MECHANICAL TRIP MEANS FOR CIRCUIT BREAKER CURRENT LIMITING DEVICE COMBINATION

William Harold Edmunds, Havertown, Pa., assignor to 1-T-E Circuit Breaker Company, Philadelphia, Pa., a corporation of Pennsylvania

Application November 12, 1954, Serial No. 468,343

3 Claims. (Cl. 200—116)

My invention relates to circuit protective equipment which electrically and mechanically coordinates a current limiting device with a circuit breaker and more particularly is directed to a novel arrangement whereby the force of a current limiting device trip pin is multiplied by means of a linkage mechanism in order to trip a large air circuit breaker.

In my copending applications Serial No. 316,221, filed October 22, 1952, and Serial No. 461,378, filed October 11, 1954, I have shown a multiple circuit breaker with a current limiting device electrically and mechanically associated with each pole.

The current limiting device may have an integral construction of the type shown in Patent No. 2,592,399, issued April 8, 1952, so that it is responsive to the rate of current rise and will interrupt severe short-circuit currents within less than a quarter of a cycle. That is, the let-through current for the current limiting device may be a small percentage of the available short-circuit current which the circuit is capable of delivering. This device is coordinated with the standard time delay and instantaneous trip units of the circuit breaker so that for all current magnitudes below a first predetermined value, either the instantaneous or the time delay trip unit of the circuit breaker will initiate simultaneous opening of all of the cooperating contacts of the circuit breaker.

In the event a fault current is above a first predetermined magnitude, then the current limiting device will rupture before the trip units of the circuit breaker operate. In order to prevent single phasing, the current limiting device is provided with a striker pin which, when the fusible element ruptures, will be driven forward to impart a hammer-blow force on the tripper bar of the circuit breaker so that all the cooperating contacts thereof will be simultaneously opened.

With this arrangement of electrical and mechanical coordination, between the circuit breaker and the current limiting device, the interrupting capacity requirements of the circuit breaker is substantially reduced and does not have to be equal to the magnitude of the available short-circuit current which the circuit is capable of delivering. Thus, as fully disclosed in copending application Serial No. 461,378, filed October 11, 1954, the use of this coordinated device is particularly applicable to low voltage, high current circuit application.

As noted in the above identified copending applications, the striker pin of the current limiting device operates directly on the tripper bar of the circuit breaker. However, in an air circuit breaker having a steel back of the type shown in copending applications Serial No. 254,549, filed November 1, 1951, Serial No. 423,782, filed April 15, 1954, and Serial No. 445,984, filed July 25, 1954, a force is required to rotate the tripper bar in order to release the common latch to permit the operating mechanism to move the cooperating contacts to their disengaged position. Thus, in air circuit breakers with steel backs, it is not presently feasible to have the striker pin to operate directly on the common tripper bar since there is an insufficient force available to rotate the trip bar to achieve release of the latching surfaces.

My invention is directed to a novel arrangement wherein the force on the striker pin, which is released when the current limiting device ruptures, is multiplied through a linkage mechanism to thereby insure operation of the common tripper bar whenever one of the current limiting devices ruptures.

Accordingly, a primary object of my invention is to provide a circuit breaker-current limiting combination in which electrical and mechanical coordination is achieved between the protective devices with a force multiplying means so that a current limiting device striker pin will be capable of rotating the common tripper bar when the devices rupture.

Another object of my invention is to provide a link mechanism between a current limiting device and a common tripper bar of a circuit breaker so that a relatively small force released by the rupture of the current limiting device will be multiplied so that all the cooperating contacts of the circuit breaker will be simultaneously opened whenever the current limiting device interrupts a current flowing in the pole associated therewith.

These and other objects will be apparent from the following description when taken in connection with the drawings in which:

Figure 1 is a perspective view of an air circuit breaker. The circuit breaker can be tripped by either the time delay armature 142, the instantaneous armature 143 or the current limiting device 10.

Figure 2 is a partial side view illustrating a current limiting device electrically associated with each pole and mechanically associated with the circuit breaker. For the sake of simplicity, the illustration of Figure 1 shows a single pole of a multi-pole circuit breaker. However, it will be apparent that although there is a common latch 185—186 and a common cradle and latch for all poles of the circuit breaker, there is a time delay trip unit, an instantaneous trip unit and a current limiting device associated with each pole of the circuit breaker, each of which in turn operates on the common tripper bar 170.

The operation of the circuit breaker is as follows:

On the occurrence of an overcurrent or fault current sufficient to energize the magnets of either the time delay armature 142 or the instantaneous armature 143, so that these units will function prior to the operation of the current limiting device 10, the operated armature will rotate in a clockwise direction thereby engaging the extension 146 on the shaft 140, resulting in the automatic movement of the cooperating contacts 60—61 from their engaged to their disengaged position, as seen in Figure 1.

The rotation of shaft 140 causes a link 162 to be moved through angle 163. The transitory movement of link 162 causes the rotation of the common tripper bar 170 which is the common tripper bar of the circuit breaker. The counterclockwise rotation of the common tripper bar 170 releases the latch 182—185 thereby resulting in the automatic movement of the cooperating contacts 60—61 from their engaged to their disengaged position, as seen in Figure 1.

It will be noted that the common tripper bar 170 has an abutment 178 which may be engaged by the roller 179 which, in turn, is rotated by means of the manual handle 184. The manual handle 184 is attached to the shaft 180 which, in turn, is rotated by means of the manual handle 184. The manual handle 184 is attached to the shaft 180 which, in turn, has a crank 181 rigidly attached thereto with the roller 179 on one end thereof. Thus, when the shaft 180 is rotated by the closing handle 184, the roller 179 engages the abutment 178 to rotate the common tripper bar 170 in a clockwise direction so that the cooperating contacts 60—61 can be moved from their engaged to their disengaged position.
As will hereinafter be more fully explained, the common tripper bar 179 can also be rotated by means of the current limiting devices 10a, 10b or 10c which operate through a linkage mechanism to impart a force thereto. Thus, the circuit breaker can be opened by either the time delay armature 142, the instantaneous armature 143, the current limiting device 10, or manually by means of the handle 184.

The latch surface 177 is an integral part of the trip arm 185 and engages the milled section 186 of the common tripper bar 179 so that a small angular rotation of the common tripper bar 170 will release the latch 177—180.

The trip arm 185 is pivoted at 187 on a long pin 188. The pin 188 is also engaged on the trip arm extension 189 at point 183. The movable arm 190 is pivoted on pin 188 and extends beneath a roller 193. The roller 193 is the pivot point of a toggle mechanism consisting of two links 194 and 195 and is carried by a pin 202 which pivots the meeting of links 194 and 195 which are each comprised of two arms. Arms 194 are pivoted on floating pin 196 and arms 195 are pivoted on pin 204.

The arms 194 support a rod 197 at 198 and 199, respectively. The rod 197 carries one end of a restoring spring 203 which is tensioned by means of a stationary shaft.

The restoring spring 203 exerts a tension on the link 194 which tends to open or break the toggle mechanism. Link 194 is pivoted on a floating pin 196 which is supported by link arm 195 and its extension 199 being parallel to the pin 198. The other link 195 of the toggle is pivoted on movable link 200 which is connected by means of an adjustable insulator 201 to the movable contact assembly 61 and pivoted on contact bar 496.

When the toggle mechanism consisting of links 194 and 195 is straightened out by means hereinafter described, pressure is put on movable link 200 by means of link 190 and bearing pin 204. The movable link 200 is pinned to insulator 201 by pin 205 and moves so as to advance the insulator 201 and the movable contacts 61 towards the stationary contact 60.

In the exploded view shown in Figure 1, the contacts are open and the toggle mechanism consisting of links 194 and 195 is collapsed. The circuit breaker may be closed by a variety of methods. The circuit can be closed manually by means of shaft 180 rotated by closing handle 184, described above. If shaft 180 is rotated in the direction indicated by arrow 184a, the roller 179 will engage the bevel on arm 190 and force the arm 190 against roller 193 thus straightening out the toggle mechanism and closing the circuit breaker contacts 60—61.

The movable links 200 are under an opening tension by means of opening spring 210 so that if no additional locking action other than described above for supporting the toggle existed, the circuit breaker would reopen immediately upon releasing the shaft 180. The locking device is supplied by means of a prop latch 211 which is located on a shaft 121 whose longitudinal axis is parallel to the axis of the milled shaft 170, and the rod 140. The prop latch 211 has two arms 213 and 214.

The latch surface 213 is located, when the circuit breaker is open, adjacent the roller 193. When the roller 193 is forced upward, as due to the pressure of arm 190, the roller pushes against prop latch 211 rotating the prop latch 211 on shaft 212. When the roller 193 has cleared the top of prop latch 213, the prop latch 213 snaps underneath the roller 193 due to the compression of this spring 220. The spring 220 which is wound on the shaft 212 has one end on an indentation 221 of crank 211, the other end borne against a shaft 222 which pierces the trip arm 185. The shafts 212 and 222 have been moved out of position in the exploded view for the sake of clarity. Actually, the shaft 222 pierces the trip arm 185 at point 207. The longitudinal axis of shaft 222 is essentially parallel to the longitudinal axis of shaft 212 and milled shaft 170.

When the roller 193 is moved, straightening the toggle, it causes the crank 211 to rotate compressing spring 220. The roller clears the top of prop latch 213 letting the crank rotate in the opposite direction until the prop latch 213 is directly beneath supporting the roller 193. The other arm 214 of prop latch 211 bears against the shaft 222 preventing further rotation of the crank 211 so that the latch surface 213 is stopped directly beneath the roller 193. The spring 220 is under compression normally so that the arm 214 is constantly bearing against the shaft 222. When the toggle is straightened, the rotation of the prop latch 211 moves the arm 214 away from the shaft 222 until the roller 193 clears the top of prop latch 213. Then the reverse rotation of the crank 211 occurs until the arm 214 again bears against the shaft 212.

Thus, when the toggle is straightened and the circuit breaker closed, the prop latch 211 locks the toggle 194—195 and thus locks the circuit breaker in a closed position.

The closing handle 184, by means of the shaft 180, after closing the circuit breaker by means of the rotations of roller 179 against the arm 190, as described above, is returned to its normal position by means of a crank 230.

The crank 230 is pivoted on a stationary pin 231.

The crank 181 described above has an indentation 222 which meets a roller 233 of crank 230. The crank 230 supports pin 234 which has a restraining spring 235 engaged at one end 236. The restraining spring 235 is attached to an angle 237 and is tensed on the pin 236 causing the crank 230 to rotate. The rotation of crank 230 causes the roller 233 to meet the indentation 232 returning the crank 181 to its normal position.

The circuit breaker may also be closed by closing means 300, 341, as disclosed in copending application Serial No. 385,714, filed October 2, 1953.

As heretofore noted, the circuit breaker is provided with a time delay trip armature 142 and an instantaneous trip armature 143 which function in a manner well known in the art as, for example, described in copending application Serial No. 254,559, filed November 1, 1951.

Also as heretofore noted, the circuit breaker is provided with a current limiting unit which is both an interrupting device and a trip unit. The current limiting device 10 has a fusible element with a plurality of reduced cross-sectional areas and is surrounded by quartz crystal. The unit is also provided with a striker pin 11 which is normally inoperative.

The construction whereby the stored energy for the striker pin 11 is released upon the rupturing of a fusible element, is shown in copending application Serial No. 316,221, filed October 22, 1952, and Serial No. 461,378, filed October 11, 1954.

The current limiting device 10 has electrical terminals 12 and 13 by which it is connected in electrical series with the cooperating contacts 60—61 of the phase or pole with which it is associated. Thus, for example, as shown in the figures, the current limiting device 10 is removably retained within the clip terminal means 14—15. Thus, for each pole of the circuit breaker, the current will flow from the source through the current limiting device 10 through the cooperating contacts 60—61 to the load.

Each current limiting device 10 is positioned so that its striker pin is in close proximity to the lever 16. A common bar 18 is provided with an extension lever 16a, 16b, 16c respectively extending therefrom for each pole of the circuit breaker. The common bar 18 is pivoted around fixed pivot 19 and the extension lever 16 is rigidly attached thereto.

The left extension of the lever 16 has a rod 20 pivotally mounted thereon at point 21. The rod 20 may be made of a plurality of sections 22—23—24 with the member 23 threaded engaging the end sections 22—24 so that the effective length of the rod 20 can be adjusted by altering the threaded engagement between the three members.
The top end of the rod 20 has a member 23 pivotally mounted thereon at point 24. The member 23 contains openings to receive the screws 25 and 26. A plate 27 is positioned on one side of the common tripper bar 170 and the screws 25—26 which extend through the plate 27 are in threadable engagement with the plate 27. Hence, the plate 27 is effectively bolted to the common tripper bar 170.

On the occurrence of a severe short-circuit current, the current limiting device 10 will rupture thereby interrupting the current flow in the phase with which it is associated. The ruptured portion of the current limiting device 10 will permit a spring to release stored energy so that the striker pin 11 will be driven upwardly thereby rotating its associated extension bar 16 in a counterclockwise direction around the fixed pivot 19. This rotation will pull the rod 20 downwardly thereby causing the left-hand end of the plate 27 to rotate downwardly.

This motion will cause the common tripper bar 170 to be rotated in a counterclockwise direction to thereby release the latch 177—186. Thus, the striker pin 10 is operatively connected to the common tripper bar 170 by means of linkage mechanism 16—20.

By providing a long arm of the extension lever 16 on the right of pivot 19 and a relatively short arm on the left of this pivot, it is possible to multiply the force on the striker pin 10. Thus, even though a relatively large force is required to rotate the common tripper bar 170, a relatively small force driving the striker pin upwardly will be multiplied through linkage mechanism 16—20 so that a sufficient force is imparted to the plate 27 to rotate the common tripper bar 170 in a counterclockwise direction to release the latch 177—186.

Hence, with my novel arrangement, a force multiplying means is provided through linkage mechanism so that a relatively small spring can be used in connection with the current limiting device 10 and still obtain sufficient force to rotate the common tripper bar and release the latch of the circuit breaker.

In the foregoing, I have described my invention only in connection with preferred embodiments thereof. Many variations and modifications of the principles of my invention within the scope of the description herein are obvious. Accordingly, I prefer to be bound not by the specific disclosure herein, but only by the appended claims.

I claim:
1. A circuit protective arrangement comprised of a multipole circuit breaker and a current limiting device associated with each pole thereof; each pole of said circuit breaker having a pair of cooperating contacts and a first trip means; said first trip means operatively connected to a common tripper bar to effect simultaneous disengagement of the cooperating contacts associated with each pole of said circuit breaker; said first trip device rendered operative on the occurrence of a fault current below a first predetermined current magnitude; said current limiting device having a striker pin normally held in an inoperative position; a mechanical device operatively connecting each of said striker pins to said common tripper bar; said mechanical device being comprised of an auxiliary common tripper bar and a linkage; said auxiliary common tripper bar having relatively long extensions extending in a direction and positioned to be engaged respectively by said striker pin of one of said current limiting devices associated therewith; said auxiliary common tripper bar having a relatively short extension; said short extension being operatively connected to said common tripper bar by said linkage; said auxiliary common tripper bar along with its plurality of long extensions and short extension serving as a force multiplying means for said current limiting devices.
2. A circuit protective arrangement comprised of a multipole circuit breaker and a current limiting device associated with each pole thereof; each pole of said circuit breaker having a pair of cooperating contacts and a first trip means; said first trip means operatively connected to a common tripper bar to effect simultaneous disengagement of the cooperating contacts associated with each pole of said circuit breaker; said first trip device rendered operative on the occurrence of a fault current below a first predetermined current magnitude; each of said pair of cooperating contacts having a current limiting device connected in electrical series therewith; said current limiting device effective to interrupt current flow above a first predetermined current magnitude; said current limiting device having a striker pin normally held in an inoperative position; mechanical means operatively connected between said striker pin and said common tripper bar; said striker pin operatively connected to rotate said common tripper bar through said mechanical means when said current limiting device interrupts said circuit; said mechanical means being comprised of an auxiliary common tripper bar and a linkage member to multiply the force of said striker pin to a magnitude sufficient to rotate said common tripper bar; said auxiliary common tripper bar having a plurality of long extensions corresponding to the number of poles of said circuit breaker and having one of said current limiting devices associated respectively with each of said long extensions; a short extension from said auxiliary common tripper bar, one end of said linkage connected to said common tripper bar and the other end of said linkage connected to said short extension; said linkage being adjustable in length.
3. A multi-pole automatic circuit interrupter being comprised of pairs of cooperating contacts, manual control means, operating mechanism and trip elements; said operating mechanism containing a common tripper bar; a current limiting device associated with each pair of said cooperating contacts; said pairs of cooperating contacts having an engaged and disengaged position; said manual control means, said trip elements and said current limiting devices being operative through said common tripper bar of said operating mechanism to effect movement of said pairs of cooperating contacts from said engaged position to said disengaged position; each of said current limiting devices having a stored energy means releasable on the occurrence of a predetermined fault current; an auxiliary common tripper bar; said auxiliary common tripper bar having a plurality of long extensions and a short extension; said short extension from said auxiliary common tripper bar connected to said common tripper bar by a linkage; said linkage being adjustable; said plurality of long extensions from said auxiliary common tripper bar each being positioned respectively for engagement by said stored energy device of said current limiting device associated therewith; each of said current limiting devices operative to move said common tripper bar through said long extension, said auxiliary common tripper bar, said short extension and said adjustable linkage.

References Cited in the file of this patent
UNITED STATES PATENTS
2,330,690 Dannenberg Sept. 28, 1943
2,473,196 Dannenberg June 14, 1949