July 13, 1965 J. P. ELLSWORTH ETAL 3,194,922

CIRCUIT INTERRUPTER WITH IMPROVED COMPACT ARRANGEMENT OF PARTS

Filed Aug. 8, 1961 2 Sheets-Sheet 1

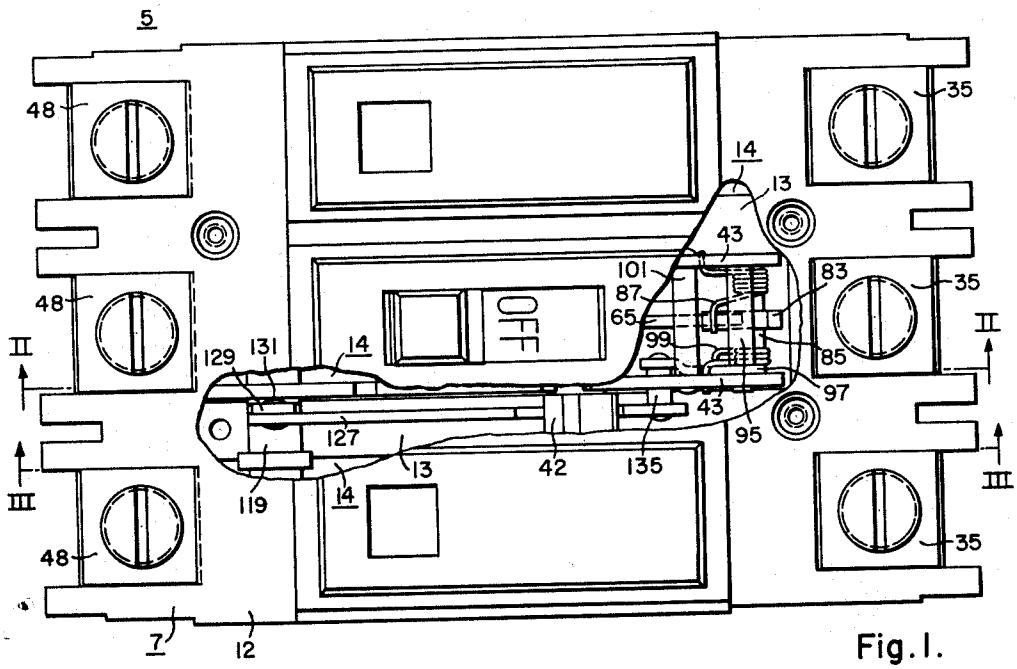


Fig. 1.

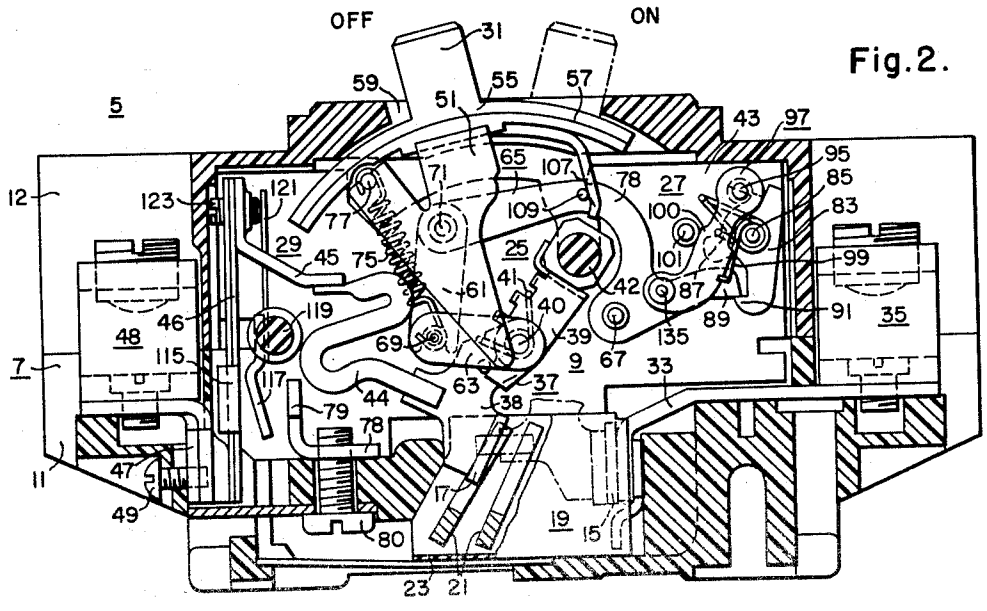


Fig. 2.

WITNESSES

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CIRCUIT INTERRUPTER WITH IMPROVED COMPACT ARRANGEMENT OF PARTS

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Fig. 3.

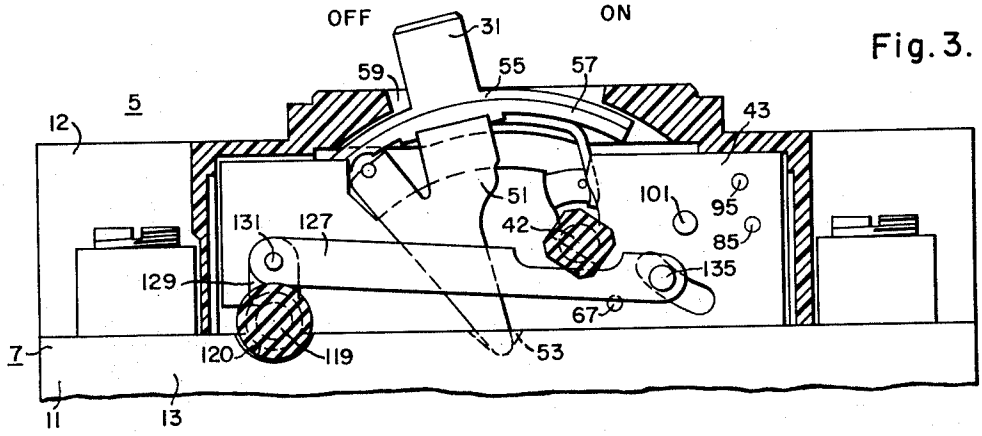


Fig. 4.

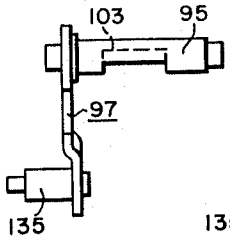


Fig. 5.

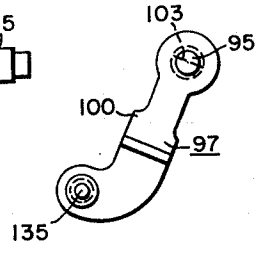


Fig. 7.

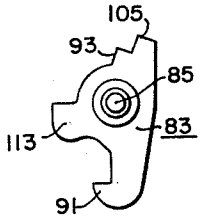
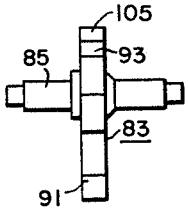


Fig. 6.



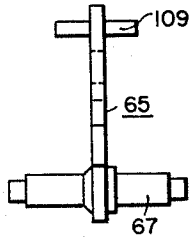


Fig. 8.

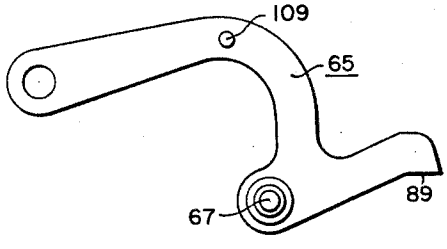


Fig. 9.

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3,194,922

CIRCUIT INTERRUPTER WITH IMPROVED COMPACT ARRANGEMENT OF PARTS

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Filed Aug. 8, 1961, Ser. No. 130,045
7 Claims. (Cl. 200—116)

This invention relates to circuit interrupters and more particularly to circuit breakers for controlling lighting and moderate power electric circuits.

In order to provide the industrial market with less expensive installations that take up less plant space without sacrificing power ratings or efficiency, circuit-breaker engineers often devote a considerable amount of time and effort developing compactly constructed circuit breakers having increased current carrying and interrupting ratings. These compact breakers are not only less expensive to manufacture; but they also save space in control centers. Thus, panelboard and control panel builders can manufacture and assemble smaller and less expensive control centers for the industrial market.

Accordingly, an object of this invention is to provide an improved compactly constructed circuit breaker.

In certain types of circuit breakers, the requisite operating structures comprise cooperable contacts, an arc-extinguishing structure or space in which an arc can be drawn and extinguished, an operating mechanism for operating the contact structure, or handle for manual operation of the operating mechanism, a latch structure for maintaining the operating mechanism in operating position and a trip structure automatically operable thermally and/or magnetically upon the occurrence of certain abnormal current conditions to operate the latch structure to release the operating mechanism to effect opening of the contacts.

Another object of this invention is to provide an improved circuit breaker having the above-mentioned structures constructed and arranged in such a manner as to take full advantage of the available space within the circuit breaker housing.

Another object of this invention is to provide a circuit breaker having a mechanism with increased current-carrying and interrupting capacity which mechanism is disposed within a circuit breaker housing that is no higher, no wider and only nominally longer than prior art circuit breakers having less current-carrying and interrupting capacities. Thus, the improved higher rated circuit breaker of this invention can be mounted on standard panel-board mountings that formerly supported lower rated circuit breakers.

A further object of this invention is to provide an improved circuit breaker having a trip structure that is operatively connected to a latch structure which structures are disposed on opposite sides or ends of the circuit-breaker operating mechanism.

A general object of the invention is to provide a circuit breaker having an improved circuit-breaker mechanism.

The invention, both as to construction and operation, together with additional objects and advantages thereof, will be best understood from the following detailed description when read in conjunction with the accompanying drawings, in which:

FIGURE 1 is a top plan view on an enlarged scale of a circuit breaker embodying the features of this invention, a part of the cover being broken away to more clearly show some of the parts;

FIG. 2 is a vertical sectional view of the circuit breaker taken substantially along the line II—II of FIG. 1, and looking in the direction indicated by the arrows; the circuit breaker being shown in the open circuit position;

FIG. 3 is a vertical sectional view, of part of the circuit breaker, taken substantially along the line III—III of FIG. 1, and looking in the direction indicated by the arrows;

FIGS. 4 and 5 are an end view and a side view, respectively, of one of the latch members of the circuit breaker mechanism;

FIGS. 6 and 7 are an end and a side view, respectively of another of the latch members of the circuit breaker mechanism; and,

FIGS. 8 and 9 are an end and a side view, respectively, of the releasable member of the circuit breaker mechanism.

Referring to the drawings, and particularly to FIGS. 1–3 thereof, a three-pole type circuit breaker 5 shown therein comprises a housing 7 having a circuit-breaker mechanism 9 (FIG. 2) supported therein. The housing 7 is a two-part housing comprising a base 11 and a cover 12 both of which are composed of a molded insulating material. Cooperating insulating barriers 13 (FIGS. 1 and 3) in the base and cover serve to provide three compartments 14 (FIG. 1) for the three pole units in a manner well known in the art. A stationary contact 15, a movable contact 17 and an arc-extinguishing structure indicated generally at 19 are provided in each pole unit of the breaker. Each of the arc-extinguishing structures 19 comprises a plurality of slotted magnetic plates 21 supported by an insulating cover 23. The slotted magnetic plates 21 operate to extinguish the arc that is generated when the contacts 15, 17 open, in a manner well known in the art.

The circuit-breaker mechanism 9 also comprises a single operating mechanism 25, and a single latch structure 27 disposed in the center compartment or pole unit. A trip structure 29 is provided in each of the three pole units for effecting automatic opening of the breaker. A single handle 31 is provided for manual operation of the circuit breaker to open and close the circuit breaker in a manner to be hereinafter specifically described.

The stationary contact 15 for each pole unit is rigidly mounted on the inner end of a conducting strip 33. A solderless terminal connector 35 of a type well known in the art is provided at the outer end of each of the conducting strips 33 to permit connection of the circuit breaker in an electric circuit. The movable contact 17 for each of the pole units is mounted on a movable contact arm 37 that comprises two parts 38 and 39 that are pivotally connected by means of a pivot pin 40. In each pole unit, a spring 41 biases the part 38 of the movable contact arm 37 about the pivot 40 to provide resilient contact pressure when the movable contact arm 37 is in the closed position. The movable contact arms 37 for the several pole units of the breaker are all rigidly secured to a common insulating tie bar 42 that is rotatably supported on two insulating side plates 43 (FIG. 1) which insulating side plates 43 support the operating mechanism 25 and latch mechanism 27 in the center compartment 14 of the circuit breaker.

In each pole unit, a flexible conductor 44 is welded at one end to the part 38 of the movable contact arm 37 and at the other end to one end of a conducting strip 45. The other end of the conducting strip 45 is welded to the upper end of a bimetal member 46. The lower end of the bimetal member 46 is connected to a conductor 47 that has a solderless terminal connector 48 attached to its outer end. A screw 49 secures the conductor 47, bimetal 46, and the parts carried by these members, to the base 11 of the housing 7.

When the breaker 5 is in the closed position, the circuit through each pole unit extends from the terminal connector 35 through the conducting strip 33, the contacts 15 and 17, the part 38 of the movable contact arm 37, the flexible conductor 44, the conducting strip 45, the bimetal member 46, the conductor 47 to the terminal connector 48.

The operating mechanism 25 (FIG. 2) comprises an inverted generally U-shaped operating lever 51 having its inner ends pivoted in generally V-shaped notches 53 (FIG. 3) in the insulating barriers 13 that are molded integral with the housing base 11. An operating member 55, which includes the handle 31 and an arcuate insulating shield 57, is mounted on the outer end of the operating lever 51. The handle 31 extends out through an opening 59 which opening 59 is closed by the arcuate shield 57 in all positions of the operating member 55.

The movable contact arm 37 for the center pole unit of the breaker is operatively connected by means of a toggle comprising toggle links 61 and 63, to one end of a releasable member or cradle 65 that is pivotally supported, intermediate its ends, on the insulating side plates 43 by means of a pin 67.

The toggle links 61 and 63 are pivotally connected together by means of a knee pivot pin 69. The toggle link 61 is pivotally connected to one end of the releasable member 65 by means of a pivot pin 71, and the toggle link 63 is pivotally connected to the part 39 of the movable contact arm 37 for the center pole unit by means of the pivot pin 40. Two overcenter springs 75 (only one being shown in FIG. 2) are connected under tension between the knee pivot pin 69 of the toggle 61, 63, and a pin 77 that is supported in the upper portion of the operating lever 51. As can be seen in FIG. 2, the tie bar 42 is positioned within the confines of a generally V-shaped portion 78 of the releasable member 65. The generally V-shaped portion 78 is the part of the releasable member 65 that extends between the pivots 67 and 71.

The side plates 43 and the parts supported thereby are connected to the housing base 11 by means of a bracket 78 (FIG. 2) having extensions 79 that engage in suitable openings in the side plates. The bracket 78 is held to the base 11 by means of a screw 80.

The circuit breaker 5 is shown in FIGS. 1–3 in the "off" or open-circuit position. The contacts are manually closed by clockwise movement of the handle 31 from the "off" position (FIG. 2) to the "on" position, which movement moves the operating lever 51 clockwise about the pivot 53 (FIG. 3). This movement moves the line of action of the overcenter springs 75 to the right of the line 69–71 whereupon the springs 75 operate to straighten the toggle 61, 63 and move the movable contact arm 37 for the center pole unit counterclockwise, which movement, because all of the movable contact arms 37 are connected to the common rotatable tie bar 42, moves all of the contact arms 37 of the several pole units of the breaker to the closed position with a snap action.

The contacts are manually opened by movement of the handle 31, counterclockwise from the "on" position to the "off" position, which movement moves the operating lever 51 counterclockwise about the pivot (FIG. 3). This movement moves the line of action of the overcenter springs 75 to the left of the line 69–71 whereupon the overcenter springs 75 operate to effect collapse of the toggle 61, 63 and opening movement of the movable contact arm 37 for the center pole unit which movement, because of the common tie bar 42, moves all of the movable contact arms 37 to the open position shown in FIG. 2 with a snap action.

The above-mentioned manual opening and closing operations of the circuit breaker can be properly effected only when the releasable member 65 is latched in the normal position shown in FIG. 2 by means of the latch structure 27.

The latch structure 27 (FIG. 2) comprises a main latch 83 (FIGS. 6 and 7) that is pivotally supported between the insulating side plates 43 by means of a pin 85. A torsion spring 87 (FIGS. 1 and 2) biases the main latch 83 counterclockwise about the pivot 85. The releasable member 65 is biased in a clockwise direction about the pivot 67 by means of the overcenter springs 75 which motion is prevented when the parts are in the latched position shown in FIG. 2 by engagement of one end 89 of the releasable member 65 with a latch portion 91 of the main latch 83. These forces tend to rotate the main latch 83 in a counterclockwise direction about the pivot 85 which motion is prevented by engagement of a portion 93 (FIG. 7) on the main latch 83 with the periphery of a cylindrical pin or rod 95 that is part of a secondary latch member 97 (FIGS. 4 and 5). The pin 95 of the secondary latch member 97 is positioned in suitable openings in the insulating side plates 43 to rotatably support the latch member 97 on the side plates. A torsion spring 99 (FIGS. 1 and 2) biases the secondary latch member 97 clockwise about the pivot 95. This clockwise movement is limited by engagement of a part 100 of the secondary latch member 97 with a pin 101 that is supported between the insulating side plates 43.

Upon the occurrence of an automatic tripping operation, the secondary latch member 97 is moved counterclockwise about the pivot 95 in a manner to be hereinafter specifically described. This motion rotates the pin portion 95 of the secondary latch member 97 to a position wherein the portion 93 (FIG. 7) of the main latch member 83 is adjacent a notch 103 (FIG. 4) in the pin 95, whereupon the force of the overcenter springs 75 operates to pivot the releasable member 65 clockwise about the pivot 67. This movement of the releasable member 65 moves the main latch 83 counterclockwise rapidly moving the latch portion 93 (FIG. 7) into the slot 103 (FIG. 4) of the pin portion 95 of the secondary latch member 97. This motion is limited by engagement of a portion 105 (FIG. 7) of the main latch 83 with the periphery of the pin 95. When the main latch 83 snaps into the above position, the latch portion 91 thereon clears the end 89 of the releasable member 65 releasing the member 65. The force of the torsion spring 87 maintains the main latch 83 in this unlatched position. When the releasable member 65 is released, the overcenter springs 75 operate to rotate this member clockwise about the pivot 67, which movement moves the line of action of the operating springs 75 to the left of the line 69–71 of the toggle 61, 63 (which toggle is straightened when the contacts are in the closed position), whereupon the overcenter springs 75 operate to collapse the toggle 61, 63 to effect opening of the contact arms 37 for all of the pole units of the circuit breaker in the same manner hereinbefore described.

During this automatic opening or tripping operation, the handle 31 is moved, to a tripped position intermediate the "off" and "on" positions, thereby giving a visual indication that a tripping operation has occurred.

Before the contacts can be closed following a tripping or automatic opening operation, it is necessary to reset and relatch the mechanism. This is accomplished by moving the handle 31 counterclockwise from the intermediate "tripped" position to the extreme "off" position. During this movement, a projection 107 on the operating lever 51 engages a pin 109 that is rigidly attached to the releasable member 65 moving the releasable member 65 counterclockwise about the pivot 67. Near the end of this movement, the end 89 of the releasable member 65 engages a portion 113 (FIG. 7) of the main latch 83 moving the main latch 83 clockwise about its pivot 85 to clear the position 93 thereof from the notch 103 (FIG. 4) of the pin 95 whereupon the torsion spring 99 (FIG. 2) operates to rotate the pin 95 and the secondary latch member 97 clockwise to the latching position. There-

after, when the handle 31 is released, the main latch 83 is again restrained from unlatching movement by engagement of the portion 93 (FIG. 7) with the periphery of the bar 95 and the clockwise tripping movement of the releasable member 65 is prevented by engagement of the end 89 thereof with the latch portion 91 of the main latch 83. The contacts can then be closed manually in the same manner previously described by movement of the handle 31 from the "off" to the "on" position.

The secondary latch member 97 is moved to the unlatched position during an automatic tripping operation by means of the trip structure 29 (FIG. 2). In addition to the bimetal member 46, the trip structure 29, there being one in each of the compartments 14 or pole units of the circuit breaker, comprises a U-shaped magnetic member 115 rigidly secured to the bimetal member 46. An armature 117 is disposed adjacent the legs or pole faces of the magnetic member 115 and is supported on an insulating trip bar 119 that is common to all of the pole units of the breaker. The trip bar 119 is rotatably supported in depressions 120 (FIG. 3) in the barriers 13 of the housing base 11. An insulating member 121, for each pole unit, is also attached to the trip bar 119 and the free end thereof engages an adjusting screw 123 that is threaded through the bimetal member 46 and conducting strip 45. The adjusting screw 123 can be rotated to move the insulating member 121 and rotate the trip bar 119 to vary the dimension of the gap between the armature 117 and magnetic member 115.

The trip structure 29 and latch structure 27 are connected by means of an elongated insulating connecting member 127 (FIGS. 1 and 3). The connecting member 127 is pivotally connected at one end to an insulating member 129 by means of a pivot pin 131 which member 129 is rigidly secured to the trip bar 119. The connecting member 127 is pivotally connected at the other end thereof to a pin 135 (FIGS. 4 and 5) that is rigidly secured to the secondary latch member 97.

Upon the occurrence of an overload current of, for example, up to 1000% of normal rated current in any of the pole units of the circuit breaker, the bimetal member 46 for that pole unit is heated and it deflects to the right. This movement, because of the engagement of the associated adjusting screw 123 with the associated insulating member 121, rotates the insulating member to rotate the common trip bar 119, and the member 129 (FIG. 3) in a clockwise direction. This movement moves the elongated connecting member 127 to the right (FIGS. 1 and 3) to move the secondary latch member 97 counterclockwise about its pivot 95 to release the main latch member 83 and effect automatic opening of the contacts of all of the pole units in the same manner hereinbefore specifically described.

Upon the occurrence of an overload or short-circuit current of, for example, 1000% or more of rated current in any of the pole units of the breaker, this current flowing through the bimetal 46, of the overloaded pole unit, generates a magnetic flux in the associated magnetic member 115 that is strong enough to attract the associated armature 117 moving the armature 117 and the common trip bar 119, to which the armature is attached, clockwise. This clockwise movement of the trip bar 119 moves to move the connecting member 127 to the right (FIGS. 1 and 3) the secondary latch member 97 counterclockwise about its pivot 95. This counterclockwise movement of the secondary latch member 97 releases the main latch member 83 to effect automatic opening of the contacts in all of the pole units in the same manner hereinbefore specifically described.

When the breaker is reset and relatched after an automatic tripping operation, the secondary latch 97 is reset, in the position in which it is shown in FIGS. 1 and 2, in the manner hereinbefore specifically described. This resetting operation also resets all of the parts that are connected to the secondary latch 97. Thus, when the breaker is reset the connecting member 127, trip bar 119 and the insulating member 121 and armature 127 that are attached to the trip bar 119, are all reset in the operating position shown in FIGS. 1–3.

From the foregoing description, it will be understood that there is provided a circuit breaker having an improved compactly constructed circuit-breaker mechanism. The latch structure and trip structure are disposed on opposite sides of the operating mechanism and they are connected by means of an elongated connecting member. Thus, full advantage is taken of the available space on both sides of the operating mechanism. The releasable trip member is pivoted intermediate its ends and it is latched at one end thereof in the normal operating position by the latch structure. The other end of the trip member is connected to the toggle of the operating mechanism. With this arrangement, a full tripping movement of the releasable member occurs in a limited amount of space. The common tie bar is rotatably supported within the confines of a generally V-shaped part on one side of the intermediate pivot of the releasable member. Thus, in each pole unit the contact arm carried by the tie bar swings in an arc moving the contact that is supported thereon in an arc-extinguishing space or structure that is disposed on a side of the operating mechanism that is opposite the operating handle of the breaker. The improved compact circuit breaker of this invention is no wider, no higher and only nominally longer than prior-art circuit breakers having less current-carrying and interrupting capacities.

While the invention has been disclosed in accordance with the provisions of the patent statutes, it is to be understood that various changes in the structural details and arrangement of parts thereof may be made without departing from the spirit of the invention.

We claim as our invention:

1. A circuit breaker comprising, in combination, a stationary contact, a movable contact cooperable with said stationary contact to open and close an electric circuit, an operating mechanism comprising a releasable member and overcenter spring means, latch means disposed on a first side of said operating mechanism and latching said releasable member in a normal position, trip means disposed on a side of said operating mechanism which is opposite said first side, means operatively connecting said trip means to said latch means, upon the occurrence of certain abnormal current conditions, said trip means automatically operating through said connecting means to move said latch means to effect release of said releasable member, and said releasable member when released moving to operate said overcenter spring means to effect opening of said contacts.

2. A multi-pole circuit breaker comprising, in combination, a housing having three compartments therein, stationary and movable contacts in each of said compartments, a movable contact arm in each of said compartments carrying the associated movable contact thereon, a common tie bar connecting said movable contact arms for unitary movement, an operating mechanism comprising a releasable member, trip means in each of said compartments disposed at one side of said operating mechanism, a common trip bar operatively connected to all of said trip means, latch means supported within said housing on a side of said operating mechanism which is opposite said first side, said latch means comprising a latch member movable to release said releasable member, said releasable member when released operating to effect movement of said tie bar to effect opening of all of said contacts, connecting means operatively connecting said trip bar to said movable latch member, and upon the occurrence of certain overload current conditions in any of said compartments the trip means in the overloaded compartment operating to effect movement of said trip bar to move said connecting means to thereby

move said movable latch member to release said releasable member.

3. A circuit breaker comprising, in combination, a stationary contact, a movable contact, a movable contact arm carrying said movable contact and movable to open and close said contacts, an operation mechanism comprising a releasable member pivotally supported on a fixed pivot and overcenter spring means, a manually operable handle disposed on a first side of said operating mechanism and being movable to operate said overcenter spring means to open and close said contacts, an arc-extinguishing structure for extinguishing an arc drawn when said contacts open, said arc-extinguishing structure being disposed on a second side of said operating mechanism opposite said first side, latch means disposed on a third side of said operating mechanism and latching said releasable member in a normal position, trip means disposed on a fourth side of said operating mechanism opposite said third side, means operatively connecting said latch means to said trip means, said trip means being automatically operable upon the occurrence of certain abnormal current conditions to operate said connecting means to operate said latch mean to release said releasable member, and said releasable member when released pivoting to move said overcenter spring means to effect opening of said contacts.

4. In a multi-pole circuit braker having a housing divided into three compartments, stationary and movable contacts in each compartment, a movable contact arm in each compartment carrying the associated movable contact thereon, a tie bar connecting said movable contact arms for unitary movement, trip means supported at one end of said housing within each of said compartments, a common trip bar operatively connected to all of said trip means, latch means supported within said housing at the end opposite said one end, an operating mechanism supported within said housing intermediate said ends, said latch means latching said operating mechanism in a normal position and being releasable to release said operating mechanism, said operating mechanism when released operating to move said tie bar to open all of said contacts, connecting means comprising an elongated connecting member operatively connected at one end of said common trip bar and at the other end to said latch means, upon the occurrence of certain overload current conditions in any of said compartments the trip means in the overloaded compartment operating to move said common trip bar to move said connecting member to release said latch means, an arc-extinguishing structure in each compartment disposed below said operating mechanism and serving to extinguish an arc drawn when the associated contacts open, and an operating handle extending from said housing above said operating mechanism and being manually operable when said operating mechanism is latched in said normal position to operate said operating mechanism to open and close all of said contacts.

5. A circuit breaker comprising, in combination, a stationary contact, a movable contact arm carrying said movable contact and being movable about a pivot to open and close said contacts, operating mechanism comprising a releasable member pivotally supported intermedate its ends, a toggle connected to one end of said releasable member, latch means latching the other end of said releasable member, said releasable member comprising a generally U-shaped portion between said pivot and said one end thereof, said pivot of said movable contact arm being disposed generally within the confines of said generally U-shaped portion, trip means operable upon the occurrence of certain abnormal current conditions to operate said latch means to release said releasable member, and said releasable member when released pivoting to effect opening of said contacts.

6. A circuit breaker comprising, in combination, a stationary contact, a movable contact, a movable contact arm carrying said movable contact and being movable about a pivot to open and close said contacts, an operating mechanism comprising a releasable member pivotally supported intermediate its ends, a toggle connected to one end of said releasable member, latch means disposed on a first side of said operating mechanism and latching the other end of said releasable member, a said releasable member comprising a generally U-shaped portion between said pivot and said one end thereof, said pivot of said movable contact arm being disposed within the confines of said generally U-shaped portion, trip means disposed on a side of said operating mechanism which is opposite said first side, connecting means operatively connecting said trip means with said latch means, upon the occurrence of certain abnormal current conditions said trip means operating through said connecting means to operate said latch means to release said releasable member, and said releasable member when released pivoting to effect opening of said contacts.

7. A circuit breaker comprising, in combination, a stationary contact, a movable contact, a movable contact arm carrying said movable contact and being movable about a pivot to open and close said contacts, an operating mechanism comprising a releasable member pivotally supported intermediate its ends, a toggle connected at one end of said releasable member, latch means disposed on a first side of said operating mechanism and latching the other end of said releasable member in a normal position, said releasable member comprising a generally U-shaped portion between said pivot and said one end thereof, said pivot of said movable contact arm being disposed generally within the confines of said generally U-shaped portion, trip means disposed on a second side of said operating mechanism opposite said first side, means operatively connecting said trip means and said latch means, said trip means being operable upon the occurrence of certain abnormal current conditions to operate said latch means to release said releasable member, and said releasable member when released pivoting to effect collapse of said toggle to effect opening of said contacts, said contacts when opening establishing an arc therebetween, an arc-extinguishing structure for extinguishing said arc and being disposed on a third side of said operating mechanism, an operating handle disposed on a fourth side of said operating mechanism opposite said third side, and when said releasable member is latched in said normal position said operaing handle being manually movable to effect opening and closing of said contacts.

References Cited by the Examiner

UNITED STATES PATENTS

2,329,053	9/43	Jennings	200—116
2,370,024	2/45	Dyer	200—88
2,459,629	1/49	Dorfman et al.	200—116
2,526,861	10/50	Getchell	200—116
2,620,417	12/52	Lewis	200—116
2,913,542	11/59	Myers	200—116

FOREIGN PATENTS

334,401	1/36	Italy.

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