Sept. 13, 1966 H. P. FRANZ 3,273,089

CIRCUIT BREAKER LINKAGE AUXILIARY TRIPPING ARRANGEMENT

Filed April 29, 1963 4 Sheets-Sheet 1

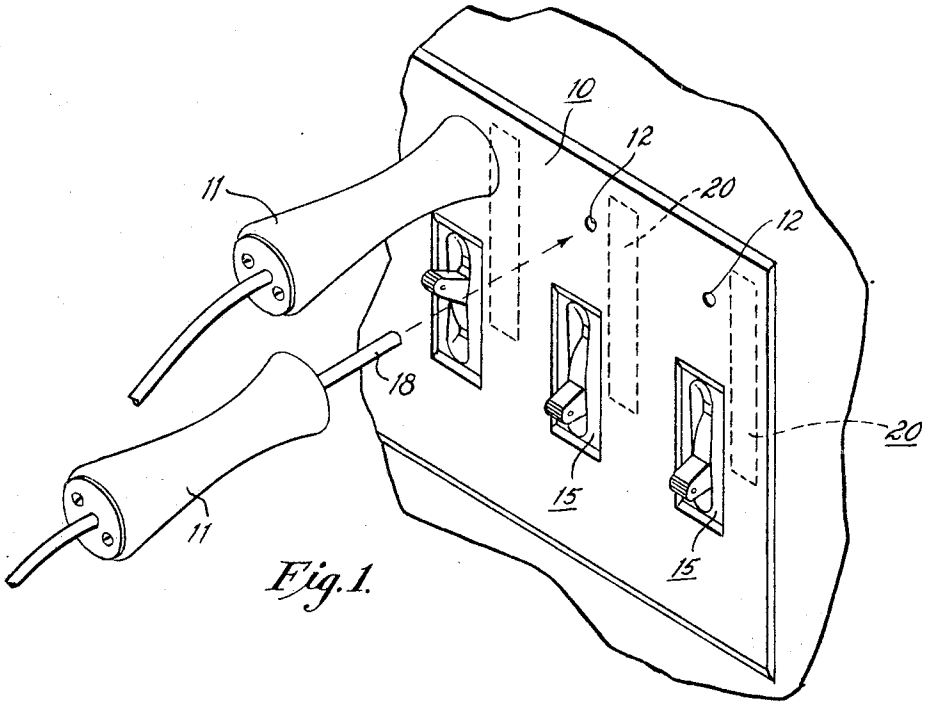


Fig. 1.

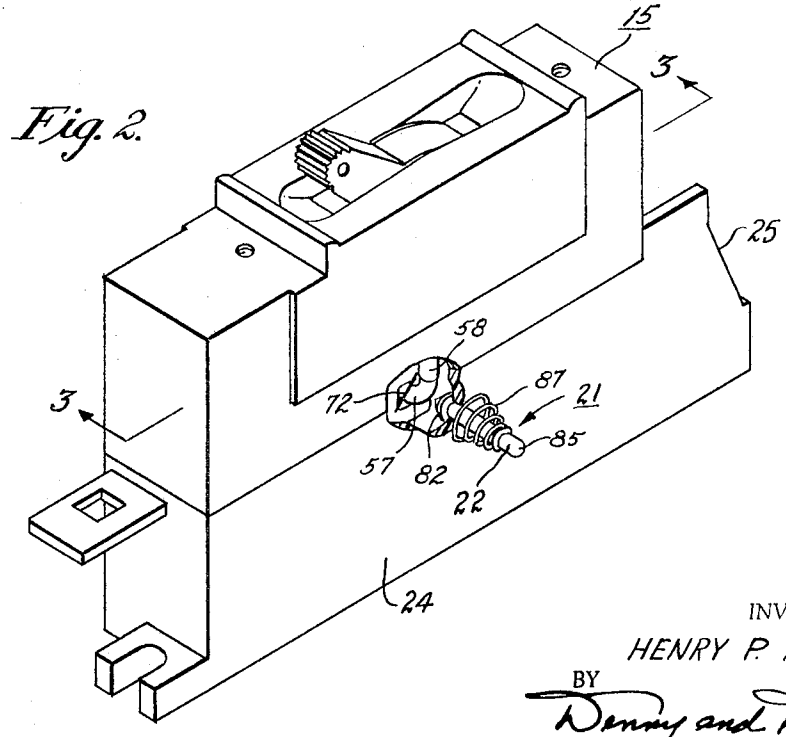


Fig. 2.

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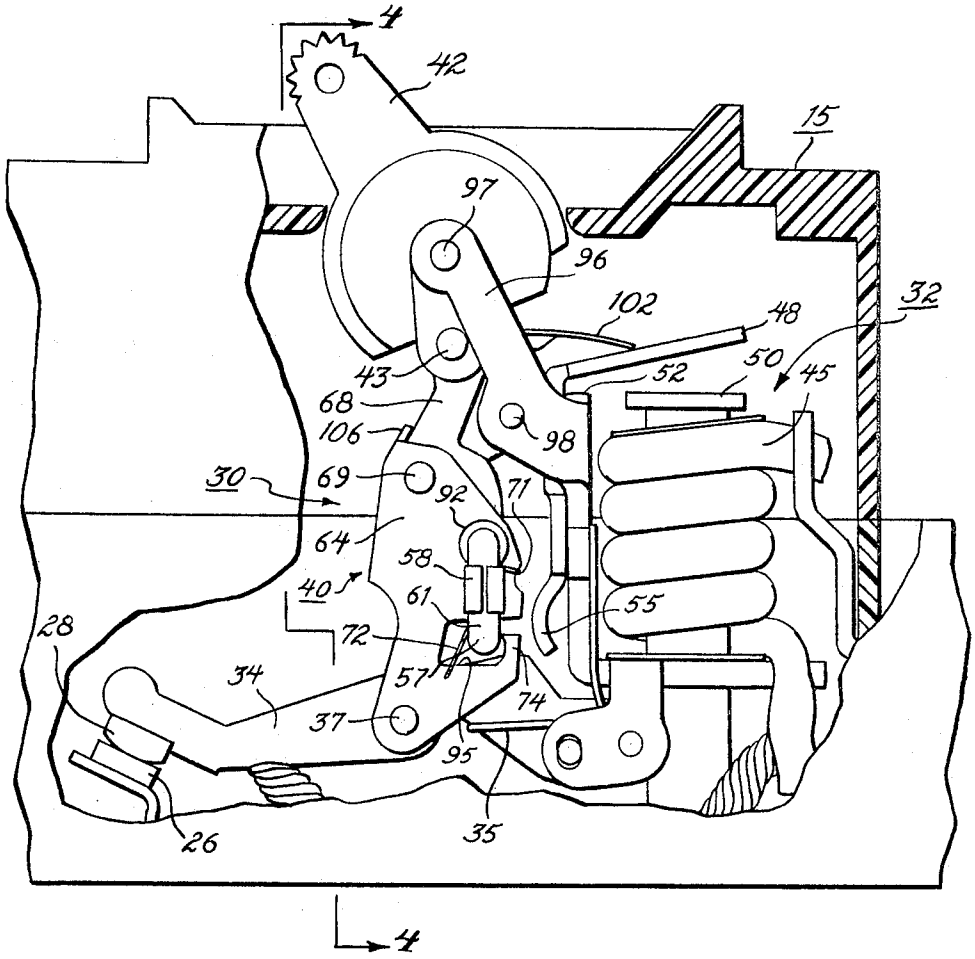


Fig. 3.

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CIRCUIT BREAKER LINKAGE AUXILIARY TRIPPING ARRANGEMENT

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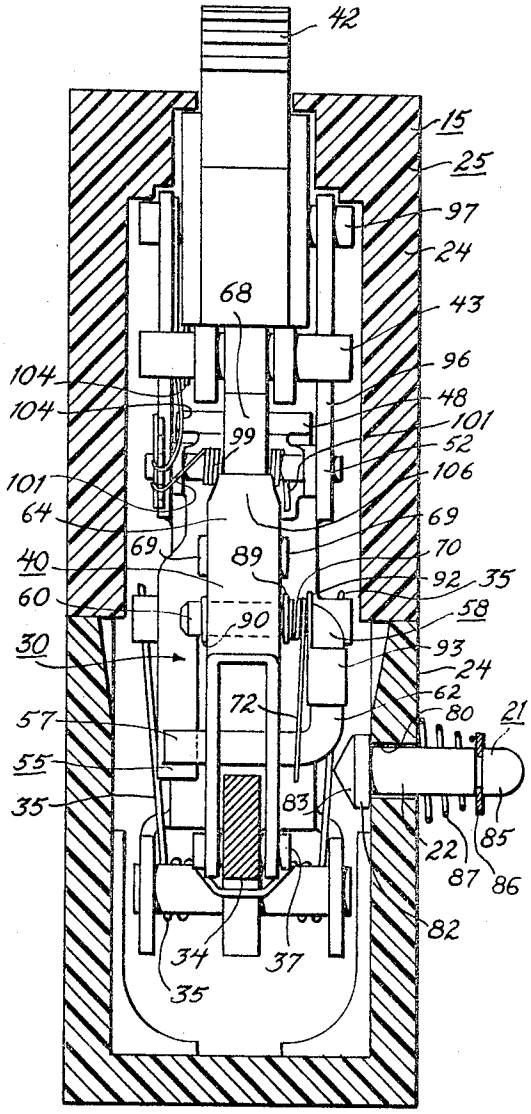


Fig. 4.

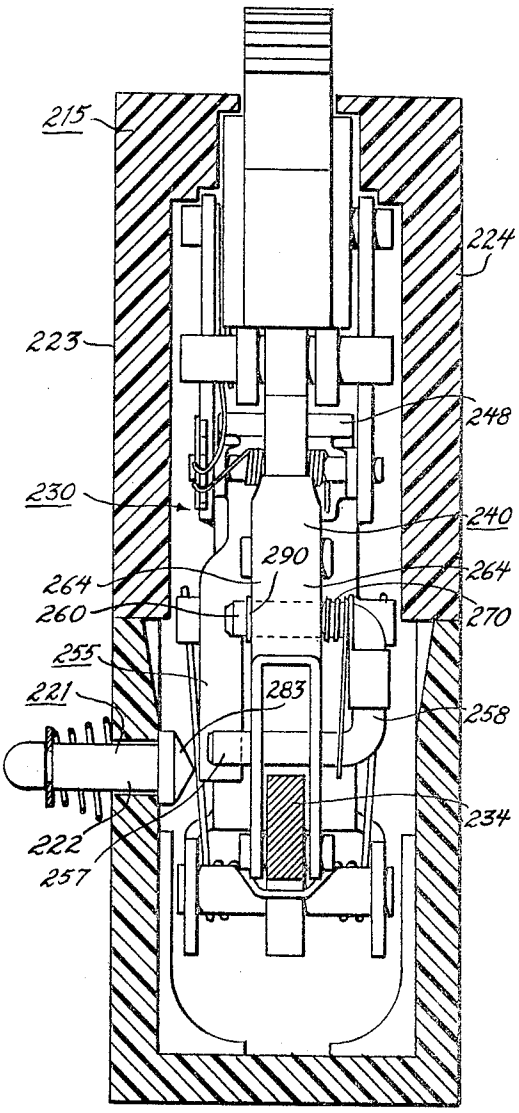


Fig. 6.

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CIRCUIT BREAKER LINKAGE AUXILIARY TRIPPING ARRANGEMENT

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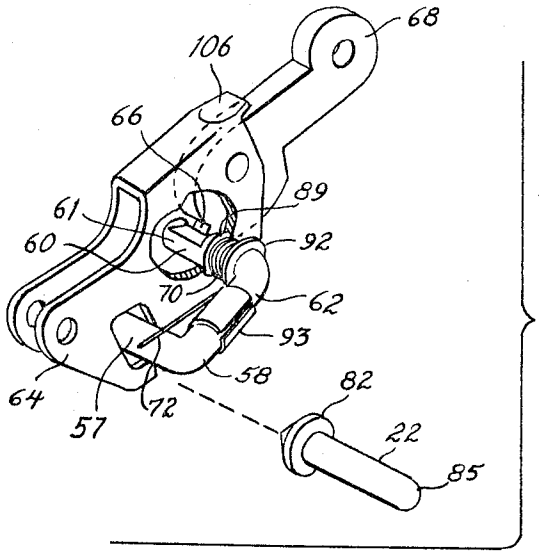


Fig. 5.

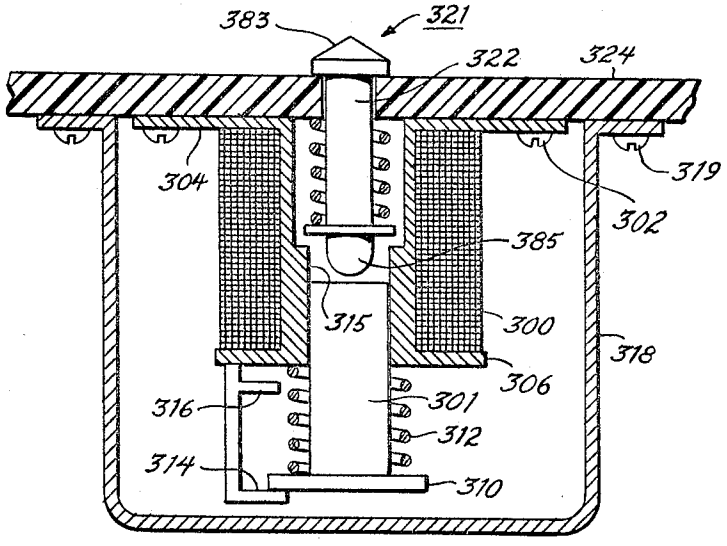


Fig. 7.

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United States Patent Office 3,273,089 Patented Sept. 13, 1966

3,273,089

CIRCUIT BREAKER LINKAGE AUXILIARY TRIPPING ARRANGEMENT

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Filed Apr. 29, 1963, Ser. No. 276,358
5 Claims. (Cl. 335—166)

This invention relates to circuit breaker linkages and, in particular, to devices that may be associated with the circuit breaker linkages for the auxiliary tripping of the linkages. That is, this invention provides an improved device for tripping the circuit breaker linkage, the device functioning independently of the electromagnetic means within the circuit breaker that trips the circuit breaker linkage on predetermined electrical conditions in the circuit to which the circuit breaker is connected.

As is known, circuit breakers may be used as "on-off" switches for the circuits in which they are connected. In some instances it is desired that the circuit be deenergized when an element is being added to the circuit or when the element is being removed from the circuit. This invention provides a device for automatically tripping the circuit breaker to the open contacts position, that is, switching the circuit breaker to the "off" contacts position in which the device is operatively associated with the circuit breaker linkage and may be mechanically connected, by suitable links, so that movement of the mentioned element into or out of the circuit will actuate the device to trip the circuit breaker linkage, assuming that the circuit breaker is in the contacts closed or "on" position.

An object of this invention is to provide a simplified device for tripping the linkage of a circuit breaker, the device being responsive to a mechanical motion outside the circuit breaker for tripping the linkage of the circuit breaker within the circuit breaker case.

In one embodiment of the invention, a circuit breaker comprises a collapsible linkage and a latch pintle controlled by an electromagnetic mechanism comprising an electromagnetic coil and an armature all of which are enclosed by an insulator case. The latch pintle, on predetermined overloads, is engaged by a tripping arm (the latter controlled by the armature) and pivoted thereby to a position where it permits the collapse of the linkage.

The circuit breaker case is provided with a hole through which extends a trip rod or plunger biased to a first position by a spring, this first position being out of engagement with the latch pintle in all positions of the linkage. However, when the linkage is in the contacts closed or "on" position, the trip rod is movable (by a force external to the circuit breaker) to a second position and into engagement with the latch pintle for moving the latter to a position where it permits the linkage to collapse.

The foregoing and other objects of the invention, the principles of the invention, and the best modes in which I have contemplated applying such principles will more fully appear from the following description and accompanying drawings in illustration thereof.

In the drawings:

FIG. 1 is a partial perspective view of a panel including circuit breakers incorporating the present invention and plug and cord sets insertable into suitable receptacle openings;

FIG. 2 is an enlarged, perspective view of one of the circuit breakers utilized in the panel illustrated in FIG. 1 wherein a side case wall has been broken away to show some of the internal parts;

FIG. 3 is a side view, taken generally along the line 3—3 in FIG. 2, but enlarged, of most of the internal parts of the circuit breaker illustrated in FIG. 2, showing part of the case in cross-section;

FIG. 4 is a view taken along the line 4—4 in FIG. 3, but further enlarged over FIG. 3 and mostly in elevation;

FIG. 5 is a perspective, exploded view of the toggle links, latch pintle and trip rod;

FIG. 6 is a view similar to FIG. 4 but illustrating a modification of this invention; and

FIG. 7 is a partial view of a further embodiment adapted for remote, electrical control.

Referring to the drawings in detail, FIG. 1 illustrates a portion of a cross-connection panel **10** for use with the stage branch lighting circuits of a theatre in which a plurality of male plug and cord sets **11** cooperate with, and are insertable into, female receptacles or openings **12** for the cross-connection of lighting load circuits to dimming and non-dimming control circuits in combination with circuit breakers **15**.

Cross-connection arrangements are commonly used in stage lighting circuits to electrically connect with a lighting circuit an electrical dimmer control circuit where, for reasons of economy or expediency, each stage lighting circuit is not provided with its own electrical dimmer, i.e., its own electrical control means to vary the light intensity. Such arrangements achieve wide flexibility between plural light circuits and a lesser number of dimmer control circuits but the light circuits must be readily connectable and disconnectable from the dimmer control circuits or the non-dimmer control circuits and this connection and disconnection function is performed by the cross-connection panel **10** and the plug and cord sets **11**.

The plug and cord sets **11** comprise male contacts **18** which cooperate with female contacts (not shown) but disposed in the receptacles **12** to cross-connect lighting circuits and the dimmer circuits or the non-dimmer control circuits, as may be desired. It is seen that if the circuit is electrically energized at the time of this connection or disconnection, electrical arcing between the contact **18** and the female contact may result with consequent pitting of the contacts. To insure that the circuit is not electrically energized at such time, movement of the male contact **18** into or out of the receptacle **12** mechanically actuates a mechanical panel linkage **20** (diagrammatically illustrated by dotted lines in FIG. 1) for tripping the circuit breakers **15** to the contacts open or "off" positions (if they were in the contacts closed or "on" positions), the circuit breakers **15** being in electrical series with the associated female contacts.

Each of the circuit breakers **15** is provided with a movable tripping device **21** actuatable by the associated mechanical panel linkage **20** for each circuit breaker and, in FIG. 2, one circuit breaker **15** and one such device **21** are illustrated. Hereinafter, the description will be limited in terms of one circuit breaker but it will be understood that the others are similarly constructed.

The device **21** comprises, referring to FIGS. 2, 3 and 4, a trip rod or plunger **22** carried by a side wall **24** of the circuit breaker insulator case **25**.

The circuit breaker **15** comprises a stationary contact **26** and a movable contact **28** enclosed by the case **25**.

The action of the movable contact **28** on predetermined overload is fully set forth in Patent No. 2,360,922 and neither the linkage mechanism **30** nor the electromagnetic control device **32** therefor form part of this invention but for clarity's sake they may be briefly described as follows: The movable contact **28** is carried on the end of a movable arm **34** which is biased by a spring **35** toward the open position of the contacts **26** and **28**. The arm **34** is connected by a pintle **37** to an automatically resettable and collapsible toggle mechanism **40** which is in turn connected to a handle **42** by a spindle **43**. When the handle **42** is rotated counterclockwise, as viewed in FIG. 3, the toggle mechanism **40** and

the arm 34 all move downward and bring the contact 28 into engagement with the contact 26 (against the bias of the spring 35), the contacts 26 and 28 assuming the position illustrated in FIG. 3. Upon the occurrence of predetermined overload conditions in the coil 45 of electromagnetic control device 32 a pivotal armature 48 is magnetically attracted toward the magnetizable pole 50 to close the electromagnetic flux circuit between the L-shaped magnetizable frame 52 and the pole 50. Such movement of the armature 48 toward the pole 50 (about the pintle 98) causes the oppositely extending tripping arm 55 (which is integral with the armature 48) to move to the left (FIG. 3) and engage a trip leg 57, the latter forming part of a U-shaped latch pintle 58.

The U-shaped latch pintle 58 (FIG. 5) further comprises a latching leg 60 having a half-moon portion 61 defined by a convex surface and a flat surface, the latching leg 60 being connected to the tripping leg 57 by a base 62. The latch pintle 58 is carried by its latching leg 60 in suitable bearings formed in a carrier toggle link 64 and the convex surface of the half-moon portion 61 is engageable with a tooth 66 formed on a catch toggle link 68, the links 64 and 68 being pivotally connected by a pintle 69. Further, a spring 70 is coiled about the latching leg 60 with one spring end 71 (FIGS. 3 and 5) engaging an edge portion of the carrier link 64 and another spring end 72 overlying and engaging the tripping leg 57 for biasing the latch pintle 58 counterclockwise, as viewed in FIG. 3, and presenting to the tooth 66 the convex side of the half-moon portion 61 to latch the toggle links 64 and 68 rigidly together, movement of the tripping leg 57 in the counterclockwise direction (toward the tripping arm 55) being limited by a stop 74 formed on the carrier link 64.

Further, the toggle links 64 and 68 are positioned relative to the trip arm 55 so that when the contacts 26 and 28 are closed, the trip arm 55 is directly behind (or to the right in FIG. 3) of the trip leg 57 and upon sufficient pivotal movement of the armature 48 toward the pole 50, the trip arm 55 engages the trip leg 57 and pivots the half-moon portion 61 sufficiently for the flat surface of the latter to be presented to the tooth 66 at which time the toggle links 64 and 68 collapse automatically under pressure of the opening spring 35 and the contacts move to the open position.

Thus, the tripping device 21 provides an auxiliary arrangement for moving the U-shaped latch pintle 58 when the contacts 26 and 28 are closed and for this purpose the trip rod 22 extends through a hole 80 in the side wall 24, the trip rod being a solid piece of insulator plastic material in slidable fit relation with the portions of the wall 24 defining the hole 80. The trip rod 22 has an enlarged forward head 82 which limits movement of the trip rod to the right by engagement of the head 82 with the side wall 24, the head 82 having a cone-shaped cam end surface 83.

The hole 80 is positioned relative to the base 62 of the latch pintle 58 so that when the contacts are closed the cam surface 83 is below the base 62 and slightly spaced therefrom, but movable into engagement with the base 62 adjacent the trip leg 57 to cam upwardly the thus engaged part of the base 62 and present the flat surface of the half-moon portion 61 to the tooth 66 for collapsing the toggle links 64 and 68. Further, the trip rod 22 includes a nose 85 extending outside of the case 25, the nose 85 carrying a washer 86 in a suitable groove therein and a compression spring 87 is placed between the washer 86 and the side wall 24 to bias, at all times, the trip rod 22 to the right in FIG. 4, i.e. the retracted position in which the head 82 abuts the side wall 24.

The nose 85 is engageable by the previously mentioned panel linkage 20 to depress the trip rod 22 against the bias of the spring 87 and bring the cam surface into engagement with the base 62. Because upon engagement of the base 62 by the cam surface 83 there is a tendency for the latch pintle to move axially in the same direction as the depressing movement of the trip rod 22, a ring or retainer 89 is secured in a groove on the latching leg 60 to limit this axial movement by abutment at such time with the carrier link 64. As illustrated in FIG. 4, the latching leg 60 extends through to the other side of the carrier link 64 and another ring or retainer 90 is secured to the part of the latching leg so extending to prevent axial movement in the opposite axial direction and thereby retain the latch pintle 58 on the carrier link. Further, a collar 92 is formed (as an extension of a sleeve 93 wrapped about the base 62) to properly position on the latching leg 60, the spring 70 between the collar 92 and the ring 89. To permit movement of the trip leg 57 when engaged by the trip arm 55 or the cam surface 83, the carrier link 64 defines a hole 95 large enough for such movement.

As illustrated in FIG. 3, movement of the catch link 68 to the right when the contacts are closed under pressure of opening spring 35 is restrained by the ends of the pintle 43 which abut at this time an extension 96 of the frame 52, the frame extension also carrying the ends of the pintle 97 about which the handle pivots. Further, the armature 48 is pivotal about the armature pintle 98, the ends of which are also carried by the frame 52 and which carries a further coil spring 99 having end portions 101 for biasing the armature 48 (including the trip arm 55) in the counter-clockwise direction (FIG. 3), movement of the armature 48 in this direction being limited by a stop 102 carried by the frame 52. A further spring (not illustrated) is coiled about the handle pintle 97 and has ends 104 for, after collapse of the toggle links 64 and 68, automatically resetting the latter to the position where the tooth 66 engages the convex surface of the half-moon portion 61, movement of the links 64 and 68 during such resetting being limited by a flange 106 integral with the link 64.

Thus, it is seen that during manual opening and closing of the contacts, movement of the movable arm 34, toggle links 64 and 68, armature 48 (including the trip arm 55) and the handle 42 are all in planes generally parallel to that of FIG. 3 whereas axial movement of the trip rod 22 is at all times in a second plane generally perpendicular to those aforementioned. Further, during such manual opening and closing of the contacts all of the parts adjacent the cam surface 83, i.e., the movable arm 34, the latch pintle 58, and the carrier link 64, are spaced from the cam surface 83 when the latter is in its retracted position. That is, only when the contacts are closed (or attempted to be closed) is the cam surface 83 engageable with the latch pintle, as aforementioned.

The washer 86 is positioned on the nose 85 so that sufficient movement to the left (FIG. 4) of the cam surface 83 is permitted to engage the base 62 when the contacts are closed but this movement to the left is insufficient to cause interfering engagement between any part of the head 82 and any part of the internal circuit breaker parts (other than the intended engagement of the cam surface 83 and the base 62 as aforesaid) so that should the trip rod 22 be fully depressed when the circuit breaker contacts are open, the head 82 will not jam with any part of the internal circuit breaker parts.

It is seen from the foregoing that so long as the trip rod 22 remains depressed the circuit breaker contacts 26 and 28 cannot be reclosed. The reason for this is, of course, that when the toggle mechanism 40 is moved downwardly by the handle 42, in attempting to close the contacts, the base 62 is brought into engagement with the cam surface 83 which unlatches the tooth 66 from the convex surface of the half-moon portion 61, collapsing the toggle links 64 and 68 under the pressure of the opening spring 35. (The tooth 66 would be similarly unlatched from the half-moon portion 61 if reclosing of the contacts is attempted while the coil is energized above predetermined overload such as to move the armature 48 against the pole piece 50.) However, if the trip rod 22 is depressed and such overload energizes the coil, the cam

surface 83 is positioned so that it will engage the base 62 (when the toggle mechanism 40 is moved downwardly) before the arm 55 is able to do so.

It is further seen from the foregoing that whenever sufficient movement of a male contact 18 into or out of a female receptacle takes place, the associated panel linkage 20 engages the nose 85 of the trip rod 22 and depresses the latter until, if the circuit breaker contacts 26 and 28 are closed, the cam surface 83 engages the base 62 of the latch pintle 58 to collapse the toggle links 64 and 68, opening the contacts 26 and 28, all as aforedescribed.

FIG. 6 illustrates a modification of this invention in which the tripping device 221 is associated with the said wall 223, the side wall 223 being the opposite side wall to the side wall 224, the latter corresponding to the side wall 24 in FIG. 4. In the embodiment of FIG. 6 the parts which are similar to those illustrated in the previous embodiment bear the same numeral with a prefix 2, and essentially the internal parts of the circuit breaker 215 illustrated in FIG. 6 correspond to those illustrated in the previous embodiment. Thus, FIG. 6 illustrates a linkage mechanism 230 including the movable arm 234, a toggle linkage 240, and a trip arm 255 controlled by the armature 248.

The U-shaped latch pintle 258 also corresponds to that previously described but no element corresponding to the ring 89 is included in the embodiment of FIG. 6 and the spring 270, at the left, bears against a side of the carrier link 264, because when the trip rod 222 is depressed it engages the left hand extremity portion of the tripping leg 257, i.e., the part that extends to the left, beyond the carrier link 264, and any tendency of the U-shaped latch pintle 258 to move axially to the right during engagement by the cam surface 283, while the trip leg 257 is moved upward thereby, is resisted by the ring 290 carried by the left hand extremity portion of the latching leg 260. In all other respects the embodiment of FIG. 6 is constructed similar to that described previously.

FIG. 7 is a fragmentary view illustrating how this invention may be modified for remote control by providing an electrical solenoid coil 300 and a plunger core 301, the latter being of magnetizable material. The solenoid coil 300 is associated with a circuit breaker constructed as first described herein but having a tripping device 321 with a longer nose 385 (than that illustrated in the previous embodiments) surrounded by the coil 300. The solenoid coil 300 is coaxial with the tripping device 321 and attached to the side wall 324 by screws 302 extending through feet 304 formed in the support 306 for the coil 300 and into the side wall 324. The core 301 is formed with a shoulder 310 and a compression spring 312 biases the core 301 away from the nose 385 and against a stop 314 carried by the support 306.

The core 301 is slidable is a central hole 315 defined by the support 306, the upper end of the core being spaced from the closest part of the nose 385 (when the coil 300 is energized below a predetermined level) and being moved, upon sufficient energization of the coil 300, into engagement with the nose 385 for depressing the trip rod 322 sufficiently until the cam surface 383 engages the U-shaped latch pintle (not illustrated in FIG. 7) for the purposes described in the previous embodiments, upward movement of the core 301 being limited by the stop 316 also carried by the support 306. As illustrated the tripping device 321, hole 315 and core 301 are all coaxial and a suitable case 318 may enclose the solenoid coil 300, core 301 and the related parts, the case 318 being attached to the side wall 324 by suitable screws 319.

Having described this invention, I claim:

1. In combination, a circuit breaker comprising a case, an automatically resettable linkage for controlling a pair of separable contacts enclosed by said case, said circuit breaker further comprising an electromagnetic means for controlling said linkage, said linkage including a latch releaseable by said electromagnetic means, a spring for automatically resetting said linkage, a trip rod carried by said case, a second spring biasing said trip rod out of engagement with said latch, and said trip rod being movable into engagement with said latch against the bias of said second spring for moving said latch to a position allowing said linkage to collapse and said contacts to open.

2. In combination, a circuit breaker having a case enclosing a pair of separable contacts, an automatically collapsible linkage for moving one of said contacts to the contacts open position, said linkage comprising a toggle formed by two links one of which is a catch link and other a carrier link, a U-shaped latch carried by said carrier link, said latch including a base and a latching leg cooperating with said carrier and catch links to form a substantially rigid toggle, a movable arm carrying one of said contacts, a contacts opening spring biasing said movable arm to the contacts open position, a trip rod carried by said case and extending through said case, a second spring biasing said trip rod away from engagement with said U-shaped latch, said trip rod being movable into engagement with the base of said U-shaped latch when said contacts are closed to unlatch said toggle whereby it collapses under pressure of said contacts opening spring, said U-shaped latch being biased toward latching engagement with the toggle catch link, and a collar mounted on the latching leg to resist axial movement thereof when said U-shaped latch is engaged by the trip rod.

3. In combination, a circuit breaker having a case enclosing a pair of separable contacts, an automatically resettable and collapsible linkage for moving one of said contacts to the contacts open position, a movable arm carrying one of said contacts, a contacts opening spring biasing said movable arm to the open contacts position, a means for latching said linkage to prevent the collapse of said linkage when the contacts are closed, movement of said linkage and said means being generally in parallel planes, a second spring for automatically resetting said linkage, a trip rod carried by said circuit breaker case and movable in a further plane generally perpendicular to the first mentioned planes, a third spring for biasing said trip rod out of engagement with said means but said trip rod being movable into engagement therewith to permit said linkage to collapse under pressure of said contacts opening spring, said third spring also automatically resetting said trip rod to its initial position subsequent to the collapse of the linkage.

4. The structure recited in claim 3 and further including an electrical solenoid carried by said circuit breaker case, said solenoid comprising a coil and a movable core, said core being biased out of engagement with said trip rod and engageable therewith upon predetermined electrical conditions in said coil, whereby said circuit breaker contacts may be opened from a remote location.

5. In combination, a circuit breaker having a case enclosing a pair of separable contacts, an automatically collapsible and resettable linkage for moving one of said contacts to the contacts open position, a movable arm carrying one of said contacts, a contacts opening spring biasing said movable arms to the contacts open position, said linkage comprising a toggle formed by two links, one of which is a catch link and the other a carrier link, a U-shaped latching pintle carried by said carrier link, said latching pintle including a latching leg, a base, and a tripping leg, said latching leg cooperating with one of said links to form a substantially rigid toggle, a second spring for automatically resetting said linkage, a trip rod carried by said case, a third spring biasing said trip rod away from engagement with said U-shaped latching pintle, said trip rod being movable into engagement with said U-shaped latching pintle when said contacts are closed to unlatch said toggle whereby it collapses under pressure of said contacts opening spring, said U-shaped

latching pintle being biased toward latching engagement with the toggle catch link, said trip rod being engageable with the U-shaped latching pintle at the extremity portion of the tripping leg, a retainer mounted on the latch leg on the same side of said carrier link as said trip rod to resist axial movement thereof when said U-shaped latching pintle is engaged by the trip rod.

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