

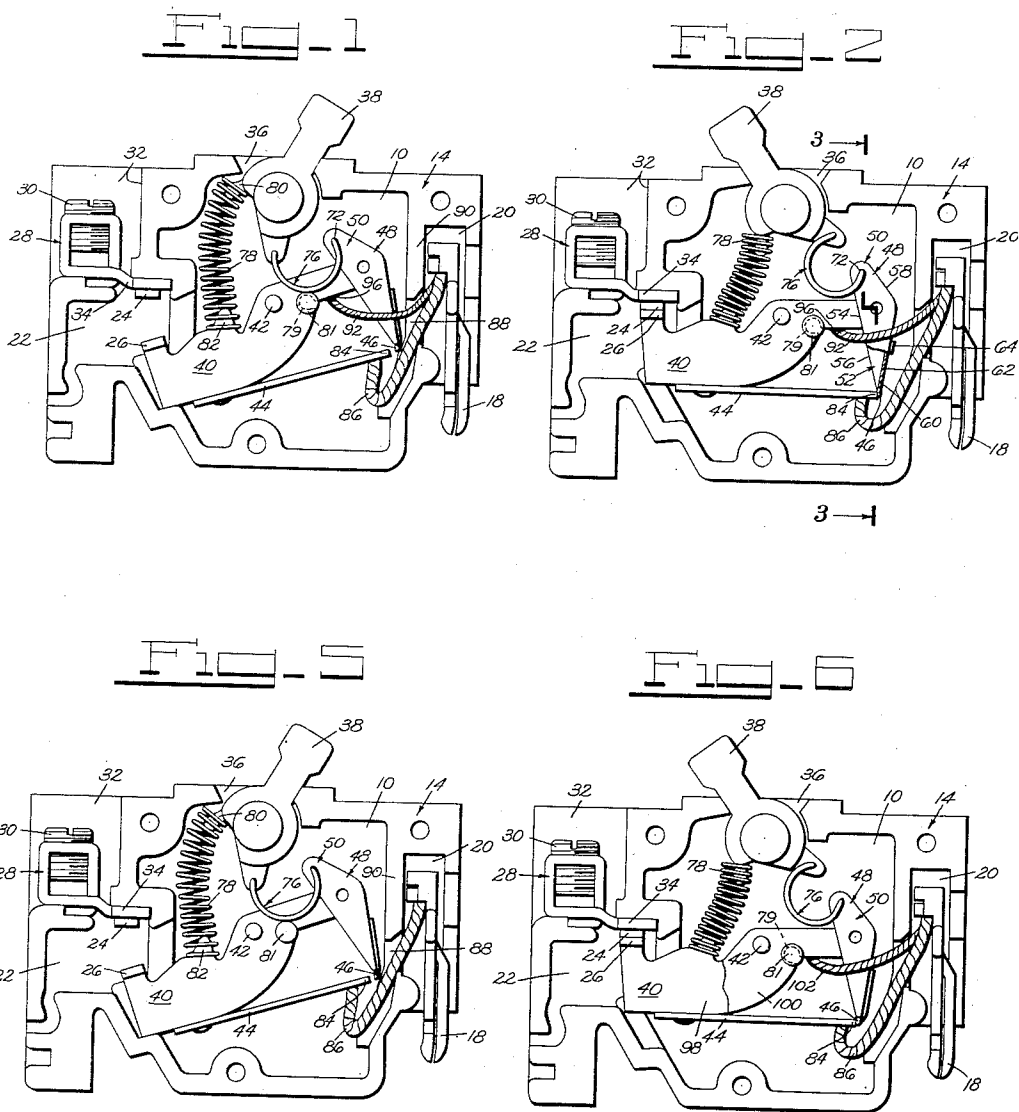
Aug. 7, 1956

T. M. COLE
CIRCUIT BREAKERS

2,758,174

Filed Sept. 14, 1950

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

Fig. 3

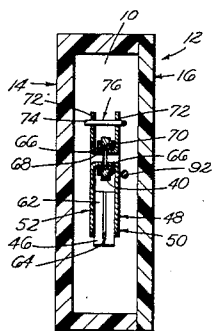


Fig. 7

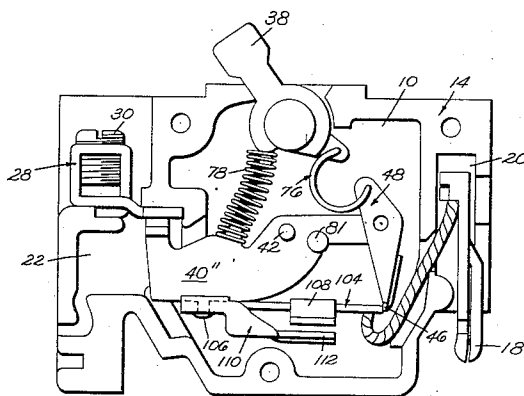
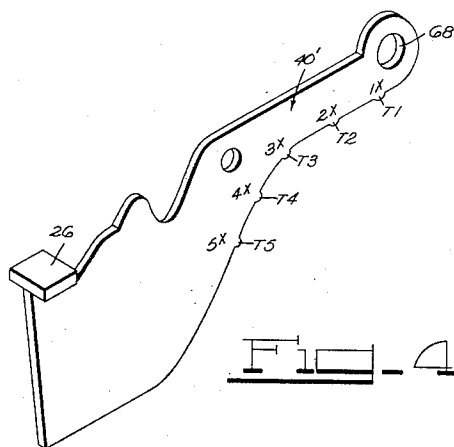


Fig. 4

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1

2,758,174

CIRCUIT BREAKERS

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Application September 14, 1950, Serial No. 184,749

8 Claims. (Cl. 200—116)

This invention relates to automatic circuit breakers and more particularly, but without restriction, to circuit breakers of the general type disclosed in United States Patents Nos. 2,174,669, 2,209,319, 2,209,352, 2,209,353, and Re. No. 23,188.

The present invention is related to the subject matter of my copending application Ser. No. 127,433, filed Nov. 15, 1949, now U. S. Patent No. 2,647,186, dated July 28, 1953, and assigned to the assignee hereof.

One object of the present invention is to provide circuit breakers which are automatically tripped by operation of a thermostatic bimetallic or other flexible strip and which are of such character that breakers of different ratings may be produced without requiring variations in the size of the flexible strips.

Another object is to enable circuit breakers of different ratings to be produced from component parts of the same size and shape.

Therefore, the primary object of the present invention is the provision of means, other than thermal-current responsive members, for setting the current ratings of circuit breakers.

The above and other objects, features and advantages of the present invention will be more fully understood from the following description considered in connection with the accompanying illustrative drawings.

In the drawings:

Fig. 1 is a side view of a circuit breaker embodying the present invention, one part of the casing being removed, the circuit breaker being open;

Fig. 2 is a view similar to Fig. 1, showing the circuit breaker closed, portions thereof being broken away;

Fig. 3 is a sectional view on the line 3—3 of Fig. 2;

Fig. 4 is a perspective view, on an enlarged scale, of a movable contact arm according to the embodiment of Figs. 1 and 2;

Fig. 5 is a side view of a circuit breaker illustrating another embodiment of the present invention, one part of the casing being removed, the circuit breaker being open;

Fig. 6 is a view similar to Fig. 5, showing the circuit breaker closed; and

Fig. 7 is a side view of a circuit breaker illustrating an additional embodiment of the present invention, one part of the casing being removed, the circuit breaker being closed.

Referring now to Figs. 1 through 4 of the drawings in detail, as here shown, the circuit breaker mechanism of the present invention is disposed within a chamber 10 defined in a two part insulation housing or casing 12 comprising a body part 14 and cover or closure part 16. In the illustrated embodiment of the invention, the circuit breaker is of the "plug-in" type, being provided with a plug-in terminal prong or stab contact 18 mounted within a chamber 20 formed in the housing and extending therefrom for making contact with a terminal plate assembly, such as that described in application, Ser. No. 127,432

2

filed Nov. 15, 1949, by Paul M. Christensen and myself, as joint inventors, now U. S. Patent No. 2,647,225, dated July 28, 1953, and assigned to the assignee of my present application. However, it will be understood that the present invention is not limited to circuit breakers of the "plug-in" type but is applicable as well to circuit breakers which are not provided with plug-in terminals, the stab contact, per se, not forming a part of the invention to which this application is directed.

In addition to chambers 10 and 20, the casing is also provided with arcing chamber 22 in which the stationary contact 24 and the movable contact 26 are disposed for relative movement. A terminal member 28, provided with a terminal screw 30, is mounted in a recess 32 formed in the casing, above arcing chamber 22. Said terminal member is provided with a portion 34 which extends into the arcing chamber for mounting the stationary contact 24. The casing is also provided with an opening 36 through which an insulated pivoted handle 38 projects for manual operation of the circuit breaker mechanism, said handle being mounted as illustrated and described in my copending application Ser. No. 127,433.

Referring now to the circuit breaker mechanism disposed in chamber 10, said mechanism includes a manually operable member, here shown as the above mentioned pivoted handle 38. A movable contact member or arm 40 is mounted in chamber 10 for pivotal movement on pivot pin 42, the opposite ends of which are received in the casing parts, as illustrated and described in said application Ser. No. 127,433. At one end thereof, member 40 carries the contact 26 which is engageable with and disengageable from the companion stationary contact 24. A thermal-current responsive control member 44, here shown as a thermostatic bi-metallic flexible strip, is secured in a suitable manner, as by welding, to a side edge of contact member 40. The free end of bi-metallic strip 44 is arranged to releasably engage the latch element 46 at one end of an actuating member or lever 48, pivotally mounted on the end of movable contact member 40, opposite the end which carries the contact 26.

As here shown, and as illustrated and described in detail in my said copending application Ser. No. 127,433, the lever 48 is preferably formed in one piece of current-conductive sheet metal and comprises the laterally spaced opposing walls 50 and 52 open between the marginal edges 54 and 56 thereof, and partially closed between the opposite marginal edges 58 and 60 thereof, by the integral wall 62 which is provided with the aforementioned latch element 46, depending below said opposing walls, and with the longitudinal reinforcing bead 64 offset laterally outwardly thereof. The walls 50 and 52 are provided with the confronting punched-in projections 66 which are mounted for pivotal movement in a bearing aperture 68 provided in the movable contact member 40.

An insulation bushing 70 is provided in bearing aperture 68 to insulate lever 48 from the member 40. However, said bushing may be omitted, as hereinafter described. It will be noted that when lever 48 is mounted on the movable member 40, the walls 50 and 52 straddle said movable member. At their free ends, each of said walls is provided with an aperture 72. One end 74 of a resilient link 76 extends with slight clearance through the aligned apertures 72 (Fig. 3) and the other end of said link is pivotally engaged with the adjacent end of handle 38. A coil compression spring 78 is operatively interposed between the movable contact member 40 and the handle 38 for biasing the movable contact member to its open position. One end of said spring engages a lug 80 carried by handle 38 and the other end of said spring engages a lug 82 integral with the movable contact member 40. The mechanism constituted by handle 38, movable contact member 40, thermal strip 44, lever 48 and

link 76 is similar to and operates substantially in the same way as corresponding mechanism in the above identified United States Patent Re. No. 23,188.

It will be understood that member 44 operates to latch the manually operable actuating mechanism 43 to the movable contact member 40 and to unlatch the actuating mechanism from the movable contact member, the unlatching taking place upon deflection of member 44 causing the disengagement of end 84 thereof from the edge of latch element 46 of lever 48 upon the occurrence of an overload or under other abnormal predetermined current conditions in the circuit controlled by the circuit breaker. When member 44 is deflected from engagement with lever 48, spring 78 is effective to move contact member 40 to its open position, i. e., from the position illustrated in Fig. 2, to the position illustrated in Fig. 1. Calibration means, such as the peripherally interrupted tapered aperture 79 and a tapered pin 81, illustrated and described in detail in my copending application Ser. No. 127,433, may be provided in the movable contact member 40 for calibrating the circuit breaker.

The thermal element 44 is connected in series with movable contact member 40 and the circuit which is to be controlled by the circuit breaker. For this purpose a flexible metallic conductor or connector 86 is connected to said thermal element, preferably adjacent the free end 84 thereof and extends from chamber 10 through an opening 88 in wall portion 90 into chamber 20 for connection to the stab contact 18 which makes contact with a power line in the terminal panel assembly of my copending application Ser. No. 127,432, described above.

Pursuant to the present invention, provision is made for varying the response of the circuit-breaker mechanism without changing the thermal element 44. In this connection, an insulated flexible metallic connector or pig-tail conductor 92 is connected between the movable member 40 and the stab contact 18. As here shown, one end 96 of connector 92 is secured in a suitable manner, as by soldering, to a predetermined point on the movable member 40. Said connector 92 extends through opening 88 in wall portion 90 into chamber 20 for connection to the stab-terminal member 18, or to the conductor 86 connected to said terminal member. It will be understood that sufficient slack is provided in connector 92 so as not to impede the movement of the circuit breaker mechanism to and from the positions thereof illustrated in Figs. 1 and 2.

Without the connector 92, due to the insulated bushing 70, no current would flow through the movable member 40 to the lever 48, and all of the current would flow through said member to and through the terminal strip 44. However, said connector 92 is effective to establish an additional path for current flow through the circuit breaker to provide two parallel current paths. One current path is from terminal member 28, through the engaged contacts 24 and 26, through the member 40, through bi-metallic strip 44, and through connector 86 to terminal 18. The second and additional current path is from terminal member 28, through the engaged contacts 24 and 26, through the member 40, and through the connector 92 to terminal 18. By having a portion of the total current flow through the circuit breaker by-pass the strip 44 due to the addition of the conductor 92, it is obvious that a greater total current flow can now pass through the circuit breaker before strip 44 is heated to the point where it flexes sufficiently to disengage latch 46. For example, assuming that 16 amperes of current is required to supply the heat necessary to flex strip 44 sufficiently to disengage latch 46, it is apparent that, without connector 92 so that all the current flows through strip 44, the circuit breaker will trip when the current, in the circuit in which the circuit breaker is connected, reaches the basic current rating of 16 amperes. However, with connector 92 resulting in the establishment of an additional parallel current path through the circuit

breaker to reduce the current flow through strip 44, and assuming that the total resistance in the path which includes strip 44 is one-third of the total resistance in the path which includes connector 92, only 12 amperes will flow through the strip 44 and the latter will not flex sufficiently to disengage latch 46. With the same resistance relationships, it will require a total current of $21\frac{1}{3}$ amperes in the controlled circuit in order to have a flow of 16 amperes through the strip to unlatch the latter. Therefore, it will be apparent that the addition of the connector 92 results in an increase of the current-response of the circuit breaker, without changing any of the components thereof to provide an operating current-rating different from the basic current rating. It is also within the scope of the present invention to omit the insulated bushing 70 so that there will be an additional parallel current path which includes member 40 and lever 48. This will establish a third current path in addition to the two previously described. It will be apparent that even with this additional third current path, the use of connector 92 will still result in a reduction of current flow through the strip 44, since the current between terminals 28 and 18 will divide three ways, whereby to increase the response of the circuit breaker. In addition, it is also within the scope of the present invention, especially where bushing 70 is omitted to connect end 96 of connector 92 to the actuating member 48, whereby to provide for two parallel current paths, as described, for reducing the current flow through strip 44.

By connecting end 96 of connector 92 to different points of movable member 40, the total resistance of the current path including said connector may be varied for varying the current flow through strip 44 whereby to vary the current response of the circuit breaker without changing the strip or any other component. The shorter the distance or current path between end 96 and the movable contact 26, the smaller the amount of metal of member 40 in the current path and, therefore, the smaller the total resistance in the current path which includes the connector and, therefore, the larger the total current flow required to unlatch a strip 44 of fixed dimensions. The greater the distance between end 96 and the movable contact 26, the greater the amount of metal of member 40 in the current path and, therefore, the larger the total resistance in the current path which includes said connector and, therefore the smaller the total current flow required to unlatch a strip 44 of fixed dimensions. In other words, the response or current-rating of a particular circuit breaker is increased, as end 96 is positioned closer to contact 26, and said response or current-rating is decreased as end 96 is connected farther away from said movable contact. Fig. 4 illustrates a movable contact arm 40' which is similar in conductivity to contact arm 40, and which is provided with calibration means to facilitate the obtaining of various responses or current-ratings in a circuit breaker without changing the flexible strip 44 or any other component thereof. As here shown, arm 40' is provided with a plurality of terminal points or taps T1 through T5 for facilitating the connection of end 96 of connector 92 to said arm. Said arm is also provided with a calibration indicia for each terminal for indicating the response or current-rating of the circuit breaker when the connector is connected to each of said terminals. For example, indicia IX at terminal T1 may indicate a minimum current-rating of 5 amperes. Indicia 2X at terminal T2 may indicate a current-rating of 10 amperes, indicia 3X indicating 15 amperes, indicia 4X indicating 20 amperes, and indicia 5X indicating 25 amperes. In this manner, it is possible to provide a series of circuit breakers, all of which have the same parts, and merely by connecting end 96 of connectors 92 to different predetermined points along the movable arms thereof, all of said circuit breakers may be set for different responses. Another embodiment of my invention is illustrated in

5

Figs. 5 and 6 wherein all the component parts are the same as in Figs. 1 and 2, except that both the connector 92 and the insulated bushing 70 are omitted in this form of the invention. In this form of circuit breaker, there are two parallel paths, one which includes flexible strip 44, as heretofore described, and the other which extends from terminal member 30, through engaged contacts 24 and 26, through movable arm 40 and lever 48, to strip 44 and connector 86 to terminal 18. Provision is made for varying the circuit breaker response by changing the conductivity of movable arm 40. With a movable arm of increased conductivity, or decreased resistance, the same result is achieved as moving end 96 of connector 92, in the embodiment illustrated in Figs. 1 and 2, closer to movable contact 26, namely to increase the response of the circuit breaker. With a movable arm of decreased conductivity, or increased resistance, the same result is achieved as moving end 96 of connector away from movable contact 26, namely to decrease the response of the circuit-breaker. For example, and not by way of limitation, arm 40 may be fabricated of copper or copper alloys where a high current rating or response is desired. For an intermediate current rating, the arm may be formed of stainless steel, and for a low current rating the arm may be formed of nichrome. For use with a bimetallic strip having a predetermined thermal-current rating, each of these arms would preferably have a current-rating indicia thereon, so that in assembling a circuit breaker for a specific response it would merely be necessary to select the proper arm. In all other respects, the circuit breaker would operate in the same manner, as heretofore described, Fig. 5 illustrating the closed condition of the mechanism thereof and Fig. 6 illustrating the open condition of said mechanism.

It is also within the scope of the present invention, in the embodiment illustrated in Figs. 5 and 6, to form arm 40, in one piece, but to provide said arm with portions of different resistance values, respectively, as illustrated and described in my copending application Ser. No. 127,433. For example, as illustrated in Fig. 6, portion 98 which carries the movable contact 26 and bimetallic member 44, may be formed from a metal of one resistance and the remaining portion 100 may be formed of a metal of higher or lower resistance than portion 98, depending upon the desired overall resistance of arm 40. By predetermining the overall resistance of arm 40, the current flow therethrough from terminal 28, through the lever 48, may be increased or decreased, as the case may be, to decrease or increase the current flow through the parallel path which includes the member 44. By varying the resistance of either of these portions, for example, but not by way of limitation, by changing the relative dimensions thereof, or by changing the respective metals of either or both portions, the current flow through the parallel paths including the strip 44 and the member 40, may be varied to vary the response of the circuit breaker. It will also be apparent that the resistance of portion 100 may be maintained constant and by varying the resistance of portion 98 only, the response of the circuit breaker may be varied since the current for both parallel paths flows through portion 98.

Since, in the circuit breaker illustrated in Figs. 5 and 6, there is a current flow from member 40, through lever 48 to latch 46, and from said latch to end portion 84 of strip 44 and through connector 86, there is the possibility of arcing occurring upon the unlatching of the strip and the lever. To eliminate or minimize said arcing, means are provided to by-pass the current flow between the lever and the strip. As illustrated in Fig. 6, a pigtail coupling or flexible connector 102 is connected between member 40 and the flexible connector 86. Connector 102 is effective to by-pass most of the current flow through the lever and thereby to minimize arcing. It will be understood that connector 102 may be connected otherwise than as shown to by-pass current flow between latch 46 and end portion 84 of the strip.

6

Pursuant to the embodiment illustrated in Fig. 7, the thermal current-responsive member 44 is replaced by a flexible latch member 104 formed of current conducting material which is not necessarily provided with a thermal current-responsive characteristic. As here shown, and as fully illustrated and described in my copending application Ser. No. 127,433, movable contact member 40' is provided with an integral depending portion 106 which extends through one end of latch 104 which is welded, or otherwise secured, to member 40'. An electro-magnetic member 108 is secured, preferably by welding, or in other suitable manner, on latch 104, near the free end thereof, and a companion rigid armature 110 is disposed in spaced confronting relation to electro-magnetic member 108. Said armature is secured to the fixed end of latch 104, the depending portion 106 extending through the armature and being riveted to the outer surface thereof. At its free end, the armature is provided with portion 112 disposed in spaced confronting relation with the electro-magnetic member 108.

It will be understood that upon the occurrence of a predetermined current flow through latch 104, resulting from the occurrence of a predetermined current in the external circuit in which the circuit breaker is connected, the electro-magnetic device is operable instantaneously to effect disengagement of the companion contact members. In this connection it will be understood that upon the occurrence of such excess current flow through latch 104, the magnetic attraction between members 108 and 110 is sufficient to cause relative movement thereof. Since the armature 110 is rigid and the latch 104, which carries electro magnetic member 108, is flexible, member 108 is movable by magnetic attraction toward portion 112 of member 110, thus deflecting or unlatching member 104 from the latch portion 46 of lever 48.

It will be apparent that the response of the circuit breaker of Fig. 7, may be varied either through the use of the connector 92 of Figs. 1 and 2, or by changing the conductivity of movable arm 40', as described with reference to Figs. 5 and 6. With a connector 92 connected between movable arm 40' and terminal 18, in the same manner as described in connection with Figs. 1 and 2, a second current path will be established, as previously described in connection with said figures. Said second current path will reduce the current flow through member 104 to increase the current response of the circuit breaker. Similarly, the resistance of the arm 40' may be changed by substituting an arm formed of a metal having a lower or a higher resistance, as the case may be, as previously described in connection with Figs. 5 and 6, or the same result may be achieved by forming arm 40' of different metallic portions to provide a desired overall resistance, as previously described in connection with said latter figures. It will be understood that the relative current flow through flexible latch 104 may be varied by varying the relative current flow through movable arm 40', in any of said previously described manners, whereby to vary the response of the circuit breaker.

It will be understood that strip 104 may be a thermo-static bimetallic strip, as in Figs. 1, 2, 5 and 6 so that the breaker shown in Fig. 7 may trip either thermostatically or electromagnetically as in Reissue Patent No. 23,188. Conversely, the breakers shown in Figs. 1, 2, 5 and 6 having the bimetal strips may be provided with the electromagnetic trip device 108—110 shown in Fig. 7.

While I have shown and described the preferred embodiment of my invention, it will be understood that various changes may be made in the present invention without departing from the underlying idea or principles of the invention within the scope of the appended claims.

Having thus described my invention, what I claim and desire to secure by Letters Patent, is:

1. In an automatic circuit breaker which comprises a stationary contact, a movable contact member pro-

vided with a contact engageable with and disengageable from said stationary contact, manually operable actuating means, and means for effecting the disengagement of said contacts in response to a predetermined current in the circuit; means to vary the response of said circuit breaker for maintaining the engagement of said contacts upon the occurrence in the circuit of a current greater than said predetermined current, said means comprising circuit means for subjecting said disengaging means to a predetermined portion only of said greater current and additional circuit means in said circuit breaker in shunt with said first mentioned circuit means for passing the remaining portion of said greater current through said circuit breaker, said disengaging means effecting the disengagement of said contact when said predetermined portion equals said predetermined current, at least one of said circuit means including said movable contact member, and means to vary the current flow path through said movable contact member whereby to vary the response of said circuit breaker, and said terminal member having permanent electrical connections both with said flexible member and with said higher resistance portion of the movable contact member whereby to minimize arcing between said flexible member and said actuating means upon disengagement thereof.

2. In an automatic circuit breaker having relatively movable companion contacts engageable with and disengageable from each other, and actuating means for operatively effecting said engagement and disengagement thereof; a terminal member, a movable contact member on which one of said contacts is carried, and tripping means including a flexible member in normal engagement with said actuating means for releasably latching said movable contact member thereto for operation by said actuating means, said movable contact member having portions of lower and higher resistances, respectively, and said flexible member being electrically connected to the portion of said movable contact member of the lower resistance and said actuating means including a part which is connected to said higher resistance portion of the movable contact member.

3. In a circuit breaker mechanism comprising a movable current-conductive contact member, manually operable actuating means, a flexible current-conductive control element bodily carried by and movable with said contact member and operable to latch said actuating means to the contact member and upon overload to unlatch the same by deflection of the control element, said control element being in series circuit with said contact member, and a terminal element electrically connected to said control element to provide a current path through the breaker; the combination with said movable contact member and said terminal element of a conductor interconnecting said contact member and said terminal element to establish an additional current path through said breaker which is in shunt with said control element and which includes said contact member, said contact member having a plurality of spaced terminals longitudinally thereof for predetermining the portion thereof in said additional current path, said conductor being connected to a selected one of said terminals on said contact member to predetermine the relative conductivity of said current paths, whereby to predetermine the response of the circuit breaker.

4. An automatic circuit breaker comprising a pair of spaced terminal elements, a stationary contact electrically connected to one of said elements, a current-conductive member provided with a companion contact and mounted for movement to engage and disengage said contacts, and means for effecting automatic disengagement of said contacts upon overload, said means including a current-conductive control device electrically connected to said movable member and operable to releasably latch the latter in circuit making condition and upon overload to unlatch the latter for move-

ment to circuit-interrupting disposition, and current-conductive means electrically connecting the other terminal element to said control device for providing a control-current path between said terminal elements and through said control device in the engaged condition of said contacts, said current-conductive means electrically connecting said other terminal element to said movable member to provide a shunt current path between said elements and through said movable member for predetermining the current-response characteristic of said circuit breaker, said current-conductive means comprising a first electrical conductor interconnecting said other terminal element and said control device and a second electrical conductor interconnecting said other terminal element and said movable member, said movable member being an elongated part provided with a plurality of terminals spaced longitudinally thereof relative to said companion contact, said second electrical conductor being connected to one of the terminals of said part, whereby the portion of said part which is in said shunt circuit extends from said companion contact to said one terminal.

5. In an automatic circuit breaker having a stationary contact and a companion contact movable for engagement with and disengagement from said stationary contact, and means for effecting automatic disengagement of said contacts upon overload, said means including a movable current-conductive member electrically connected to said movable contact and operable to effect said movement thereof and a current-conductive control device connected in series with said movable member and operable to releasably latch the latter in circuit-making condition and upon overload to unlatch the latter for movement to circuit-interrupting disposition, a terminal element for said breaker, and current-conductive means electrically connecting said terminal element to said control device for providing a control-current path from said terminal element through said control device to said stationary contact in the engaged condition of said contacts, said current-conductive means electrically connecting said terminal element to said movable member to provide a shunt current path through said movable member between said terminal element and said stationary contact for predetermining the current-response characteristic of said circuit breaker, said movable member being an elongated part provided with a plurality of terminals spaced longitudinally thereof relative to said companion contact, said current-conductive means being connected to one of the terminals of said part, whereby the portion of said part which is in said shunt current path extends from said companion contact to said terminal element.

6. In an automatic circuit breaker having relatively movable companion contacts engageable with and disengageable from each other, and actuating means for operatively effecting said engagement and disengagement thereof; a terminal member, a movable contact member on which one of said contacts is carried, and tripping means including a flexible member in normal engagement with said actuating means for releasably latching said movable contact member thereto for operation by said actuating means, said terminal member having a permanent electrical connection both with said movable contact member and with said flexible member to form parallel circuits between said terminal member and said contacts in the engaged condition of said contacts and to minimize arcing between said flexible member and said actuating means when the flexible member disengages the actuating means.

7. In an automatic circuit breaker having a stationary contact, a movable contact engageable and disengageable therewith and actuating means for operatively effecting the engagement thereof; a terminal member, a movable contact member on which said movable contact is carried, and a flexible member carried by said mov-

9

able member and in normal releasable engagement with said actuating means for releasably latching said movable contact member thereto, said terminal member being in circuit with said flexible member, and said terminal member having a permanent electrical connection with said movable contact member for minimizing arcing between said flexible member and said actuating means when the flexible member disengages said actuating means.

8. In an automatic circuit breaker having a stationary contact, a movable contact engageable and disengageable therewith and actuating means for operatively effecting the engagement thereof; a terminal member, a movable contact member on which said movable contact is carried, and a flexible member carried by said movable member and in normal engagement with said actuating means for releasably latching said movable contact member thereto, said terminal member being in constant circuit relation with said flexible member, and means for minimizing arcing between said flexible member and said actuating means when the latter is disengaged by said flexible member upon tripping of the circuit breaker comprising an electrical conductor permanently interconnecting said terminal member and said movable contact member.

25

10

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