



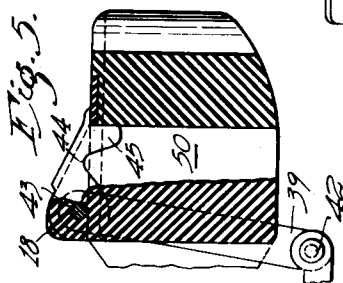
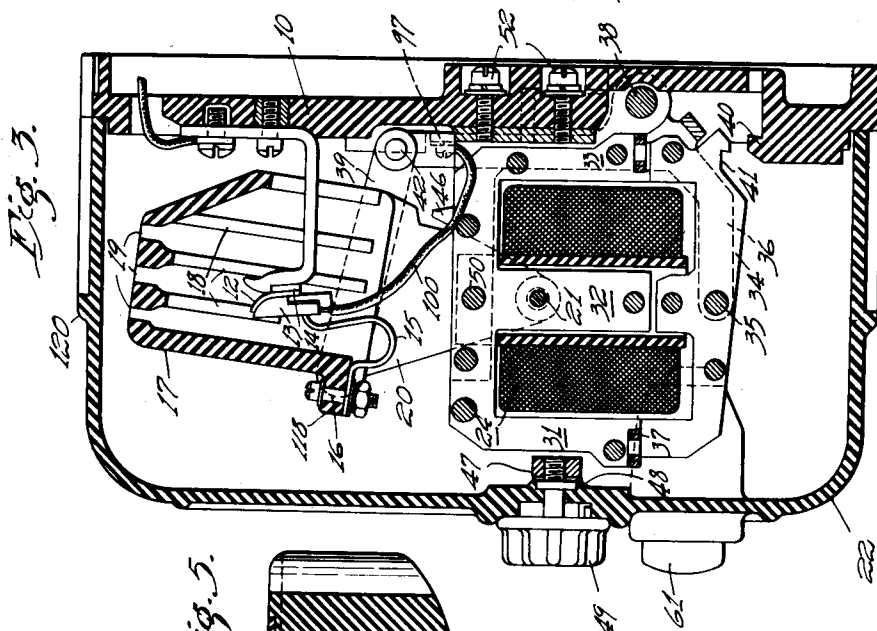
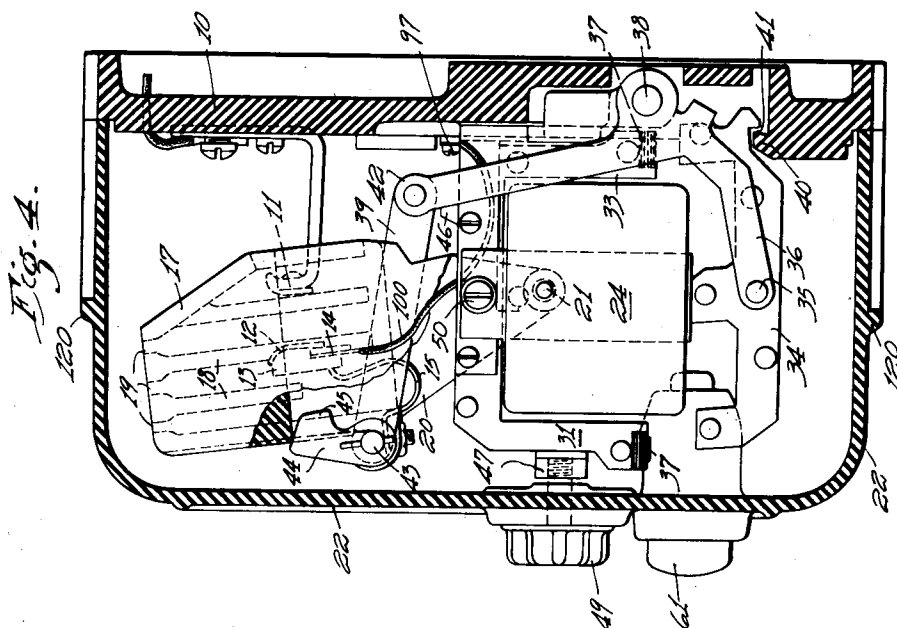
Oct. 22, 1935.

G. C. ARMSTRONG ET AL

2,018,340

RELAY

Original Filed July 30, 1932 3 Sheets-Sheet 2



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Fig. 6.

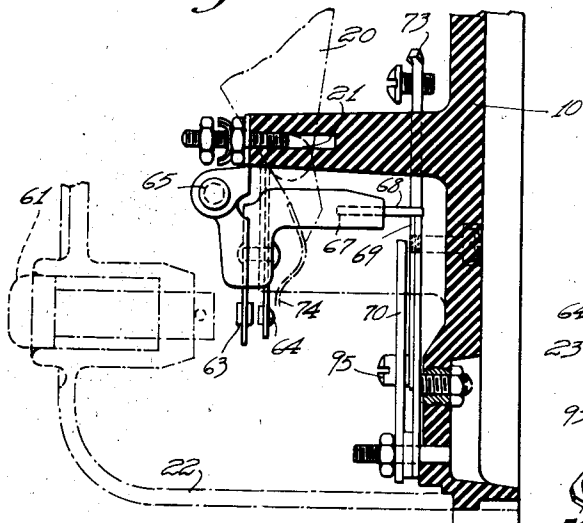


Fig. 8.

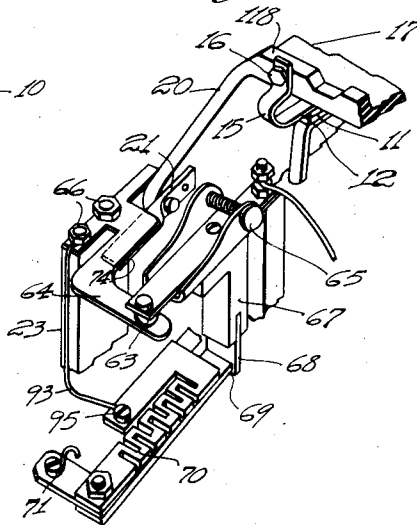


Fig. 7.

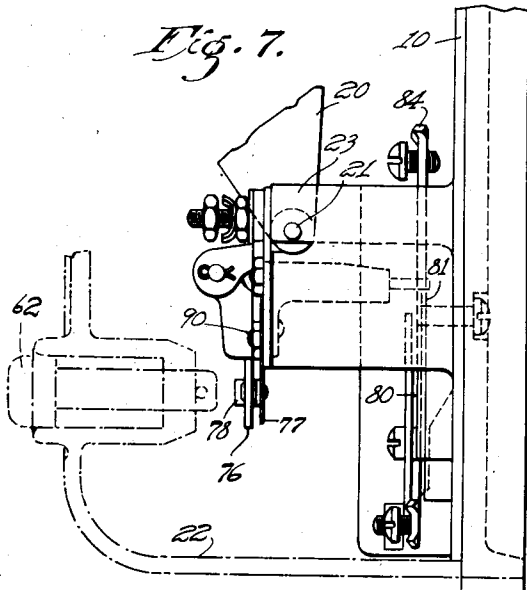
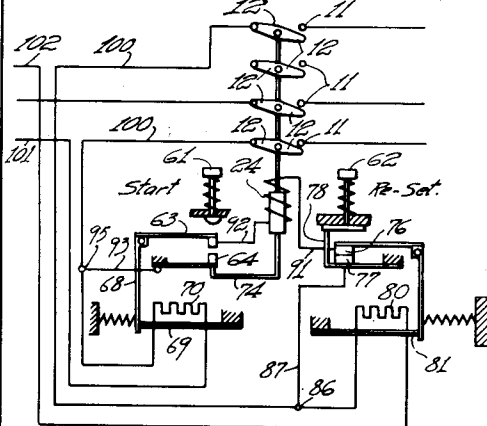


Fig. 9.



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## UNITED STATES PATENT OFFICE

2,018,340

## RELAY

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Original application July 30, 1932, Serial No. 626,594. Divided and this application April 14, 1934, Serial No. 720,612

11 Claims. (Cl. 175—294)

This application is a division of our application Serial No. 626,594 filed July 30, 1932.

Our invention relates to relays, and more particularly to relays of the line-starter type that are especially designed to cooperate with electric devices protected by safety features.

An object of our invention is the provision of a relay of the class indicated that shall be reliable and compact, and be economically manufactured and installed.

Another object of our invention is to prevent the closing of the contact members of a relay when the magnetizing winding of the relay is de-energized.

A still further object of our invention is to so construct and arrange the base or support of a relay that the base constitutes a part of the enclosure for the relay and may be mounted with or without conduit fittings of any kind.

A still further object of our invention is to so construct and so mount the arc chute of a contactor that its movable contact members may be carried thereby, thus eliminating the usual cross-bar upon which the movable contact members are mounted and making it impossible to operate the relay with the arc chute removed.

It is also an object of our invention to provide for operating a relay or contactor by a set of push-buttons, and for independently actuating the contact fingers of the push-buttons by thermal elements, which, when heated to a predetermined value, interrupt the circuit for energizing the magnetizing winding of the relay or contactor and thereby disconnect the load from the supply source.

It is likewise an object of our invention to provide an interlock operable by the closure of the contact members of a relay for constraining the contact fingers of a start push-button in a closed-circuit position when the pressure on the start push-button is released.

Other objects and a fuller understanding of our invention may be had by referring to the following specification, taken in connection with the accompanying drawings, in which:

Figure 1 is a front elevational view, partly in section, of a relay embodying the features of our invention, the cover being removed to show the structural features thereof;

Fig. 2 is a bottom plan view of our relay with the cover removed to show the structural features thereof;

Fig. 3 is a cross-sectional view of our relay taken along the line III—III of Fig. 1 looking toward the left and showing the cover in place;

Fig. 4 is a cross-sectional view, similar to the view of Fig. 3, of our relay but taken along the line IV—IV of Fig. 1;

Fig. 5 is a fragmentary cross-sectional view of the arc chute, and illustrates, particularly, the releasable connection between the actuating lever and the arc chute;

Fig. 6 is a fragmentary view, partly in section, of our relay, and illustrates, particularly, the contact fingers of the start push-button, in combination with an electrical interlock that is actuated by the arc chute, and the thermal element which insures overload protection for one phase;

Fig. 7 is a fragmentary view of our relay, and illustrates, particularly, the contact fingers of the re-set push-button, in combination with the thermal element that insures overload protection for another phase;

Fig. 8 is a perspective view of the contact fingers for the start push-button, in combination with the mechanical interlock that is operated by the arc chute and the thermal element which insures overload protection;

Fig. 9 is a diagrammatic view of the electrical connections for our relay.

With particular reference to the drawings, our relay or contactor comprises, in general, a base or support 10 upon which the various parts of the relay are mounted, a plurality of stationary contact members 11 carried by the support 10, a magnetizable core having three legs 31, 32 and 33, a magnetizable winding 24 surrounding the middle leg 32, an armature 34, a pivotally mounted arc chute 17, a plurality of movable contact members 12 resiliently mounted upon the arc chute, a start push-button 61 and a re-set push-button 62.

The arc chute 17 is preferably constructed in the form of a unitary structure, and is provided with separate compartments for each set of contact members 11 and 12. The inner walls of each compartment of the arc chute are provided with substantially parallel ribs 18 and the top of each of the compartments is provided with openings 19 through which the hot gases may escape. The effect of the ribs 18 is such that they hasten the extinguishment of the arc, a provision which materially lengthens the life of the contact members.

As illustrated, the sides 20 of the arc chute 17 depend downwardly and are pivotally connected at a pivot-point 21 to the side members 23 that are mounted upon opposite sides of the support 10. The front of the arc chute 17 is provided with projecting edges 118 and resilient

springs 15 for carrying the movable contact members 12 are mounted on these edges by means of bolt 16. A shoe 13 that substantially surrounds the movable contact member 12 is mounted upon the free end of the resilient spring 15. The shoe 13 is preferably made of magnetic material so that the field about the arc is materially increased, thus causing the arc to travel more rapidly towards the tips of the contact members. This provision also materially lengthens the life of the contact members 11 and 12. As a further means for lengthening the life of the contact members and to reduce the heating resulting from contact resistance, their engaging surfaces may be provided with silver or other suitable metal which is very little affected by the intense heat of the arc.

As shown best in Fig. 1, the sides of the shoes 13 are provided with outwardly extending tabs 14. Accordingly, when the arc chute 17 is actuated to the open-circuit position (see Fig. 4) the central rib 18 engages the outwardly extending tabs 14, and thereby constrains the movable contact member 12 to the open-circuit position. However, when the arc chute 17 is actuated to the closed-circuit position (see Fig. 3), the movable contact member 12 firmly engages the stationary contact member 11, as the central rib 18 is slightly in advance of the stationary contact member 12 and it thereby no longer engages the outward extending tabs 14. From the foregoing, it is observed that the arc chute 17 not only serves the purpose of an arc chute, but likewise constitutes a support for the movable contact member 12. This construction eliminates the usual cross-bar upon which the movable contact member 12 is mounted. Furthermore, this construction makes it impossible to operate the relay with the arc chute removed, a requirement specified for safety purposes.

As shown in Figs. 1, 3 and 4, the stationary contact members 11 may be suitably mounted upon the upper portion of the support 10. Therefore, when wiring or installing the relay the conductor leads may be brought through suitable openings near the top edge of the support 10 and be directly connected to the stationary contacts 11. Each of the movable contact members 12 is individually connected, by means of flexible conductors 100, to the upper ends of conductor bars 73, 84, 97, and 98 that are mounted in suitable channels provided therefor on the lower portion of the support 10. (See Fig. 1.) Accordingly, when wiring and installing the relay the conductor leads for the movable contacts 12 may be brought through suitable openings near the bottom edge of the support 10 and be connected to the lower ends of the conductor bars.

As illustrated best in Figs. 3 and 4, the magnetizable core 24 that actuates the armature 34 is provided with three legs 31, 32 and 33. As shown in Fig. 3, the magnetizable core may be mounted upon the support 10 by the screws 52 or any other suitable means. The pole faces of the two outside legs 31 and 33 of the magnetizable core are provided with shading coils to prevent the armature from chattering when the relay is operated by alternating current.

The magnetizable winding 24 is of the "self-sustained" type and is adapted to surround the central leg 32. The upper end of the rectangular tube upon which the winding is wound extends beyond the winding, and one pair of the opposite sides thereof are cut away so that the remaining pair of opposite sides straddles the top central

portion of the magnetizable core. (See Figs. 3 and 4.) The winding 24 is then retained in position by a screw 50 which passes through the upper extended ends of the rectangular tube and the top central portion of the magnetizable core. A mounting of this type is very simple and economical to construct and install in that it requires no retaining clips or wedging blocks of any kind to hold the magnetizable winding in position.

The mounting of the armature 34 and the manner in which it is inter-connected with the arc chute 17, is a radical departure from the conventional manner heretofore practiced in the art. As illustrated, the armature 34 is mechanically connected to the arc chute 17 by means of a pivotally mounted member 36 and an inter-connecting link 39. The pivotally mounted member 36 is pivoted at a pivot-point 38, and comprises two spaced members, the lower portion of which straddles the armature 34 and the upper portion 20 of which straddles the leg 33 of the magnetizable core. The upper ends of the spaced members are brought together and pivotally connected to the inter-connecting link 39 at a pivot-point 42. A stop 46 is provided upon the upper surface of the magnetizable core to limit the forward movement of the pivotally mounted member 36. As illustrated, the central portion of the armature 34 is pivotally connected at a pivot-point 35 to the lower ends of the spaced pivotally mounted member 36. Therefore, by means of this construction the armature 34 moves not only upwardly, when attracted by the main core, but also outwardly in a longitudinal direction, causing the pivot-point 35 to describe an arcuate path. The rear end of the armature 34 is provided with a latch or hook 41 adapted to engage a projecting or obstructing portion 40 of the support 10, when the magnetizable winding 24 is deenergized (see Fig. 4). The pivot-point 35 is slightly to the left of the center of gravity of the armature 34 so that the rearward end of the armature, when the magnetizable winding 24 is deenergized, always drops by means of gravity and engages the obstruction 40 of the support 10. In this position, should the relay be unduly jarred or should an accidental force be applied in a clockwise direction to the arc chute 17, the latching engagement would constrain the longitudinal movement of the armature 34, and thus prevent the closure of the contact members 11 and 12. It will be noted that each armature is provided with suitable shading coils 37.

For the purpose of releasing the latch 41 of the armature 34, when the magnetizable winding 24 is energized, we provide for making the air gap between the leg 33 and the rear end of the armature less than the air gap between the leg 31 and the forward end of the armature. Consequently when the winding 24 is energized, the rear end of the armature 34 is first attracted upwardly and, just as soon as the latch 41 clears the obstruction 40, the armature 34 is allowed to move forwardly, in a longitudinal direction, and thus actuate the arc chute 17 to the closed-circuit position (see Fig. 3).

When the magnetizable winding 24 is deenergized, the armature 34 swings downwardly and rearwardly at the same time, causing the pivot-point 35 to describe an arcuate path, until the latch 41 again engages the obstruction 40. As is readily apparent, with this type of armature mounting, no additional parts are required for obstructing the closing of the contact members when the magnetizable winding 24 is deenergized.

As shown in Figs. 4 and 5, the forward end of the inter-connecting link 39 is releasably connected to the arc chute 17, so that the arc chute may be readily tipped forwardly for wiring the relay or for inspecting of the contact members thereof. As shown best in Fig. 5, the projecting edge 18 of the arc chute 17 is provided with a transverse recess for receiving a pin 43. Pivotal-ly connected to the pin 43, and straddling the outer end of the inter-connecting link 39, is a clip 44 having inwardly projecting resilient tabs 45 which engage a slot 50' when the clip 44 is in the locked position. When releasing the outer end of the inter-connecting link 39 from the arc chute 17, it is only necessary to grasp the clip 44 and withdraw it until the inwardly projecting tabs 45 clear the slot 50'. The pin 43 may then be raised out of its recess for releasing the arc chute 17.

The relay is operated by a start push-button 61 which engages a set of contact fingers 63 and 64, and a reset push-button 62 which engages a set of contact fingers 76 and 77. (See Figs. 6 and 7.) With reference to Fig. 6, the contact fingers 63 and 64 are normally constrained in the open-circuit position, and they are disposed to be separately and independently operated by means of a mechanical interlock 74 actuated by one of the sides 20 of the arc chute 17 and a thermal element 69 that is responsive to the current flowing through one of the sets of contact members 11 and 12.

The electrical interlock lever 74 comprises a finger that is connected to the lower end of the left-hand side 20 of the arc chute. Consequently, when the arc chute 17 is in the open-circuit position, being the position shown in Figs. 2 and 6, the electrical interlock lever 74 is positioned at a slight distance from the contact finger 64. However, when the arc chute 17 is actuated to the closed-circuit position by first depressing the start push-button 61 and energizing the magnetizable winding 24 the electrical interlock lever 74 moves upwardly and constrains the lower contact finger 64 to engage the contact finger 63, even though the pressure on the start button 61 has been released.

With reference to Fig. 7, the contact fingers 76 and 77 are normally constrained to their closed-circuit positions and are disposed to be separately and independently operated by means of a thermal element 81 that is responsive to the current flowing through one of the sets of contact members 11 and 12. Upon the outer end of the contact finger 77 is mounted an upwardly projecting member 78, which, when the re-set push-button is depressed, breaks the electrical contact between the contact fingers 76 and 77. In this respect, the re-set push-button 62 also constitutes a stop push-button, because, when the relay is in a closed-circuit position it may be readily tripped or opened by merely depressing the re-set push-button. Inasmuch as the mounting and construction of the set of contact fingers for the start and re-set push-buttons are similar, a description with respect to the start push-button only will be given.

As is best shown in Fig. 8, the lower contact finger 64 is constructed of an irregular-shaped, thin piece of resilient material and may be connected to the side member 23 by means of the nuts 66 or other suitable means. The upper finger 63 is connected to a spring-actuated clip, pivotally mounted at a pivot-point 65. Depending from the spring-actuated clip is a block mem-

ber 67 in which is inserted, in the lower end thereof, a flat engaging member 68. Mounted in front of the engaging member 68 is a thermal element 69 with its free end contacting the engaging member 68. A heating element 70, which is connected in circuit relation with one of the sets of contact members 11 and 12, is mounted above the thermal element 69. In this manner, when the thermal element 69 is heated to a predetermined temperature its free end swings downwardly and clears the lower end of the engaging member 68, and thus allows the spring that surrounds the pivot-pin 65 to bias the lower end of the engaging member 68 on top of the thermal element 69. Also, at the same time, the contact member 63 swings upwardly and breaks the electrical engagement with the contact finger 64, even though the electrical interlock lever 74 is biasing the contact finger 64 upwardly.

The reset switch device shown in Fig. 7 comprising the reset push-button 62, contact fingers 76 and 77 and the thermal element 81, is substantially the same as the device shown in detail in Fig. 8, except that the thermal element 81 normally functions to retain the contact fingers 76 and 77 in engagement against the force of the biasing spring tending to actuate them apart.

As shown best in Fig. 9, the heating element 70 for the start push button 61 is connected in series-circuit relation with the set of contact members 11 and 12 on the left of the relay, and the heating element 80 for the re-set push button 62 is connected in series-circuit relation with the set of contacts 11 and 12 on the right of the relay.

With respect to the heating element 70 that is associated with the start push-button 61 the current flowing through the conductor 101 also flows through the heating element 70 to the terminal 95 and thence through the flexible conductor 100, and the set of contact members 11 and 12 on the left side of the relay to the outgoing conductor. Similarly, with respect to the heating element 80 for the reset push-button, the current flowing through the conductor 102, flows through the heating element to the terminal 86 and thence through the flexible conductor 100, and the set of contact members 11 and 12 on the right side of the relay to the outgoing conductor. The magnetizing winding 24 is connected in shunt circuit-relation with the two heating units 70 and 80. Hence, the current for operating the magnetizing winding 24, after leaving the terminal 95, flows through a flexible conductor 93, the contact fingers 63 and 64, (assuming that they are closed), the flexible conductor 92, the winding 24, the flexible conductor 91, the contact fingers 76 and 77, and the flexible conductor 87 to the terminal 86.

In explaining the operation of the relay, let it be assumed that the conductors are energized and that the arc chute 17 is in the open-circuit position. In order to energize the magnetizable winding 24 the start push-button 61 is depressed. Just as soon as the contact member 63 engages the contact member 64, the shunt circuit is completed for energizing the magnetizable winding 24. The arc chute 17 is, accordingly, actuated in a clockwise direction to the close-circuit position. In this position of the arc chute 17, the electrical interlock lever 74 is actuated upwardly and constrains the contact finger 64 to firmly engage the contact member 63, even though the push-button 61 is no longer depressed. Accordingly, the relay remains continuously energized.

However, should an overload condition prevail for a predetermined length of time, either one or both of the thermal elements 69 or 81 may respond to interrupt the circuit that energizes the magnetizable winding 24. In the event that both of the thermal elements respond simultaneously to interrupt the circuit that energizes the magnetizable winding 24, or in the event that only the thermal element 81 that is associated with the re-set push button 62 responds to interrupt the circuit that energizes the magnetizable winding 34, it is necessary for the operator to first depress the re-set push-button 62 before depressing the push-button 61 for reenergizing the magnetizable winding 24. However, in the event that only the thermal element 69 that is associated with the start push-button 61 responds to interrupt the circuit for energizing the magnetizable winding 24, it is only necessary for the operator to depress the push-button 61 to reenergize the magnetizable winding 24.

In practice, the general procedure is to always depress the reset push-button 62, after the relay is tripped by an overload condition, because, when the cover is on the relay, the operator has no way of telling whether one or both of the thermal elements have responded.

As shown in Figs. 3 and 4 the relay is provided with a cover 22, which is disposed to engage a notched recess around the perimeter of the support 10. The cover 22 may be secured to the base 10 in any suitable manner. As illustrated, a threaded screw, having a retaining disc 48 and a knob 49, is provided to readily engage a threaded opening in a bracket 47 that is mechanically connected to the magnetizing core. By this construction, the support 10 also comprises a portion of the enclosure for the relay. The back of the support 10 is suitably recessed in order to provide available space for the conductor leads when mounting the relay. In mounting the relay upon a panel or wall, or upon a machine tool bracket or leg in which the wiring is concealed, the conductor leads may be brought through a hole in the wall or the panel concealed by the relay and thence through the openings near the top and bottom edges of the support 10 and be connected to the contact terminals of the relay without the use of conduit fittings of any kind.

Since certain changes in our invention may be made without departing from the spirit and scope thereof, it is intended that all matters contained in the foregoing description and shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

We claim as our invention:

1. A circuit controlling device comprising a plurality of relatively movable contact members means including an electro-magnet operable to actuate the contact members into engagement, switch means operable to control the energization of the electro-magnet, means responsive to the closure of the relatively movable contact members disposed to retain the switch means in the closed position, and thermal means disposed to normally hold the switch means in a predetermined position and operable to open said switch means in the event that the current flowing through the contact members exceeds a predetermined value.

2. A circuit controlling device comprising a plurality of relatively movable contact members, means including an electro-magnet operable to actuate the contact members into engagement, switch means operable to control the energization

of the electro-magnet, resilient means actuated by the contact members disposed to retain the switch means in its closed position, a thermal element disposed to normally hold the switch means in a predetermined position, a heating coil for said thermal element connected to be energized by current flowing through the contact members and effective upon the current exceeding a predetermined value to cause the thermal element to release the switch means and deenergize the electro-magnet.

3. A circuit controlling device comprising a plurality of stationary contact members and a plurality of movable contact members, means including an electro-magnet for actuating the movable contact members into engagement with the stationary contact members, switch means for controlling the energization of the electro-magnet, said switch means comprising relatively movable contact elements and a thermal device disposed to normally retain said contact elements in a predetermined relative position, means operable to close said contact elements to energize the electro-magnet and close the movable contact members of the device, and means responsive to the closure of said movable contact members disposed to retain the contact elements of the switch means in closed position, said thermal device being operative in response to the current flowing through the contact members exceeding a predetermined value for releasing the contact elements of the switch means from their normal predetermined relative position to deenergize the electro-magnet.

4. A circuit controlling device comprising a plurality of stationary contact members and a plurality of movable contact members, means including an electro-magnet for actuating the movable contact members into engagement with the stationary contact members, switch means for controlling the energization of the electro-magnet, said switch means comprising a stationary flexible contact element and a movable flexible contact element biased to move away from the stationary element, a thermal device disposed to retain the movable contact element in a predetermined open position with respect to the stationary element, manually-operable means for actuating the flexible contact elements together to energize the electro-magnet, and means actuated by the movable contact members of the device for retaining said flexible contact elements in engagement, said thermal device being operable in the event the current flowing through the contact members exceeds a predetermined value to release the movable contact element of the switch means to deenergize the electro-magnet.

5. In a relay having relatively movable main contact members, in combination, electro-responsive means for actuating the contact members into engagement, a switch device having a pair of relatively movable contact elements for controlling the energization of the electro-responsive means, means actuated by the electro-responsive means for holding the contact elements of the switch device together to maintain the contact members of the relay closed, and a second switch device having relatively movable contact elements and a thermal device normally holding the contact elements closed for also controlling the energization of the electro-responsive means, said thermal device being operable on flow of a predetermined maximum load current through the main contact members of the relay to deenergize the electro-responsive means.

6. In a relay having relatively movable main contact members, in combination, electro-responsive means for actuating the contact members into engagement, a switch device having a pair of relatively movable contact elements for controlling the energization of the electro-responsive means, said switch device being manually operable to closed position and having a thermal element operable when the current flowing in the main contact members exceeds a predetermined value to release the contact elements, and a second switch device having relatively-movable contact elements biased to the open position for also controlling the energization of the electro-responsive means, said second switch device having a thermal element normally holding the contact elements in engagement and operable when the current flowing through the main contact members exceeds a predetermined value to deenergize the electro-responsive means, and means controlled by the closure of the main contact members for retaining the contact elements of the first mentioned switch means in engagement.

7. In a relay device for controlling load circuits and providing overload protection therefor, in combination, relatively movable main contact members for controlling the circuit, means including an electro-magnet for actuating the main contact members into engagement to close the load-circuit, a pair of thermal switch devices for controlling the electro-magnet, one of said switches having a normally-open position determined by its thermal element with means to actuate it to its closed position, the other of said thermal switch devices being normally held in a closed position by its thermal element and released in response to a predetermined maximum load on the circuit, means responsive to the closure of the main contact members operable to retain the first-mentioned thermal switch device in its closed position, said thermal elements being operable in response to a predetermined overload to release their respective switch devices to open the energizing circuit of the electro-magnet at two points, and means for actuating the second-mentioned thermal switch device to its normally-closed position.

8. In a relay having relatively movable contact members, in combination, a magnetizable core, a winding for said core, an armature for actuating the contact members, a pair of relatively movable contact fingers that are connected in circuit relation with the said winding, means for actuating the contact fingers, said means including a push button, an interlock governed by the movements of the armature and a thermal element that is responsive to the current flowing through the contact members, a second pair of relatively movable contact fingers that are connected in circuit relation with the said winding, and means for actuating the said second pair of contact fingers, said means including a push button

and a thermal element that is responsive to the current flowing through the contact members.

9. In a relay having relatively movable contact members, in combination, a magnetizable core, a winding for said core, an armature for actuating the contact members, a push button having a pair of relatively movable contact fingers that are connected in circuit relation with the said winding, means independent of the push button for actuating the contact fingers, said independent actuating means being governed by the movements of the armature, and a second push-button having a pair of relatively movable contact fingers that are connected in circuit relation with the said winding.

10. In a relay having relatively movable contact members, in combination, a magnetizable core, a winding for said core, an armature for actuating the contact members, a push button having a pair of relatively movable contact fingers connected in circuit relation with the said winding, means independent of the push button for actuating the contact fingers, said independent actuating means including an interlock governed by the armature and a thermal element responsive to the current flowing through the contact members, a second push button having a pair of relatively movable contact fingers connected in circuit relation with the said winding, and means independent of the second push button for actuating the contact fingers thereof, said means including a thermal element responsive to the current flowing through the contact members.

11. In a relay having relatively movable contact members, in combination, a magnetizable core, a winding for said core, an armature for actuating the contact members, a push button having a pair of relatively movable contact fingers connected in circuit relation with the said winding, said contact fingers being normally biased to open-circuit position, a second push button having a pair of relatively movable contact fingers connected in circuit-relation with the said winding, said contact fingers being normally biased to closed-circuit position, the contact fingers of both of the push buttons being also connected in circuit relation with the contact members so that, when the first-mentioned push button is depressed the said winding is energized, an interlock associated with the first-mentioned push button and governed by the said armature, said interlock being so positioned that, when the armature is raised, the interlock biases the contact fingers of the first-mentioned push button to closed-circuit position even though the said push button is no longer depressed, and thermal elements associated with both push buttons to actuate the contact fingers thereof to open-circuit position when an overload occurs.

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