July 23, 1963 J. M. SPRAGUE 3,098,912

MOVABLE ARM ACTUATED INTERCONNECTED CIRCUIT BREAKERS

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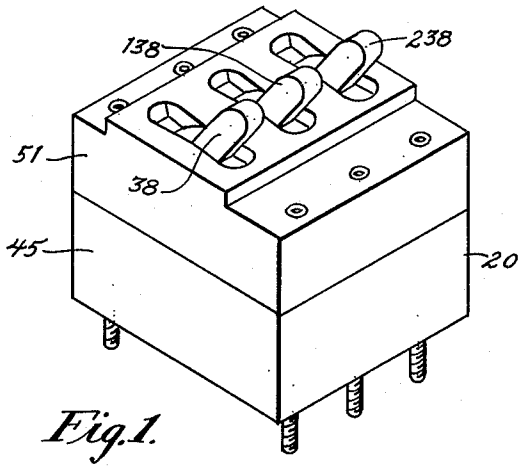

Fig. 1.

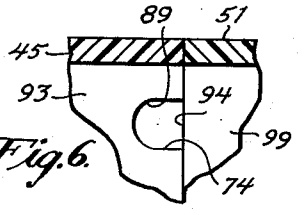

Fig. 6.

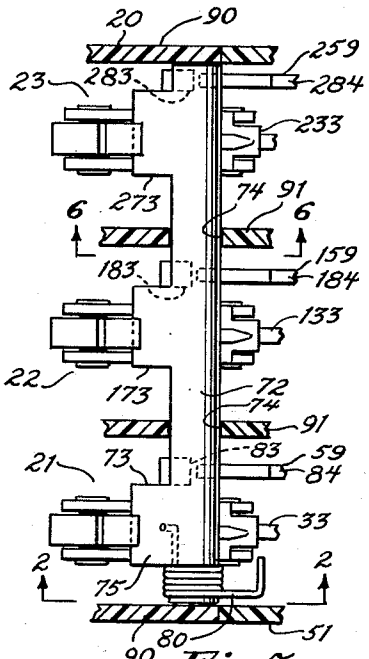

Fig. 5.

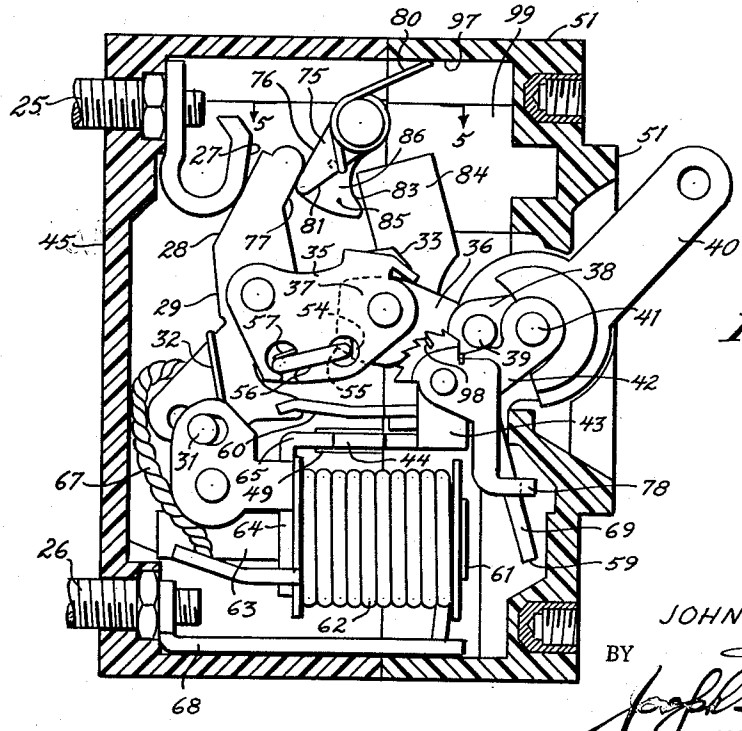

Fig. 2.

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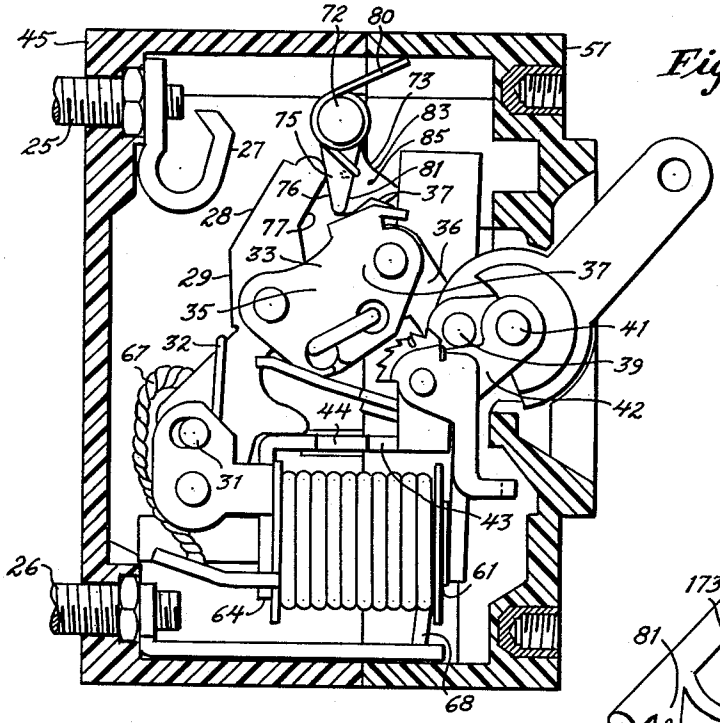

Fig. 3.

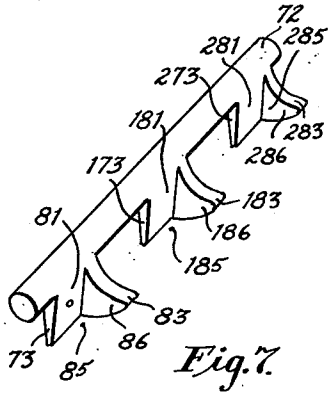

Fig. 7.

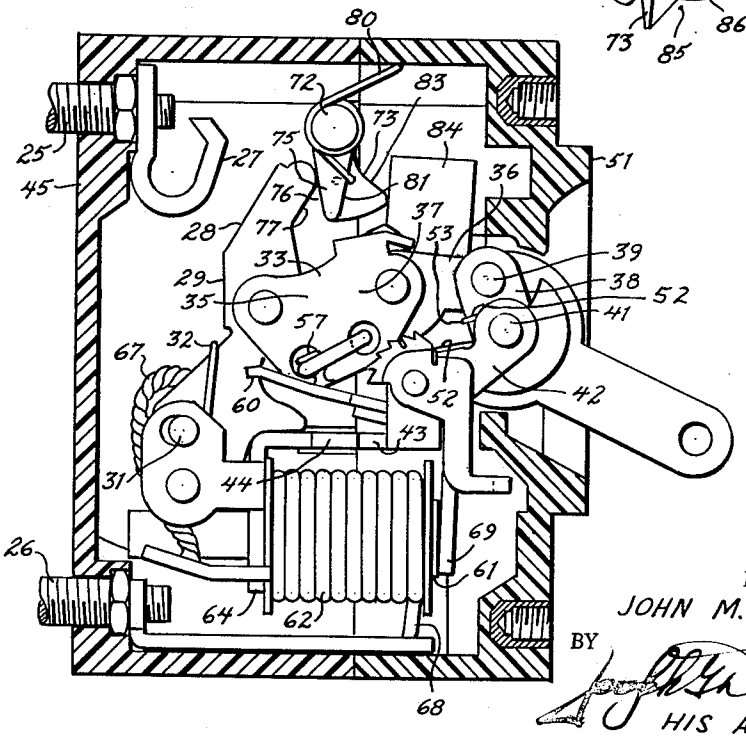

Fig. 4.

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MOVABLE ARM ACTUATED INTERCONNECTED CIRCUIT BREAKERS

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10 Claims. (Cl. 200—107)

This invention relates to multipole circuit breakers of the type in which all of the poles of the circuit breaker are constructed as similar units. An object of the present invention is to provide an improved arrangement for interconnecting the poles of the circuit breakers in which the opening force on the movable contact is transmitted by a cam directly to the tripping device of the associated non-overloaded poles upon opening movement of one movable contact arm due to an overload in that pole or manual opening of the contacts of one pole.

It is desirable to simplify the construction of circuit breakers of this type and this invention provides an integral, one piece molded member for interconnecting the multipoles, in the shape of an elongated bar having spaced along its length a cam surface for each pole, each cam being directly engageable with a movable arm and a trip initiating member. Further, the insulator casing for the multipoles is provided with opposed walls with bearings partially formed therein adjacent the juncture between the one casing part and the other casing part. The assembly of the casing parts together completes the bearings and retains the elongated bar in its proper position. Thus, it is another object to provide a wall structure forming bearings for the interconnecting bar adjacent the juncture of the casing parts.

This invention is incorporated, in one embodiment, in three similar circuit breakers each having a toggle linkage for operating the movable contact. Further, each has an electromagnet, including a coil, which upon predetermined overloads, actuates an armature that trips the toggle linkage and allows the movable contact to be pivoted by the movable arm out of engagement with the stationary contact, due to the bias of an opening spring on the movable arm. An elongated pivotal bar is provided with a cam for each pole and each pivotal cam is disposed between a portion of the armature and the movable contact of each circuit breaker pole. The cam is biased into engagement with the movable arm and the armature portion is biased toward engagement with the cam.

Upon a predetermined overload in any one pole, it is thus seen that the armature of this pole will be actuated by the electromagnetic flux and pivoted in the direction to trip the toggle linkage, causing the associated movable contact to separate from the stationary contact. As soon as the movable contact arm, of the overload pole, starts to move away from the stationary contact it pivots the associated cam and, consequently, the other cams pivot their armature portions in the direction to trip their linkages substantially simultaneously with the collapse of the toggle linkage of the overload pole.

The foregoing and other objects of the invention, and the best mode 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 perspective view, illustrating a three pole circuit breaker unit incorporating the present invention;

FIG. 2 is a side elevation, partly in section, taken adjacent an end pole, and showing the contacts in the closed position;

FIG. 3 is a view similar to FIG. 2 but showing the mechanism after tripping, but before automatic resetting thereof;

FIG. 4 is a view similar to FIG. 3 but showing the open position of the contacts and the mechanism after resetting;

FIG. 5 is a partial view taken along the line 5—5 in FIG. 2;

FIG. 6 is a partial view taken along the line 6—6 in FIG. 5; and

FIG. 7 is a perspective view of the interconnecting cam bar.

Referring to the drawings, this invention is embodied in a multipole circuit breaker unit comprising an insulating casing 20 enclosing three similar circuit breaker poles 21, 22 and 23, each of which has similar components. Hence, only the components of circuit breaker pole 21 will be described in detail, it being understood that the others are similar. However, when necessary to clarify the description, the components of the other circuit breakers will be mentioned with the prefix 1 added for circuit breaker 22, and the prefix 2 added for circuit breaker 23, to better distinguish the various parts.

The circuit breaker 21 is provided with terminals 25 and 26 for connecting the unit to a desired circuit. The terminal 25 is connected to a stationary contact 27 which cooperates with a movable contact 28, the latter being carried by a movable arm 29. The movable arm 29 pivots about a pintle 31 and is biased by a spring 32 to the open position of the contacts.

The movable arm 29 comprises part of a linkage mechanism which includes a toggle 33 comprising links 35 and 36. The link 35 is pivotally connected to the movable arm 29 at one end and to the link 36 at the other end to form the knee 37 of the toggle. The link 36 is pivotally connected at the other end to the handle link 38 by a pintle 39. The handle link 38 oscillates about a fixed pivot 41 supported by extending through openings in the two parallel, spaced extensions 42 of the frame 43, the latter being positioned by opposed lugs 44 in opposed slots 49 formed in the walls of the casing part 45, FIG. 2. The frame 43 is restrained in its proper position by the cover casing part 51 which has wall structure (not illustrated) engaging the ends of the pin 41 extending beyond the frame extensions 42 for restraining movement to the right of the frame when the contacts are closed. The handle link 38, is biased to the off position of the contacts by a torsion reset spring 52 (FIG. 4) the ends of which are wound about the pivot 41 and held stationary by the frame extensions 42, the yoke 53 engaging the underside of the handle link 38 and biasing it to the off position.

The toggle link 36 is provided with a tooth portion 54 (FIG. 2) for engaging a half moon 55 of a latch 56 carried by the link 35 for locking the toggle in the overcenter position during automatic resetting. The latch 56 is biased in the counterclockwise direction by a spring 57.

The latch 56 is tripped by a pivotal armature 59 having three arms, namely a left hand unlatching member 60, an attracted end 69 and a balance portion 84. The left hand unlatching member 60, as viewed in FIG. 2, engages the latch 56 upon an overload and turns it against the bias of the spring 57 to present the flat portion of the half moon 55 to the tooth 54, thereby allowing the toggle 33 to collapse upwardly under the bias of the spring 32, when the armature's right hand end 69 (FIG. 2) is attracted upon overload, toward the pole piece 61 of an electromagnet comprising a coil 62 formed about a tube 63, the latter projecting through a leg 64 of the L-shaped frame 43. The tube 63 houses a movable core

of magnetic material biased toward the left-hand end of the tube to provide a time delay below certain overload currents before tripping of the unit. The tube 63 is soldered to the frame leg 64 and the coil 62 has one end connected to the movable arm 29 by a flexible conductor 67 and the other end connected by a conductor 68 to the terminal 26.

The tripping of the adjacent poles is effected upon the electromagnetic tripping of any one pole, by a unitary insulator elongated bar 72, having formed thereon spaced cams 73, 173 and 273.

The bar 72 has two portions intermediate its ends, FIG. 5 (one portion between cams 73 and 173 and the other between cams 173 and 273), disposed in bearings 74 formed in the two partition insulator walls 91 separating the circuit breakers.

Referring to one of the cams, the cam 73 comprises a generally triangular depending portion 75 having a straight front surface 76 biased into slidable abutment with the rear straight surface 77 of the movable arm 29, as illustrated in FIG. 2, by one torsion spring 80 which serves to so bias the entire bar 72 and, hence, all of the cams 73, 173 and 273. To provide for force distribution over a wide surface area, the surfaces 76 and 77 abut along a common plane, as illustrated in FIG. 2, which also facilitates relative sliding movement of the two surfaces 76 and 77.

The far face 81 of the triangular cam portion 75, with respect to the movable arm 29, is provided with a curved cam finger 83 projecting toward the balance portion 84 of the armature 59, along only an axial portion of the face 81 of the triangular cam portion 75 (FIGS. 5 and 7) so that a recess 85 is formed between the rear face 81 and the side face 86 of the finger 83 into which the knee portion 37 of the toggle 33 may enter during the tripping movement of the linkage, as illustrated in FIG. 3. As illustrated in FIG. 5, the balance portions 84, 184 and 284 are in side by side relation with the toggles 33, 133 and 233. Pivotal movements of the balance portions 84, 184 and 284 are in planes which are parallel to the planes in which movement of the toggles take place but each toggle is spaced at all times from its associated cam and the associated armature balance portion.

In manual opening or closing of the contacts 27 and 28, i.e., in movement from the position of FIG. 2 to that of FIG. 4, or vice versa, each cam remains independent of the associated toggle linkage, since the toggle 33 is positioned with respect to the cam 73 so that no interference takes place because the toggle is spaced from the cam 73 in their closest position, the contacts open position illustrated by FIG. 4, and in manually closing the contacts, the linkage movement is such that the toggle knee 37 moves downwardly and becomes more spaced from the cam, compare FIGS. 2 and 4. A comparison of FIGS. 2 and 4 also shows the relative sliding movement between surfaces 76 and 77 which takes place during opening and closing movements of the movable arm 29, due to abutment of surfaces 76 and 77 between the pivotal axes of the movable arm 29 and the bar 72 as they rotate in opposite directions.

As illustrated in FIG. 6, the bearings 74 each comprise a U-shaped open ended bearing notch 89, in the two insulator walls 91 of the casing part 45, adjacent the line of juncture between the casing parts 45 and 51. Each notch 89 is closed by a vertical surface 94, of the mating insulator walls 99 in the cover casing part 51, which with the walls 93 form the partitions 91 for the circuit breakers 21, 22 and 23 at right angles to the line of juncture of the casing parts 45 and 51. Longitudinal movement of the bar 72 is limited by the abutment of the ends of bar 72 with the outer, opposed walls 90 of the casing part 45, FIG. 5. As illustrated the line of juncture of the casing parts 45 and 51 is parallel to that of the longitudinal axis of the bar 72.

As illustrated, the spring 80 has one end against an inner surface 97 of the cover casing part 51 and another end against the rear cam face for biasing the bar 72 so that the cam surface 76 abuts the surface 77 of the movable arm 29, FIG. 2. This spring bias would tend to move the bar 72 out of the bearing notches 89 were it not for the surfaces 94. Thus, the surfaces 94 are tangent to a circle which would be defined if the semicircular base of the U-shaped notches were a complete circle and this imaginary circle has a slightly larger diameter than the diameter of the bar 72 so that the bar 72 is freely rotatable in the bearings so formed.

The armature 59 is biased by a spring 98 so that the unlatching member 60 is urged away from the latch 56 and the balance end 84 is biased counterclockwise toward the cam finger 83 and against a limiting stop 78 turned out from a well secured to one of the frame extensions 42.

The cam finger 83 is positioned to impinge upon the balance portions 84 of the armature but in the closed position of the contacts, FIG. 2, it is spaced therefrom to prevent accidental tripping of the breaker due to vibration or shock. In the open position of the contacts, FIG. 4, the movable arm surface 77 biases the cam finger 83 into contact with the balance portion 84, so that the armature is held against the pole piece 61.

The handle spring 52 also resets the toggle linkage as well as moving the handle to the off position after the armature trips the linkage. The relation of the toggle 33, latch 56, and unlatching armature member 60 is such that in the contacts open position (FIG. 4) the unlatching member 60 is spaced from the latch 56, as illustrated. Further, in moving from the off to the on contacts positions, the unlatching member 60 moves down sufficiently to provide a space between the latch 56 and unlatching member 60, movement of the unlatching member 60 being due to the armature spring bias which actuates the armature as soon as the movable contact movement starts, relieving the bias of the cam finger 83 on the balance portion 84.

Upon an overload in any one pole, for instance, the pole illustrated in FIG. 2, sufficient to trip the pole, the armature 59 is rotated about its pivot into engagement with and rotates the latch 56 against the bias of the latch spring 57 sufficiently for the tooth 54 to clear the half moon 55. The over center toggle 33 immediately collapses under pressure from the opening spring 32 and the movable arm 29 starts to separate from the stationary contact 27. As the separating movement starts, rotation of the cam bar 72 also starts because of the abutment of the movable arm surface 77 and the cam surface 76. Continued movement of the movable arm 29 and continued pivoting of the cam bar 72 causes the cam finger to move toward the balance portion 84. Since the cams 73, 173 and 273 are interconnected by the bar 72, all of the cams are pivoted similarly.

Since the associated poles are not overloaded, the armatures 159 and 259 have not been pivoted toward their pole pieces. Consequently because of the aforementioned movement of the cams, the cam fingers 183 and 283 (FIG. 5) impinge forcefully upon their associated armature balance portions 184 and 284 and turn the armatures in the direction to unlatch the associated latches, whereby all of the poles of the circuit breakers are opened substantially simultaneously. Thus, it is seen that the initial force required to trip the first or overloaded pole is not greater than the force which would be required to trip the circuit breaker if it were not associated with other circuit breakers, i.e., the force required to rotate one latch against its own spring. Also, the force to rotate all of the cams and the connecting bar 72 is derived from the opening spring 32 of one pole. Since the opening spring 32 is made strong enough to open the contacts under possible adverse circumstances, a reservoir of power is available sufficient to rotate the interconnecting bar and the armatures of the associated non-overloaded poles.

FIG. 3 illustrates the overloaded pole immediately after

tripping and after the movable contact arm 29 has rotated the cam bar 72 and, hence, the three cams in the contact opening direction. FIG. 4 illustrates the overloaded pole after the mechanism has been automatically reset due to the bias of the spring 52. The spring 52 forces the handle link 38 to rotate, moving the handle 40 to the off position wherein the tooth 54 is restrainably engaged by the half moon 55.

It is to be noted that the opening of all three poles occurs in a more direct response to the opening of the contacts of the overloaded pole. The time lead of the overloaded pole, for instance, circuit breaker 21, is the amount of time required for the cam finger 83 to travel the small clearance distance between it and the balance 84 and thereafter through the pivotal distance to unlatch the latches. Upon the rotation of the latches of the circuit breakers 22 and 23 the toggles thereof also collapse and their contacts start to open. Thus, by properly proportioning the various parts, the contacts of the non-overloaded circuit breaker poles start to open before the contacts of the overloaded circuit breakers are entirely open, resulting in a substantially simultaneous opening of the contacts of all the poles of the unit.

While FIGS. 3 and 4 have been discussed in connection with the overloaded pole it is seen that the positions of the mechanism (immediately after tripping and in the off position of the contacts) are the same whether the tripping occurs due to the overload being in the pole illustrated or in an adjacent pole.

The cams 73, 173 and 273 and interconnecting bar 72 are integrally formed from a suitable insulating, moldable material of sufficient rigidity, such as nylon.

Movement of the mechanism in the opening direction is limited by abutment of the movable contact arm 29 with the horizontal portion of the frame 65. Similarly in the closed position of the contacts, the mechanism is held in a stable position by abutment of the ends of the pivot 39 (connecting the link 38 to the link 36) with a portion of the frame extension 42, FIG. 2.

It will be noted that the mechanism remains "trip free" in that if the handles are turned toward the closed position of the contacts while an overload current persists in one of the poles, all of the contacts will move to the open position of the contacts. The foregoing occurs because the armature of the overloaded pole will rotate its latch and its toggle will collapse, and simultaneously the movable arm will rotate the cam bar, resulting in the collapse of the associated toggles of the associated circuit breakers as heretofore stated. Thus all of the contacts move to the open position even if, for example, all of the handles are manually maintained thereafter in the position corresponding to the closed position of the contacts.

Also, it will be noted that when the contacts of all the poles are closed by manual movement of the handles 40 to the closed positions, FIG. 2, the subsequent manual movement of any one handle to the off position will cause movement of all the contacts and all the handles to the off position, due to the bar 72 which upon opening of the first pair of contacts causes the associated armatures of the associated poles to move in the contacts opening position. Thus, the handles need not be physically connected to each other and nevertheless simultaneous opening of all the contacts is assured whether the first pole is tripped manually or electrically.

Having described this invention, I claim:

1. The combination of a plurality of switch units, each switch unit having a pair of relatively movable contacts, an automatically resettable mechanism including a movable arm carrying one of the contacts and pivotal to a position for opening said contacts, an electromagnetic tripping device including an armature for initiating movement of said mechanism to the open position of the contacts, a cam member associated with each mechanism, all of the cam members being interconnected for simultaneous movement upon the movement of any one to move all of said mechanisms in the contacts opening direction, each of the cam members having a portion engageable with the associated movable arm and another portion engageable with the associated armature.

2. The combination of a plurality of switch units, each switch unit having a pair of relatively movable contacts, an automatically resettable toggle mechanism including a movable arm carrying one of the contacts and pivotal to a position for opening said contacts, an electromagnetic tripping device including an armature for initiating movement of said mechanism to the open position of the contacts upon an overload, said mechanism including an automatically resettable latch, spring means for automatically relatching each mechanism after electromagnetic opening of the contacts, and a cam member associated with each mechanism, all of the cam members being interconnected for simultaneous movement upon the movement of any one to move said mechanisms in the contacts opening direction, each of the cam members having a portion in force transmitting relation with the movable arm to rotate the cam members as soon as the contacts of the first switch unit start to separate each of said cam members having another portion impingable upon portions of each of the armatures of the units other than the overloaded switch unit, and said cam members being biased into abutment with said movable arms at all times.

3. The combination of a plurality of switch units, each switch unit having a stationary contact and a movable contact, a mechanism including a pivotal movable arm carrying said movable contact, a spring biasing said arm to the open position of said contacts, a tripping device including a pivotal member for initiating movement of said mechanism upon predetermined overloads, a pivotal cam associated with each mechanism and all of the cams being interconnected, each mechanism including an automatically resettable latch, spring means for automtically relatching each mechanism after electromagnetic opening of the contacts, each cam being biased toward the associated movable arm, and each pivotal member being biased toward the associated cam, each cam, each movable arm, and each tripping pivotal member of every switch unit being in direct force transmitting relationship, whereby upon opening movement of the movable arm of the overloaded switch a force is imposed directly upon the pivotal member of the associated switches to initiate opening of the contacts of the associated switches by releasing the latches of the associated mechanisms of the associated non-overloaded switch units in direct response to the movement of the movable arm of the overloaded switch, each switch unit having an individual handle for manual operation, and each handle being independent from the other handles, whereupon manual opening of one switch unit results in automatic opening of the other switch units due to pivoting of the cams.

4. The combination of a plurality of switch units, each switch unit comprising a stationary contact and a movable contact, an automatically resettable mechanism including a pivotal movable arm carrying said movable contact, a spring biasing said arm to the open position of said contacts, a tripping device including a pivotal armature member for initiating movement of said mechanism upon predetermined overloads, a pivotal cam associated with each mechanism and all of the cams being interconnected, each cam being biased toward the associated movable arm, and each pivotal armature member being biased toward the associated cam, said arm, cam and armature being in force transmitting relationship to each other, whereby upon opening movement of the movable arm of the overloaded switch a force is imposed directly upon the pivotal armature member of the associated switches to initiate opening of the contacts of the associated switches in direct response to the movement of the movable arm of the overloaded switch, each of said cams being disposed between each associated movable arm and pivotal armature member, said mechanism including a toggle and

a handle for manual operation, each of said cams having a recessed portion for accommodating a portion of said toggles during the tripping movements of said mechanisms so that said toggles remain independent of said cams and said toggles being also independent of said cams at all other times.

5. The combination of a plurality of switch units, each unit having a stationary contact and a movable contact, a mechanism including a pivotal movable arm carrying said movable contact and a latch carried by the mechanism and trippable to collapse the mechanism and initiate separation of the contacts, a spring biasing said arm to the open position of said contacts, an electromagnetic tripping device including a pivotal armature for initiating movement of said mechanism by tripping said latch, a pivotal cam associated with each mechanism said latch being separate from said armature but being engageable by said armature to trip the latch, and a bar for interconnecting all of the cam members, said movable arm and armature being pivotal about axes in the same direction and opposite to that of the cams and bar, each cam being biased toward a force transmitting position with the associated movable arm, and each armature being biased toward a force transmitting position with the associated cam, whereby upon opening movement of the movable arm of the overloaded switch a force is imposed directly upon the armatures of the associated switches to initiate opening of the contacts of the associated switches substantially simultaneously due to movement manually of the first movable arm to the contacts open position and also upon initiation of movement of the first movable arm due to electrical tripping.

6. The combination of a plurality of switch units, each switch comprising a stationary contact and a movable contact, an automatically resetable mechanism including a pivotal movable arm carrying said movable contact, a spring biasing said arm to the open position of said contacts, an electromagnetic tripping device including a pivotal armature for initiating movement of said mechanism upon predetermined overloads, a pivotal cam associated with each mechanism and a bar for interconnecting all of the cams, said movable arm and armature being pivotal in the same direction and opposite to that of the cams and bar, each cam being biased toward force transmitting relationship with the associated movable arm, and each armature being biased toward force transmitting relationship with the associated cam, whereby upon opening movement of the movable arm of the overloaded switch a force is imposed directly upon the armature of the associated switches to initiate opening of the contacts of the associated switches substantially simultaneously with initial movement of the movable arm of the overloaded switch, an insulator casing for the switch units, said casing being divided into two portions, said casing having insulating partition walls and end walls, said partition walls having open ended bearing notches for receiving portions of said bar and said end walls limiting longitudinal movement of said bar, said notches being formed adjacent the juncture between said two casing portions in one of said casing portions, and the other of said casing portions providing retaining wall structures for closing said open ended notches to complete the bearings for the bar.

7. The combination of a plurality of similar circuit breakers, each circuit breaker having a pair of relatively movable contacts manually and electrically controllable, a linkage mechanism including a latch and movable to open and close said contacts and automatically relatchable upon opening of the contacts, a tripping device having a trip finger capable of initiating movement of said mechanism by movement from a first position out of engagement with said latch, when the contacts are closed, to a second position where it engages and releases said latch to open said contacts, said latch being carried by said mechanism away from said trip finger upon unlatching and subsequently relatched automatically, a common trip cam member associated with each mechanism and each tripping device, each common trip cam member being engageable with the associated mechanism at one portion and engageable with the associated tripping device at another portion, a bar for interconnecting the common trip cam members for simultaneous movement upon the movement of any one, whereby upon an overload only in one circuit breaker the tripping devices of the non-overloaded circuit breakers are capable of being acted upon by their associated common trip cam members to move the trip fingers to the positions for releasing the latches and move the mechanisms away from the trip fingers, the common trip cam member in each circuit breaker remaining in contact with a part of the mechanism after the contacts open, whereby the trip finger in each circuit breaker remains, upon the opening of the contacts, in its second position but out of engagement with the associated latch due to the mechanism carrying the latch away from the trip finger on the opening of the contacts, and spring means biasing said common trip cam members and said tripping devices so that the latter's trip finger is out of engagement with the associated latch, movement of the mechanisms to the contacts closed positions allowing said spring bias to move the common trip cams and the tripping devices at which time each tripping device moves to its initial position spaced from the associated latch as the associated mechanism is moved to the contacts closed position until a predetermined overload takes place or the movable arm is moved manually to the open contacts position.

8. The structure recited in claim 7 wherein each mechanism includes a movable contact arm and each common trip cam member is operatively associated therewith and biased toward engagement with the movable contact arm of its associated mechanism.

9. The combination of a plurality of similar circuit breakers, each circuit breaker having a pair of relatively movable contacts and a latchable mechanism for opening and closing the contacts, each mechanism being automatically relatachable upon electrical tripping of the mechanism and opening of the contacts upon predetermined overload, an electromagnetic tripping device for each mechanism and movable from a first position to a second tripping position for unlatching said mechanism upon predetermined overloads to trip open the associated mechanism, each mechanism including a movable contact arm, a common trip cam member in each circuit breaker operatively associated with the movable arm and the tripping device, a bar for interconnecting the common trip cam members, each common trip cam member being movable from a first position engageable with the movable arm to a second position in engagement with the tripping device by the movable arm of the overloaded circuit breaker to unlatch the mechanisms of the associated non-overloaded circuit breakers by moving the tripping devices of the non-overloaded circuit breakers to their second positions, spring means in each circuit breaker for automatically relatching each mechanism subsequent to the opening of the contacts, and further spring means biasing said common trip members toward their first positions and said tripping devices toward their first positions, whereby upon electrical tripping the mechanisms automatically relatch themselves after the contacts open but the cam members and tripping devices remain in the tripped position until the contacts are closed at which time they automatically reset themselves to the mentioned first position.

10. The combination recited in claim 9 and further including individual operators for each of the mechanisms, whereby when the operator of one circuit breaker is moved to the contacts open position after closing the contacts, the common trip cam members of all the circuit breakers are moved to their second positions, whereby the contacts of all the associated units open and their oper-

ators also move to the contacts open positions, and wherein the contacts of the circuit breakers may be selectively closed due to the individual operators.

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