July 23, 1963 N. J. SCHWARTZ ET AL 3,098,911

INTERCONNECTED CIRCUIT BREAKERS

Filed July 7, 1960 3 Sheets-Sheet 1

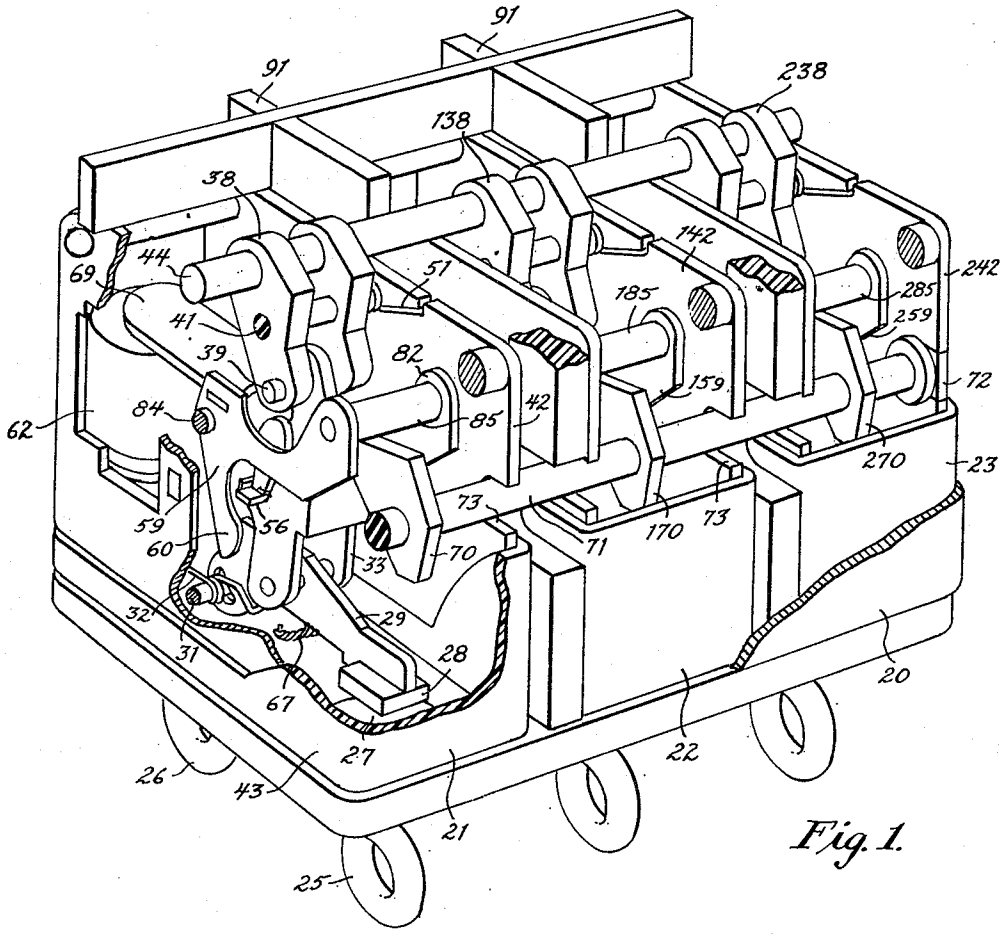

Fig. 1.

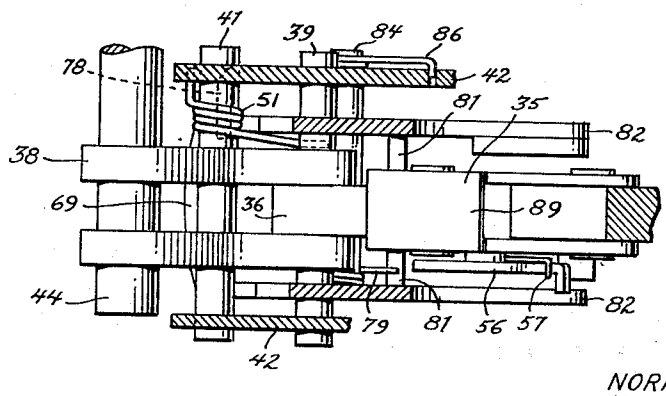

Fig. 6.

INVENTORS.
NORMAN J. SCHWARTZ
HALE H. GOLDBLATT
BY
Peter J. Patane
THEIR ATTORNEY.

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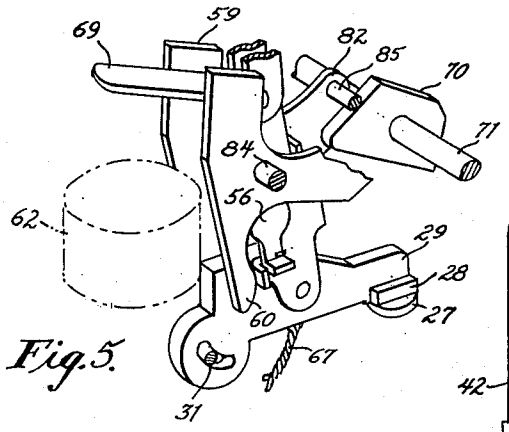


Fig. 5.

Fig. 7.

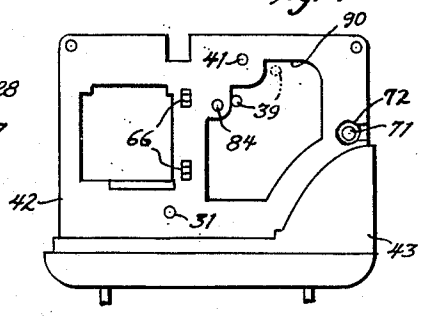
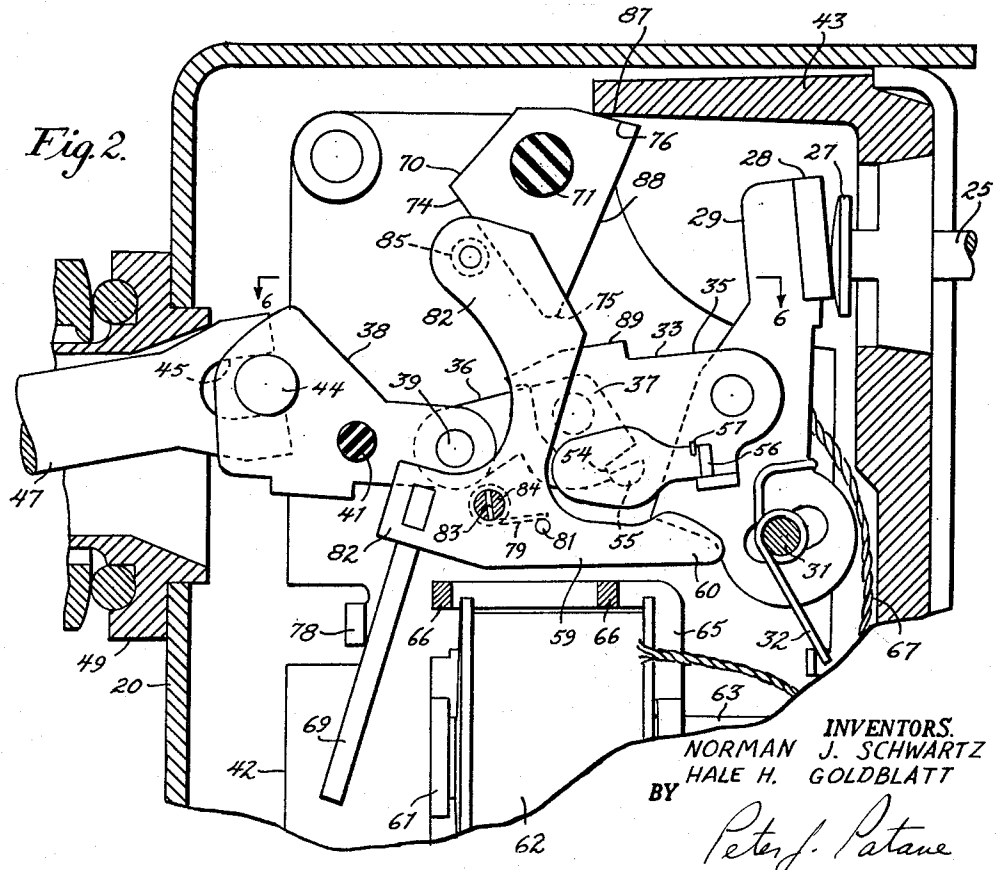


Fig. 2.



INVENTORS.
NORMAN J. SCHWARTZ
HALE H. GOLDBLATT
BY
Peter J. Patane
THEIR ATTORNEY.

July 23, 1963 N. J. SCHWARTZ ET AL 3,098,911

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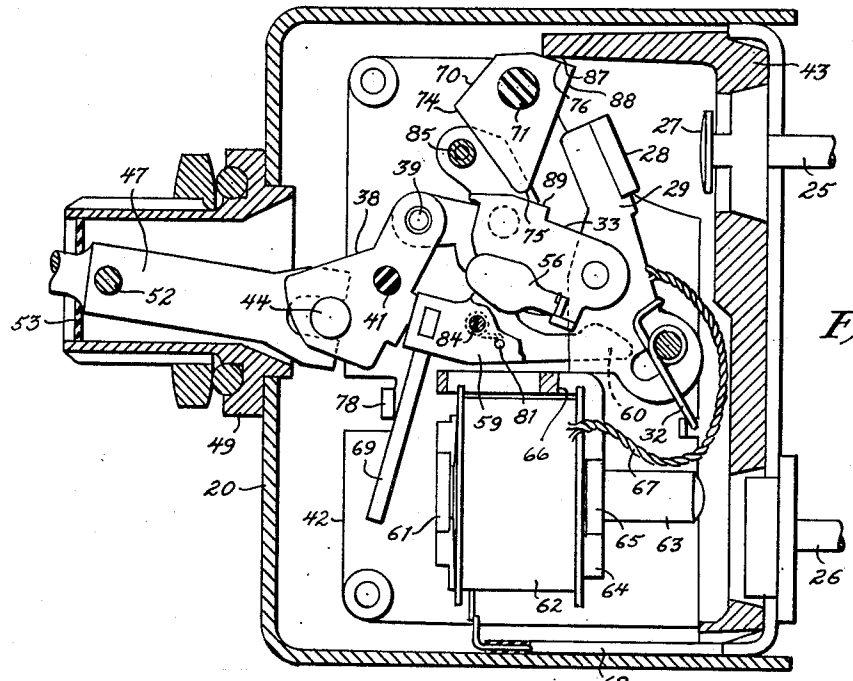

Fig. 4.

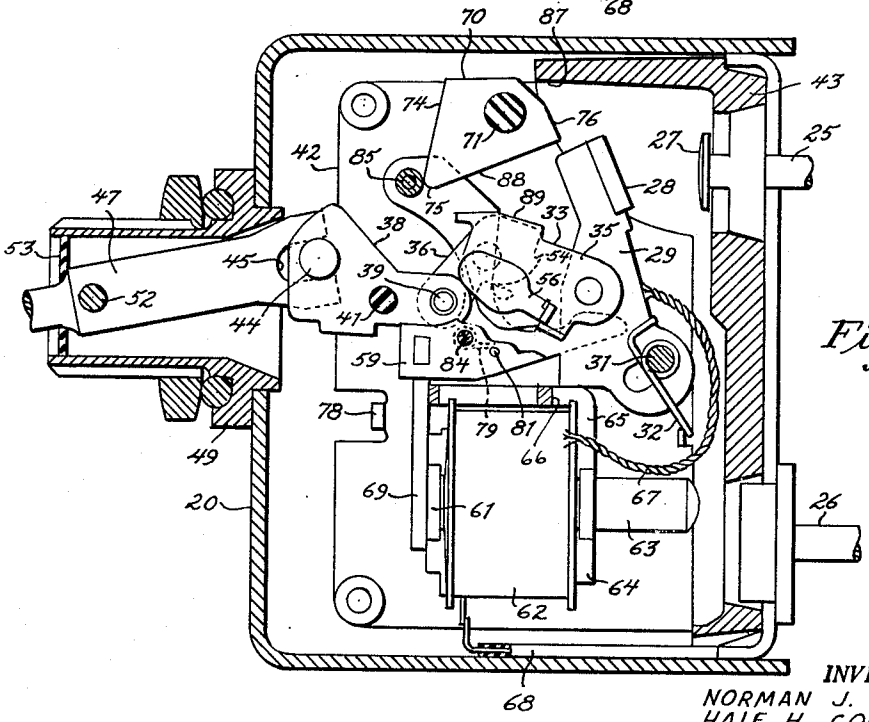

Fig. 3.

INVENTORS.
NORMAN J. SCHWARTZ
HALE H. GOLDBLATT

BY

Peter J. Patane

THEIR ATTORNEY.

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INTERCONNECTED CIRCUIT BREAKERS

Norman J. Schwartz, Yardley, and Hale H. Goldblatt, Morrisville, Pa., assignors to Heinemann Electric Company, Trenton, N.J., a corporation of New Jersey

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5 Claims. (Cl. 200—106)

This invention relates to multipole circuit breakers of the type in which each pole of the circuit breaker is constructed of similar units. One object of the present invention is to provide an improved and more economical arrangement for interconnecting the poles of such circuit breakers.

Another object of the present invention is to provide an improved interconnecting cam device in which the force to initiate action in the tripping direction is no greater than that needed to actuate any one of the poles without the use of elongated force transmitting members within the individual circuit breakers.

In one embodiment, the invention is incorporated in three similar circuit breakers each having a toggle linkage for operating the movable contact. Further, each has an electromagnetic coil which, upon a predetermined overload, attracts an armature that trips the toggle linkage and allows the movable contact to move relative to the stationary contact, under the bias of a spring.

The linkage of the circuit breaker impinges, during the tripping, upon a pivotal cam. Each of the breakers of the multipole unit is provided with similar pivotal cams, all of which are interconnected along the pivotal axis, and each pivotal cam is associated with one armature. When the first pivotal cam is actuated, by impingement therewith of the linkage, it causes all of the others to rotate into contact with their associated armatures, moving each armature in the tripping direction for opening the contacts of all of the poles substantially simultaneously.

Thus, it is seen that the tripping action of the overloaded pole is applied only against the spring force tending to maintain that particular pole in the contacts closed position. All of the contacts of all the poles are opened due to the fact that all the armatures are rotated in the latch releasing direction by the rotation of the common trip bar.

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

FIG. 1 is a perspective view, illustrating a multipole circuit breaker unit constructed in accordance with the present invention, omitting the master handle and cutting away some of the other parts;

FIG. 2 is a partial side elevation view partly in vertical section taken adjacent an end pole and adjacent the central master handle of the circuit breaker unit illustrated in FIG. 1 and showing the contacts in the closed position;

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

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 perspective view showing one of the circuit breakers in the contacts closed position;

FIG. 6 is a partial sectional view of an end pole taken along the line 6—6 in FIG. 2, looking in the direction indicated by the arrows; and

FIG. 7 is a side elevation view of a portion of the support structure for the circuit breaker mechanism.

Referring to the drawings, this invention is embodied

in a multipole circuit breaker unit comprising a metallic casing 20 enclosing the similar circuit breakers 21, 22 and 23. The components of each of the aforementioned circuit breakers are substantially the same and only those components of one circuit breaker, circuit breaker 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 pivots about a fixed 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 link 38 oscillates about a fixed pivot 41 supported by extending through openings in the vertical opposed supporting walls 42, the latter being mounted on insulating bases 43 supported by the bottom of the case 20. The handle links 38, 138 and 238 of the three circuit breakers are interconnected by an insulator rod 44. The midportion of the insulator rod 44 is pivotal and slidable in elongated slots 45 formed in a master pivotal handle 47 (FIG. 3) projecting through a neck 49 added to the casing 20. The handle links are biased to the off position of the contacts by a torsion spring 51 wound about the pivot 41 and having one end held stationary in a notch in one of the walls 42 and the other end under the pintle 39 at the connection between the link 38 and the link 36. The master handle 47 may be pivoted about a fixed pintle 52 carried by the neck 49. By soldering all the joints of the casing 20 and providing a rubber diaphragm 53 to the left of the fixed pintle 52 a sealed unit results, FIGS. 3 and 4.

The toggle link 36 is provided with a tooth portion 54 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 clockwise direction, as viewed in FIG. 2, by a spring 57 (FIG. 6).

The latch 56 is tripped by an armature 59 having a right-hand portion 60, as viewed in FIG. 2, which 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.

The armature left-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 an L-shaped frame 65. The tube 63 houses a movable magnetic core biased to the right-hand end of the tube to provide a time delay below certain overload currents before tripping of the unit. The L-shaped frame 65 is provided with lugs 66 extending through the vertical support walls 42 and the coil 62 has one end connected to the movable contact 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 affected upon the automatic tripping of any one pole through the pivotal cams 70, 170 and 270 and the interconnecting common insulator bar 71. Referring to one of the cams, the cam

70 is formed from a polygonal member of suitable rigidity having a generally triangular appearance. The cam 70 is formed from insulating material and secured to the common bar 71 so that pivotal movement of one of the cams 70, 170 or 270 causes pivotal movement of the bar 71 and associated cams.

The bar 71 has end portions disposed in bearings 72 formed in the end walls 42 and 242 of the circuit breakers 21 and 23, respectively, the intermediate walls having notches 73 to accommodate the bar 71. The cam 70 has two operating surfaces, a straight side 74 and a curved nose 75, and a rotation limiting surface 76, the latter abutting a portion 87 of the base 43. As viewed in FIG. 1, rotation in a counterclockwise direction is limited by this abutment.

The armature 59 is biased by a spring 79 so that the end 60 of the armature is urged away from the latch 56 and the end 69 is biased clockwise toward the cam surface 74 and against a rectangular limiting stop 78 turned out from one of the walls 42. The spring 79 has one end abutting a shaft 81 connecting the spaced generally L-shaped armature members 82 and the other end of the spring 79 is disposed in a slot 83 formed in one end portion of the armature pivot 84 carried by the walls 42. The other end portion of the pivot 84 is connected to a spring 86 for holding the pivot stationary, the ends of the spring 86 being held stationary in a notch in one of the walls 42.

The cam 70 is generally disposed between the L-shaped armature members 82 and positioned for the surface 74 to impinge upon the shaft 85 connecting the top portion (FIG. 2) of the L-shaped armature members 82. Also, the cam is generally disposed at one side of the unit between the contact arm 29, the link 35 of the toggle 33 and the upper portion (FIG. 2) of the L-shaped armature members 82 with no part of the mechanism between the cam 70 and the adjacent part of the casing 20.

The weight and shape of the cam 70 is such that a force is exerted, when in the contacts closed position and the apparatus disposed as illustrated in FIG. 1, about the bar 71 tending to bias the cam 70 in the counterclockwise direction against the portion 87 of the base 43.

The nose 75 is disposed above the knee 37 of the toggle 33 but spaced therefrom in the closed position of the contacts 27 and 28, FIG. 2. The cam surface 74 is positioned to impinge upon the shaft 85 but in the closed position of the contacts, FIG. 2, is also slightly spaced therefrom to prevent accidental tripping of the breaker due to vibration or shock. As illustrated, in FIG. 4, this slight clearance between surface 74 and shaft 85 exists in the open position of the contacts also. The cam 70 has a relieved surface 88 so that no interference will result between the movable contact 29 and the cam 70 in any position of the mechanism.

If desired, torsion springs (not illustrated) may be wound about the bar 71 having spring ends secured to the bar 71 and other ends secured in notches in the vertical walls, 42, 142 and 242 for increasing the bias of the cam 70 toward the stop 87.

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 84 into engagement with and rotates the latch 56 against the bias of the latch spring 57 sufficienly for the tooth 54 to clear the half moon 55. The overcenter toggle 33 immediately collapses under pressure from the opening spring 32. The collapse of the toggle 33 and its movement through the space between the cam surface 75 and the channel shaped portion 89 of the link 35, causes the portion 89 to forcefully impinge upon the cam surface 75, for rotating the cam 70 clockwise and, through the bar 71, the associated cams 170 and 270 of the adjacent poles.

Rotation of the adjacent cams 170 and 270 causes their surfaces 174 and 274 to forcefully impinge upon shafts 185 and 285 and to rotate the armatures 159 and 259 in the direction to release their toggles by rotating the associated latches in the toggle releasing direction. 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 71 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 all the trip levers and interconnecting bar.

FIG. 3 illustrates the overloaded pole immediately after tripping and after the toggle 33 has impinged upon the cam surface 75 and rotated the three cams 70, 170 and 270 of the multipole circuit breaker in the contacts opening direction.

FIG. 4 illustrates the overloaded pole after the mechanism has been reset due to the bias of the spring 51. The spring 51 forces the link 38 to rotate, moving the handle 47 to the off position and the toggle 33 to the reset 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 substantially simultaneously since the time lead of the overloaded pole, for instance circuit breaker 21, is the amount of time required for the toggle 33 to travel the clearance distance between the channel shaped portion 89 and impinge upon the cam 70 plus the time required to travel through the slight clearance between the cam surface 74 and armature shaft 85 and thereafter to rotate the armatures and latches of the associated, nonoverloaded circuit breakers 22 and 23. 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 nonoverloaded circuit breakers 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 cam 70 is formed from a suitable insulating material to provide for filing or otherwise adjusting the surfaces 74 and 75 upon final assembly and testing so that manufacturing variations may be compensated for and calibration of the circuit breakers made.

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 vertical walls 42, as illustrated in FIG. 7. Also illustrated in FIG. 7, in dotted lines, is the position of the pivot 39 when the mechanism is in the contacts open position showing that the ends of the pivot 39 are spaced from the walls 42 in this position, the walls 42 being provided with suitable openings 90.

From the foregoing it is seen that the bar 71 serves two functions in being a pivot for each cam and an interconnection between the cams 70, 170 and 270. Each cam may be thought of as comprising two cam surfaces, one surface actuated by the mechanism of the circuit breaker when the circuit breaker is tripped upon an overload occurring in its coil and the other surface for tripping the circuit breakers (adjacent to the one which is overloaded) by moving all of the armatures in the direction to release all of the latches from restraining engagement with all of the link teeth.

It will be noted that the mechanism remains "trip free" in that if the master handle 47 is 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, followed by impingement of the collapsed toggle upon the cam, 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, the master handle is manually maintained thereafter in the position corresponding to the closed position of the contacts.

The circuit breakers 21, 22 and 23 are electrically spaced from each other and the metallic casing 20 by being supported by the insulator bases 43 on the base of the casing 20 and physically spaced from the other walls of the casing 20 and each other. If desired, insulator spacers 91 may be placed in these spaces and/or the casing may be formed of an insulating material.

Summarizing, it is seen that the master handle 47 is capable of moving the operating mechanism of all three circuit breakers to open or close the contacts of all three circuit breakers, independently of the cams 70, 170 and 270 and interconnecting bar 71. If the contacts of all the circuit breakers have been moved to the closed position, and an overload occurs in one of the coils, the armature of the mechanism associated with this coil will be rotated, referring to FIG. 2, so that the armature end 69 moves toward the pole piece 61 and the armature end 60 rotates the latch 56. Rotation of the latch 56 allows the toggle 33 to collapse and the movable contact 28 to start its opening movement. Substantially simultaneously with the initial opening movement of the contact 28, the channel portion 89 traverses the space between the link 35 and the cam nose 75 and forcefully impinges on the cam nose 75. This impingement causes all of the cams 70, 170 and 270 to rotate in the direction tending to rotate all the armatures by engagement of the cams with the armature shafts 185 and 285 and in the direction necessary to remove the restraint of the latches (of the untripped poles) from their associated toggles, whereupon the associated toggles (of the poles other than the overloaded pole collapse and their associated contacts open also, substantially simultaneously with the opening of the contacts of the overloaded pole. After the opening of all of the contacts, the master handle 47 moves to the off position and simultaneously automatically resets the toggle, the nose 75 also clearing the toggle in the off position of the contacts.

Having described this invention, we claim:

1. The combination of a plurality of similar switch units, each switch unit having a pair of relatively movable contacts, an automatically resettable mechanism movable to open and close said contacts, a tripping device capable of initiating movement of said mechanism by collapsing said mechanism upon overload, an automatically resettable common trip cam member associated with each mechanism and each tripping device, each of the common trip cam members being engageable with the associated mechanism at one portion and engageable with the associated tripping device at another portion, each tripping device being also capable of being acted upon by the associated common trip cam member to trip the devices of the associated non-overloaded switch units, a bar for interconnecting all of the common trip cam members for simultaneous movement upon the movement of any one, all the cams being pivotal about the longitudinal axis of the interconnecting bar, the mechanism, the associated tripping device portion engageable thereby and the cam being all spaced from each other in the open and closed positions of the contacts, the collapsing movement of the mechanism for engagement with the associated cam, the movement of the tripping device for tripping the associated mechanism, and the movement of the cam for engagement with the associated tripping device being all in the same direction, whereby the associated members act upon the tripping devices of the associated switches to substantially simultaneously trip all of said mechanisms and open all the contacts.

2. The combination of a plurality of similar switch units, each switch unit having a pair of relatively movable contacts, an automatically resettable toggle linkage operatively connected between one of said contacts and a manual operator, a moveable overload sensing and toggle tripping device associated with the linkage, said toggle linkage being collapsible by said device to a position for opening said contacts, an automatically resettable movable common trip cam member associated and engageable with each overload sensing device, said toggle linkage being independent of the associated movable member in that the former is spaced from the latter in the closed and open positions of the contacts and engageable therewith only during the collapsing movement of the toggle linkage, a bar for interconnecting each of said movable cam members, the toggle, the associated tripping device portion engageable thereby and the cam being all spaced from each other in the open and closed positions of the contacts, the collapsing movement of the toggle for engagement with the associated cam, the movement of the tripping device for tripping the associated toggle linkage, and the movement of the cam for engagement with the associated tripping device being all in the same direction, each common trip cam member including two rigid angularly disposed surfaces interposed between the associated toggle linkage and the associated toggle tripping device, and all of the cams being pivotal about the longitudinal axis of the interconnecting bar, whereby the collapsing movement of the toggle linkage for opening the contacts of one switch unit causes all of the other common trip cam members of the associated switch units to move in the direction necessary to cause all of their associated toggle linkages to collapse and move to the contacts open position.

3. The combination of a plurality of similar switch units, each switch unit comprising a means for sensing a predetermined overload including an armature, relatively movable contacts, a collapsible linkage means for moving one of the contacts from an initial contacts open position to a contacts closed position and upon said predetermined overload condition collapsing and moving one of the contacts to the contacts open position and upon termination of said predetermined overload condition automatically resetting said collapsible linkage means to the uncollapsed position, said linkage means including a latch for maintaining said linkage means in the contacts closed position, said armature being attractable upon overload for tripping said latch whereupon said linkage means moves to the open contacts position, a common trip means for movement from an initial position to a position actuating said armature upon said predetermined overload condition and after termination of said predetermined overload condition automatically resetting to the initial position, movement of said linkage means upon unlatching being toward said common trip means and into impingement with a first portion thereof and subsequently away therefrom to an automatically relatched position spaced from said common trip means; both said common trip means and said linkage means being automatically resettable independently of the other after the termination of said overload, all of the movable common trip means of the switch units being interconnected so that movement of one causes the movement of the others, each movable common trip means having a second portion adjacent each associated armature for rotating the associated armature in the direction to unlatch the associated linkage means for opening the contacts of the switch units other than those of the initially overloaded switch unit which initiates the rotation of the movable common trip means, said first and second common trip portions being formed

by two angularly disposed cam surfaces interposed at all times between the associated linkage means and a portion of the associated armature, said linkage means including the part thereof which impinges on the common trip means being movable between the contacts closed and the contacts open positions except upon said predetermined overload without any part of the linkage means contacting said common trip means.

4. A multi-pole circuit breaker comprising in combination a plurality of similar switch units each comprising a pair of contacts, a pivotal armature, an electromagnet having a coil for attracting said armature upon a predetermined overload, an automatically resettable linkage mechanism movable to open and close said contacts, said linkage mechanism including a latch for maintaining said linkage mechanism in the contacts closed position, said armature being attractable upon overload for tripping said latch, an automatically resettable common trip pivotal cam having one portion in the path of movement of said linkage mechanism and impingeable thereby upon the tripping of the latch, said cam being rotatable by said linkage mechanism to bring another portion of the cam into abutment with a portion of said armature upon tripping of the latch of an associated switch, a common bar interconnecting the cams of each switch unit and about the longitudinal axis of which the cams are pivotal, each cam having another surface engageable with a portion of the casing toward which said cam is biased away from the associated armature, a movable arm in each switch unit for actuating one of said contacts, said linkage being collapsible toward said cam upon tripping of the latch to actuate said movable arm to the open position, each cam being disposed in the space generally bounded by the associated movable arm, the associated portion of said linkage impingeable on the cam, the associated portion of the armature impingeable upon the cam, and the associated casing portion engageable as a stop for the cam, each cam however being spaced from the associated movable arm at all times, each cam being also spaced from the associated linkage mechanism and armature at all times except that it is engageable therewith upon tripping of the linkage, whereupon an overload in any one electromagnet and the pivoting of its associated armature and the tripping of the associated latch, the associated linkage impinges on the associated cam and rotates the interconnecting bar for moving the cams of the other associated switch units in the direction to impinge upon and move their armatures in the direction to trip their associated latches for substantially simultaneously opening the contacts of all the units upon an overload in any one unit.

5. The structure recited in claim 4 in which the linkage mechanism includes a toggle mechanism, the portion of the linkage mechanism impingeable on the cam is a portion of the toggle mechanism, the portion of the cam impingeable by the toggle is disposed between the portion that impinges on the armature and the portion of the cam which is spaced at all times from the movable arm.

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