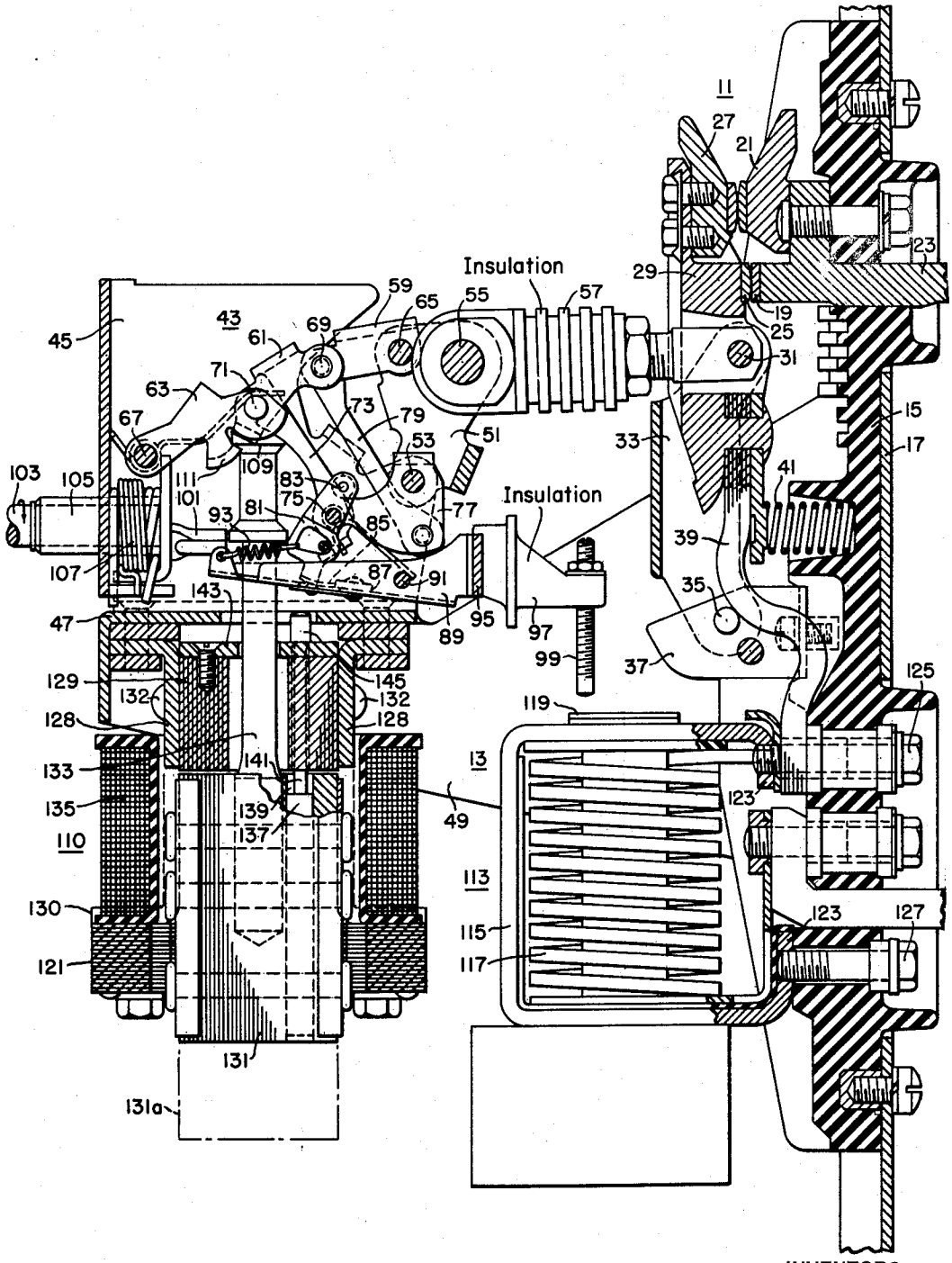
Nov. 29, 1955 B. G. TREMBLAY ET AL 2,725,442

CIRCUIT BREAKERS

Filed Feb. 11, 1950



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United States Patent Office 2,725,442
Patented Nov. 29, 1955

2,725,442

CIRCUIT BREAKERS

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Application February 11, 1950, Serial No. 143,721

12 Claims. (Cl. 200—109)

This invention relates to circuit breakers and more particularly to circuit breakers of the type used for controlling light to moderate power distribution circuits.

In certain types of circuit breakers the breaker mechanism must be reset and relatched before the breaker can be closed. When closing such circuit breakers by means of a solenoid energized by alternating current difficulty has been experienced in maintaining the latching mechanism in latching position due to a series of pulsating shocks generated by the alternating current. These pulsating shocks closely approximate 60 cycle alternating current frequency and at times are of such magnitude as to cause the latching mechanism to trip the breaker during a closing operation. The fact that such pulsating shocks occur not only at the start of a closing operation but continue throughout the entire closing operation makes it necessary to provide means for preventing unlatching of the breaker mechanism at the beginning of a closing operation as well as throughout the entire closing stroke of the solenoid.

Similar difficulties have been experienced when closing large circuit breakers by means of a solenoid energized by direct current. In such cases the large force required of the solenoid to close the breaker is such that the shock of the initial acceleration of the solenoid on the delicate latches and toggles is of sufficient magnitude as to cause false tripping of the breaker. Also, such false tripping may be caused by the shocks engendered by the engagement of the breaker contacts and when the solenoid reaches the end of its closing stroke.

It is, therefore, an object of the invention to provide a circuit breaker having a solenoid operated closing means with means effective upon energization of the solenoid and during the entire closing operation to prevent unlatching of the breaker mechanism in response to shocks.

Another object of the invention is to provide a circuit breaker having a solenoid closing device with means operative simultaneously with energization of the closing device to prevent tripping of the breaker in response to shocks.

Another object of the invention is to provide a circuit breaker having a main closing solenoid embodying a secondary solenoid effective upon energization of said closing solenoid to prevent tripping of the breaker during a closing operation of the closing solenoid.

Another object of the invention is to provide a circuit breaker having a closing solenoid including a main armature operated by said solenoid to close the breaker and embodying a secondary armature operable upon energization of the closing solenoid to prevent tripping of the breaker in response to shocks.

The novel features that are considered characteristic of the invention are set forth in the appended claims. The invention itself, however, both as to structure and operation, together with additional objects and advantages thereof, will be best understood from the following

detailed description thereof when read in conjunction with the accompanying drawing which comprises an elevational view, partly in section, of a circuit breaker embodying the principles of the invention.

Referring to the drawing, the circuit breaker includes a plurality of pole units each comprising a contact structure indicated generally at **11**, and an overcurrent trip device indicated generally at **13**. The contact structure and the trip device for each pole unit are mounted on a separate insulating base **15** which is rigidly secured to a metal supporting panel **17**. Since the pole units are alike, only the center pole unit is illustrated and described herein.

The contact structure **11** comprises stationary main and arcing contacts **19** and **21** both secured on the inner end of a terminal conducting bar **23**, and cooperating movable main and arcing contacts **25** and **27**. The movable contacts are rigidly secured to a contact carrying member **29** pivotally mounted by means of a pivot pin **31** on a U-shaped switch arm **33** which, in turn, is pivotally supported by pivot means **35** on brackets **37** rigidly mounted on the insulating base **15**.

The movable contact carrying member **29** is electrically connected by means of a flexible conductor **39** to the energizing coil of the trip device **13**. A spring **41** compressed between the movable contact carrying member **29** below its pivot **31** and the insulating base **15** provides contact pressure in the closed position of the breaker and also biases the movable contact structure in opening direction.

The movable contact structure is normally maintained in the closed position by means of an operating mechanism indicated generally at **43** mounted in a U-shaped frame **45**. The frame **45** is supported on a platform **47** which forms a cross member of a generally U-shaped main bracket comprising a pair of spaced side members **49** rigidly connected at their outer ends by the cross member or platform **47**. The platform **47** extends substantially across the width of the breaker and the side members **49** are suitably secured to the metal panel **17** on the outside of the two outer pole units of the breaker.

The operating mechanism includes a lever **51** mounted on a pivot pin **53** supported in the side members of the frame **45**. The lever **51** carries a rod **55** extending across all of the poles of the breaker and is connected by means of insulating connecting members **57** to the pivot pins **31** in the free ends of the switch arms **33** for the several poles of the breaker so that upon operation of the rod **55** the movable contacts of all of the poles move in unison.

An operating linkage comprising toggle links **59, 61** and **63** is provided to releasably hold the lever **51** and consequently the movable contacts in the closed position and to operate the movable contacts to open and closed positions. The toggle link **59** is pivotally connected to the lever **51** by means of a pivot pin **65** and the toggle link **63** is pivoted on a fixed pivot **67** supported in the frame **45**. The toggle link **61** is pivotally connected to the links **59** and **63**, respectively, by knee pivot pins **69** and **71**.

The linkage **59, 61, 63** comprises two toggles, one of which **59—61** may be designated as the tripping toggle and the other **61—63** as the closing toggle. The tripping toggle **59—61** is normally slightly underset above a line drawn through the centers of the pivot pins **65—71** and the closing toggle **61—63** is normally underset below a line drawn through the centers of pivot pins **67—69**. The closing toggle **61—63** is normally prevented from collapsing downward by a support member **73** pivoted on a pivot pin **75** supported in the frame **45** and having a shouldered portion engaging under the knee pivot pin **71**.

The tripping toggle **59—61** is normally biased in a direction to cause its collapse by a component of the force

of the springs 41 which bias the movable contact structures for the three poles of the breaker in opening direction and bias the connecting members 57 toward the left (Fig. 1). The tripping toggle 59—61 is normally prevented from collapsing by means of a main latch member 77 pivoted on the pin 53 and connected by means of a link 79 to the knee pin 69 of the tripping toggle.

The main latch member 77 is held in latching position by an intermediate latch lever 81 pivoted on the pin 75. The intermediate latch lever 81 carries at its upper end a latch roller 83 engaging the main latch 77 and at its lower end has a latching portion 85 normally engaging a latch member 87 on a channel-shaped latch 89 pivoted on a pivot pin 91 in the frame 45. A spring 93 serves to bias the latch lever 81 and the latch 89 to their latching positions.

A trip bar 95, extending across all of the poles of the breaker, is rigidly mounted on the right-hand end of the channel-shaped latch 89 and has insulating brackets 97 (only one being shown) secured thereto, there being a bracket 97 for each pole of the breaker. Each of the brackets 97 has a screw 99 adjustably mounted thereon for cooperating with the trip device 13 of its associated pole in a manner to be presently described.

The breaker is tripped open manually by means of a cam member 101 mounted on the inner end of a handle shaft 103 journaled in a bearing 105 mounted in the front piece of the frame 45. The handle is not shown in the drawing but is rigidly secured to the outer end of the shaft 103 and biased in both directions to a central position in a well known manner by means of a spring 107.

Rotation of the handle shaft 103 in tripping direction causes the cam member 101 to engage and actuate the latch member 89 in counterclockwise or unlatching direction to unlatch the intermediate latch lever 81, which, in turn, releases the main latch 77. This permits the tripping toggle 59—61 to collapse upwardly to effect opening of the breaker contacts. During the collapse of the tripping toggle a portion 109 of the toggle link 61 engages and actuates the support member 73 to a non-supporting position, thereby freeing the closing toggle 61—63. The closing toggle thereupon collapses downwardly and during its collapse resets and relatches the tripping toggle 59—61.

The breaker is automatically tripped open by operation of the trip device 13 for any pole of the breaker. The trip device 13 may be of any suitable type preferably of the type fully disclosed and claimed in copending application Serial No. 748,808, filed May 17, 1947, by H. L. Rawlins and J. Sandin, now Patent No. 2,519,291, issued August 15, 1950, and assigned to the assignee of the instant application.

The trip device 13 includes generally a tripping electromagnet 113 including a C-shaped magnet yoke 115, an energizing winding 117 and a core structure 119 movable upon energization of the winding 117 to engage the screw 99 and actuate the trip bar 95 to trip the breaker. The ends of the magnet yoke 115 are bent over as at 123 to form mounting feet which are drilled and tapped to receive mounting bolts 125 and 127 for mounting the trip device on the insulating base 15 as shown in the drawing.

The contacts are closed either manually by operation of the handle shaft 103 or by a closing solenoid indicated generally at 110. In order to close the contacts manually, the shaft 103 is rotated in the direction indicated by the arrow, that is, clockwise as viewed from the front of the breaker. This operation of the shaft 103 engages the eccentric cam 101 with a projection 111 on the toggle link 63, and straightens the closing toggle 61—63. Since, at this time, the knee of the tripping toggle 59—61 is restrained by the link 79 and the main latch 77, the thrust of straightening the closing toggle 61—63 is transmitted by the toggle link 59 to rotate the lever 51 in a clockwise direction. This movement of the lever 51 is transmitted by the tie rod 55 and the several connections 57 to the switch arms 33 to simultaneously close the contacts for all of the poles of the breaker. As the knee pin 71 for the closing toggle 61—63 arrives at the position shown in the support 73 is moved into supporting engagement with the pin 71 to maintain the contacts closed. Upon release of the handle the spring 107 restores the shaft 103 and the cam 101 to their normal position.

The circuit breaker may be closed by energization of the closing solenoid 110 which may be effected either manually or automatically by closing a suitable switch (not shown). The solenoid 110 comprises a fixed laminated magnet yoke 121 supported on a bracket 128 secured to the underside of the platform 47. The bracket 128 extends downwardly and has feet 130 struck outwardly therefrom to which the magnet yoke 121 is rigidly secured. Also secured to the bracket 128 by means of rivets 132 is a fixed core member 129. A movable armature 131 is attached to the lower end of an operating rod 133 which extends upwardly through clearance openings in the fixed core 129, the platform 47 and the channel-shaped trip member 89 and has its upper end pivotally supported on the knee pivot pin 71 of the closing toggle 61—63. An energizing coil 135 wound on an insulating spool is supported on the magnet yoke 121.

In the closed position of the breaker, as shown in the drawing, the armature 131 is held in its raised position by the support 73 which holds the closing toggle in its extended position. When the breaker is tripped open the closing toggle 61—63 collapses downwardly, as previously described, permitting the armature 131 to assume its lower unattracted position indicated at 131*a*. Thereafter, upon energization of the coil 135, the armature 131 is attracted upwardly straightening the closing toggle 61—63 and closing the contacts.

Means is provided to prevent tripping of the breaker during the entire solenoid closing operation from the time the closing solenoid is energized until the contacts are fully closed. Energization of the closing solenoid by alternating current produces a series of pulsating shocks closely approximating 60 cycle alternating current frequency which sometimes are of sufficient magnitude to cause tripping movement of the light-load latch mechanism and consequently tripping of the breaker. Conventional anti-shock devices usually are operated in response to a single shock. Since, in the case of an alternating current closing solenoid, the series of impulse shocks occurs throughout the closing operation, a conventional anti-shock device, which might respond to a single shock, would be ineffective to prevent operation of the latch mechanism in response to succeeding impulse shocks.

The means for preventing tripping operation of the latch mechanism in response to shocks throughout the entire closing operation comprises a secondary armature 137 disposed in an opening 139 in the closing armature 131. A rod 141 attached to the secondary armature 137 extends upwardly through clearance openings in the fixed core member 129 and a stop plate 143 secured to the top of the core member 129. The enlarged upper end 145 of the rod 141 in the unattracted position of the secondary armature 137 rests on the stop plate 143 which limits the downward movement of the armature 137.

When the closing solenoid 110 is energized to effect closing of the breaker the secondary armature 137 is immediately attracted upwardly and quickly moves the enlarged upper end 145 thereof into engagement with the underside of the channel-shaped latch member 89 and continues to exert an upward force thereon as long as the closing solenoid is energized to oppose tripping movement of the latch 89.

It will thus be seen that the armature 137 applies a continuous pressure to the latch member 89 opposing tripping operation thereof throughout the entire solenoid closing operation. The force applied by the armature 137 to the latch member 89 is sufficient to prevent operation of the latch in response to shocks occurring at any

time during the solenoid closing operation, but is not great enough to prevent actuation of the latch by the trip device 13 when the latter is energized in response to excessive overload currents.

Upon deenergization of the closing solenoid 110 the secondary armature 137 falls of its own weight to the position shown.

We claim as our invention:

1. A circuit breaker comprising relatively movable contact means, operating means for said contact means comprising a linkage collapsible to cause opening of said contact means, releasable means normally restraining said linkage in thrust transmitting position, trip means operable in response to overload currents to release said releasable means to cause collapse of said linkage and opening of said contact means, means operable upon collapse of said linkage to reset said linkage to thrust transmitting position and to reset said releasable means to restraining position, closing means comprising a solenoid including a main armature movable upon energization of said solenoid to move said linkage and close said contact means, and a secondary armature movable by energization of said solenoid to engage and apply a force to said releasable means opposing operation of said releasable means in response to shocks occurring during a closing operation of said solenoid.

2. A circuit breaker comprising relatively movable contact means, operating means for said contact means comprising thrust transmitting means connected to said contact means, releasable means normally restraining said thrust transmitting means in thrust transmitting position to maintain said contact means in closed position, trip means operable in response to overload currents to release said releasable means to cause collapse of said thrust transmitting means and opening of said contact means, electroresponsive closing means including a first armature operable when said electroresponsive means is energized to actuate said thrust transmitting means and close said contact means, and a second armature movable by energization of said electroresponsive means to engage and apply a force to said releasable means to prevent release of said releasable means in response to shock during an entire closing operation.

3. A circuit breaker comprising relatively movable contacts, operating means for said contacts comprising a linkage connected to said contacts, latch means normally restraining said linkage in thrust transmitting position to hold said contacts in closed position, a trip device operable in response to overload currents to actuate said latch means to permit collapse of said linkage and opening of said contacts, electroresponsive closing means including a first armature movable upon energization of said electroresponsive means to operate said linkage to close said contacts, and a second armature movable upon energization of said electroresponsive means to engage and apply a force to said latch opposing unlatching movement of said latch means, in response to shocks occurring at any time during a closing operation of said electroresponsive means.

4. A circuit breaker comprising relatively movable contact means, a switch member movable to open and close said contact means, releasable operating mechanism for moving said switch member to open and close said contact means, means releasably restraining said operating mechanism in closed position, trip means responsive to overload currents to actuate said releasable restraining means to release said operating mechanism and effect automatic opening operation of said switch member, electroresponsive closing means comprising an energizing winding, a main armature connected to said operating mechanism operable upon energization of said winding to actuate said operating mechanism and close said contact means, and a secondary armature movable to attracted position by energization of said electroresponsive means and held in attracted position as long as said electroresponsive means is energized to engage and apply a continuous force to said restraining means opposing releasing movement of said restraining means in response to shocks during the entire closing movement of said main armature.

5. A circuit breaker comprising relatively movable contact means, operating means for said contact means comprising a linkage collapsible to effect automatic opening of said contact means, latch means normally restraining said linkage in position to hold said contact means closed, trip means operable in response to overload currents for actuating said latch means to cause collapse of said linkage and opening of said contact means, a closing electromagnet comprising an energizing winding, a first armature disposed within said winding and operable upon energization of said winding to actuate said linkage to close said contact means, and a second armature disposed within said winding and movable upon energization of said winding to engage and apply a force to said latch means opposing releasing movement of said latch means in response to shocks occurring during a closing operation.

6. A circuit breaker comprising relatively movable contact means, operating means for said contact means comprising a linkage collapsible to effect automatic opening of said contact means, latch means normally restraining said linkage in position to hold said contact means closed, trip means operable in response to overload currents for actuating said latch means to cause collapse of said linkage and opening of said contact means, a closing electromagnet comprising an energizing winding, a first armature disposed within said winding and operable upon energization of said winding to actuate said linkage to close said contact means, and a second armature disposed within said winding and movable upon energization of said winding to engage and apply a force to said latch means opposing releasing movement of said latch means in response to shocks occurring during a closing operation, said trip means being operable in response to excessive overload currents to actuate said latch means and effect opening of said contact means irrespective of the energized condition of said closing electromagnet.

7. A circuit breaker having a releasable operating mechanish biased open, restraining means normally restraining said operating mechanism in closed position, trip means responsive to abnormal conditions to actuate said restraining means to effect an opening operation of said operating mechanism, electroresponsive means having an armature, said armature being movable upon energization of said electroresponsive means to effect a closing operation of said operating mechanism, and said electroresponsive means having a second armature movable by energization of said electroresponsive means to engage and prevent actuation of said restraining means.

8. A circuit breaker having releasable operating mechanism, restraining means normally releasably restraining said operating mechanism in closed position, means responsive to abnormal conditions for moving said restraining means to a non-restraining position to cause an opening operation of said operating mechanism, electroresponsive closing means including a relatively heavy armature movable a relatively long distance in response to energization of said electroresponsive closing means to actuate said operating mechanism to close said breaker, and a relatively light armature normally disengaged from said restraining means movable a relatively short distance by energization of said electroresponsive closing means to engage and prevent movement of said restraining means to said non-restraining position to thereby prevent release of said operating mechanism during a closing operation of said operating mechanism.

9. A circuit breaker operating mechanism biased open, restraining means releasably restraining said operating mechanism in closed position and movable to a non-restraining position to release said operating mechanism and effect opening of said breaker, a trip device for ap-

plying a force to said restraining means to move said restraining means to said non-restraining position, power closing means operable when energized to close said breaker, and a force applying device movable independently of said restraining means by energization of said power closing means to engage said restraining means and apply a force to said restraining means opposing movement of said restraining means to said non-restraining position to thereby prevent release of said operating mechanism during a closing operation of said operating mechanism, said force applying device applying insufficient force to said restraining means to prevent movement thereof by said trip device.

10. A circuit breaker having a releasable operating mechanism biased open, restraining means normally restraining said operating mechanism in closed position, trip means responsive to abnormal conditions to actuate said restraining means to effect an opening operation of said operating mechanism, means operable during an opening operation of said mechanism to reset said mechanism and to reset said restraining means to restraining position, electroresponsive closing means having an armature, said armature being operable when said closing means is energized to effect a closing operation of said operating mechanism, and said electroresponsive means having a second armature movable independently of said restraining means by energization of said electroresponsive means to engage said restraining means and prevent actuation of said restraining means to thereby prevent release of said operating mechanism during a closing operation of said operating mechanism.

11. A circuit breaker having operating mechanism biased open, restraining means releasably restraining said operating mechanism in closed position, said restraining means being movable to a non-restraining position to release said operating mechanism and effect opening of said breaker, power means operable when energized to actuate said operating mechanism to close said breaker, and a member normally disengaged from said restraining means and movable in response to energization of said power means to engage said restraining means and apply a force to said restraining means opposing movement of said restraining means to said non-restraining position to thereby prevent release of said operating mechanism during a closing operation of said operating mechanism.

12. A circuit breaker comprising operating mechanism biased open and releasable to effect opening of said breaker, latch means having a latching surface for engaging and releasably restraining said operating mechanism in closed position, trip means for actuating said latch means to a non-latching position to effect opening of said breaker, electroresponsive closing means including a relatively heavy armature, said armature being movable a relatively long distance upon energization of said electroresponsive closing means to actuate said operating mechanism and close said breaker, said electroresponsive means also including a relatively light armature movable independently of said latch means, said relatively light armature being movable in response to energization of said electroresponsive means a relatively short distance to engage said latch means at a point adjacent said latch surface and prevent movement of said latch means to said non-latching position to thereby prevent release of said operating mechanism during a closing operation of said operating mechanism.

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