Dec. 30, 1947. H. L. VAN VALKENBURG 2,433,720

THERMAL RELAY WITH REPLACEABLE TRIPPING UNIT

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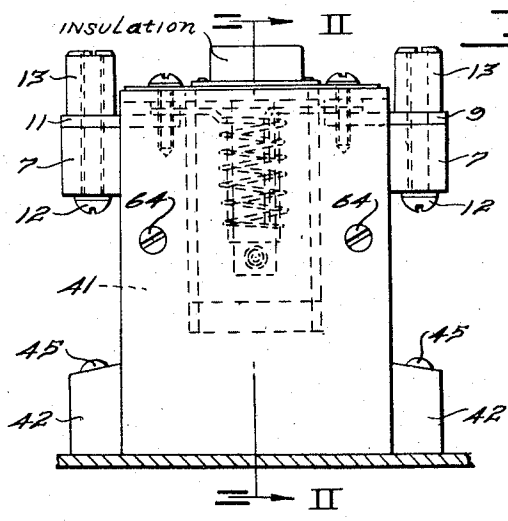


Fig. 1.

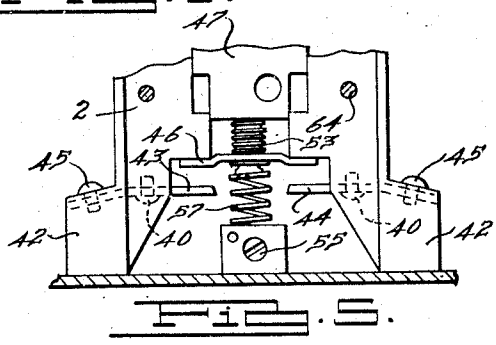


Fig. 5.

Fig. 2.

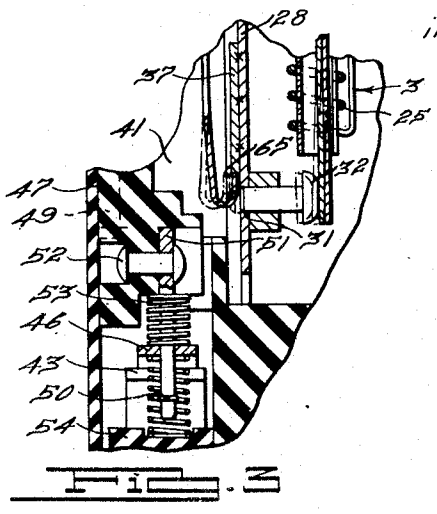
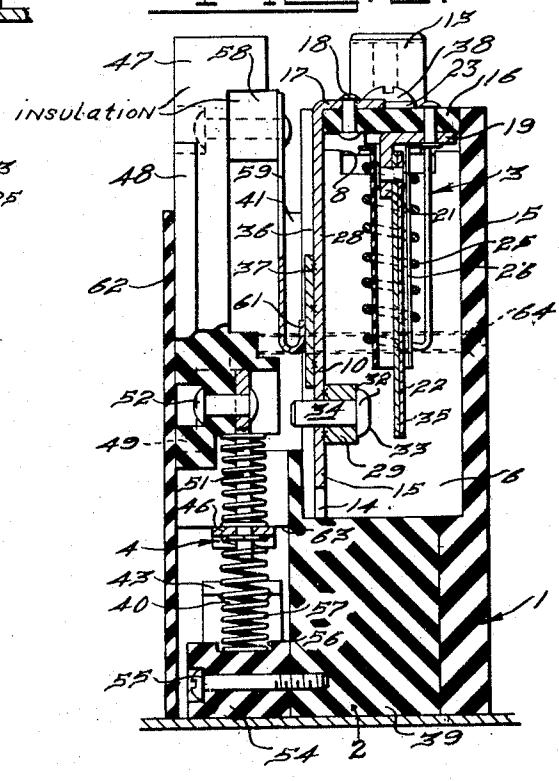


Fig. 3.



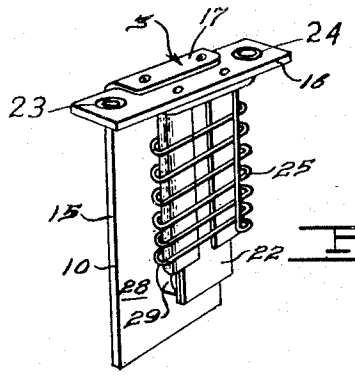


Fig. 4.

INVENTOR.
Hermon L. VanValkenburg
BY
Myron J. Seibold

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THERMAL RELAY WITH REPLACEABLE TRIPPING UNIT

Hermon L. Van Valkenburg, Wauwatosa, Wis., assignor to Square D Company, Detroit, Mich., a corporation of Michigan

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11 Claims. (Cl. 200—116)

1

This invention relates generally to relays, and more particularly to overload protective relays.

One object of the present invention is to provide an improved form of relay wherein an overload current responsive element effects separation of the contacts.

Another object of the invention is to provide an overload protective relay having a means readily interchangeable for changing the current rating at which the relay will function to break the circuit.

Another object of the invention is to provide in an overload protective relay an improved form of tripping unit and which is calibrated for predetermined performance prior to assembly to the relay.

Another object of the invention is to provide a relay of simple and compact construction and which is economical to manufacture.

Other objects and features of the invention will be readily apparent to those skilled in the art from the specification and appended drawing illustrating certain preferred embodiments in which:

Figure 1 is a front elevational view of the electrical relay according to the present invention.

Figure 2 is a sectional view taken on the line II—II of Figure 1.

Figure 3 is a fragmentary sectional view showing the relay in contacts engaged position.

Figure 4 is a detail perspective view showing the overload current responsive unit.

Figure 5 is a fragmentary sectional view showing the switching assembly.

The relay illustrated here embodying the invention is adapted for the protection of electric-energy translating devices by opening the circuit thereof on the occurrence of a current exceeding a predetermined value.

The relay, according to the present invention, comprises a pair of insulating blocks or bases, 1 and 2, with base 1 providing a support for an overload current responsive tripping unit 3 and base 2 effecting a support for a switching assembly 4. Base 1 comprises a back wall 5 and two side walls 6 extending therefrom and being substantially shorter longitudinally. Each of the side walls 6 has a projection 7 extending outwardly therefrom and each wall 6 is cut away at its top surface as at 8 to provide a horizontal groove. A pair of conducting elements, 9 and 11, are carried by base 1 being disposed on the upper surfaces of projections 7, and extending into grooves 8 provided at the tops of wall 6. Studs 12, passing through openings in projections 7, are threaded into the

2

conducting elements 9 and 11 thereby securing them to block 1. A terminal nut 13 is carried by each of the studs 12 whereby circuit wires may be attached to base 1. The side walls 6 are each provided with a longitudinal groove 14 on the inner vertical faces thereof and near their outer edges to receive the longitudinal edges of the longer leg 10 of the generally L-shaped supporting element 15 of the overload current responsive tripping unit 3 shown in Figure 4 whereby the leg 10 will be positioned in base 1 generally parallel to the back wall 5 thereof. The tripping unit 3 comprises a rectangular block 16 formed of insulating material to which is secured the shorter leg 17 of the generally L-shaped supporting element 15 by means of rivets 18. A conducting element 19 is riveted to the under face of the block 16 and has a leg 21, which extends downwardly. A bimetallic element 22 has one end thereof riveted to the leg 21. The insulating block 16 is provided with openings near either extremity and into which openings are inserted metallic sleeves or eyelets 23 and 24, the edges of which are spun over. A heater element 25 formed from a wire composed of resistance material interconnects the eyelets 23 and 24 with the extremities thereof being secured to the eyelets by the spinning of the edges thereover. The greater length of the heater element 25 is wound about the bimetallic element 21 encircling substantially the entire length thereof. A mica sheet 26 is disposed about bimetallic element 22 and lies between the heater element 25 and the bimetal 22 to insulate them. Near the lower extremity of the longer leg 10 of the supporting element 15 and on the inner surface 28 thereof, there is welded a housing 29, the opening of which coincides with an opening 31 extending through leg 10. A pin 32 comprising a head 33 and a shank 34 has the shank 34 thereof disposed within these openings. The free end 35 of bimetal 22 is disposed adjacent head 33 of pin 32 and is engageable therewith to effect rectilinear movement thereof on the occurrence of predetermined current conditions and for a purpose to be hereinafter described. On the outer surface 36 of the leg 10 of supporting member 15 and above opening 31 is welded a rectangular plate 37 whose purpose will be described. Unit 3 is assembled to block 1 by fitting the opposite longitudinal edges of leg 10 of the supporting member 15 into grooves 14 in walls 6 whereupon the unit 3 can be slid into position and the bimetallic member 21 and heater element 25 will be located substantially centrally in the space between side walls 6. Assembling of unit 3 will bring the rectangular block

16 into engagement with the top surfaces of walls 6 to prevent entrance from the top into the space between the walls. The unit 3 is maintained in position and the heater element 25 placed in a circuit with the conducting elements 9 and 11 by means of a pair of studs 38 which are adapted to pass through the sleeves 23 and 24 and to be threaded into the conducting elements 9 and 11. This arrangement provides for the ready removal of the unit 3 merely by removal of the studs 38 and another unit having a different calibration may be readily inserted.

Insulating base 2 is so molded as to effect a generally L shape embodying a rectangular portion 39 forming the shorter leg and a pair of spaced elongated wall portions 41 comprising the longer leg. Portions 42 project outwardly from the base 2 and support conducting elements 43 and 44 which are adapted to extend into base 2 and into the space between wall portions 41. Studs 40 threaded into walls 41 secure the elements 43 and 44 in place. Terminal studs 45 are receivable by the outer ends of conducting elements 43 and 44 and serve to secure the ends of circuit wiring thereto. The interiorly disposed ends of elements 43 and 44 serve as stationary contacts. A movable contact member 46 is provided within this space and is adapted to bridge the stationary contacts 43 and 44 to complete a circuit therethrough. A movable member 47 is carried by base 2 in parallel relationship with the longer leg 10 of the supporting member 15, bridging the distance between the elongated wall portions 41 and being guided for rectilinear movement by longitudinal formations 48 thereon cooperating with vertical recesses 49 provided in the walls 41. A guide piece 51 is secured to member 47 by a rivet 52 and extends downwardly therefrom. The bridging contact member 46 is slidably supported on the guide piece 51, having an opening therethrough through which the piece 51 can extend, and a snap washer 50 retains the contact member 46 on piece 51. A spring 53 is disposed around piece 51 and between the contact member 46 and a ledge on the member 47 and acts to maintain the contact member at the lower end of piece 51. A generally rectangular block 54 is provided in the space between portions 41 generally centrally thereof and is secured to portion 39 by a stud 55. The block 54 is provided with a recess 56 therein in which rests one end of a spring 57 with the other end thereof being disposed against contact member 46. Movement of the rectilinearly movable member 47 downwardly to effect engagement of the contacts will be had against the bias of spring 57. A generally rectangular block 58 is riveted to the upper portion of the movable member 47 and supports a resilient element or latch 59 the end of which is return bent to form a hook 61 to serve a purpose to be described. A plate-like member 62 formed of insulating material is secured to base 2 by studs (not shown) and serves to retain the movable member 47 within the space between the portions 41 by confining the formations 48 to longitudinal movement within recesses 49 and preventing transverse movement. The member 47 cannot be moved vertically out of base 2 for the movable contact 46 will engage with ledge formations 63 on base 2.

Bases 1 and 2 are adapted to be moved into interfitting engagement with one another to effect an insulating enclosure, wherein the elongated walls 41 of base 2 will have a vertical engagement with walls 6 of base 1, and the walls 6

will rest upon the upper horizontal surface of rectangular portion 39 of base 2, and the vertical surface of portion 39 will be brought in intimate engagement with back wall 5 of base 1. The bases 1 and 2 are maintained in interfitting engagement by a pair of studs 64 which pass through walls 6 of base 1 and are threaded into walls 41 of base 2. The distance between the two pairs of walls 6 and 41 are substantially equal and with the tripping unit 3 removed from the relay a central chamber is defined therebetween. Mounting of the tripping unit 3 in place will cause leg 10 of element 15 to act as a partition member to substantially close off communication between the spaces defined by walls 6 and walls 41 and will effect a substantially enclosed chamber in base 1 within which the bimetal 22 is disposed. With bases 1 and 2 in assembled relationship, the resilient element 59 will be disposed in engagement with the rectangular plate 37, as seen in Figure 2, and will be slightly stressed for movement to the right, and when the rectilinearly movable member 47 is manually moved downwardly to carry the bridging contact 46 into engagement with the stationary contacts 43 and 44, the resilient element 59 will move counterclockwise to carry the hooked portion 61 beyond the lower edge 65 of the plate 37, which effects a latching surface; when the hook 61 has been moved to this position, the resilient element 59 is relieved of stress and will move to cause the hook 61 to move to assume a position directly beneath the edge 65 of plate 37 so that when the movable member 47 is released it cannot move to contacts released position, the engagement of hook 61 with edge 65 preventing it. Hook 61 moving into position beneath edge 65 will engage pin 32 if it extends beyond plate 37 to move it inwardly to carry head 33 toward engagement with the bimetal 22 and engagement with bimetal 22 would limit the extent of inward movement. In the downward movement of the movable member 47 to effect contact engagement, the springs 53 and 57 are both compressed, with spring 53 exerting its bias to effect a substantial contact pressure between the stationary and movable contacts.

Assuming the parts to be in contacts engaged position, if an overload current should flow through the heater element 25, it will induce sufficient heat to be generated therein to cause the bimetallic element 22 to flex in a clockwise direction and move the pin 32 to the left to apply a force upon the hook 61 to move it clockwise and out of engagement with edge 65 of the plate 37. With the disengagement of hook 61 from plate 37, the rectilinearly movable member 47 will move upwardly under the bias of spring 57 to move the movable contact 46 out of engagement with the stationary contacts 43 and 44 to break the circuit being protected.

The resetting of the relay is accomplished by depressing the rectilinearly movable member 47 to again place hook 61 in engagement with edge 65 and the contacts in engagement.

The calibration of the relay of this invention, that is the overload current-time relationship at which automatic opening of the contacts is effected, is determined initially by the selection and sensitivity of bimetal 22 and the resistance of heater 25; thereafter the final calibration is determined by the position of the free end 35 of the bimetal 22 with respect to the latching surface 65 of plate 37. The position of the bimetal end 35 will determine the amount which it will have to move to move the pin 32 sufficiently to

unlatch the hook 61 from the latching surface 65. Since the element 15 supporting the plate 37 and the bimetal 22 are both mounted on the insulating block 16, the final calibration of the relay and the determining of the relative position of the end of the bimetal and the latching surface can be effected with the tripping unit removed from the relay assembly. This greatly facilitates the calibrating operation as it enables the calibration of the unit assembly of Figure 4 to be effected remote from the operating parts of the relay, and this unit assembly may thereafter be inserted to complete the relay structure with the calibration remaining set as exteriorly determined.

In this connection it is to be noted that the relative position of the latch hook 61 with respect to the latching surface 65 does not affect the calibration of the relay, and manufacturing variations may result in variation in the overlap of the hook with the latching surface without changing the predetermined calibration of the current responsive tripping unit. This is because regardless of the amount of overlap, the free end of the bimetal will have to move the same unlatching distance to move the free edge of the hook 61 by means of the pin 32 to remove the hook from beneath the latching surface 65. However, so long as the free end of the bimetal and the latching surface are placed in their predetermined position, the calibration will remain the same regardless of variation in the other mechanical parts. While any form of adjusting mechanism may be embodied in the relay construction for adjusting the position of the bimetal, or the latching surface, the modification shown is the simplest form in which the bimetal or its support is bent to the desired position relative to the latching surface.

While certain preferred embodiments of the invention have been specifically disclosed, it is understood that the invention is not limited thereto, as many variations will be readily apparent to those skilled in the art and the invention is to be given its broadest possible interpretation within the terms of the following claims.

What is claimed is:

1. In an overload relay, an insulating base, a stationary contact provided thereon, a movable contact for cooperation with said stationary contact, a rectilinearly movable member supporting said movable contact and operative to move said movable contact into engagement with said stationary contact, spring means, said rectilinearly movable member moving to contacts engaged position against the bias of said spring means, a tripping unit supported on said base, said tripping unit including a thermal element movable on the occurrence of an overload current, a stationary latching surface, a latch carried by said rectilinearly movable member adapted to normally engage said latching surface to maintain said rectilinearly movable member in contacts engaged position, and means operatively interconnecting said thermal element and said latch, said means being movable by said thermal element on the occurrence of an overload current to move said latch to unlatching position, said rectilinearly movable member being then movable by said spring means to effect disengagement of said movable contact from said stationary contact.

2. In an overload relay, an insulating base, a stationary contact mounted thereon, a movable contact adapted to engage and disengage said stationary contact, a rectilinearly movable member, a member mounted thereon for slidably supporting said movable contact, spring means carried by said supporting member and effective to provide pressure between said movable contact and said stationary contact when the former is moved into engagement with the latter, a second spring means, said rectilinearly movable member moving to contacts engaged position against the bias of said second spring means, a tripping unit supported on said base, said tripping unit including a thermal element movable on the occurrence of an overload current, a latch bodily movable with the said rectilinearly movable member, means automatically engageable by said latch to maintain said rectilinearly movable member in contacts engaged position upon movement of said member to said position, and means operatively interconnecting said thermal element and said latch, said means comprising a second rectilinearly movable member and being movable by said thermal element on the occurrence of an overload current to move said latch to disengaged position, said first rectilinearly movable member being then movable by said second spring means to effect disengagement of said movable contact from said stationary contact.

3. In an overload relay, an insulating base having a chamber therein, a stationary contact within said chamber, a movable contact engageable therewith, a movable member supporting said movable contact and operative to move said contact into engaged position, a tripping unit, said tripping unit including a thermal member movable on the occurrence of a current overload, a latch comprising a resilient element bodily movable with said movable contact supporting member, said latch having an end thereof return bent, means supported within said chamber and engageable by said return bent end to maintain said movable contact in engagement with said stationary contact, means movable by said thermal member on the occurrence of a current overload to engage and move said resilient latch to effect disengagement of the return bent end, and spring means operative to move said movable contact supporting member to contacts disengaged position upon disengagement of said return bent end.

4. In an overload relay, an insulating base, a stationary contact mounted thereon, a movable contact adapted to engage and disengage said stationary contact, a rectilinearly movable member, a member carried thereby and slidably supporting said movable contact, spring means carried by said supporting member and effective to provide pressure between said movable contact and said stationary contact when the former is moved into engagement with the latter, a tripping unit, said tripping unit including a thermal element movable on the occurrence of a current overload, a latch comprising an elongated resilient element having one end thereof secured to said rectilinearly movable member and the free end thereof return bent and being bodily movable upon movement of said rectilinearly movable member, means having a surface thereon engageable by said return bent end to maintain said movable contact engagement with said stationary contact, a second rectilinearly movable member interconnecting said thermal element and said latch and being movable by said thermal element on the occurrence of an overload current to move said return bent end out of engagement with said surface, said spring means

operative to move said movable contact out of engagement with said stationary contact upon release of said latch.

5. In an overload relay, an insulating base provided with a chamber therein, a stationary contact secured therein, a movable contact adapted to cooperate therewith to make and break an electrical circuit, a movable member operative to move said movable contact for engagement with said stationary contact, a partition member extending into said base and dividing said chamber, with said contacts and said movable member being disposed in one division, a thermal element movable on the occurrence of an overload current disposed in the second division, a latching surface provided on said partition member, a latch bodily movable with said movable contact operating member, said latch being engageable with said latching surface to maintain said movable contact in engagement with said stationary contact, means extending through said partition member and effecting an operative connection between said thermal element and said latch, said means being movable by said thermal element on the occurrence of an overload current to move said latch out of engagement with said latching surface to effect disengagement of said movable contact from said stationary contact.

6. In an overload relay, an insulating base provided with a chamber therein, a stationary contact secured therein, a movable contact adapted to cooperate therewith to make and break an electrical circuit, a movable member operative to move said movable contact for engagement with said stationary contact, a partition member extending into said base and dividing said chamber, with said contacts and said movable member being disposed in one division, a thermal element movable on the occurrence of an overload current disposed in the second division, a latching surface provided on said partition member, a latch element comprising a resilient element having one end thereof secured to said movable contact actuating member and having the free end thereof return bent, said return bent end being adapted to engage said latching surface when said movable contact actuating member is moved to contacts engaged position to maintain said contacts engaged, means supported by said partition and effecting an operative connection between said thermal element and said latch element, and being movable by said thermal element on the occurrence of an overload current to move said return bent end out of engagement with said latching surface, and spring means operative to move said movable contact out of engagement with said stationary contact on disengagement of said latch element.

7. In an overload relay, an insulating base provided with a chamber therein, a stationary contact secured therein, a movable contact adapted to cooperate therewith to make and break an electrical circuit, a movable member operative to move said movable contact for engagement with said stationary contact, a trip unit mountable on said base and comprising means for effecting a substantially enclosed chamber within said base, a thermal element provided by said tripping unit and disposed within said substantially enclosed chamber and being thereby separated from said contacts, said thermal element being movable on the occurrence of an overload current, a latching surface disposed outside of said substantially enclosed chamber, a latch bodily movable with said movable contact operating member, said latch being engageable with said latching surface to normally maintain said movable contact in engagement with said stationary contact, means extending from said substantially enclosed chamber and effecting a connection between said thermal element and said latch and being movable by said thermal element on the occurrence of an overload current to move said latch out of engagement with said latching surface, and spring means operable upon said disengagement of said latch to move said movable contact operating member to effect actuation of said movable contact to disengaged position.

8. In an overload relay, an insulating base provided with a chamber therein, a stationary contact secured therein, a movable contact adapted to cooperate therewith to make and break an electrical circuit, a movable member operative to move said movable contact for engagement with said stationary contact, means comprising a partition member and an insulating member secured thereto, said means cooperating with said base to divide said chamber and effect a substantially enclosed chamber, on the outside of which are disposed said contacts and said movable contact operating member, a thermal element disposed within said substantially enclosed chamber and movable on the occurrence of an overload current, a latching surface provided on said partition member, a resilient latch bodily movable with said movable contact operating member, said resilient latch being continually biased toward said partition member and engaging said latching surface to maintain said contacts normally engaged, means supported by said partition member and extending therethrough to provide a connection between said thermal member and said latch and being movable by said thermal element on the occurrence of an overload current to move said latch out of engagement with said latching surface to effect movement of said movable contact away from said stationary contact.

9. In an overload relay, an insulating base provided with a chamber therein, a stationary contact secured therein, a movable contact adapted to cooperate therewith to make and break an electrical circuit, a movable member operative to move said movable contact for engagement with said stationary contact, a trip unit removably mounted on said base, said trip unit comprising a supporting element, an insulating member secured thereto, a thermal member carried by said insulating member, a heater element mounted on said insulating member and in heat exchange relationship with said thermal member to effect flexing thereof on the occurrence of an overload current, said supporting element extending into said chamber and serving as a partition member to effect a division of said chamber, with the thermal member disposed on one side of said partition member, and the contacts and the movable contact operating member disposed on the other, a latching surface disposed on said partition member, a latch bodily movable with said movable contact operating member and being engageable with said latching surface when said contacts are engaged to normally maintain them engaged, means movable through an opening in said partition member and providing a connection between said thermal member and said latch and being movable by said thermal member on the occurrence of an overload current to move said latch out of en-

gagement with said latching surface, and spring means operative on said movable contact operating member to effect movement thereof to contacts disengaged position on disengagement of said latch.

10. In an overload relay, an insulating base provided with a chamber therein, a stationary contact secured therein, a movable contact adapted to cooperate therewith to make and break an electrical circuit, a movable member operative to move said movable contact for engagement with said stationary contact, a trip unit removably mounted on said base, said trip unit comprising a supporting element, an insulating member secured thereto, a thermal member carried by said insulating member, a heater element mounted on said insulating member and in heat exchange relationship with said thermal member to effect flexing thereof on the occurrence of an overload current, said supporting element extending into said chamber and serving as a partition member to effect a division of said chamber, with the thermal member disposed on one side of said partition member, and the contacts and the movable contact operating member disposed on the other, a latching surface disposed on said partition member, a latch comprising an elongated resilient element having one end thereof secured to said movable contact operating member and the free end thereof return bent, said latch being biased to move the return bent end thereof into engagement with said latching surface on movement of said movable contact into engagement with said stationary contact to maintain said contacts engaged, a member supported by said partition member and guided for rectilinear movement and providing an interconnection between said thermal member and said latch and being movable by said thermal member on the occurrence of an overload current to move said return bent end out of engagement with said latching surface to effect movement of said movable contact out of engagement with said stationary contact.

11. In an overload relay, an insulating base member of generally L-shape, a second insulating base member having an interfitting engagement with the L-shaped base member and cooperating therewith to provide a central chamber, a readily removable partition member dividing said central chamber, a stationary contact, a movable contact engageable therewith and a rectilinearly movable member for moving said movable contact, all disposed on one side of said partition member, a thermal element movable on the occurrence of an overload current and disposed on the opposite side of said partition member, an insulating member carried by said partition member and adapted to close said portion of the chamber within which said thermal element is disposed, a latching surface provided on said partition member, a latch bodily movable with said rectilinearly movable member, said latch automatically moving into engagement with said latching surface on movement of said rectilinearly movable member to contacts engaged position to maintain said contacts normally engaged, a member movably supported by said partition member and providing an interconnection between said thermal element and said latch and being movable by the thermal element on the occurrence of an overload current to move said latch out of engagement with said latching surface to effect movement of said movable contact out of engagement with said stationary contact.

HERMON L. VAN VALKENBURG.

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