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W. H. EDMUNDS

3,012,118

CURRENT LIMITING CIRCUIT BREAKER

Filed Oct. 29, 1958

3 Sheets-Sheet 2

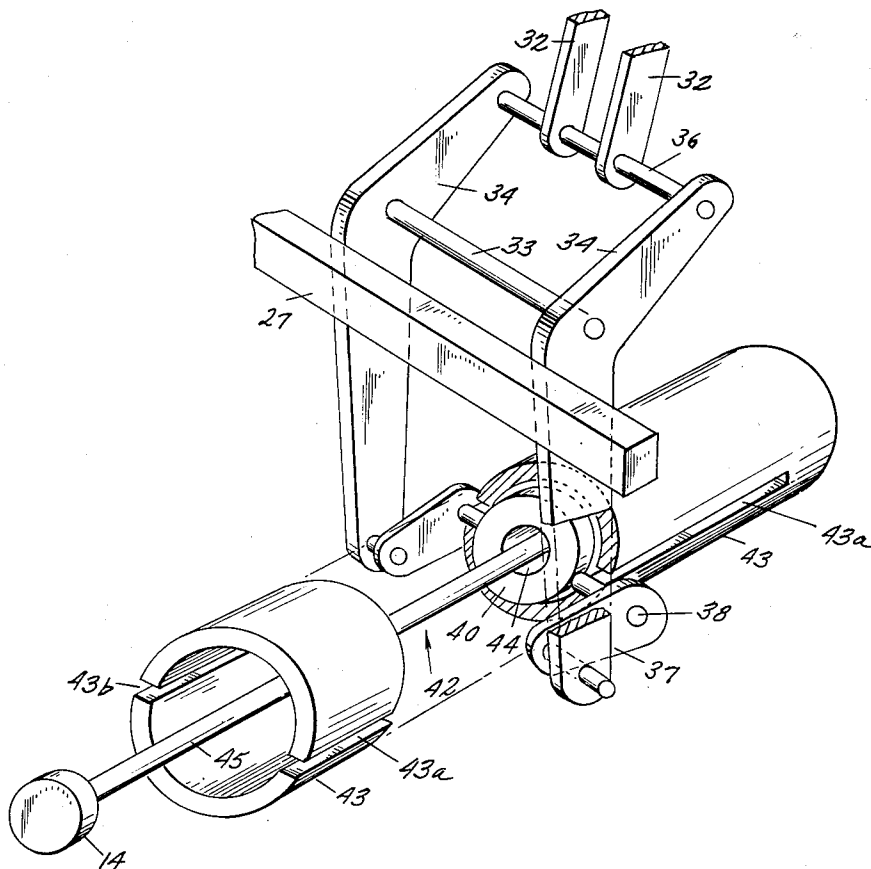


FIG. 2.

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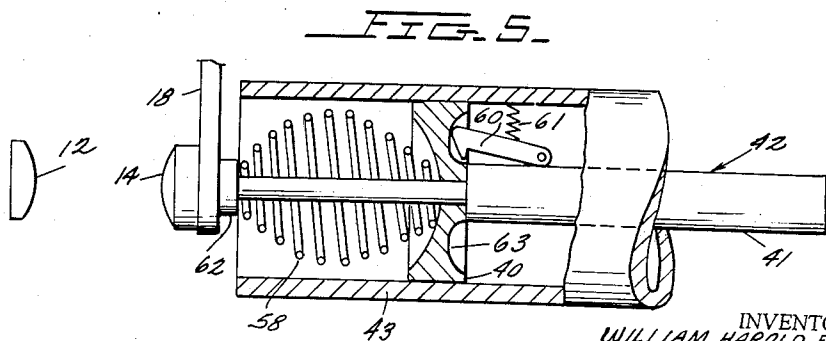
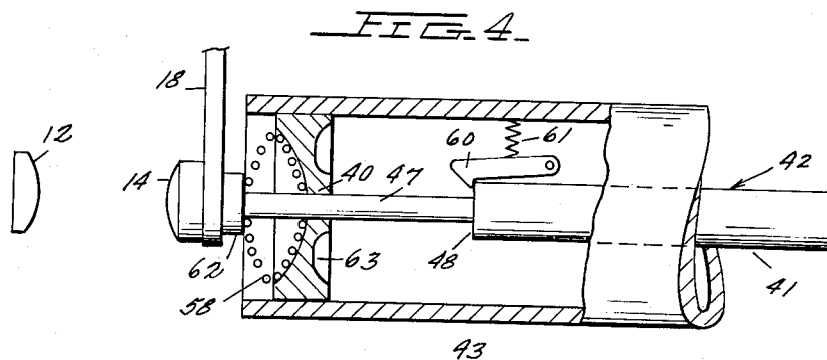
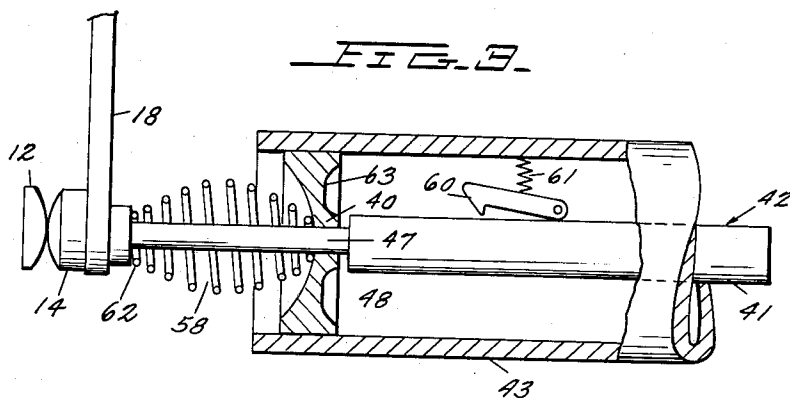
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3 Sheets-Sheet 3



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3,012,118

CURRENT LIMITING CIRCUIT BREAKER

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Filed Oct. 29, 1958, Ser. No. 770,321

15 Claims. (Cl. 200-88)

This invention relates to a current limiting circuit breaker.

In the past, relatively small circuit interrupters have been provided which consist of the combination of an electrically and mechanically coordinated circuit breaker and current limiting fuse. Circuit interrupters of this type are described in my U.S. Patent No. 2,843,702 issued July 15, 1958 entitled, Protective Device with Current Limiting Means, and assigned to the assignee of the instant application.

In circuit interrupters of this type, the circuit breaker operates to protect the line from overloads and relatively low short circuit current conditions as compared to the available short circuit current. The current limiting fuse coordinated with the circuit breaker is so designed as to operate only when the short circuit current is to exceed some predetermined value. This fuse is characterized in operating in an extremely short time and in being current limiting. In operation, the current limiting fuse will limit the short circuit current and interrupt the circuit so that the maximum available short circuit current will never pass through the circuit interrupter. Because of this, it is possible to design the circuit breaker to have a relatively low short circuit interrupting ability with relation to the available short circuit current of the line being protected. Thus, the combination provides a relatively small unit for protecting a relatively high capacity line.

The disadvantage of the above noted type of circuit interrupter is that when the fuse is operated it must be replaced. Further disadvantages lie in the relatively complex mechanism required in mechanically coordinating the operation of the current limiting fuse and its associated circuit breaker.

The principle of my invention is to provide a unitary circuit breaker which exhibits the fast operation and current limiting action of a current limiting fuse under relatively severe fault conditions, while operating normally under overload and relatively low short circuit conditions.

In essence, I have found that if the circuit breaker contacts are initially disengaged upon the occurrence of a relatively severe fault condition, the fault current will be limited in much the same manner as it is limited by the current limiting fuse. Thus, if the circuit breaker contacts may be separated quickly enough responsive to the occurrence of a severe fault condition, the "let-through" current will be substantially below the magnitude of the available short circuit current because of this current limiting action. Hence, the interrupting ability of the circuit breaker may be substantially lower than the available fault current of the system being protected. That is to say, by causing the current limiting action under severe fault conditions, the maximum available short circuit current of the system will not be permitted to flow, but only some smaller value known as the "let-through" value will flow because of the current limiting action of the circuit breaker.

In a preferred embodiment of my invention, I arrange

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the contacts so that they will "blow off" when a short circuit current beyond some predetermined value passes through the contacts prior to the time that the normal trip mechanism becomes operative. An auxiliary mechanism is also provided which will become operative to at least prevent the contacts from reclosing until the normal trip mechanism operates and the normal operating mechanism or the auxiliary mechanism itself causes complete contact separation.

Under overload conditions or under short circuit conditions which are below some predetermined magnitude, the normal trip mechanism and operating mechanism of the circuit breaker will operate to disengage the circuit breaker contacts in the usual manner. When, however, there will be a fault current which will exceed the interrupting ability of the circuit breaker, the contacts will blow off and my novel auxiliary mechanism will be operated to initially move and maintain the contacts toward a disengaged position independently of the normal circuit breaker operating means and initiate the above described current limiting action. Once the initial contact disengagement has been achieved, the contacts remain disengaged until the normal operating mechanism of the circuit breaker which takes longer to operate than does the auxiliary operating mechanism, "catches up" to the auxiliary operating mechanism so that the contacts may be driven to, or maintained in, a full disengaged position.

Accordingly, a primary object of my invention is to provide a novel circuit breaker having current limiting characteristics.

Another object of my invention is to impart current limiting characteristics to a circuit breaker by causing an initial contact separation when a short circuit current is beyond some predetermined value.

Another object of my invention is to provide an extremely fast acting current limiting circuit breaker in which the circuit breaker operation proceeds normally under relatively minor fault conditions, but has an initial high speed contact opening operation which is followed through by a complete contact opening when the fault is beyond some predetermined condition.

Another object of my invention is to provide a circuit interrupter having current limiting action whereby the interrupting ability of the circuit breaker is lower than the available short circuit current of the line to be protected.

These and other objects of my invention will become apparent from the following description when taken in connection with the drawings, in which:

FIGURE 1 shows a side cross-sectional view of an embodiment of my novel invention.

FIGURE 2 shows an exploded perspective view of the auxiliary operating mechanism of FIGURE 1.

FIGURE 3 shows a side cross-sectional view of the auxiliary operating mechanism of FIGURE 1 with the circuit breaker contacts in their engaged position.

FIGURE 4 is similar to FIGURE 3 where the circuit breaker contacts have been moved to a disengaged position by the auxiliary operating mechanism responsive to a fault which is above some predetermined magnitude.

FIGURE 5 is similar to FIGURES 3 and 4 and shows the auxiliary operating mechanism in its reset condition after the normal circuit breaker operating mechanism has moved to the disengaged position.

FIGURE 6 schematically indicates one type of interconnection between a solenoid of an auxiliary operating

mechanism and the circuit breaker contacts for a three-phase circuit breaker where there is an initial contact blow off.

FIGURE 7 illustrates a second embodiment of the manner in which the solenoid which controls the auxiliary operating mechanism may be energized where no initial blow off is required.

Referring now to FIGURE 1, my novel current limiting circuit breaker may be comprised of as many poles as is desired, FIGURE 1 showing a cross-section through a single pole. The circuit breaker is conventionally housed in a casing 10 and is comprised of a stationary contact 12 which cooperates with a movable contact 14.

The cooperating contacts 12 and 14 are conventionally associated with an arc chute means schematically illustrated as arc chute 15 in FIGURE 1 where arc chute 15 may be of any desired type. The stationary contact 12 is connected to a line lug or terminal 16, while the movable contact is connected through conductor 18 to a trip unit 20 which will be described more fully hereinafter, and the output of trip unit 20 is connected to a load lug or terminal 22 by conductor 23.

Note that the current path through contacts 12, 14 and conductor 18 has a U-shape whereby a blow off force tending to open the contacts will be created by current flow in the path.

The operating mechanism for movable contact 14 includes an operating handle 24 which is movably supported by casing 10 in any desired manner.

The operating handle 24 is operatively connected to a toggle operating mechanism through the operating spring 26 which has its upper end attached to handle 24. The toggle mechanism is comprised of a cradle link 28 which is pivotally mounted on pivot pin 29, toggle links 30 and 32 which are pivotally connected by pin 31, and an output link 34. The lower end of operating spring 26 is connected to pin 31 as illustrated in FIGURE 1. Output link 34 is a generally L-shaped member and is pivotally mounted by pivot pin 33 and, if there is more than one pole, the poles are interconnected by a common shaft 27 which is fastened to the corresponding member 34 of the pole. The output link 34, as best seen in FIGURE 2, is pivotally connected to toggle link 32 through the pin 36 and toggle link 30 is pivotally connected to cradle link 28 by pin 35. The lower end of output link 34 is then connected to pins 38 (FIGURES 1 and 2) through the intermediate links 37.

Pins 38 are connected to disk 40, and disk 40 is operatively connected to solenoid plunger 42, a portion of which extends through an aperture 44 of disk 40, as seen in FIGURE 2. More specifically, solenoid plunger 42 is comprised of a magnetic portion 41 of a diameter larger than the diameter of aperture 44 of disk 40 and a second portion 45, which is not necessarily of magnetic material and which has a diameter sufficiently small to allow portion 45 to extend through aperture 44. Portion 45, as shown in the figures, is terminated by the movable contact 14. Disk 40 is then supported within cylindrical housing 43 with pins 38 extending through slots 43a and 43b (FIGURE 2) of housing 43.

Trip unit 20 is of any standard type, such as that of my above noted U.S. Patent No. 2,843,702 and for that reason has not been shown in detail in this application. It is sufficient for the purposes of understanding the instant invention to understand that the trip unit 20 has an output latch member 46 which can latch the cradle link 28 in the position shown in FIGURE 1. The trip unit 20 may contain overload trip sensing elements such as a bimetal, and short circuit responsive trip elements such as a magnetic armature system whereby, responsive to overload conditions or responsive to short circuit currents of a relatively low magnitude, the latch member 46 will be withdrawn to unlatch cradle member 28. Clearly, when cradle member 28 is unlatched, the biasing force of toggle spring 26, which is terminated at pin 31, will

drive the cradle link 28 in a counter-clockwise direction about its pivot pin 29 to thereby rotate output link 34 counter-clockwise around its pivot 33. With the counter-clockwise rotation of output member 34 about pivot 33, the disk 40 will be driven to the right to pick up the shoulder 48 formed by the junction of portions 41 and 45 of solenoid plunger 42 so as to drive the plunger to the right, and thus drive movable contact 14 toward a disengaged position.

Accordingly, the operating mechanism, under the control of trip unit 20, will cause a disengagement of cooperating contacts 12 and 14.

Manual operation of movable contact 14 proceeds by moving the operating handle 24 to the right in order to disengage the contacts, and to the left in order to engage them. Thus, if the circuit breaker contacts are to be disengaged, the operating handle 24 is moved to the right to bring toggle spring 26 to an overcenter position with respect to pivots 31 and 35. With the spring in this position, the toggle links 30 and 32 will collapse to the right under the force of toggle spring 26 whereby output member 34 is driven counter-clockwise about its pivot 27 and the mechanism is operated to its disengaged position.

In order to manually close the contacts, the operating handle 24 is brought to the left so that the axis of spring 26 moves across the line formed by pivots 31 and 35 to cause the toggle mechanism to snap to the engaged position of FIGURE 1, the knee of the toggle moving against appropriate stop means such as stop 50 of FIGURE 1.

The above described structure is seen to operate as is typically required of a circuit breaker, under manual conditions and under trip conditions as determined by the normal trip unit 20.

The essence of my invention is to further provide a means which will operate the contacts to an initially disengaged position responsive to the occurrence of a fault which is above some predetermined magnitude.

This initial operating means is comprised of the combined blow off current path in combination with an auxiliary operating mechanism in FIGURES 1 through 5 and includes the disk 40, cylinder 43 which houses disk 40, and solenoid coil 56 which cooperates with the enlarged magnetic portion 41 of solenoid plunger 42.

An energizing means, schematically shown as energizing means 55 in FIGURE 1 is associated with solenoid coil 56 and with the main current carrying circuit (as indicated by the dotted lines) so that coil 56 will be sufficiently energized to operate the contacts under predetermined conditions. Typical energizing circuits will be described hereinafter in connection with FIGURES 6 and 7. The mechanism further provides a biasing spring, shown as barrel spring 58 in FIGURES 1 and 3 through 5, and a latch mechanism. The pivotally mounted latch 60 of FIGURES 3, 4 and 5 is biased toward a latching engagement with shoulder 48 of plunger 42 by biasing spring 61 when the plunger is withdrawn as seen in FIGURE 4. The latch 60 may be released through the annular camming notch 63 in the right hand surface of disk 40 (FIGURES 3, 4 and 5) as will be described more fully hereinafter.

The biasing spring 58 is positioned between plunger portion 45 and the left hand face of disk 40 so as to bias the movable contact 14 towards its contact engaged position. The biasing force of spring 58 is correlated with the blow off force of the contacts so that the contacts are disengaged responsive to predetermined short circuit conditions which produce predetermined blow off forces. Similarly, the solenoid coil is made operative responsive to these predetermined conditions to maintain the contacts in their disengaged position and will be ineffective under all conditions other than those in which the predetermined fault current flows.

The normal operating position of the auxiliary operating mechanism is shown in FIGURE 3 where the

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plunger extension 45 is biased towards its fully extended position by the barrel spring 58.

As previously described, the auxiliary operating mechanism is connected to the movable contact 14 independently of the normal operating mechanism including output link 34. That is to say, the operation of trip unit 20 or operating handle 24 may operate the movable contact 14 independently of the auxiliary operating mechanism. In a similar manner, contact blow off and energization of coil 56, which is sufficient to move and maintain iron plunger 42 and contact 14 against the biasing force of spring 58, will be independent of the normal operating mechanism.

In operation, if the circuit breaker is closed and carrying current and there is then a fault in the circuit, either the trip unit 20 or the contact blow off action and solenoid coil 56 will initially operate to cause contact disengagement depending upon the magnitude of the fault. Assuming first that the fault is of a relatively low short circuit type or an overload which is normally handled by the circuit breaker, the relatively low blow off forces will be suppressed by spring 58 and energized and the trip unit 20 will cause the normal interrupting operation of the circuit breaker.

Where, however, the fault is of a relatively severe nature, the contacts will initially blow off against spring 58 and the energizing means 55 will be energized so that solenoid coil 56 will continue to drive plunger 42 to the right against the biasing force of barrel spring 58 until, as shown in FIGURE 4, latch 60 under the influence of its bias spring 61 will engage shoulder 48 of plunger 42.

It is to be noted that this operation proceeds independently of the operating mechanism since the extending portion 45 of plunger 42 which carries movable contact 14 moves with respect to disk 40 even though disk 40 is held in a position which is related to the still closed position of the operating mechanism. Accordingly, the contact 14 is driven with a speed which is independent of the inertia and time delay of the operating mechanism and the normal trip unit 20.

The immediate operation of the contacts to their disengaged position will, as I have found, impart current limiting action to the breaker. Therefore, the magnitude of the current which will flow through the breaker will be substantially less than the available short circuit current of the system and the circuit breaker may have an interrupting capacity which is substantially lower than the interrupting capacity of the system being protected.

After the movable contact 14 has begun to move to a disengaged and latched open position as shown in FIGURE 4, the trip unit 20 will be operated by its instantaneous or overload trip elements so as to remove latch 46 from cradle link 28. Hence, the operating mechanism will now follow the movable contact and eventually the operating mechanism will "catch up" to the movable contact. As shown in FIGURE 6, as the disk 40 is moved to the right under the influence of the operating mechanism, the annular camming notch 63 will cam latch 60 out of latching engagement with shoulder 48 and the contact 14 will be held disengaged or will continue to move to its disengaged position by virtue of toggle spring 26 of the operating mechanism. Note that this same unlatching operation will proceed during normal operation of the operating mechanism.

The so-called cross-over point of this system, or the point above which the auxiliary operating mechanism operates, is determined by the blow off point of contact 14 against spring 58 which is a function of contact pressure, strength of spring 58 and the effective solenoid pull. One manner in which solenoid 56 may be controlled is shown in FIGURE 6 which schematically shows a three pole circuit breaker constructed in accordance with my novel invention and having line ter-

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minals 70, 72 and 74 and load terminals 76, 78 and 80 respectively. The contacts 82, 84 and 86 of each phase are provided with a cooperating solenoid coil 88, 90 and 92 respectively. Solenoid coils 88, 90 and 92 will operate their respective circuit breaker contacts 82, 84 and 86 in a manner similar to that described for the structure of FIGURES 1 through 5. The contacting elements 82, 84 and 86 are similarly associated with small normally closed auxiliary contactors 94, 96 and 98 respectively which are electrically connected in series with coils 88, 90 and 92 respectively, each series combination being connected in parallel with their respective circuit breaker contacts 82, 84 and 86. Contactors 82, 84 and 86 are mechanically connected to their respective circuit breaker contacts as indicated by the dotted lines to be moved to a disengaged position after their respective circuit breaker contact opens.

In operation, it will be seen that when there is an extremely rapid rise in current through any of the poles, this current will, when of some predetermined value, initiate contact separation of their respective circuit breaker contact by the above described blow off action. The voltage drop across the separating contacts is then impressed across the respective solenoid so that the solenoid is sufficiently energized to at least maintain the contacts in their disengaged position. After the circuit breaker contacts are fully disengaged, contactors 94, 96 and 98 in series with solenoid coils 88, 90 and 92 are moved to disengaged positions with the movement of their respective circuit breaker contacts to the disengaged position so as to completely disconnect the circuit.

An alternate mode of control which is independent of any blow off action is shown in FIGURE 7 where the solenoid coil alone causes the initial high speed contact separation. In FIGURE 7, a single pole of a circuit breaker is shown, this pole having a line terminal 100, load terminal 102 and circuit breaker contacts 104. A fault sensing means 106 is connected in series with the main current carrying circuit and the voltage drop across this element is connected between the control electrode 108 and main electrode 110 of spark gap 112 having a second main electrode 114. The impedance of element 106 may be of any desired nature whereby it delivers a firing signal to spark gap 112 under predetermined fault conditions. Thus, means 106 could be inductive so as to deliver a signal which is responsive to rate of change of current in the circuit being protected or could be resistive in nature so as to be responsive to instantaneous current magnitude. Similarly, means 106 can be comprised of any of the well known transducer schemes such as that set forth in copending application Serial No. 757,560 filed August 27, 1958 entitled, High Speed Interrupters and D.-C. Circuits, in the names of Otto Jensen and Francis R. Bingham and assigned to the assignee of the instant invention.

The main electrodes 110 and 114 are connected in series with the solenoid coil 116 which cooperates with circuit breaker contacts 104 and an energizing storage capacitor 118 and discharge resistor 119. Energy storage capacitor 118 is charged from a low voltage D.-C. source formed by the single phase bridge connected rectifier 120 and the charging resistor 122, the rectifier 120 being energized from any available voltage source connected to terminals 124 and 126.

In operation, when a predetermined type of fault is sensed by fault sensing means 106, a voltage will be impressed between electrodes 108 and 110 which is sufficient to fire the spark gap between main electrodes 110 and 114. Capacitor 118 will then discharge through the spark gap 112 and into the solenoid coil 116 to produce a high energy pulse across coil 116 which will be of a closely controlled magnitude and a uniform magnitude for any operation to cause initial contact separation as described above.

Although I have described preferred embodiments of my novel invention, many variations and modifications will now be obvious to those skilled in the art, and I prefer therefore to be limited not by the specific disclosure herein, but only by the appended claims.

I claim:

1. A current limiting circuit breaker; said current limiting circuit breaker comprising a pair of cooperating contacts having an engaged and disengaged position with respect to one another, a manual operating means operatively connected to at least one of said pair of cooperating contacts, a latch means for normally latching said pair of cooperating contacts on said engaged position and a fault responsive operating means operatively connected to at least one of said pair of cooperating contacts; a housing, said pair of cooperating contacts, said manual operating means, and said fault responsive operating means being contained within said housing; a portion of said manual operating means extending through said housing to be accessible to manual operation; said fault responsive operating means including means to initiate a relatively high speed disengagement of said pair of cooperating contacts responsive to fault conditions in the circuit including said circuit breaker and means for holding said cooperating contacts in said disengaged position for a period of time at least sufficient to operate said latch means; said holding means including circuit elements for measuring electrical conditions in the circuit containing said circuit breaker and being operable responsive to fault conditions in said circuit; said fault responsive operating means being operable independently of said manual operating means and said latch means.

2. A current limiting circuit breaker; said current limiting circuit breaker comprising a pair of cooperating contacts having an engaged and disengaged position with respect to one another, a manual operating means operatively connected to at least one of said pair of cooperating contacts, a latch means for normally latching said pair of cooperating contacts on said engaged position and a fault responsive operating means operatively connected to at least one of said pair of cooperating contacts; a housing, said pair of cooperating contacts, said manual operating means, and said fault responsive operating means being contained within said housing; a portion of said manual operating means extending through said housing to be accessible to manual operation; said fault responsive operating means including means to at least initiate a relatively high speed disengagement of said pair of cooperating contacts responsive to fault conditions in the circuit including said circuit breaker and means for holding said cooperating contacts in said disengaged position for a period of time at least sufficient to operate said latch means; said holding means including circuit elements for measuring electrical conditions in the circuit containing said circuit breaker and being operable responsive to fault conditions in said circuit; said fault responsive operating means being operable independently of said manual operating means and said latch means; said initial disengagement of said cooperating contacts having a current limiting action on the current through said circuit breaker whereby the fault capacity of said current limiting circuit breaker is substantially below the available fault capacity of the circuit being protected.

3. In a circuit breaker; a relatively fixed contact and a relatively movable contact movable into and out of engagement with respect to said relatively stationary contact; an operating mechanism operatively connected to said movable contact, a manual operating means, a latch means for normally latching said relatively movable contact in said engaged position, and an overload trip means; said operating mechanism being operatively connected to said manual operating means and to said latch means; said manual operating means operating said

movable contact between said engaged and disengaged position responsive to manual operation thereof; said overload trip means operating said latch means to operate said movable contact to a disengaged position responsive to overload currents of less than a predetermined nature; an auxiliary contact operating mechanism; said auxiliary contact operating mechanism being operatively connected to said movable contact independently of said operating mechanism; said auxiliary contact operating means being operable responsive to the occurrence of a fault current of greater than said predetermined nature; said auxiliary contact operating mechanism including means for moving said movable contact toward a disengaged position at high speed, independently of said operating mechanism and said latch means responsive to fault currents of greater than said predetermined nature and means for holding said movable contact in said disengaged position for a period of time at least sufficient to operate said latch means.

4. In a circuit breaker; a relatively fixed contact and a relatively movable contact movable into and out of engagement with respect to said relatively stationary contact; an operating mechanism operatively connected to said movable contact, a manual operating means, a latch means for normally latching said relatively movable contact in said engaged position, and an overload trip means; said operating mechanism being operatively connected to said manual operating means and to said latch means; said manual operating means operating said movable contact between said engaged and disengaged position responsive to manual operation thereof; said overload trip means operating said latch means to operate said movable contact to a disengaged position responsive to overload currents of less than a predetermined nature; an auxiliary contact operating mechanism; said auxiliary contact operating mechanism being operatively connected to said movable contact independently of said operating mechanism; said auxiliary contact operating means being operable responsive to the occurrence of a fault current of greater than said predetermined nature; said auxiliary contact operating mechanism including means for moving said movable contact toward a disengaged position at high speed, independently of said operating mechanism and said latch means responsive to fault currents of greater than said predetermined nature and means for holding said movable contact in said disengaged position for a period of time at least sufficient to operate said latch means; said auxiliary contact operating mechanism imparting current limiting characteristics to said circuit breaker whereby said circuit breaker has a fault capacity smaller than the available fault capacity of the circuit being protected.

5. A current limiting circuit breaker; said current limiting circuit breaker comprising a pair of cooperating contacts, an operating mechanism including latch means operatively associated with at least one of said pair of cooperating contacts for controlling movement of said pair of cooperating contacts between an engaged and disengaged position, a fault sensing means operatively connected to said operating mechanism for moving said contacts from said engaged position to said disengaged position responsive to fault conditions and an auxiliary contact operating means; said auxiliary contact operating means being operatively associated with said pair of cooperating contacts to impart at least an initial movement to a disengaged position upon energization thereof; said auxiliary contact operating means including means for holding said cooperating contacts in said disengaged position for a period of time at least sufficient to operate said latch means; said holding means being operable responsive to fault conditions above a predetermined value; said fault sensing means being operable to cause contact disengagement responsive to fault conditions below said predetermined value; said auxiliary contact operating means being operable independent of said op-

erating mechanism including said latch means; said initial disengagement of said cooperable contacts by said auxiliary operating means having a current limiting action on the current flow through said circuit breaker; said circuit breaker having an interrupting capacity substantially below the fault capacity of the circuit containing said circuit breaker; said auxiliary contact operating means including a blow off current path for said pair of cooperating contacts.

6. In a circuit breaker; a relatively fixed contact and a relatively movable contact movable into and out of engagement with respect to said relatively stationary contact; an operating mechanism including latch means operatively connected to said movable contact, a manual operating means, and an overload trip means; said operating mechanism being operatively connected to said manual operating means and to said overload trip means; said manual operating means operating said movable contact between said engaged and disengaged position responsive to manual operation thereof; said overload trip means operating said movable contact to a disengaged position responsive to overload currents of less than a predetermined nature; an auxiliary contact operating mechanism; said auxiliary contact operating mechanism being operatively connected to said movable contact independently of said operating mechanism including latch means; said auxiliary contact operating means being operable responsive to the occurrence of a fault current of greater than said predetermined nature; said auxiliary contact operating mechanism including means for moving said movable contact toward a disengaged position at high speed, independently of said operating mechanism responsive to fault currents of greater than said predetermined nature and means for holding said movable contact in said disengaged position for a period of time at least sufficient to operate said latch means; said moving means including circuit elements arranged to cause blow off of said relatively movable contact responsive to said fault currents greater than said predetermined value.

7. In combination; a circuit and a circuit interrupting device in series therewith; said circuit interrupter comprising a current limiting circuit breaker; said current limiting circuit breaker comprising a pair of cooperating contacts, an operating mechanism operatively associated with at least one of said pair of cooperating contacts for controlling movement of said pair of cooperating contacts between an engaged and disengaged position, a fault sensing means operatively connected to said operating mechanism for moving said contacts from said engaged position to said disengaged position responsive to fault conditions and an auxiliary contact operating means; said auxiliary contact operating means being operatively associated with said pair of cooperating contacts to impart at least an initial movement of said pair of cooperating contacts to a disengaged position upon energization thereof; said auxiliary contact operating means being operable responsive to fault conditions above a predetermined value and causing at least said initial movement of said cooperating contacts during said fault conditions above a predetermined value; means responsive to said fault conditions above said predetermined value for holding said cooperating contacts in said disengaged position for a period of time at least sufficient for operation of said fault sensing means; said circuit being capable of delivering fault current in excess of the fault current which can be carried by said current limiting circuit breaker; said current limiting circuit breaker preventing the fault current of said circuit from reaching said value in excess of the capacity of said current limiting circuit breaker.

8. In combination; a circuit and a circuit interrupting device in series therewith; said circuit interrupting device comprising a current limiting circuit breaker; said current limiting circuit breaker comprising a pair of cooperating contacts, an operating mechanism operatively associated with at least one of said pair of cooperating

contacts for controlling movement of said pair of cooperating contacts between an engaged and disengaged position, a fault sensing means operatively connected to said operating mechanism for moving said contacts from said engaged position to said disengaged position responsive to fault conditions and an auxiliary contact operating means; said auxiliary contact operating means being operatively associated with said pair of cooperating contacts to impart at least an initial movement of said cooperating contacts to a disengaged position upon energization thereof; said auxiliary contact operating means being operable responsive to fault conditions above a predetermined value; means responsive to a fault condition above said predetermined value for holding said contacts in said disengaged position a period of time which is more than sufficient to operate said fault sensing means; said auxiliary contact operating means being operable independent of said operating mechanism; said circuit being capable of delivering fault current in excess of the fault current which can be carried by said current limiting circuit breaker; said current limiting circuit breaker preventing the fault current of said circuit from reaching said value in excess of the capacity of said current limiting circuit breaker.

9. In combination; a circuit and a circuit interrupting device in series therewith; said circuit interrupting device comprising a current limiting circuit breaker; said current limiting circuit breaker comprising a pair of cooperating contacts, an operating mechanism operatively associated with at least one of said pair of cooperating contacts for controlling movement of said pair of cooperating contacts between an engaged and disengaged position, a fault sensing means operatively connected to said operating mechanism for moving said contacts from said engaged position to said disengaged position responsive to fault conditions and an auxiliary contact operating means; said auxiliary contact operating means being operatively associated with said pair of cooperating contacts to impart at least an initial movement of said cooperating contacts to a disengaged position upon energization thereof; said auxiliary contact operating means being operable responsive to fault conditions above a predetermined value; means responsive to fault conditions above said predetermined value for holding said cooperating contacts in said disengaged position for a period of time which is more than sufficient to operate said fault sensing means; said fault sensing means being operable to cause contact disengagement responsive to fault conditions below said predetermined value; said auxiliary contact operating means being operable independent of said operating mechanism; said initial disengagement of said cooperable contacts by said auxiliary operating means having a current limiting action on the current flow through said circuit breaker; said circuit breaker having an interrupting capacity substantially below the fault capacity of the circuit containing said circuit breaker; said circuit being capable of delivering fault current in excess of the fault current which can be carried by said current limiting circuit breaker; said current limiting circuit breaker preventing the fault current of said circuit from reaching said value in excess of the capacity of said current limiting circuit breaker.

10. In combination; a circuit and a circuit interrupting device in series therewith; said circuit interrupting device comprising a current limiting circuit breaker; said current limiting circuit breaker comprising a pair of cooperating contacts, an operating mechanism operatively associated with at least one of said pair of cooperating contacts for controlling movement of said pair of cooperating contacts between an engaged and disengaged position, a fault sensing means operatively connected to said operating mechanism for moving said contacts from said engaged position to said disengaged position responsive to fault conditions and an auxiliary contact operating means; said auxiliary contact operating means

being operatively associated with said pair of cooperating contacts to impart at least an initial movement of said cooperating contacts to a disengaged position upon energization thereof; said auxiliary contact operating means being operable responsive to fault conditions above a predetermined value; means responsive to fault conditions above said predetermined value for holding said cooperating contacts in said disengaged position for a period of time which is more than sufficient to operate said fault sensing means; said auxiliary contact operating means being operable independent of said operating mechanism; said auxiliary contact operating means being operable in a shorter time than said operating mechanism; said operating mechanism operating after said auxiliary contact operating means to at least hold said cooperating contacts in a disengaged position; said circuit being capable of delivering fault current in excess of the fault current which can be carried by said current limiting circuit breaker; said current limiting circuit breaker preventing the fault current of said circuit from reaching said value in excess of the capacity of said current limiting circuit breaker.

11. In combination; a circuit and a circuit interrupting device in series therewith; said circuit interrupting device comprising a current limiting circuit breaker; said current limiting circuit breaker comprising a pair of cooperating contacts, an operating mechanism operatively associated with at least one of said pair of cooperating contacts for controlling movement of said pair of cooperating contacts between an engaged and disengaged position; a fault sensing means operatively connected to said operating mechanism for moving said contacts from said engaged position to said disengaged position responsive to fault conditions and an auxiliary contact operating means; said auxiliary contact operating means being operatively associated with said pair of cooperating contacts to impart at least an initial movement of said cooperating contacts to a disengaged position upon energization thereof; said auxiliary contact operating means being operable responsive to fault conditions above a predetermined value; said auxiliary contact operating means being operable independent of said operating mechanism; said auxiliary contact operating means being operable in a shorter time than said operating mechanism; said operating mechanism operating after said auxiliary contact operating means to at least hold said cooperating contacts in a disengaged position; said auxiliary contact operating mechanism including latch means for latching said cooperating contacts disengaged at least until said operating mechanism is operated by said fault sensing means; said circuit being capable of delivering fault current in excess of the fault current which can be carried by said current limiting circuit breaker; said current limiting circuit breaker preventing the fault current of said circuit from reaching said value in excess of the capacity of said current limiting circuit breaker.

12. In combination; a circuit and a circuit interrupting device in series therewith; said circuit interrupting device comprising a current limiting circuit breaker; said current limiting circuit breaker comprising a pair of cooperating contacts having an engaged and disengaged position with respect to one another, a manual operating means operatively connected to at least one of said pair of cooperating contacts, and a fault responsive operating means operatively connected to at least one of said pair of cooperating contacts; said fault responsive operating means being operable to at least initiate a relatively high speed disengagement of said pair of cooperating contacts responsive to fault conditions in the circuit including said circuit breaker; means responsive to fault conditions in said circuit for holding said cooperating contacts in said disengaged position for a predetermined period of time; fault responsive means including circuit elements for measuring electrical conditions in the circuit containing said circuit breaker and operating said fault responsive

operating means responsive to fault conditions in said circuit; said fault responsive operating means being operable independently of said manual operating means; said circuit being capable of delivering fault current in excess of the fault current which can be carried by said current limiting circuit breaker; said current limiting circuit breaker preventing the fault current of said circuit from reaching said value in excess of the capacity of said current limiting circuit breaker.

13. In combination; a circuit and a circuit interrupting device in series therewith; said circuit interrupting device comprising a current limiting circuit breaker; said current limiting circuit breaker comprising a pair of cooperating contacts having an engaged and disengaged position with respect to one another, a manual operating means operatively connected to at least one of said pair of cooperating contacts, and a fault responsive operating means operatively connected to at least one of said pair of cooperating contacts; said fault responsive operating means being operable to at least initiate a relatively high speed disengagement of said pair of cooperating contacts responsive to fault conditions in the circuit including said circuit breaker; means responsive to said fault conditions for holding said cooperating contacts in said disengaged position for a predetermined period of time; fault responsive operating means including circuit elements for measuring electrical conditions in the circuit containing said circuit breaker and operating said fault responsive operating means responsive to fault conditions in said circuit; said fault responsive operating means being operable independently of said manual operating means; said initial disengagement of said cooperating contacts having current limiting action on current through said circuit breaker whereby the fault capacity of said current limiting circuit breaker is substantially below the available fault capacity of the circuit being protected; said circuit being capable of delivering fault current in excess of the fault current which can be carried by said current limiting circuit breaker; said current limiting circuit breaker preventing the fault current of said circuit from reaching said value in excess of the capacity of said current limiting circuit breaker.

14. In combination; a circuit and a circuit breaker therefor connected in series with said circuit; said circuit breaker having a movable contact, a first operating means operatively connected to said movable contact for moving said contact to a predetermined position by manual actuation and by overload trip means and a second operating means operatively connected to said movable contact and being independent of said first operating means for operating said movable contact toward said predetermined position at high speed responsive to fault conditions in excess of a predetermined nature; said second operating means being faster acting than said first operating means; said circuit being capable of delivering fault current in excess of the fault current capable of being carried by said circuit breaker; means responsive to fault conditions in excess of said predetermined nature for holding said movable contact in said predetermined position for a period of time which is more than sufficient to operate said overload trip means; said circuit breaker imparting a current limiting action to fault current in said circuit whereby the fault current in said circuit is held below the fault current capable of being carried by said circuit breaker.

15. A circuit breaker comprising a relatively stationary contact, a relatively movable contact movable into and out of engagement with respect to said relatively stationary contact, an armature connected to said relatively movable contact, first means operatively connected to said armature, said first means having a closed position for urging said contacts into engagement and an open position for urging said contacts out of engagement, latch means abutting said first means for holding said first means in said first position; trip means responsive to

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fault currents passing through said contacts for releasing said latch means to enable said first means to assume said open position, second means responsive to said fault current for rapidly moving said contacts out of engagement while said first means remains in said closed position 5 with said latch means abutting said first means, said second means including a solenoid inductively coupled to said armature.

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