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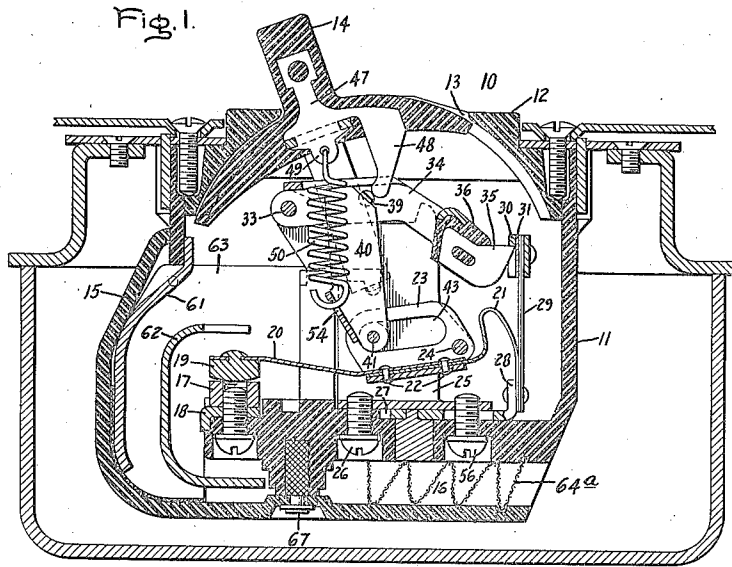
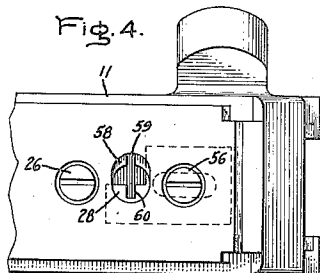
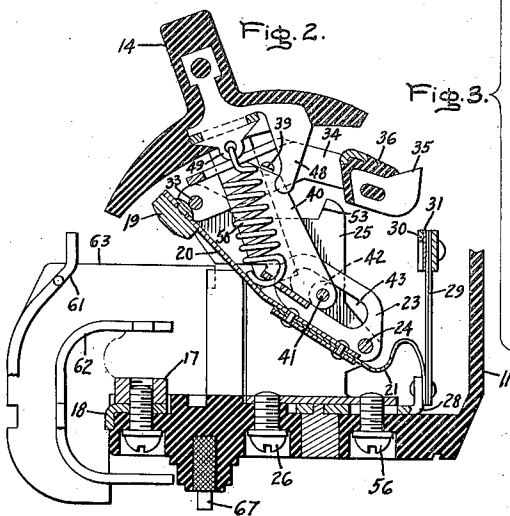
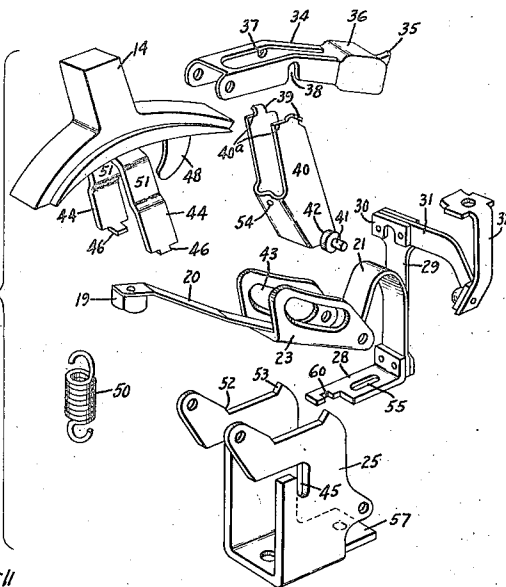
F. G. VON HOORN

2,065,357

CIRCUIT BREAKER

Filed Nov. 21, 1935

2 Sheets-Sheet 1



Inventor:
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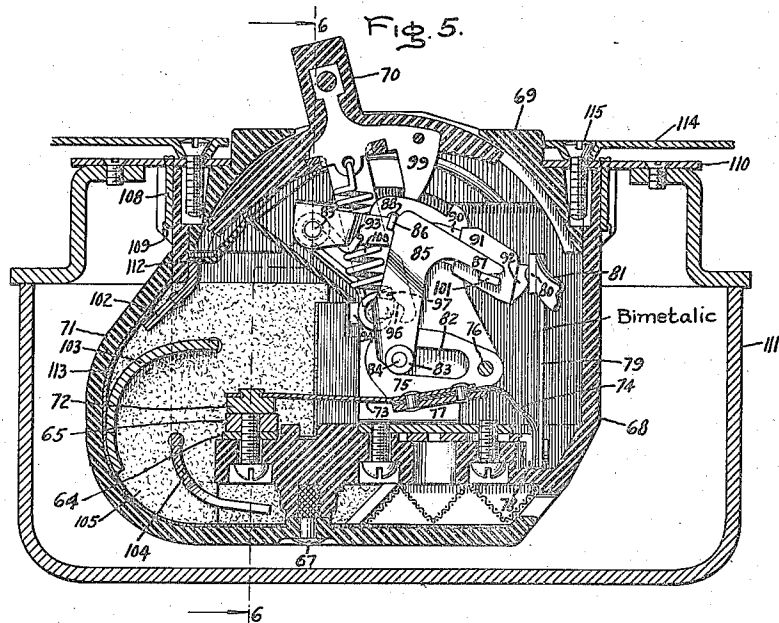
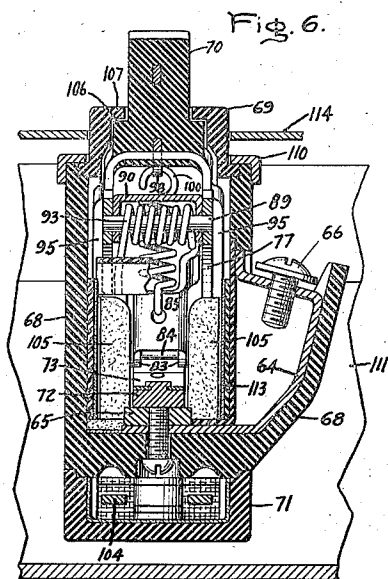
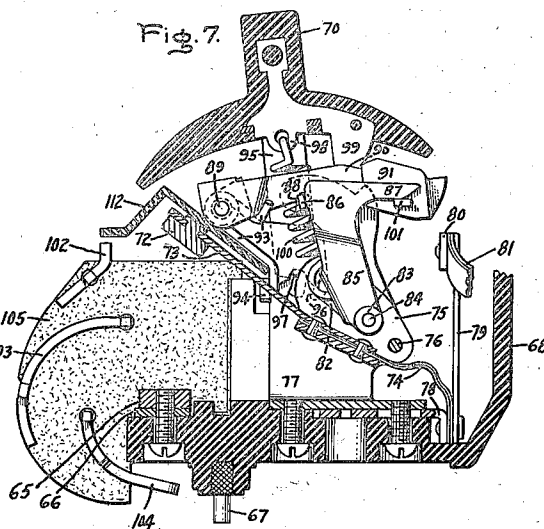
F. G. VON HOORN

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CIRCUIT BREAKER

Filed Nov. 21, 1935

2 Sheets-Sheet 2



Inventor:
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UNITED STATES PATENT OFFICE

2,065,357

CIRCUIT BREAKER

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New York

Application November 21, 1935, Serial No. 50,907

16 Claims. (Cl. 200—116)

This application is a continuation in part of my prior application Serial No. 719,125, filed April 15, 1934, entitled "Circuit breakers."

The invention relates to circuit breakers, more particularly to circuit breakers of the type known as "branch-circuit" circuit breakers which provide the protective features of a fuse as well as the advantages of a manually operable switch, and has for an object the provision of a compact circuit breaker of this type which is simple and inexpensive to construct and which is reliable in its operation.

Heretofore circuit breakers of this type have been provided with manual means for opening and closing the circuit breaker and with current responsive means for automatically tripping the circuit breaker upon the occurrence of predetermined current conditions independently of the manual means. Much is yet to be desired, however, in reducing the size of such circuit breakers while retaining the ability of the circuit breaker to meet the severe service requirements encountered. It is further desirable that such circuit breakers be provided with means for readily adjusting the current rating of the circuit breaker, together with locking means for rendering the adjusting means tamperproof after the circuit breaker has been calibrated initially.

In carrying out my invention in one form, I provide manual means for operating the movable contact of the circuit breaker between open and closed circuit positions with a snap action, and adjustable current responsive means for automatically operating the movable contact to an open circuit position independently of the manual means. More specifically, I provide a switch member having an inclined slot and a pivoted operating link carrying a roller which cooperates with the slot. Manual means are provided for rotating the operating link about its pivot between two positions with a snap action, whereupon the roller cooperates with the slot to operate the switch member between open and closed circuit positions with a snap action. Tripping means are also provided, comprising a tripping bar normally latched in one position by a thermal element and releasable to rotate the operating link in a direction to operate the switch member to open circuit position, together with means for adjusting the normal position of the thermal element relative to the tripping bar to vary the value of the current at which the tripping bar is released.

For a more complete understanding of my invention, reference should now be had to the drawings in which Fig. 1 is an elevational sectional view of a circuit breaker embodying my invention; Fig. 2 is a fragmentary view similar to Fig. 1, showing the circuit breaker in its automatically tripped position; Fig. 3 is a view in ex-

ploded perspective of the operating mechanism of the circuit breaker shown in Fig. 1; Fig. 4 is a fragmentary view of the base of the circuit breaker with the arc chute removed; Fig. 5 is a sectional elevational view of a preferred form of circuit breaker embodying my invention; Fig. 6 is a sectional view taken along the line 6—6 of Fig. 5; and Fig. 7 is a fragmentary view of the circuit breaker shown in Fig. 5 with the operating parts in the automatically tripped position.

Referring now to Figs. 1 to 4 inclusive of the drawings, I have shown a circuit breaker 10 which is identical with the circuit breaker disclosed in my above referred to application, comprising an insulated base or container 11 provided with a cover 12 having an aperture 13 therein through which extends an insulated operating handle 14. As shown, the lower portion of the left-hand wall of the base member 11 is cut away and a closure member 15 is provided which extends along the lower side of the base 11 so as to form an arc chute or passageway 16.

Supported on the base member 11, is a fixed contact 17 which engages a suitable lead-in conductor 18 which will be more fully described hereinafter. Arranged in engaging relation with the fixed contact 17, is a movable contact 19 which is secured to one end of a resilient member or contact arm 20, preferably formed of phosphor bronze, the opposite end of which is secured in intimate electrical engagement with one end of a flexible conductor 21 by means of rivets 22, which extend through the yoke portion of a U-shaped switch member 23 which is pivotally mounted on a pin 24, the opposite ends of which are supported by a U-shaped frame 25. As shown, the yoke portion of this U-shaped frame 25 is secured to the base member 11 by a suitable screw 26, and a portion of the base member is cut away to provide a channel 27 in which is arranged a slidable member 28. This slidable member 28, the function of which will be more fully described hereinafter, is provided with an upturned end to which is riveted the opposite end of the flexible conductor 21 and the lower end of a bimetallic thermal element 29. As shown best in Fig. 3, the opposite end of the thermal element supports a latching member 30 and one end of a flexible conductor 31, the opposite end of which is secured to a terminal strap 32 (Fig. 3).

Pivotally mounted on a pin 33 supported adjacent the upper end of the U-shaped frame 25, is a channel-shaped tripping bar 34, the free end of which supports a latching member or tip 35 by means of a body of molded insulating material 36. Intermediate its end, this tripping bar 34 is provided with an aperture 37 and a slot 38 (Fig. 3) arranged to be engaged by a pair of outwardly extending ears 39 formed on the upper ends of the arms of a U-shaped operating link 40, the

lower end of which supports a pin 41, the outer ends of the pin supporting rollers 42, only one of which is shown. As shown in Fig. 1, these rollers 42 are arranged to cooperate with a pair of inclined slots 43 which are formed in the up-standing arms of the U-shaped switch member 23.

The insulated operating handle 14 is provided with a pair of downwardly extending legs 44, preferably formed, as shown, by molding a U-shaped metallic insert into the handle 14, and the U-shaped frame 25 is provided with a pair of slots 45, only one of which is shown, for cooperation with a pair of inwardly extending fingers 46 formed on the lower ends of the arms 44. Likewise the insulated handle 14 is provided with a second metallic insert 47 having a pair of downwardly extending fingers 48 and 49, and an over-center spring 50 is provided, the opposite ends of which are respectively connected to the finger 49 and to the yoke portion of the operating link 40.

In assembling the parts together, one of the projections 39 is inserted in the aperture 37 in the channel-shaped tripping bar 34, and the arms of the operating link 40 are pressed slightly together until the other one of the projections 39 will slide into the slot 38. The lower end of the operating link 40 is then inserted between the arms of the U-shaped switch member 23, the pin 41 is inserted and the rollers 42 are mounted on the respective ends of the pin. This partial assembly of parts is then placed between the arms of the U-shaped frame 25 in nesting relation, so that the frame prevents the dislodgment of the rollers 42 from the slots 43 in the U-shaped switch member 23. The pivot pin 24 is then inserted through suitable aligned apertures in the frame 25 and the switch member 23, and the pivot pin 33 is inserted through aligned apertures in the frame 25 and the tripping bar 34.

It will be apparent now that the slidable member 28 may be placed beneath the yoke of the U-shaped frame 25, and the operating handle 14 may be placed in its proper position by inserting the fingers 46 in the slots 45. When placed in this position, the operating handle 14 may be pivoted about the fingers 46, and as will be seen best in Fig. 3, the legs 44 which extend from the operating handle 14 are provided with inwardly bent portions 51 which cooperate with suitable upwardly extending portions 52 and 53 formed on the upper portion of the frame 25 to limit the pivotal movement of the operating handle. One end of the overcenter spring 50 may now be secured to the finger 49 on the operating handle, and the other end of the overcenter spring may be hooked through a suitable hole 54 in the yoke portion of the operating link 40.

The assembly of the circuit breaker is now completed by lowering the frame 25 and its associated parts into the container formed by the base member 11 and securing the frame to the base member by means of the screw 26. As heretofore mentioned, the slidable member 28 rests in a channel 27 formed in the base member, and as shown, this slidable member is provided with an elongate slot 55 through which extends a screw 56, the end of the screw threadedly engaging an extending portion 57 of the frame 25.

Referring now to Fig. 4, it will be observed that the base member 11 is provided with an aperture 58 intermediate the countersunk openings which accommodate the screws 26 and 56, a recess 59 forming a portion of the aperture 58 being arranged directly opposite a recess 60

formed in the end of the slidable member 28. It will be apparent now that when a screw driver or the like is inserted into the recesses 59 and 60, the recess 59 will serve as a fulcrum for the screw driver so that when the screw driver is turned, the slidable member 28 will be moved longitudinally to adjust the position of the thermal element 29 with respect to the latching member 35. After the position of the thermal element 29 is determined, the screw 56 may be tightened to bend the extending portion 57 of the frame 25 into frictional engagement with the slidable member 28 and thus secure the slidable member 28 against further longitudinal movement.

Disposed adjacent the contacts 17 and 19 of the circuit breaker, in the housing formed by the closure member 15, is an arc extinguishing device of the type fully described and claimed in my above referred to prior application. For the purposes of the present application, this arc extinguishing device may be described as comprising a magnetizable structure consisting of a pair of magnetizable plates 61 and 62 mounted in spaced relation with each other and with the circuit breaker contacts by means of a pair of insulating supports 63, only one of which is shown. As shown, these magnetizable plates 61 and 62 extend outwardly from the circuit breaker contacts and then downwardly, so that the lower ends of the plates are adjacent the arc chute 16 which extends along one side of the circuit breaker. Arranged in the arc chute 16 remote from the magnetizable plates 61 and 62, is a metallic screen 64 which serves to cool the hot gases which are expelled through the arc chute in the manner described in my above referred to application.

It is now believed that a comprehensive understanding of my invention may be had from a description of the operation of the circuit breaker as a whole.

It will be assumed that the circuit breaker is connected in a circuit capable of delivering large magnitudes of current, although for normal operation the circuit breaker is called upon to interrupt currents of low magnitudes, for example, 15 to 30 amperes. The current path through the circuit breaker may be traced from the terminal strap 32 through the conductor 31, the bimetallic element 29, the conductor 21, the resilient member 20, the movable contact 19, the fixed contact 17 and by way of the conductor 18 to a second terminal (not shown). The arrangement of the conductor 18 with respect to the contact 17 and the terminal may be best understood by reference to Fig. 6. In the circuit breaker there shown a conductor 64 serves to connect a fixed contact 65 to a terminal 66, in the exact manner that the conductor 18 connects the contact 17 to its terminal.

In order to open the circuit manually, the operating handle 14 is moved in a clockwise direction, as viewed in Fig. 1, carrying with it the upper end of the overcenter spring 50. As soon as the overcenter spring 50 has moved past its dead-center position, i. e. past the projections 39 which constitute the pivot point of the operating link 40, a component of force is exerted on the operating link 40 in a direction to rotate it in a counterclockwise direction about its pivot point, so that the rollers 42 operating against the upper sides of the slots 43 quickly move the switch member 23 and the movable contact 19 to the open circuit position. Similarly, the circuit

breaker may be closed by moving the operating handle 14 in a counterclockwise direction, so as to carry the overcenter spring 50 past its dead-center position and thereby cause the operating link 40 to rotate in a clockwise direction, so that the rollers 42 bear against the lower sides of the slots 43 and operate the movable contact 19 in its closed circuit position.

As shown in Fig. 1, the resilient member 20 which supports the movable contact 19 is placed under a substantial tension during the closing of the circuit breaker, thereby providing a substantial contact pressure and a wiping action as the contacts engage each other. The spring force exerted by the resilient member 20 of course tends to rotate the movable switch member 23 towards the open circuit position. As shown in Fig. 1, however, the switch member 23 is locked in the closed circuit position due to the arrangement of the operating link 40 substantially at right angles to the slots 43. Consequently, there is not a sufficient component of force produced on the link 40 by the resilient member 20 to cause the link to move from its closed circuit position. Furthermore, this locking arrangement prevents rebound or chattering of the movable contact as it strikes the stationary contact.

It will now be assumed that a short circuit occurs with the circuit breaker parts in the position shown in Fig. 1. The resultant rush of current through the circuit breaker and the bimetallic thermal element 29 quickly heats the thermal element, causing it to bend in a clockwise direction about its support 28 to disengage the latch member 30 from the latching tip 35 carried by the tripping arm 34. Upon the release of the tripping arm 34, the full force of the overcenter spring 50 and the resilient member 20 is instantly effective to accelerate the movable parts to their open circuit positions shown in Fig. 2. The force of the overcenter spring is applied to the tripping bar through the projections 39 on the operating link 40, causing the tripping bar 34 to rotate about its pivot 33 in a counterclockwise direction. The movement of the contact 19 begins shortly after that of the tripping bar 34, since the resilient member 20 must first be relaxed, and as the movement of the tripping bar proceeds, the pivot point for the operating link 40 is transferred from the projections 39 to the pivot pin 33 by engagement of the shoulders 40a on the link 40 with the channel-shaped tripping bar 34. Accordingly, the link 40 is rotated in a counterclockwise direction about the pivot pin 33 to the position shown in Fig. 2, and the rollers 42 engage the upper sides of the slots 43 to move the contact 19 to the open circuit position shown in Fig. 2. As viewed in this figure, the final position of the movable contact 19 is directly adjacent the pivot pin 33, while the rollers 42 are midway of the slots 43.

As the movable contact 19 is separated from the stationary contact 17, an arc is drawn therebetween and as is more fully described in my above referred to application, the magnetic reaction between the magnetizable structure of the arc extinguishing device and the arc itself is such as to move the arc into engagement with the magnetizable plates 61 and 62. The arc drawn between the contacts is thus divided into a plurality of short arcs, each of which is moved outwardly and downwardly over the plates 61 and 62 by means of the magnetic reaction.

A further important action takes place incident to the formation of the arc between the

contacts. It will be remembered that the handle 14 is positioned entirely by the engagement of the fingers 46 with the slots 45 in the U-shaped frame 25 and by the force exerted by the overcenter spring 50. Thus it will be apparent that the operating handle 14 may be moved upwardly against the force of the overcenter spring, the fingers 46 moving upwardly in the slots 45. As is more fully described in my above referred to application, the operating handle 14 and the cover member 12 are provided with interlocking grooves and projections which serve to seal substantially airtightly the housing formed by the base member 11, the cover member 12, and the closure member 15 when the operating handle 14 is forced upwardly into intimate engagement with the cover member 12.

The heat due to the arc and the current flow through the circuit breaker causes an expansion of air within the circuit breaker housing and generates a substantial pressure which forces the handle member 14 upwardly to seal the circuit breaker housing so that the only available exit for the gases within the circuit breaker is through the arc chute 16. Accordingly, a rush of escaping gases takes place over and around the magnetizable plates 61 and 62, which rush of gases contributes to the downward movement of the portions of the arcs which extend between the plates and the stationary contact, so that the arc portions are moved along the plates 61 and 62 and are expelled into the arc chute 16. This rush of the gases over the plates 61 and 62 cools the gases and this cooling effect is increased by the screen 64a located in the passageway or the arc chute 16, the screen serving the additional function of arresting any particles of hot metal.

It will be understood that for overload current of small magnitude, for example, 150% of the rating of the circuit breaker, the thermal element 29 will deflect to release the tripping bar 34 in exactly the same manner as described for overload currents of short-circuit magnitude. The deflection of the thermal element required to trip the circuit breaker depends upon the overlap of the latching member 30 with the latching tip 35. This overlap is preferably determined at a factory and in order to provide tamper-proof locking means, the aperture 58 (Fig. 4) is filled with suitable material, such as solder which flows into the recesses 59 and 60, so as to form a rigid connection or key between the base member 11 and the slidable member 28. Consequently, even if the fastening screws 26 and 56 could be loosened somewhat, movement of the sliding member 28 and the bimetallic element 29 relative to the circuit breaker base is prevented. As shown, the closure member 15 is secured to the base by spinning over the end of a metallic insert 67 after the circuit breaker has been calibrated. To gain entry to the circuit breaker thereafter, the end of the insert 67 must be destroyed, making it apparent that the circuit breaker has been tampered with.

In order to reset the circuit breaker after operation to the automatically tripped position shown in Fig. 2, it is necessary to move the operating handle 14 in a clockwise direction from the position there shown, during which movement the finger 48 engages the member 35 and rotates the tripping arm 34 about its pivot 33 to the position shown in Fig. 1 in which position the tip 35 is engaged by the latch 30. During this clockwise movement of the handle 14, it will be apparent that the overcenter spring 50 will be carried past

the pivot point of the link 40 which is determined by the ears 39, and accordingly, the link 40 will be rotated in a counterclockwise direction about its pivot point. Since the switch member 23 and the movable contact 19 are already in the open circuit position, however, this rotation of the link 40 will have no effect other than to move the rollers 42 toward the right-hand end of the slots 43, as viewed in Fig. 2. The circuit breaker contacts may now be reclosed, as described above, by simply rotating the handle 14 to the position shown in Fig. 1.

Although further details of the construction and operation of this embodiment of my invention are set forth in my above referred to application, particularly with reference to the arc extinguishing means, it is not believed that any further description is necessary for the purposes of the present application.

In Figs. 5, 6 and 7, I have shown what is now believed to be the preferred embodiment of my invention. The circuit breaker here shown comprises a base member or container 68, a cover member 69, an operating handle 70 and a closure member 71 which are respectively similar in construction to the corresponding parts of the circuit breaker described above. The previously mentioned fixed contact 65 and conductor 64 are secured to the base 68 for cooperation with a movable contact 72 which is supported on one end of a resilient member 73, the other end of which is secured to a flexible conductor 74 and a U-shaped switch member 75 which is pivotally supported on a pin 76 carried by a U-shaped frame 77. The other end of the flexible conductor 74 is connected to a slidable member 78 which supports a bimetallic element 79. The upper end of the bimetallic element 79 supports a latch member 80 and is secured to a flexible conductor 81. It will be understood that the slidable member 78 is similar in construction and in its arrangement with respect to the base 68 and the U-shaped frame 77 to the construction and arrangement of the slidable member 28 described above.

The upstanding legs (only one of which is shown) of the U-shaped switch member 75 are provided with slots 82 for cooperation with suitable rollers 83, one of the rollers 83 being supported on each end of a pin 84 which pin is carried by a U-shaped operating link 85. Adjacent the upper end of the link 85, each arm thereof is provided with an outwardly extending ear 86 and with a finger 87, the ears 86 being arranged to engage suitable notches 88 (Fig. 7) in the frame 77 to provide pivot points for the link 85. Pivotaly supported on a pin 89 carried by the upwardly extending arms of the frame 77, is a channel-shaped tripping bar 90, the free end of which is provided with an insulating member 91 which carries a latch tip 92 arranged to cooperate with the latch plate 80 carried by the bimetallic element 79.

This tripping bar 90 is biased for rotation in a counterclockwise direction from the latched position shown in Fig. 5 by a coil spring 93 which surrounds the pin 89, and is arranged with one end engaging the tripping bar 90 and its other end engaging a lug 94 which extends outwardly from the frame 77.

As shown, the operating member 70 is provided with a U-shaped metallic insert having a pair of downwardly extending legs 95, the lower ends of which are provided with suitable notches 96 for engaging outwardly extending ears 97 formed on the frame 77 pivotally to support the oper-

ating handle 70. A second metallic insert in the operating handle 70 is provided with downwardly extending fingers 98 and 99, the finger 98 supporting one end of an overcenter spring 100, the other end of which is secured to the yoke of the U-shaped operating link 85.

With the parts in the position shown in Fig. 5, it will be seen that the overcenter spring urges the ears 86 formed on the operating link 85 into engagement with the notches 88 formed in the frame 77 and likewise, urges the notched ends of the members 95 which extend downwardly from the handle 70 into engagement with the ears 97 formed on the frame 77. In order manually to open the circuit breaker, the operating handle 70 is rotated in a clockwise direction from the position shown in Fig. 5 about the pivot point determined by the ears 97, so as to carry the spring 100 overcenter relative to the pivot point determined by the ears 86. Thereupon the operating link 85 is rotated in a counterclockwise direction about its pivot point, and the rollers 83 engage the upper sides of the slots 82 to operate the switch member 75 and the movable contact 72 to the open circuit position with a snap action. Movement of the handle 70 in this direction is limited by the engagement of the finger 99 with the insulating member 91 carried by the tripping arm 90.

Likewise, in order to close the circuit breaker manually, the operating handle 70 is moved in a counterclockwise direction about its pivot point, and the overcenter spring is thus moved past the pivot point determined by the ears 86 so as to rotate the operating link in a clockwise direction, whereupon the rollers 83 engage the lower sides of the slots 82 and operate the switch member 75 and the movable contact 72 to the closed circuit position shown in Fig. 5. As described in connection with Figs. 1 to 4, the resilient member 73 is placed under tension during the circuit closing operation but the right angle relation of the operating link 85 and the slots 82 serves to maintain the circuit breaker locked in its closed circuit position.

Upon the occurrence of overload or short-circuit conditions, the bimetallic element 79 will be heated and will flex so as to move the latch member 80 out of engagement with the latch tip 92, whereupon the tripping bar 90 will be quickly rotated in a counterclockwise direction about its pivot 89 by the tripping spring 93. As shown, the insulating member 91 carried by the tripping bar 90 is provided with outwardly extending portions 101 which are arranged to engage the fingers 87 on the operating link 85, and accordingly, as the tripping bar 90 moves in a counterclockwise direction, the operating link 85 will be rotated in a counterclockwise direction about its pivot point and the rollers 83 engaging the upper sides of the slots 82 will operate the switch member 75 and the movable contact 72 to the position shown in Fig. 7.

During this counterclockwise rotation of the operating link 85, it will be seen that the lower end of the overcenter spring 100 will be carried from the position shown in Fig. 5 on the left-hand side of the lugs 97 to the position shown in Fig. 7 on the right-hand side of the lugs 97. Accordingly, the bias exerted on the operating handle 70 by the overcenter spring 100 will be reversed and the operating handle 70 will move to the central position shown in Fig. 7, thereby indicating that the circuit breaker has been automatically tripped. This central position of the operating

handle is determined by the engagement of the finger 99 with the insulating member 91 carried by the tripping bar 90.

After an automatic tripping operation, the circuit breaker may be reset by moving the operating handle from the central position shown in Fig. 7 in a clockwise direction, the finger 99 bearing on the insulating member 91 and returning the tripping bar 90 to the latched position shown in Fig. 5. Thereafter the operating handle may be moved in a counterclockwise direction to the position shown in Fig. 5 to operate the movable contact to the closed circuit position. It will be understood of course that the circuit breaker may be adjusted to respond to a predetermined overload current by moving the slidable member 78 in the same manner as described above in connection with the slidable member 28.

In this embodiment of my invention, the arc extinguishing device is provided with three magnetizable plates 102, 103 and 104 supported in spaced relation by suitable insulating members 105. These magnetizable plates 102, 103 and 104 function to move the arc outwardly and downwardly into the arc chute formed by the closure member 71 in substantially the same manner as the magnetizable plates 61 and 62 shown in Figs. 1 and 2. A shield 112 formed of insulating material is provided to protect the operating parts of the circuit breaker from direct contact with the arc, and as shown, the insulating member 105 as well as the walls of the closure member 71 are lined with heat resisting material 113, such as asbestos.

It will be understood that the operating member 70 is arranged to be moved upwardly by the pressure generated by the arc upon the occurrence of short-circuit conditions, so as to seal substantially air-tightly the circuit breaker housing.

In Fig. 6, I have shown the operating member 70 provided with shoulders 106 arranged to cooperate with shoulders 107 formed on the cover member 69.

It will further be understood that means must be provided for securely fastening the cover member 69 of the circuit breaker shown in Figs. 5 to 7 and the cover member 12 of the circuit breaker shown in Figs. 1 to 4 to their respective base members. Referring particularly to Figs. 5 and 6, I provide a pair of locking plates 108 which are respectively provided with ears (not shown) for engaging suitable notches 109 formed in the upper portion of the base member 68 so as to lock the plates 108 relative to the circuit breaker base. As shown, the upper ends of the locking plates 108 extend through apertures in a fastening plate 110 and are riveted over the fastening plate which overlies the cover member 69 and the base member 68 as shown best in Fig. 6. This fastening plate 110 also serves to support the circuit breaker in a suitable conduit box 111, and a suitable face plate 114 may be secured thereto as by the screws 115.

While I have shown a particular embodiment of my invention, it will be understood, of course, that I do not wish to be limited thereto since many modifications may be made and I, therefore, contemplate by the appended claims to cover any such modification as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A circuit breaker comprising a switch member movable between open and closed circuit po-

sitions, said switch member being provided with a slot, an operating link having a portion slidably mounted in said slot, means mounting said link for pivotal movement, overcenter spring means for rotating said link about said pivotal mounting means to move said portion of said link along said slot and thereby operate said switch member between said open and closed circuit positions, a tripping bar biased for movement from a normal position to a tripped position, current responsive means normally retaining said tripping bar in said normal position for releasing said tripping bar for movement to said tripped position in response to a predetermined current flow, and means responsive to movement of said tripping bar to said tripped position for rotating said operating link in a direction to move said portion of said link along said slot and thereby operate said switch member to open circuit position.

2. In a circuit breaker, the combination of a switch member movable to open and closed positions, said switch member being provided with an inclined slot, a tripping bar movable from a normal position to a tripped position, an operating link having one end slidably mounted within said inclined slot, pivoting means for the other end of said link, an overcenter spring for rotating said link about said pivoting means to move said one end of said link along said slot and thereby operate said switch member to said open and closed positions, a thermal element normally maintaining said tripping bar in said normal position and operable by overload current to release said tripping bar, and connecting means between said bar and said link operative by movement of said bar to rotate said link in a direction to move said one end of said link along said slot and thereby operate said switch member to said open position.

3. A circuit breaker comprising a switch member movable between open and closed circuit positions, said switch member being provided with a slot, an operating link, a roller supported by said link for movement within said slot, means mounting said link for pivotal movement, overcenter spring means for rotating said link about said pivotal mounting means to move said roller along said slot and thereby operate said switch member between open and closed circuit positions, a tripping bar biased for movement from a normal position to a tripped position, a thermal element normally maintaining said bar in said normal position for releasing said bar upon the occurrence of predetermined current conditions, and connecting means responsive to the movement of said bar to said tripped position for rotating said operating link in a direction to move said roller along said slot and thereby operate said switch member to open circuit position.

4. In a circuit breaker, the combination of a switch member movable to open and closed positions, said switch member being provided with an inclined slot, an operating link having one end slidably engaging said slot, pivot means for the other end of said link, an overcenter spring operable between predetermined positions for rotating said link in opposite directions about said pivot means so as to apply the force of said spring to said switch member to operate it to said open and closed positions, a tripping bar, thermal latching means normally maintaining said tripping bar in a given position and operable by overload current to release said trip-

ping bar, and a connection between said bar and said link for rotating said link in a direction to move said one end of said link along said slot and thereby operate said switch member to said open circuit position, said end of said link coming to rest midway of said slot as said switch member reaches its open circuit position.

5. A circuit breaker comprising a switch member movable between open and closed circuit positions, said switch member being provided with a slot, a pivotally mounted operating link having a portion extending into said slot for slidable engagement with said switch member, overcenter spring means for rotating said operating link about its pivot to operate said switch member between said open and closed circuit positions, a tripping bar, a tripping spring biasing said bar from a normal position to a tripped position, current responsive means normally maintaining said bar in said normal position for releasing said bar in response to predetermined current conditions, and means responsive to movement of said bar in accordance with its bias for rotating said operating link in a direction to operate said switch member to said open circuit position.

6. A circuit breaker comprising a switch member movable between open and closed circuit positions, said switch member being provided with a slot, a pivotally mounted operating link having a portion extending into said slot for slidable engagement with said switch member, overcenter spring means for rotating said operating link about its pivot to operate said switch member between said open and closed circuit positions, a tripping bar, a tripping spring biasing said bar from a normal position to a tripped position, a thermal element normally maintaining said bar in said normal position for releasing said bar in response to predetermined overload conditions, and means responsive to movement of said bar by said tripping spring for rotating said operating link against the force exerted by said overcenter spring to operate said switch member to said open circuit position.

7. A circuit breaker comprising a switch member movable between open and closed circuit positions, said switch member being provided with a slot, a pivotally mounted operating link having a portion extending into said slot for slidable engagement with said switch member, a pivoted operating handle movable between on and off positions, overcenter spring means connected between said handle and said link for moving said link about its pivot to operate said switch member between said open and closed circuit positions in response to movement of said handle, a tripping bar, a tripping spring biasing said bar from a normal to a tripped position, thermal means for normally retaining said bar in said normal position against its bias and for releasing said bar in response to overload conditions, means responsive to movement of said tripping bar by said tripping spring for rotating said link in a direction to operate said switch member to said open circuit position, said rotation of said link carrying said overcenter spring means overcenter relative to the pivot point of said handle to operate said handle from said on position, and means for arresting the movement of said handle in an intermediate position to indicate that said circuit breaker has been automatically tripped.

8. A circuit breaker provided with a fixed contact and a movable contact operable between

open and closed circuit positions, a tripping bar operatively associated with said movable contact and normally biased from a closed circuit position to an open circuit position for causing the operation of said movable contact from a closed circuit position to said open circuit position, said bar being provided with a latching end, a thermal element provided with a latching member for engaging said latching end to maintain said tripping bar in its closed circuit position, means adjustably supporting said thermal element comprising a slidable member for supporting said thermal element, guiding means for said slidable member for permitting longitudinal movement of said slidable member, said slidable member and said guiding means being provided with cooperating notches so that a screw driver or the like inserted in said notches can be used to move said slidable member to adjust the position of said latching member with respect to said latching end of said tripping bar, and locking means for securing said supporting member in fixed position after said adjustment is completed.

9. In combination with a circuit breaker having an insulating base provided with a channel, a U-shaped frame supported on said base and provided with a projection extending from the closed end of said frame in a direction parallel with said channel, an adjustable member provided with an elongated slot mounted in said channel and beneath said frame, a locking screw extending through said base, said elongated slot and into screw-threaded engagement with the outer end of said extension, a bi-metal thermal element provided with a latching member at one end, means fixedly securing said thermal element at its opposite end to said adjustable member, said adjustable member and said base being provided with cooperating notches for the insertion of a screw driver or the like by means of which said adjustable member can be moved along said channel to adjust the position of said thermal element, said locking screw cooperating with said extension to clamp said adjustable member between said extension and said base of said circuit breaker.

10. The combination in a circuit breaker of a support, a slidable plate, a thermal element, means fixedly securing one end of said thermal element to said plate, guiding means for guiding said plate for longitudinal movement to adjust the position of said thermal element, and releasable clamping means for holding said plate against movement, said plate and said guiding means being provided with cooperating recesses into which an instrument may be inserted to form a driving connection for moving said plate when said clamping means is released.

11. The combination in a circuit breaker of a support, a slidable plate, a thermal element, means fixedly securing one end of said thermal element to said plate, guiding means for guiding said plate for longitudinal movement, said plate and said guiding means being provided with cooperating recesses into which an instrument may be inserted to form a driving connection for moving said slidable plate.

12. The combination in a circuit breaker provided with a supporting base of a thermal element, a slidable plate provided with a supporting portion for said element, guide means for guiding said plate for longitudinal movement to adjust said thermal element, releasable clamping means for holding said plate against move-

ment, said plate and said guide means having cooperating recesses into which an instrument may be inserted to form a driving connection for moving said plate when said clamping means is released, and said base having an aperture in alignment with said recesses through which said instrument can be inserted and through which a material solid at normal temperatures can be poured into said recesses to lock said slidable plate against movement independently of said clamping means.

13. A circuit breaker mechanism comprising a U-shaped switch member movable to open and closed circuit positions, the respective arms of said switch member being provided with inclined slots, a U-shaped frame, a pivot pin for pivotally supporting one end of said switch member on said frame, an operating link provided with apertures at one end, a pin extending through said apertures, a roller mounted on each end of said pin and in cooperative relation with said respective slots, a pair of outwardly turned projections on the opposite end of said operating link, a second switch member provided with a hole for receiving one of said projections, and a slot for receiving the other of said projections to provide pivots for the movement of said link in opposite directions, and an overcenter spring for operating said link in opposite directions whereby said rollers in connection with said slots apply the force of said spring to said switch member to operate it to said open and closed positions.

14. A circuit breaker mechanism comprising a U-shaped switch member movable to open and closed circuit positions, the respective arms of said switch member being provided with slots, a U-shaped frame, a pivot pin for pivotally supporting one end of said switch member on said frame, an operating link provided with apertures at one end, a supporting pin extending through said apertures, rollers mounted on the opposite ends of said supporting pin in cooperative relation with said slots, a pair of outwardly turned projections on the opposite end of said operating link, mounting means for said operating link including apertures for receiving said projections to provide pivots for the movement of said link in opposite directions, at least one of said apertures comprising a slot, and an overcenter spring for operating said link in opposite directions whereby said rollers in cooperation with said slots apply the force of said spring to said switch member to operate said switch member between said open and closed circuit positions, said overcenter spring at all times retaining said projections in pivotal engagement with said mounting means.

15. A circuit breaker comprising a supporting base, a U-shaped frame the arms of which extend upwardly from said base, each of said arms having an L-shaped slot one portion of which provides a passageway from one side of said frame to the other portion of said slot, a U-shaped switch member each of the respective arms of which is provided with an inclined slot, a pivot pin extending through the arms of said frame and the arms of said switch member for pivotally supporting the switch member for movement between open and closed circuit positions, said U-shaped switch member nesting between the arms of said U-shaped frame, a U-shaped operating link the respective arms of

which nest between the arms of said U-shaped switch member, a pivot pin extending within one end of said U-shaped operating link, a pair of rollers mounted on the respective ends of said pin, each roller being guided by said slots and maintained in said slots by the cooperation of the arms of said link on one side of said rollers and the arms of said frame on the other side of said rollers, the opposite end of said link being provided with projections, a second switch member provided with a hole for receiving one of said projections and a slot for receiving the other of said projections to form a pivotal mounting for the rotation of said link, an operating member provided with a pair of legs spaced apart one from the other and each of which legs is provided with an inwardly extending projection, said projections cooperatively engaging said L-shaped slot for pivotally supporting said operating member, and an overcenter spring having one end connected between said legs and the other end connected to said operating link for rotating said link in opposite directions so as to apply the force of said overcenter spring to said switch member to operate it to said open and closed circuit positions, the normal bias of said spring maintaining said operating member in said L-shaped slots and maintaining said link in said pivotal mounting against said second switch member.

16. A circuit breaker comprising a supporting base, a U-shaped frame the arms of which extend upwardly from said base, a U-shaped switch member the respective arms of which are provided with slots, a pivot pin extending through the arms of said frame and said switch member for pivotally supporting the switch member for movement between open and closed circuit positions, said switch member nesting between the arms of said U-shaped frame, a U-shaped operating link the arms of which nest within the arms of said U-shaped switch member, a supporting pin extending between the arms of said link adjacent one end thereof, a pair of rollers mounted on the respective ends of said supporting pin, said rollers being guided by said slots and maintained in said slots by the cooperation of the arms of said link on one side of each roller and the arms of said frame on the other side of each roller, outwardly extending projections on the arms of said link adjacent the other end thereof, mounting means for said link including apertures for receiving said projections to form a pivotal mounting for said link, at least one of said apertures comprising a slot, an operating member provided with a pair of spaced apart legs within which the upstanding arms of said U-shaped frame nest, said legs and said frame arms having cooperating notches and projections for pivotally supporting said operating member, and an overcenter spring having one end connected to said operating member and the other end connected to said operating link for rotating said link in opposite directions so as to apply the force of said spring to said switch member to operate said switch member to said open and closed circuit positions, the bias of said spring maintaining the cooperating notches and projections on said operating member and said frame in pivotal engagement and maintaining said link in pivotal engagement with said mounting means.

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