating reset rod 101 having a notch 103 (FIG. 4) therein protrudes from the housing 5. An adjusting spring 105 has one end thereof disposed in the notch 103, and the other end protruding from the housing 5. The external 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 thereof. When the spring 105 is in the slot 111, the relay is set for a hand resetting operation, and when the spring 105 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 FIGS. 1-4 in the actuated position with the spring 105 (FIG. 4) being in the hand-reset position. When the parts are in the position seen, the contact 57 of the movable contact structure 49 engages the contact 79 of the relatively stationary contact structure 71. The relay is reset back to an initial position by manual depression of the reset rod 101 during which movement a shoulder portion 113 (FIG. 4) of the rod 101 engages the extension 81 of the relatively stationary contact arm 73 moving the resilient contact arm 73 and the movable contact arm 47 counterclockwise (FIG. 2) to move the contact arm 47 and spring 43 to a position where the spring 43 is overcenter with respect to the contact arm 47 whereupon the spring 43 operates to move the contact arm 47 into engagement with the contact 67 flexing the resilient contact arm 63 to the right (FIG. 2) until the back portion of the contact 67 engages the terminal 65. The parts then remain in the initial position until the relay is actuated.

The controlling circuit of the relay 3 passes from the terminal strip 87 (FIG. 2) through the heater 95 to the terminal strip 91. When the parts are in an initial position wherein the contact 55 of the movable contact arm 47 engages the relatively stationary contact 67, and an overload current passes through the controlling circuit, heat from the heater 95 operates to flex the bimetal 19 to actuate the relay. The high expansion side of the bimetal 19 is on the left (FIG. 2) and, when the bimetal is heated, the lower or free end of the actuating bimetal 19 moves to the right. This movement of the bimetal 19 operates, through the thrust transmitting member 33, to move the compensating bimetal 37 and support member 39 in a counterclockwise (FIG. 2) direction about the pivot 41. During this movement, the spring 43 is carried 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 into the position seen in FIGS. 2 and 4 in which position the contact 57 of the movable contact arm 47 engages the relatively stationary contact 79 on the contact arm 71. In the position seen in FIGS. 2 and 4, the spring 43 is so positioned that it holds the movable contact arm 47 in the actuated position about the pivot 51 and the compensating bimetal 37 and support 39 in the actuated position about the pivot 41. Thereafter, the parts can be reset to the initial position in the same manner hereinbefore described.

When it is desired to have the relay 3 reset automatically after it has been actuated, the free end of the spring 105 (FIG. 4) 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 of the inner end of the spring 105 operates to move the reset rod 101 to a lower position. When the reset rod 101 is in the lower position, and the relay is actuated by means of an overload current, the movable contact arm 47 will move only to the position shown in dotted lines in FIG. 2. This actuated movement is so limited by engagement of the portion 81 of the contact arm 73 with the shoulder portion 113 (FIG. 4) of the reset rod 101. When the parts are in this actuated position, the spring 43 is overcenter with respect to the contact arm 47 so that the spring 43 maintains the contact arm in the actuated posi-

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tion; but the spring 43 still biases the compensating bimetal 37 and support 39 clockwise about the pivot 41, which clockwise movement is prevented because of the engagement of the compensating bimetal 37 with the thrust transmitting member 33 which member engages the lower end of the actuating bimetal 19. When the bimetal 19 cools and the lower end thereof moves back to the left (FIG. 2) to no longer prevent this clockwise movement of the bimetal 37 and support 39, the spring 43 automatically moves the bimetal 37 and support 39 clockwise, whereupon the spring 43 moves overcenter to the right (FIG. 2) 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. The parts will thereafter remain in the initial position until the relay is again actuated by an overload current.

The bimetal 37 compensates for movement of the actuating bimetal 19 in response to changes in ambient temperature. The high expansion side of the compensating bimetal 37 is 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 flexes to the right (FIG. 2) in response to a rise in the ambient temperature, the compensating bimetal 37 will flex an equal amount to the right without affecting any significant movement of the support 39, spring 43 and contact arm 47. Thereafter, if the ambient temperature drops, and the actuating bimetal 19 moves back to the left, the compensating bimetal 37 will move back to the left without affecting 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 is seen in FIG. 2, 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 leads of the controlled circuit are connected to the common terminal strip 53 and to the normally closed terminal strip 65. When so connected, and when the relay is in the initial or normally closed position, the controlled circuit passes through the common conducting strip 53, the movable contact arm 47, the contact 55, the contact 67, the relatively stationary contact arm 63 to the conducting strip 65. When the relay is actuated by an overload current through the conductor 87, heater 95 and conductor 91, the parts will move to the actuated or open circuit position seen in FIG. 2. Thereafter, the relay can be reset either automatically or manually to the initial or closed circuit position in the manner hereinbefore described.

If it is desired to control a normally open circuit by means of the relay 3, leads are connected to the common conducting strip 53 and the normally open conducting strip 77. Thus, the initial position of the relay would be normally open and upon actuation of the relay to the position seen in FIG. 2, 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 conducting strip 77. The circuit is opened when the relay is reset either manually or automatically.

As is seen in FIG. 2, when the relay 3 is operated to the actuated position and the adjusting spring 105 (FIG. 4) is in the hand reset position, the indicating portion 59 of the movable contact arm 47 moves out through an opening 121 (FIG. 3) in the housing 5 to provide a visual indication that the relay has been actuated. Thereafter, when the relay is reset, the indicator 59 moves back into the housing. With the provision of the indicator 59 in the relay 3, a worker, looking at a number of similar relays in a panelboard, can readily see which of the relays has tripped and must be manually reset.

A different embodiment of the invention is shown in FIGS. 7 and 8. The relay shown in FIGS. 7 and 8 is

similar in many respects to the relay shown in FIGS. 1-4 and, therefore, only new elements are identified by reference characters not found in FIGS. 1-4, whereas other elements which are substantially identical with or equivalent to elements found in FIGS. 1-4 are designated by means of primed numbers corresponding to the numbers used in FIGS. 1-4.

The controlling circuit of the relay 3' extends from the terminal strip 87' through the actuating bimetal 19', the flexible conductor 125 to the conducting strip 91'. Thus, the bimetal 19' is heated directly by current passing therethrough rather than indirectly by means of a heater as is the case in the relay 3 seen in FIG. 2. The relay 3' can be used to control two separate circuits which are voltage independent. A first of these circuits, which is a normally closed circuit, extends from a terminal strip 127 (FIG. 7) through a conducting tab 129, the movable contact arm 47', the movable contact 55', the relatively stationary contact 67', the contact arm 63', to a conducting strip 131. When the parts are in the initial position seen in FIGS. 7 and 8 and the relay 3' is thereafter actuated by an overload current passing through the controlling circuit, the bimetal 19' flexes to move the thrust-transmitting member 33' to the right (FIG. 7) to move the compensating bimetal 37' and support 39' in a counterclockwise direction about the pivot 41' to move the spring 43 overcenter whereupon the spring operates to move the movable contact arm 47' clockwise about its pivot 51' to open the contacts 55', 67'. During this movement, the side of the movable contact arm 47' which is opposite the side that supports the contact 55', engages an insulating member 132 (FIG. 8) that is slidably supported in a suitable track in the molded housing part 7; and moves the member 132 to the right (FIG. 8) during which movement the member 132 moves a resilient conducting member 133 to the right to engage a contact 134 with a contact 135. This movement closes a circuit that extends from a terminal conductor 139, through the resilient conducting member 133, the contact 134, the contact 135, a resilient conducting strip 141 to a terminal conductor 143. When the bimetal 19' thereafter cools and moves back to the original position in which it appears in FIG. 7, the circuit breaker is reset (either automatically or manually depending upon whether the outer end of the spring 105' is positioned in the slot 109' or the slot 111'), back to the initial position seen in FIGS. 7 and 8 in which position the contacts 55', 67' of the normally closed circuit are closed and the contacts 133, 135 of the normally open circuit are open. As is best seen in FIG. 8, if the spring 105' is set for a hand-resetting operation and the reset rod 101 is pushed down, a cam surface 145 on the reset rod 101' engages the conducting strip 141 moving this member and the resilient conducting strip 133 to the left (FIG. 8) to move the insulating member 132 to the left to move the movable contact arm 47' and the movable contact 55' to the left (FIG. 8) to a position where the spring 43' (FIG. 7) is overcenter with respect to the contact arm 47' and operates to move the movable contact arm 47' back to the initial position with a snap action. As is seen in FIG. 8, the conducting strips 133 and 141 are resilient so that they will automatically move back to the initial position seen in FIG. 8 after the relay has been actuated and reset.

If the free end of the spring 105' (FIG. 8) is moved to the slot 109', the relay will be set to automatically reset after it has been actuated. In this case the reset rod 101' will be moved down to bias the conductor 141 to the left to limit movement of the conductor 133, the member 132, the contact arm 47' and the spring 43'. When the relay has been actuated, the parts will be so positioned that the spring 43' will operate automatically, in the same manner hereinbefore described with relation to the relay seen in FIGS. 1-4, to move the contact arm

47' back to the initial position seen in FIGS. 7 and 8 when the bimetal 19' cools and returns to the initial position.

As can be seen in FIGS. 7 and 8, the two circuits (one a normally closed circuit from the conductor 127 to the conductor 131 and the other a normally open circuit from the conductor 139 to the conductor 143) are voltage independent in that they are separate circuits completely insulated from each other. The relay 3' can be connected to control only one of the circuits, or it can be connected to simultaneously control both of the circuits.

Improved means are provided for adjusting the rating of the relay 3'. As is seen in FIG. 7, an adjusting screw 147 having an insulating knob 149 at its outer end is mounted in a tapped opening in the conducting strip 131. Thus, this member can be rotated to move the flexible relatively stationary contact member 63' either to the left or to the right as seen in FIG. 7 to adjust the normal or initial position of the movable contact arm 47'. This adjustment will control the rating of the relay by controlling the amount of work of the actuating bimetal 19' that is necessary in order to effect movement of the overcenter spring 43' to an overcenter position. Thus, the relay will be actuated upon the occurrence of more or less overload current depending on whether the knob 149 is rotated to pivot the contact arm 47' counterclockwise (FIG. 7) or clockwise respectively. In order to provide that the relay 3' cannot be over-adjusted to a position where nuisance tripping would occur or where a severe overload current could damage the parts, a stop portion 151 is molded integral with the housing part 7' to limit movement of the adjusting knob 149 in both directions.

From the foregoing, it can be understood that there is provided by this invention an improved thermal overload relay that can be connected to control either a normally open or a normally closed circuit. The relay is manually reset by operation of a reset rod to actuate a resilient stationary contact structure to move a contact structure and spring to a position where the spring is overcenter with respect to the contact structure whereupon the spring operates to move the contact structure to a normal or initial position. The relay is automatically reset when the reset rod is positioned to position the resilient stationary contact structure and movable contact structure so that when the thermal means cools the spring will automatically be in an overcenter position to automatically move the movable contact structure to the initial position. In another embodiment of the invention, there is provided an improved overload relay that can be connected to control either a normally open circuit or a normally closed circuit, or to simultaneously control both of said circuits which circuits are voltage-independent. The invention also provides improved indicating means for indicating that a relay has been actuated by means of an overload current condition. The invention also provides improved means for adjusting a thermal overload relay to vary the rating of the relay.

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, in combination, a housing, a first relatively stationary contact supported in said housing, a movable contact structure supported in said housing in an initial position engaging said first relatively stationary contact, a second relatively stationary contact supported in said housing, current responsive means supported in said housing and operable upon the occurrence of certain current conditions to automatically effect movement of said movable contact structure to an actuated position out of engagement with said first relatively stationary contact and in engagement

with said second relatively stationary contact, and reset means supported on said housing and operable to actuate said second relatively stationary contact to effect movement of said movable contact structure back to said initial position.

2. An electric control device comprising, in combination, a housing, a first relatively stationary contact supported in said housing, a movable contact structure supported in said housing in an initial position engaging said first relatively stationary contact, a second relatively stationary contact supported in said housing, overcenter spring means supported in said housing, bimetal means supported in said housing, said bimetal means being heated upon the occurrence of certain current conditions and moving to operate said overcenter spring means to effect movement of said movable contact structure to an actuated position out of engagement with said first relatively stationary contact and in engagement with said second relatively stationary contact, reset means extending from said housing and being manually operable to move said second relatively stationary contact to operate said overcenter spring means to thereby effect movement of said movable contact structure back to said initial position.

3. An electric control device comprising, in combination, a housing, a first relatively stationary contact supported in said housing, a movable contact structure in an initial position engaging said first relatively stationary contact, a second relatively stationary contact supported in said housing and comprising a resilient member having a second contact thereon, overcenter spring means supported in said housing, current responsive means supported in said housing and operating upon the occurrence of certain current conditions to relatively position said overcenter spring means to effect movement of said movable contact structure to an actuated position out of engagement with said first relatively stationary contact and in engagement with said second contact, reset means extending from said housing and being manually operable to flex said resilient member to relatively position said overcenter spring means to thereby effect movement of said movable contact structure from said actuated position to said initial position.

4. An electric control device comprising, in combination, a housing, a first relatively stationary contact supported in said housing, a movable contact structure supported in said housing in an initial position engaging said first relatively stationary contact, a second relatively stationary contact supported in said housing, bimetal means supported in said housing, said bimetal means being heated upon the occurrence of certain current conditions and deflecting to effect movement of said movable contact structure to an actuated position away from said first relatively stationary contact and in engagement with said second relatively stationary contact, reset means extending from said housing, said reset means being in a first position to position said second relatively stationary contact and said movable contact structure after actuation of said movable contact structure so that when said bimetal cools said movable contact structure will be automatically moved back to said initial position, means for positioning said reset means in a second position to thereby position said second relatively stationary contact and said movable contact structure after actuation of said movable contact structure so that when said bimetal cools said movable contact structure will remain in engagement with said second relatively stationary contact, and said reset means when in said second position and after actuation of said movable contact structure being movable to move said first relatively stationary contact to thereby effect movement of said movable contact structure back to said initial position.

5. An electric control device comprising, in combination, a housing, a first relatively stationary contact supported in said housing, a movable contact structure sup-

ported in said housing in an initial position engaging said first relatively stationary contact, a second relatively stationary contact supported in said housing, overcenter spring means supported in said housing, bimetal means supported in said housing, said bimetal means being heated upon the occurrence of certain current conditions and deflecting to relatively position said overcenter spring means to effect movement of said movable contact structure to an actuated position in which position said movable contact structure is out of engagement with said first relatively stationary contact and in engagement with said second relatively stationary contact, reset means extending from said housing said reset means being in a first position to effect automatic movement of said movable contact structure from said actuated position to said initial position when said bimetal cools, means for positioning said reset means in a second position so that said movable contact structure will remain in said actuated position when said bimetal cools, and when said reset means is in said second position, said reset means being manually movable to move said first relatively stationary contact to relatively position said overcenter spring means to thereby effect movement of said movable contact structure from said actuated position to said initial position.

6. An electric control device comprising, in combination, a housing, a first relatively stationary contact supported in said housing, a movable contact structure supported in said housing in an initial position engaging said first relatively stationary contact, a second relatively stationary contact supported in said housing, overcenter spring means supported in said housing, a bimetal member supported in said housing, said bimetal member being heated upon the occurrence of certain current conditions and deflecting to operate said overcenter spring means to effect movement of said movable contact structure from said initial position to an actuated position in which actuated position said movable contact structure is out of engagement with said first relatively stationary contact and in engagement with said second relatively stationary contact, reset means extending from said housing, said reset means being in a first position to position said movable contact structure when said movable contact structure is in said actuated position so that when said bimetal cools said overcenter spring means will operate automatically to move said movable contact structure back to said initial position, said reset means being settable in a second position to thereby position said movable contact structure when said movable contact structure is in said actuated position so that when said bimetal cools said movable contact structure will remain in said actuated position, and when said reset means is in said second position said reset means being manually movable to move said first relatively stationary contact to operate said overcenter spring means to thereby effect movement of said movable contact structure from said actuated position to said initial position, bimetal means supported in said housing and operating to compensate for movement of said bimetal member in response to changes in ambient temperature.

7. An electric control device comprising, in combination, a housing, a relatively stationary contact supported in said housing, a movable contact structure supported in said housing in an initial position engaging said relatively stationary contact, a relatively stationary flexible contact structure supported in said housing, overcenter spring means supported in said housing, an actuating bimetal member supported in said housing, a compensating bimetal member supported in said housing, means operatively connecting said actuating bimetal member with said compensating bimetal member, said actuating bimetal member being heated upon the occurrence of certain current conditions and deflecting to move said compensating bimetal member to operate said overcenter spring means to effect movement of said movable structure from said initial position to an actuated position in

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which actuated position said movable contact structure is out of engagement with said relatively stationary contact and in engagement with said flexible contact structure, reset means extending from said housing, said reset means being in a first position to position said flexible contact structure to thereby position said movable contact structure when said movable contact structure is in an actuated position so that when said actuating bimetal member cools said overcenter spring means will operate automatically to effect movement of said movable contact structure from said actuated position to said initial position, means for positioning said reset means in a second position to position said flexible contact structure to thereby position said movable contact structure when said movable contact structure is actuated so that when said actuating bimetal cools said movable contact structure will remain in said actuated position, and said reset means when in said second position being manually movable to move said relatively stationary flexible contact structure to thereby effect movement of said movable contact

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structure from said actuated position to said initial position.

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