CIRCUIT BREAKER.

Merrill G. Leonard, Sharon, Pa., assignor to Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., a corporation of Pennsylvania

Application October 9, 1936, Serial No. 104,942

21 Claims. (Cl. 280—116)

My invention relates to apparatus for interrupting electrical circuits, in general, and more particularly to circuit breaker structures of the protective type which include one or more electro-responsive trip devices for automatically effecting the opening of the contact means of the circuit breaker in response to predetermined overload conditions in the circuits controlled by the breaker.

10 In circuit breakers of the above mentioned type, the electro-responsive device for effecting opening of the contact means in response to overload conditions usually consists of an electromagnetic or bimetallic device or both, connected in series circuit with the contact means of the breaker so as to be responsive to predetermined values of current flowing in the circuit controlled by the breaker. When such circuit breakers are installed for use in electrical systems, they are often called upon to interrupt circuits including highly inductive loads and are often subjected to heavy overloads or to short circuit conditions. In opening a circuit breaker under such conditions, it is well known that current continues to flow therethrough for an appreciable length of time after separation of the contacts due to the formation and persistence of an arc at the contacts. Arc extinguishing devices are usually provided for extinguishing the arc thus formed as quickly as possible. In spite of the provision of such devices, however, the current continues to flow for a length of time sufficient in many instances to damage or destroy the trip devices of the breaker.

It is, therefore, the primary purpose of my invention to provide circuit breakers of the above-mentioned type with a means for protecting the electro-responsive trip device or devices from arc currents.

Another object of my invention is to provide a means for excluding the electro-responsive trip device of the circuit breaker from the circuit of the arc and contacts as soon as the contacts start to open.

Another object of my invention is to provide a circuit breaker with novel internal circuit connections for protecting the trip device of the breaker from excessive currents.

Another object of my invention is to provide a circuit breaker having an arc extinguishing means with novel internal circuit connections including a part of said arc extinguishing means for excluding the trip device of the breaker from the circuit of the arc upon initial separating movement of the contacts.

Another object of my invention is to provide a circuit breaker with means for protecting the trip device thereof by immediately transferring the arc circuit formed incident to separation of the contacts to an auxiliary contact not included in the circuit of the trip device.

Another object of my invention is to provide a means for protecting the trip device of a circuit breaker by transferring the arc circuit formed incident to separation of the main contacts to an auxiliary contact not included in the circuit of the trip device; in which the auxiliary contact constitutes a part of the arc extinguishing means.

The novel features that I consider characteristic of my invention are set forth in particular in the appended claims. The invention itself, however, both as to structure and operation, together with additional objects and advantages thereof, will best be understood from the following detailed description of specific embodiments thereof when read in connection with the accompanying drawing, in which:

Figure 1 is a vertical sectional view of a circuit breaker having the features of my invention, Fig. 2 is a diagrammatic view illustrating one form of electrical connections for the various elements of the breaker for carrying out the purposes of my invention, Fig. 3 is a diagrammatic view similar to Fig. 2 illustrating a slightly modified form of apparatus and electrical connections for carrying out the purposes of my invention; and, Fig. 4 is a plan view of the arc extinguishing device associated with the contacts of the circuit breaker.

In the accompanying drawing, the invention has been shown applied to one particular form of circuit breaker structure embodying an electro-responsive trip device and an arc extinguishing means of the spaced plate type. The particular circuit breaker structure shown was selected for illustrative purposes only and it will readily appear from the following detailed description that the invention is not limited in its application to any one particular circuit breaker structure but that it is capable of association with any form of circuit interrupting device embodying an electro-responsive trip device and an arc extinguishing device.

The circuit breaker illustrated in Fig. 1 is of the same general mechanical structure as disclosed in the United States Patent No. 2,044,187,
granted to H. D. Dorfman and John H. Shuler and assigned to the assignee of this invention; hence only a brief description of the same will be given in this application.

Referring to Fig. 1, the base 7 of the circuit breaker is of molded insulating material and has mounted in recesses provided therein the end terminals 9 and 11, a main stationary contact 13, a movable contact 15, the circuit breaker operating mechanism indicated generally at 17, an electro-responsive trip device 19, and an arc extinguishing means indicated generally at 21.

An operating handle 23 also of molded insulating material is provided for actuating the operating mechanism 17. The trip device 19 is supported on the base 7 and positioned with respect to the operating mechanism by means of two suitable screws 25 (only the front screw being shown) which engage threaded inserts 26 molded into the base 7. These screws also serve to connect the trip device in the internal circuit of the breaker which will be described hereinafter.

The arc extinguishing means are secured to the base in any suitable manner as for example by the screws 27 which extend through suitable openings therein. A cover 28 of molded insulating material is removable mounted on the base by means of bolts (not shown).

The main stationary contact 13 is mounted on a metallic plate 31 which will hereinafter be termed an arc runner. The arc runner is secured to the base by any suitable means such as one of the screws 27.

Both the movable and stationary contacts are constructed of arc resisting material, the former being composed of a silver molybdenum alloy and the latter being composed of finely divided silver and graphite compressed into a conglomerate mass. The arc runner 31 may also be constructed of an arc resisting conducting material similar to the stationary contact 13.

The movable contact 15 has a channel shaped frame 33 which is pivotally supported on a U shaped main frame 35 of the circuit breaker operating mechanism 17 through the agency of a pivot pin 37. The movable contact 15 is rigidly affixed by means of a rivet to the free end of a resilient switch arm 39 which is preferably constructed of spring steel. The switch arm itself is affixed to the channel shaped frame 33 by means of two other rivets.

The operating mechanism 17 comprises in general, the U shaped base or main frame 35, a pair of toggle links 41 and 43 for actuating the channel shaped frame 33 of the movable contact 15, a releasable trigger 45 for restraining the toggle links in an operative position, an operating member 23, and a pair of overcenter springs 47 (only one being shown) for connecting the operating member to the knee pivot of the toggle links 41 and 43.

The operating member 23 has a bifurcated portion 49, the legs of which are pivotally mounted on the sides of the main frame 35 through the agency of pivot pins 51. The releasable trigger 45 is pivotally mounted at one end to the sides of the main frame 35 by means of a pivot pin 53 and has a projecting portion 54 adapted to be normally engaged and held by the trip device 19. The operating member 23 has a hooking portion 55 secured to the underside thereof which is adapted to engage a shouder 57 formed on the trigger 45 for resetting the trigger after the release of the same by the trip device. The lower end of the toggle link 41 is pivoted to the channel shaped frame 33 by means of a pivot pin 55. The upper end of the toggle link 41 is pivotally connected by means of the knee pivot pin 51 with the lower end of the bifurcated portion 49 of the operating member 23. The trigger 45 provides a releasable restraining means for holding the toggle links in an operative position when the contacts 13 and 15 are engaged.

The movement of the trigger member 45 in a clockwise direction is limited by a projection 65 which extends inwardly from one side of the main frame 35. The limits of motion of the bifurcated portion 49 of the operating member 23 are defined by the edges 67 of offset portions of the side walls of the main frame 35. The plate 65, the portion of the operating member 23 projects through a slot 69 provided in the cover 28.

The trip device 19 comprises a U shaped current carrying bimetallic trip element 71. A latch plate 73 is mechanically fastened to the upper end of the trip element 71 and therefrom by means of mica plates 75, the latch plate being held in position by two spaced rivets 77 (only one being shown) which extend through a retaining plate 78 and enlarged openings in the top portion of the bimetallic trip element 71 itself. The trip element is supported upon its own terminals 80 (only one being shown) through the agency of rivets 78. The projecting portion 54 of the trigger 45 is normally adapted to be engaged under the lower edge of the latch plate 73 between the rivets 77.

The arc extinguishing means 21 consists of a plurality of spaced plates 81 of magnetic material each insulated from the adjacent plates and provided with a slot 83. The slots in the plates are of substantially the same outline as the movable contact 15 and the position of the plates is such that the slots form a path adapted to be traversed by the movable contact 15 in moving into and out of engagement with the stationary contact 13. The plates 81 are assembled between two side walls 85 of insulating material. Projecting lugs 87 are provided on the plates for engagement in openings in the side walls 85.

When the movable contact 15 moves away from its engagement with the stationary contact, toward open circuit position, an arc is drawn which creates a magnetic field surrounding the path of the arc. The magnetic plates 81 so unbalance the field adjacent the arc that the arc is moved into the spaces between the plates where it is quickly cooled and extinguished. The plates 81 cause the arc to be immediately transferred from the stationary contact 13 to the arc runner 31 thus protecting the stationary contact from damage by contact with the arc. The arc is split up into a series of short arcs between the adjacent plates 81, the first short arc being immediately established between the arc runner 31 and the bottom plate of the stack.

The operation of the circuit breaker will now be briefly describer 23 has been shown in the open circuit position with the trigger or restraining member 45 in the set or latched position in which it is held by the latch plate 73 of the trip element 71. The toggle links 41-43 are in their collapsed position. It will be noted
that the trigger 45 is at all times biased in a clockwise direction by the reaction force of the overcenter springs 41. Let it be assumed that it is desired to manually close the circuit breaker.

The operating member 23 is moved from the position shown in a clockwise direction about its pivot pin 51, by the releasing member 15 as it has reached the limit of its travel in a clockwise direction, the line of action of the overcenter springs 41 is brought to the right of the center line of the toggle. This results in producing a force which automatically moves the toggle links 14 with increasing acceleration to their overcenter position which effects movement of the movable contact 15 to the closed circuit position with a snap action. To open the contacts, the operating member 23 is moved from its closed position by releasing engagement with its pivot pin 51 to its open circuit position shown in Fig. 1. Substantially the reverse action takes place. The line of action of the overcenter springs is moved to the left of the center line of the toggle which produces a force which automatically moves the toggle links 14 with increasing acceleration to their collapsed position shown in Fig. 1. The collapsing of the toggle causes movement of the movable contact 15 to its open circuit position with a snap action.

The bimetallic trip element 71 is adapted to be automatically actuated by the operating member of the breaker as will be described hereinafter. With the circuit breaker in the closed circuit position; upon the occurrence of an overload condition of predetermined magnitude, the increased loss in the bimetallic trip element results in the production of sufficient heat to cause that element to deflect in a direction away from the operating mechanism 17. If the overload persists for a sufficient length of time, this deflection becomes great enough to move the latch plate 59 out of its releasing engagement with the projection portion 55 of the trigger 45. This unloading of the trigger 45 allows the member to rotate in a clockwise direction about its pivot pin 55 under the influence of the reaction forces of the overcenter springs 41. Almost immediately the upper end of the toggle link 42 which is pivoted to the trigger 45 by the pin 82, is moved a sufficient distance to the right of the center line of the toggle to cause the toggle to collapse under the influence of the overcenter springs 41 exerting their tension on the knee pivot pin 51. The channel shaped frame 32 is rotated about its pivot pin 37 by the collapse of the toggle, thus moving the movable contact 15 to its open circuit position with a snap action in the same manner as described for the manual operation.

Following the tripping operation and the resulting change in position of the knee pivot pin 51, the operating handle 23 is biased in a counter-clockwise direction but moves only to a mid-position in the slot 25 of the cover 25. This movement of the handle 23 to the mid-position following the tripping operation serves as a ready indicating means for showing that the circuit has been opened in response to an abnormal electrical condition.

The entire mechanism is restorable after a tripping operation by movement of the operating member 23 to the full open circuit position as soon as the bimetallic trip element 71 has cooled sufficiently to restore the latch plate 73 to the position shown in Fig. 1. This movement causes the hook portion 55 of the operating member to engage and move the trigger member 45 in a counter-clockwise direction until its projecting portion 54 engages under the latch plate 73. The breaker may then be closed manually in the manner previously described.

The operating mechanism 17 is trip free of the operating member 23 in any position of the parts, i.e., the movable contact 15 may be tripped to the open circuit position irrespective of the position of the operating member 23.

It has been the practice in most circuit breakers of the above-mentioned type to connect the electro-responsive trip device or bimetallic trip element in series circuit relationship with the contact means of the breaker in order that the device may respond to overload conditions. When the breaker having the above-mentioned connection is manually operated to open a circuit including a highly inductive load, or when it is automatically opened in normally large overload or short circuit condition, the persistence of the arc after the separation of the contacts may result in damage or destruction of the trip device with the resulting loss of the safety feature in subsequent overloads.

The means for protecting the electro-responsive trip device from the damage indicated above will now be described.

The electro-responsive trip device or the bimetallic trip element in the present disclosure is protected from abnormal current conditions by means of novel internal circuit connections for connecting the trip device in a certain circuit relationship with the terminals, contact means and a part of the arc extinguishing means. In one form of the invention, the connections are made as follows: Referring to Fig. 2, a conductor 58 connects the lead terminal to the rear terminal 32 of the bimetallic trip element 71. The forward terminal 30 of the trip element 71 is connected directly to the arc runner 31 and stationary contact 18 by means of an insulated conductor 31. The movable contact 15 is connected through the agency of the switch arm 50 with an insulated conductor 32, which is, in turn, connected to the line terminal 11 of the circuit breaker. The conductor 58 is electrically connected to the line terminal 11 by means of the terminal connector screw 56. (See Fig. 2.) It will be noted that the connections described above place the bimetallic trip element 71 in series circuit relationship with the stationary contact 18, the movable contact 15 and terminals 30 and 31 of the circuit breaker when the contacts are closed. The insulated shunt conductor 59 connects the back terminal 32 to the bimetallic trip element 71 with the bottom plate 28 of the arc extinguishing means 24. The conductors 58 and 59 are connected to the terminals of the bimetallic trip element through the agency of the screws 25. The insulated conductor 51 is connected to the stationary contact 18 and arc runner 31 through the agency of a screw 12 (see Fig. 1). A recess 55 is provided in the base 7 of the circuit breaker for receiving the insulated conductor wires 51, 53 and 56 (see Fig. 2). The operation of the breaker with the form of connections described above is as follows:

With the contacts in the closed circuit position, the circuit through the breaker extends from the line terminal 11 through the conductor 56, the 70 switch arm 39, movable contact 15, stationary contact 13, insulated conductor 91, the front terminal 80 of the bimetallic trip element 71, the bimetallic trip element 71, the back terminal 52 of the trip element and the conductor 88 to the 75...
load terminal 3. If the movable contact 15 is moved toward open circuit position either in response to operation of the operating member 23 or in response to a tripping operation by means of the bimetallic element 71, an arc is formed between the contact 13 and the movable contact 15. The arc is immediately transferred from the stationary contact 13 to the arc runner 31 by the unbalanced magnetic field caused by the plates 31. As has been previously described, the arc is split up into a series of short arcs extending between the plates 31 and between the bottom plate 31 and the arc runner 31. The short arc between the arc runner 31 and the bottom plate 31 of the stack is sustained only by the voltage drop across the bimetallic trip element 71. This voltage is so low that the short arc between the bottom plate 31 and the arc runner 31 is immediately extinguished, thus excluding the bimetallic trip element from the circuit of the remaining arc or arcs. The arc circuit then extends from the load terminal 9 through the conductor 33 to the bottom plate 31 of the stack through the arc in the space between the plates 31 to the movable contact 15 and through the conductor 33 to the line terminal 11. It will thus be seen that the bimetallic trip element is excluded from the circuit of the arc as soon as the movable contact moves a sufficient distance to establish an arc either between the stationary contact and the bottom plate or between the arc runner and the bottom plate of the arc extinguishing means. Hence the arc current can have no damaging effect on the bimetallic trip element. If the voltage drop across the bimetallic trip element should be too high, more than one of the arc extinguishing contacts could be included between the arc runner and the bimetallic connector 33.

A slightly modified form of arc extinguishing means and circuit connections for accomplishing the purposes of the invention are shown in Fig. 8. In Fig. 9, the arc runner is divided into two sections 32 and 33. The insulated conductor 35 which is connected to the back terminal of the bimetallic trip element 71 instead of being connected to the bottom magnetic plate 31 as in Fig. 6, is connected to the end section 32 of the arc runner. All of the other electrical connections and elements are the same as the corresponding connections and elements shown in Figs. 1 and 2. The operation of this modified form of apparatus and circuit is similar in principle to the embodiment shown in Figs. 1 and 2. When the movable contact is in the closed circuit position, the electro-responsive trip device or bimetallic trip element 71 is connected in series circuit relationship with the contacts 13 and 15 through the following circuit: Line terminal 9, insulated conductor 33, switch arm 32, movable contact 15, stationary trip arm 31, insulated conductor 33, bimetallic trip element 71, conductor 39 and load terminal 5. As soon as the movable contact starts to move to the open circuit position either in response to a manual or a tripping operation, the arc formed at the contacts is transferred to the extreme end section 32 of the arc runner by the unbalanced magnetic field produced by the plates 31. The end section 32 of the arc runner constitutes, in effect, an auxiliary contact to which the arc is transferred as soon as the movable contact starts to move to the open circuit position. As soon as the movable contact 15 is transferred to the end section 32 of the arc runner, the electro-responsive trip device or bimetallic trip element 71 is excluded from the circuit of the arc by means of the insulated shunt conductor 39. The arc circuit then extends from the load terminal 9 through conductor 33 and the insulated shunt conductor 39 to the end section 32 of the arc runner, through the stack of plates, through the movable contact 15, through the stack of plates, through the arc runner 31 and the insulated conductor 33 to the line terminal 11. It will be noted that in the embodiment shown by Figs. 1 and 2, the bottom magnetic plate of the arc extinguishing means constitutes, in effect, an auxiliary contact to which the arc is transferred upon initial movement of the movable contact toward its open circuit position. An important feature of the invention lies in the fact that the current-responsive element is shunted out of the circuit as soon as the movable contact has moved only a short distance and before it has moved to the full open position. This removes the current-responsive element from the circuit before it has time to heat up and burn out. It is also advantageous that the circuit of my device does not require a connection to the top arm of the extinguishing plate which would impart a voltage across the arc extinguisher even when the circuit is open and would permit a leakage current to flow if the fibre side plates of the arc extinguisher should become damp or carbonized.

While the invention has been shown associated with a particular form of circuit breaker, it is obvious that the invention is equally applicable to any form of circuit interrupting device which includes an electro-responsive trip device and an arc extinguishing means or arc moving means. For example, the various forms of electro-responsive trip devices may be substituted for the U-shaped bimetallic trip element illustrated. The trip device may be either in the form of a thermally responsive device or in the form of an electromagnetic trip device. Likewise, various other forms of arc extinguishing devices may be used. The arc extinguishing means illustrated is merely selected for simplicity to illustrate the principle of the invention. One particularly effective form of arc extinguishing means to which the invention is applicable is disclosed in the United States Patent No. 2,953,604 granted to Benjamain W. Brainard, and assigned to the assignee of this invention.

It will thus be seen that I have provided a novel means associated with a circuit interrupting device of the protective type for protecting the electro-responsive trip device thereof from damage by the arc current.

While in accordance with the provisions of the patent statutes, I have disclosed the foregoing details of several embodiments of my invention, it is to be understood that many of the details are merely illustrative and that variations in addition to those herein mentioned, in precise form may be made without departing from the spirit of the invention. I desire, therefore, that the language of the accompanying claims shall be accorded the broadest reasonable construction and that my invention be limited only by what is explicitly stated in the claims and by the prior art.

I claim as my invention:

1. A circuit interrupting device comprising a switch contacts, electro-responsive means for effecting separation of said contacts connected in circuit, a trip device electrically connected to the contacts, means for transferring the arc current between the contacts is transferred, and means for shunting the arc current around said electro-
of the movable contact to the open circuit position
in response to a predetermined condition, an
auxiliary contact, means for excluding said de-
vice from the circuit of the arc and for transfer-
ing of the arc from said auxiliary contact upon
initial movement of said movable contact toward
open circuit position.
8. A circuit breaker comprising a stationary
contact and a movable contact between which an
arc is drawn, an electro-responsive trip device
connected in the circuit leading to the stationary
contact for effecting opening of said contacts an
arc extinguishing means including a series of
spaced notched plates of magnetic material for
transferring the arc from said contacts to said
plates and a connection for excluding said de-
vice and said stationary contact from the circuit
of the arc upon movement of the movable contact
toward open circuit position.
9. In a circuit breaker the combination of
swicth contacts, electro-responsive means con-
ected in circuit with said contacts for effecting
separation of said contacts in response to prede-
termined conditions and means for excluding the
electro-responsive device from the circuit of the arc
formed incident to separation of the con-
tacts, said means being operable in response to
the initial separating movement of the contacts.
10. In a circuit breaker the combination of
switch contacts, a thermal bimetallic device in
30 circuit with said contacts for effecting separation
of said contacts in response to predetermined
conditions, and means for excluding the thermal
bimetallic device from the circuit of the arc
formed incident to the separation of said con-
tacts, said means being operable in response to
the separation of said contacts and as soon as
said contacts have separated a small part of
their total distance of separation.
11. In a circuit breaker the combination of
30 line and load terminals, a stationary contact, a
movable contact connected to said line terminal,
an electro-responsive device having one terminal
thereof connected to the load terminal and its
other terminal connected to said stationary con-
tact for effecting movement of the movable con-
tact to open circuit position in response to prede-
termined conditions, an arc extinguishing means
comprising an arc runner connected to said stacionary contact and a series of
spaced notched plates of magnetic material for effecting
transfer of the arc formed incident to separation
of the contacts from the stationary contact to
said arc runner and said plates and a connection
completed by the transfer of the arc to said arc
runner for excluding said electro-responsive de-
vice from the circuit of the arc as soon as the
movable contact has moved a small part of its
total movement toward open circuit position.
12. In a circuit breaker the combination of
line and load terminals, a stationary contact, a
movable contact connected to said line terminal,
an electro-responsive device having one terminal
thereof connected to the load terminal and its
other terminal connected to said stationary con-
tact for effecting movement of the movable con-
tact to open circuit position in response to prede-
termined conditions, an arc extinguishing means
comprising an arc runner connected to said stacionary contact and a series of
notched spaced 30 plates of magnetic material for effecting transfer of the arc formed incident to separation
of the contacts from the stationary contact to
said arc runner and said plates and a connection
from the load side of said electro-responsive device to one

of said plates for excluding said device from the circuit of the arc upon initial movement of said movable contact toward open circuit position.

5. In a circuit breaker the combination of line and load terminals, a stationary contact, a movable contact connected to one of said terminals, an electro-responsive device having one terminal thereof connected to the other terminal and its other terminal connected to said stationary contact for effecting movement of the movable contact to open circuit position in response to predetermined conditions, an arc extinguishing means comprising an arc runner connected to said stationary contact and a plurality of spaced plates of magnetic material for effecting transfer of the arc formed incident to separation of the contacts from said stationary contact to said movable contact.

10. In a circuit breaker the combination of line and load terminals, a stationary contact, a movable contact connected to one of said terminals, an electro-responsive device having one terminal thereof connected to the other terminal and its other terminal connected to said stationary contact for effecting movement of the movable contact to open circuit position in response to predetermined conditions, an arc extinguishing device comprising a divided arc runner having one section thereof connected to said stationary contact, the other section thereof insulated therefrom, a plurality of spaced plates of magnetic material for effecting transfer of the arc formed incident to separation of the contacts from said stationary contact to said movable contact for excluding said device from the circuit of the arc as soon as said movable contact has moved a small part of its total movement toward open circuit position.

15. In a circuit breaker the combination of line and load terminals, a stationary contact, a movable contact connected to one of said terminals, an electro-responsive device having one terminal thereof connected to the other terminal and its other terminal connected to said stationary contact for effecting movement of the movable contact to open circuit position in response to predetermined conditions, an arc extinguishing means comprising an arc runner connected to said stationary contact and a plurality of spaced plates of magnetic material for effecting transfer of the arc formed incident to separation of the contacts from said stationary contact to said movable contact.

20. In a circuit breaker the combination of line and load terminals, a movable contact connected to the line terminal, a stationary contact, a bimetallic device having one terminal thereof connected to the load terminal and its other terminal connected to said stationary contact for effecting movement of said movable contact to open circuit position in response to predetermined conditions, an arc extinguishing device comprising a divided arc runner and said plate, and a connection from the first mentioned terminal of said movable contact to said insulated section of the arc runner for excluding said electro-responsive means from the circuit of the arc upon initial movement of said movable contact toward open circuit position.

25. In a circuit breaker the combination of line and load terminals, a movable contact connected to the line terminal, a stationary contact, a bimetallic device having one terminal connected to the load terminal and its other terminal connected to said stationary contact for effecting movement of said movable contact to open circuit position in response to predetermined conditions, an arc extinguishing device comprising a divided arc runner and said plate, and a connection from the first mentioned terminal of said movable contact to said insulated section of the arc runner for excluding said means from the circuit of the arc as soon as said movable contact has moved a small part of its total movement toward open circuit position.

30. In a circuit breaker the combination of a stationary contact, a movable contact, an electro-responsive device normally connected in circuit with said contacts for effecting movement of the movable contact to open circuit position in response to predetermined overload conditions, an auxiliary conducting member to which the end of the arc established on the stationary contact is transferrable and means for excluding said electro-responsive device from the circuit of the arc upon transfer of the end of the arc from the stationary contact to said auxiliary conducting member.

35. In a circuit breaker the combination of a stationary contact, a movable contact, a bimetallic device connected in circuit with said contacts for effecting movement of the movable contact to open circuit position in response to predetermined overload conditions, means for transferring the arc formed incident to separation of the contacts from said stationary contact to said movable contact, a conductor connected to said auxiliary contact for excluding said device from the circuit of the arc immediately after said movable contact has moved a small distance toward open circuit position.

40. In a circuit interrupter, the combination of a stationary contact, a movable contact, an electro-responsive device normally connected in circuit with said contacts, a plurality of spaced plates of magnetic material for effecting transfer of the arc formed incident to separation of the contacts from said stationary contact to said movable contact, an auxiliary conducting member to which the end of the arc established on the stationary contact is transferrable and means for excluding said electro-responsive device from the circuit of the arc upon transfer of the end of the arc from the stationary contact to said auxiliary conducting member.

45. In a circuit interrupter, the combination of a stationary contact, a movable contact, an electro-responsive device normally connected in circuit with said contacts, a plurality of spaced plates of magnetic material for effecting transfer of the arc formed incident to separation of the contacts from said stationary contact to said movable contact, an auxiliary conducting member to which the end of the arc established on the stationary contact is transferrable and means for excluding said electro-responsive device from the circuit of the arc upon transfer of the end of the arc from the stationary contact to said auxiliary conducting member.

50. In a circuit interrupter, the combination of a stationary contact, a movable contact, an electro-responsive device normally connected in circuit with said contacts, a plurality of spaced plates of magnetic material for effecting transfer of the arc formed incident to separation of the contacts from said stationary contact to said movable contact, an auxiliary conducting member to which the end of the arc established on the stationary contact is transferrable and means for excluding said electro-responsive device from the circuit of the arc upon transfer of the end of the arc from the stationary contact to said auxiliary conducting member.

55. In a circuit interrupter, the combination of a stationary contact, a movable contact, an electro-responsive device normally connected in circuit with said contacts, a plurality of spaced plates of magnetic material for effecting transfer of the arc formed incident to separation of the contacts from said stationary contact to said movable contact, an auxiliary conducting member to which the end of the arc established on the stationary contact is transferrable and means for excluding said electro-responsive device from the circuit of the arc upon transfer of the end of the arc from the stationary contact to said auxiliary conducting member.

60. In a circuit interrupter, the combination of a stationary contact, a movable contact, an electro-responsive device normally connected in circuit with said contacts, a plurality of spaced plates of magnetic material for effecting transfer of the arc formed incident to separation of the contacts from said stationary contact to said movable contact, an auxiliary conducting member to which the end of the arc established on the stationary contact is transferrable and means for excluding said electro-responsive device from the circuit of the arc upon transfer of the end of the arc from the stationary contact to said auxiliary conducting member.

65. In a circuit interrupter, the combination of a stationary contact, a movable contact, an electro-responsive device normally connected in circuit with said contacts, a plurality of spaced plates of magnetic material for effecting transfer of the arc formed incident to separation of the contacts from said stationary contact to said movable contact, an auxiliary conducting member to which the end of the arc established on the stationary contact is transferrable and means for excluding said electro-responsive device from the circuit of the arc upon transfer of the end of the arc from the stationary contact to said auxiliary conducting member.

70. In a circuit interrupter, the combination of a stationary contact, a movable contact, an electro-responsive device normally connected in circuit with said contacts, a plurality of spaced plates of magnetic material for effecting transfer of the arc formed incident to separation of the contacts from said stationary contact to said movable contact, an auxiliary conducting member to which the end of the arc established on the stationary contact is transferrable and means for excluding said electro-responsive device from the circuit of the arc upon transfer of the end of the arc from the stationary contact to said auxiliary conducting member.

MERRILL G. LEONARD.