July 18, 1944. R. H. SWINGLE 2,354,157

ENCLOSED CIRCUIT BREAKER

Filed July 9, 1942 3 Sheets-Sheet 1

Fig. 1.

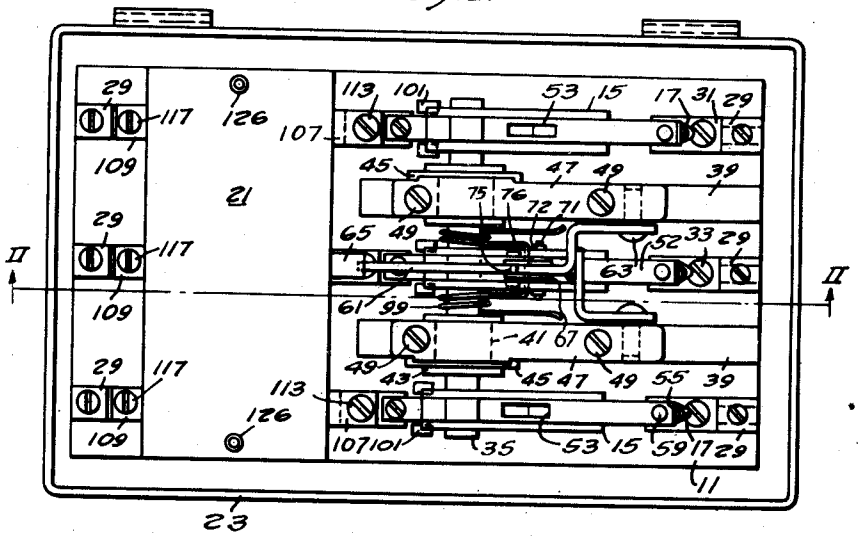
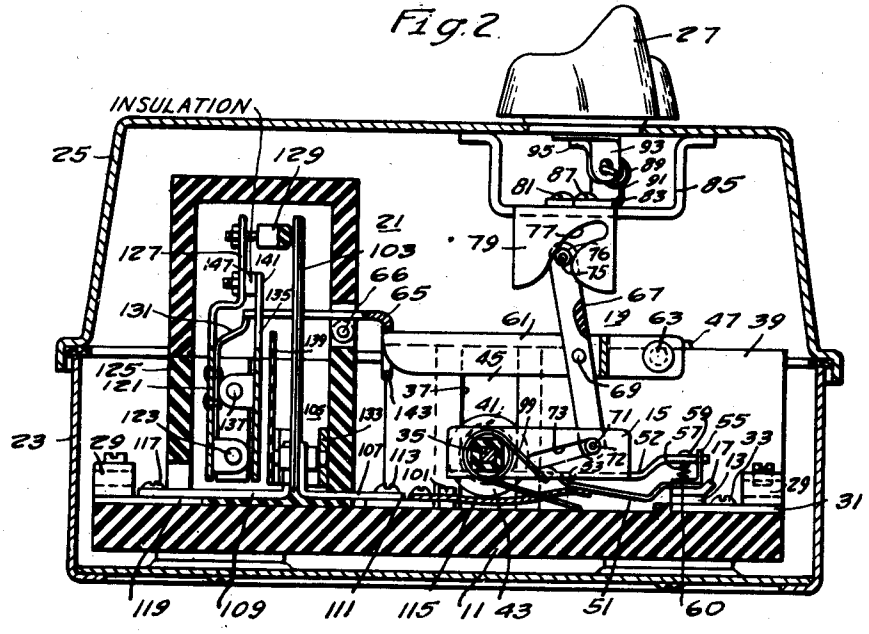


Fig. 2.



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Fig. 3.

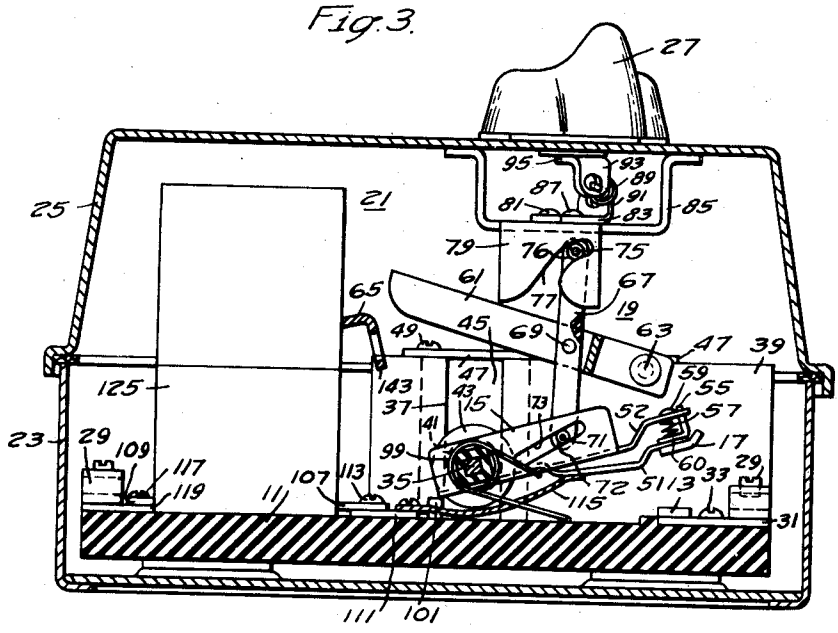


Fig. 4.

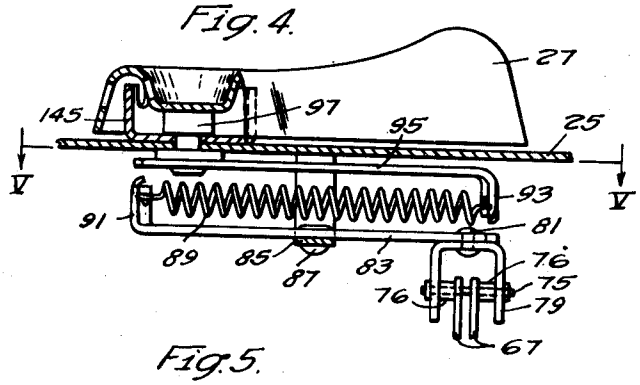
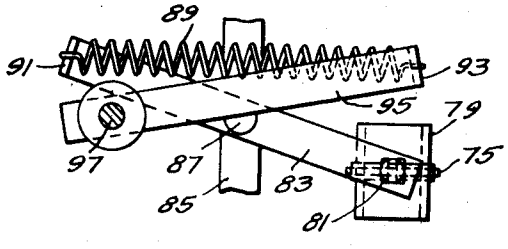


Fig. 5.



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ENCLOSED CIRCUIT BREAKER

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Fig. 6.

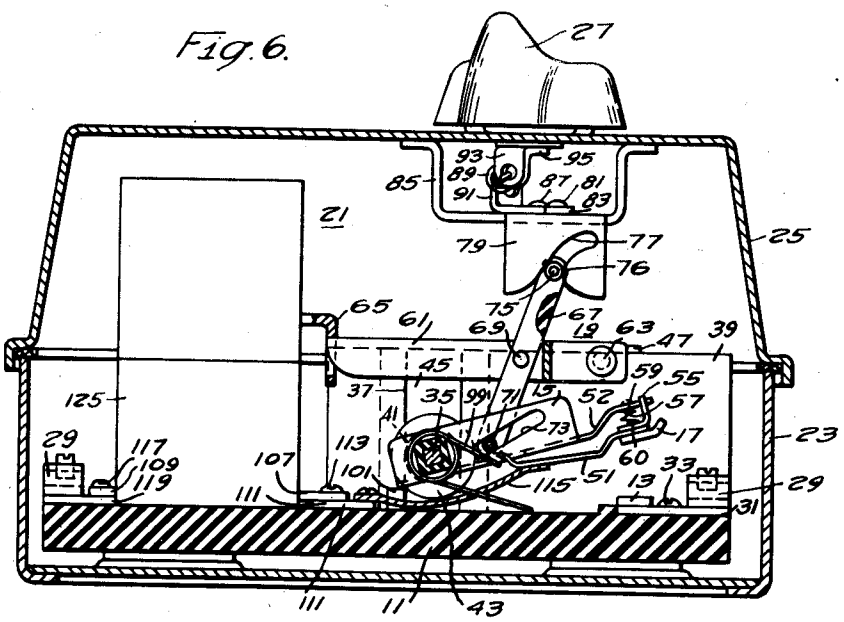


Fig. 7.

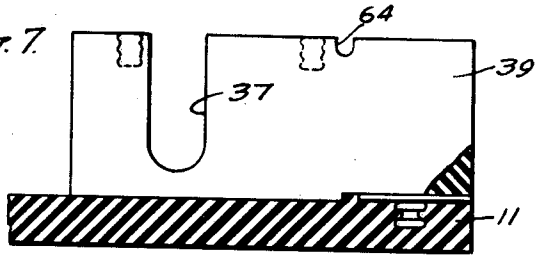


Fig. 8.

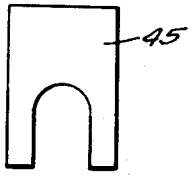


Fig. 9.

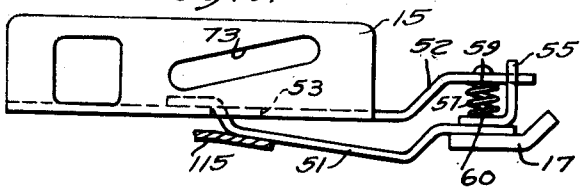
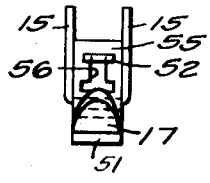


Fig. 10.



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2,354,157

UNITED STATES PATENT OFFICE

2,354,157

ENCLOSED CIRCUIT BREAKER

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Application July 9, 1942, Serial No. 450,269

19 Claims. (Cl. 200—116)

The invention relates to circuit breakers and, more particularly, to automatically and manually operable circuit breakers of the industrial type which are mounted in a metal enclosing housing and operable manually by an operating handle on the enclosing housing.

One object of the invention is to provide an improved industrial circuit breaker mounted in an enclosing housing having an openable cover on which is mounted the manual operating means, the parts of the circuit breaker mechanism being readily accessible from the front for inspection, removal and renewal when the cover of the enclosing housing is open.

Another object of the invention is to provide an improved industrial type circuit breaker mounted in an enclosing housing having an openable cover and a manual operating mechanism mounted on the cover for manually operating the contacts with a snap action to open or closed position.

Another object of the invention is to provide an improved industrial type circuit breaker which is manually and automatically operable, having a metal enclosing housing constituting the only enclosure for the breaker elements and wherein the manual operating mechanism is mounted on the openable cover of the housing, the contact means and the means for automatically opening the contacts being mounted within the housing.

Another object of the invention is to provide a manually and automatically operable circuit breaker enclosed in a housing and embodying an improved trip-free operating mechanism including a manual operating means mounted on the openable cover of the housing and separably engageable with the remaining part of the mechanism which is mounted in the housing and accessible when the cover is open.

Another object of the invention is to provide an enclosed circuit breaker having manual operating means mounted on the openable cover of the enclosure for opening and closing with a snap action the contacts within the housing, the manual operating means being separably engageable with one end of a pivotally mounted operating lever, the other end of which operatively engages the contact means.

Another object of the invention is to provide an improved type of trip-free-from-the-handle mechanism for a circuit breaker.

Another object of the invention is to provide a circuit breaker having a base of molded insulating material having recesses, slots and projections for directly supporting the various parts of the mechanism without the use of a separate metal frame, thereby simplifying the structure and reducing its cost.

Another object of the invention is to provide a circuit breaker in which the major parts are readily removable from the front of the breaker for inspection or renewal without exposing the trip unit, which is sealed, to the danger of having its calibration changed either inadvertently or by deliberate tampering.

Another object of the invention is to provide an improved industrial type circuit breaker that is simple, safe and reliable in operation and inexpensive to manufacture.

The novel features that are considered characteristic of the invention are set forth in particular in the appended claims. The invention itself, however, both as to structure and operation, together with additional objects and advantages thereof will be best understood from the following detailed description thereof when read in connection with the accompanying drawings, in which:

Figure 1 is a top plan view of a three pole circuit breaker embodying the principles of the invention, with the cover of the enclosing housing removed to more clearly show the breaker mechanism.

Fig. 2 is a vertical sectional view of the breaker shown in Fig. 1, and taken substantially on line II—II of Fig. 1, the breaker being shown in the closed position.

Fig. 3 is a vertical sectional view of the breaker showing the breaker mechanism in the tripped open position.

Fig. 4 is a fragmentary sectional view of the manual operating mechanism mounted on the openable cover.

Fig. 5 is a sectional view showing the snap-acting device and taken substantially on line V—V of Fig. 4.

Fig. 6 is a vertical sectional view similar to Fig. 3 but showing the operating mechanism reset following an automatic opening operation.

Fig. 7 is a detailed view partly in section showing one of the barriers.

Fig. 8 is a detailed view of one of the U-shaped retaining members for retaining the tie-bar in position.

Fig. 9 is an enlarged detail view of one of the switch members and the contact removably supported thereon.

Fig. 10 is an enlarged end view of the contact structure showing the method of supporting the

free end of the contact member on the switch arm.

Referring to the drawings, the circuit breaker illustrated is of the three pole type and comprises generally, a base 11 of molded insulating material, stationary contacts 13, movable switch members 15 carrying movable contacts 17 which cooperate with the stationary contacts, an operating mechanism indicated generally at 19 and a trip device indicated generally at 21. The base 11 is suitably secured to the back wall of a metal housing 23 and is provided with an openable cover 25 hinged to a side wall of the housing. The housing 23 together with the hinged cover 25 completely encloses the breaker mechanism with the exception of an operating handle 27 rotatably mounted on the cover 25 and movable therewith when the cover is opened.

A plurality of end terminals 29 (Fig. 1) are provided there being a terminal 29 adjacent each end of each of the poles of the breaker. Each of the right-hand terminals 29 (Figs. 1 and 2) is electrically secured to the outer end of a short conductor 31 which is, in turn, removably secured in a recess in the base 11 by means of a screw 33. The stationary contacts 13 are mounted on the inner ends of the corresponding conductors 31.

Each of the switch members 15 comprises a channel-shaped frame secured to a square insulated tie-bar 35 supported for rotary movement in notches 37 of barriers 39 (Fig. 7) molded integral with the base 11 and extending outwardly between the center pole and the two outer poles of the breaker. The tie-bar 35 is removably supported and journaled in the notches 37 by means of flanged spools 41 of insulating material which are provided with square openings extending axially therethrough for receiving the tie-bar and cylindrical bearing surfaces which fit into the rounded bottoms of the notches 37 in the barriers 39. The outer flanges 43 of the spools 41 are spaced apart a greater distance than the width of the barriers 39 and U-shaped members 45 (see also Fig. 8) of insulating material are inserted between the outer flanges of the spools and the outer surfaces of the barriers. Metal strips 47 of substantially the same width as the barriers are secured by means of screws 49 to the top of the barriers to removably retain the spools 41 and the tie-bar 35 against upward movement, the strips 47 being of greater width than the barriers adjacent the members 45.

Each of the movable switch members 15 carries a removable contact member 51 upon which is mounted the movable contact 17. The center portion 53 of the channel-shaped member 15 has an opening 53 therein near its pivoted end to receive the formed inner end of the members 51. An angular member 55 rigidly secured to the free end of the member 51 (Fig. 3) is provided wtih a T-slot 56 (Fig. 10), adapted to receive the projecting end of the member 52. Contact pressure is provided, when the contacts are closed, by a coil spring 57 seated on a spring guide 59 secured to the member 52 of the switch member and a spring guide 60 on the member 55, and compressed between the member 52 of the switch arm 15 and the contact member 51.

The operating mechanism 19 includes a bifurcated releasable trip member 61 (Figs. 1, 2 and 3) each leg of which carries a pivot pin 63 pivotally supported in bearing recesses 64 formed in the outer edges of the barriers 39, the pivots 63 being removably held in place in the bearing recesses by means of the strips 47. The opposite or left-hand end of the trip arm 61 is normally engaged by a latch member 65 pivotally mounted at 66 and associated with the trip device 21, to releasably restrain the operating arm in closed contact position. The latch member 65 is operable under predetermined circuit conditions to release the operating arm 61 to thereby cause automatic opening of the contacts as will be hereinafter described.

An operating lever 67, comprising a pair of spaced parallel levers of insulating material disposed one on each side of the arm 61, is pivotally mounted by means of a pivot pin 69 on the operating arm 61.

The lower ends of the levers 67 project between the side members of the frame 15 of one movable switch member and are connected together by a pin 71. The pin 71 extends laterally in both directions and carries rollers 72 which engage slots 73 in the side members of the movable contact frame 15 for the center pole of the breaker. The outer ends of the levers 67 are joined by a pin 75 which carries a pair of rollers 76 engaging cam slots 77 formed in the two sides of a U-shaped operating cam 79 (Figs. 2, 3, 4 and 5). The cam 79 is pivotally mounted by means of a pivot pin 81 on one end of a lever 83 which is pivotally supported on a U-shaped bracket 85 by means of a pivot pin 87. The two legs of the bracket 85 are secured to the inner surface of the cover 25 of the housing.

An overcenter spring 89 (Figs. 4 and 5) has one end anchored to the formed-over end 91 of the lever 83 and the other end of the spring is anchored to the formed end 93 of a manual operating arm 95 secured to the inner end of a short shaft 97. The shaft 97 is mounted for rotation in the cover 25 and the operating handle 27 is secured to the outer end thereof.

Referring particularly to Figs. 2 and 5. the contacts are opened manually by rotation of the operating handle 27 in a clockwise direction to the "off" position. This movement, through the agency of the shaft 97 rotates the operating arm 95 in a clockwise direction (Fig. 5). This movement increases the tension of the overcenter spring 89 and also moves the line of action of the spring overcenter below the pivot 87 (Fig. 5) and to the left of the pivot 87 as viewed in Fig. 2. When this occurs the spring 89 applies a force to the lever 83 which causes rotation of the lever in a counterclockwise direction (Fig. 5) moving the cam member 79 upwardly (Fig. 5) and to the right from the Fig. 2 position to the Fig. 6 position with a snap action. Since, at this time, the arm 61 is latched in its Fig. 1 position, the pivot 69 of the lever 67 is fixed and the movement toward the right of the cam 79, due to the connection 75—77, rocks the operating lever 67 clockwise about its pivot 69 with a snap action. Due to the pin and slot connection 71—73 between the operating lever 67 and the switch member 15 for the center pole and by means of the tie-bar 35, the switch members 15 for all of the poles will be rotated in a counterclockwise direction from the position shown in Fig. 2 to the Fig. 6 position to simultaneously open the contacts 13—17 for all of the poles with a snap action. The opening movement of the switch members 15 is accelerated by a spring 99, coiled about the center portion of the tie-bar 35 and having one end bearing against the base 11 and the other end bearing against the under side of the center pole switch member 15 thereby biasing

all of the switch members in opening direction. The counterclockwise, or opening movement of the switch member 15, is limited by stop blocks 101 molded integral with the base for engaging the inner ends of the switch members.

The contacts are closed manually by rotating the operating handle 27 counterclockwise from the "off" position to the "on" position. This operates the arm 95 (Fig. 5) in a counterclockwise direction moving the line of action of the over-center spring 89 above the pivot 87 whereupon the spring exerts a force on the lever 83 causing the lever to rotate in a clockwise direction (Fig. 5) thereby moving the cam member 79 toward the left from the position shown in Fig. 6 to the Fig. 2 position with a snap action. Through the pin and slot connection 75—77 this movement of the cam 79 reverses the movement of the lever 67 and rocks this lever in a counterclockwise direction (Fig. 6). The pin 71 moving in a counterclockwise direction in the slots 73 in the center pole switch member, cams the movable contact assemblage clockwise to effect closing of the contacts for all of the poles.

The trip device, indicated generally at 21, is of the type disclosed in Patent No. 2,048,114, granted to H. S. Gano et al. July 21, 1936, and assigned to the assignee of this invention. For a complete understanding of the construction and operation of the trip device, reference may be had to this patent. Only a brief description of the trip device will be given herein.

The trip device 21 is an enclosed and sealed unitary structure removably mounted on the base 11 of the breaker, and includes a thermally responsive element 103 and an electromagnetically responsive trip member indicated generally at 105 for each pole of the breaker. The thermal element comprises a U-shaped bimetallic member having one leg secured to a conductor 107 and the other leg secured to a conductor 109. The conductor 107 is secured to a connector 111 and to the base 11 by a screw 113. The connection 111 is of conducting material and also has secured thereto one end of a flexible shunt conductor 115 whose other end is electrically connected to the contact carrying member 51. The conductor 109 is secured by means of a screw 117 to the inner end of a conductor 119 and to the base 11. The outer end of the conductor 119 has the left-hand terminal 29 secured thereto, thus completing the electrical circuit through the breaker and the trip device. Since the circuits for each pole are alike only the circuit for the center pole (Fig. 2) will be traced. This circuit extends from the right-hand terminal 29 through the conductor 31, the stationary and movable contacts 13 and 17, respectively, the contact member 51, the flexible conductor 115, connector 111, conductor 107, bimetal element 103, conductors 109 and 119 to the left-hand terminal 29.

A trip bar 121 common to all of the poles of the breaker is pivotally supported at each end by pins 123 (only one being shown) projecting inwardly from the end walls of a housing 125 which encloses the trip device. The trip bar 121 is provided with three projecting members 127 each of which carries at its free end an adjustable insulating button 129 cooperating with the corresponding bimetal element 103. Mounted on the trip bar is a latch 131 the end of which cooperates with the latch member 65 to restrain the operating lever 61 in closed circuit position.

When the bimetal element 103 for any one of the poles is heated in response to a persistent overload below a predetermined value its free end deflects toward the left rocking the trip bar 121 and the latch 131 counterclockwise about the pivot 123 to release the latch member 65 whereupon, the operating lever 61 being no longer restrained, permits the spring 99 to rock the switch arms 15 counterclockwise, until it engages the limit stop 101, to open the contacts. During this movement of the switch member 15, the lever 67 is thrust upwardly rotating the operating lever 61 clockwise about the pivot pins 63. As the lever 67 travels upwardly, the rollers 76 follow the contour of the cam slots 77 which causes the lever 67 to rotate in a clockwise direction about the pivot 69. The mechanism is shown in Fig. 3 in the tripped open position.

The trip bar 121 is also operated electromagnetically in response to overload currents above the predetermined value or short circuits to instantaneously trip the breaker. The trip magnet 105 (Fig. 2), there being a magnet 105 provided for each pole, comprises an E-shaped magnet core 133 suitably mounted in the trip device and having the center portion thereof extending between the legs of the U-shaped bimetal element 103. An armature 135 extending across all of the poles of the breaker is pivotally supported at each end by pivot pins 137 (only one being shown) projecting inwardly from the end walls of the housing 125. An insulating member 139 is disposed between the armature 135 and the magnet core 133 to insulate the armature from the core. The armature 135 has three upwardly extending projections 141 engageable with adjustable buttons 147 on the trip bar 121. The legs of the bimetal element 103 form a U-shaped loop around the center members of the E-shaped core member and serves to energize the magnet.

Upon the occurrence of an overload above the predetermined value, or a short circuit, the magnet 105 is energized and attracts the armature 135 rocking the armature and, by means of the insulating connection 147, rocks the trip bar 121 counterclockwise to effect release of the operating lever 61 in the previously described manner.

It should be noted that the tripping point or calibration of the breaker is determined by the adjustment of the bottoms 129 and 147 and by the amount of overlap between the trip bar latch 131 and the left-hand end of the latch member 65. The tripping point is independent of the amount of overlap between the right-hand end of the latch 65 and the end of the tripping member 61, because the latch 65 moves quickly to release the end of the tripping member 61 as soon as the trip bar latch 131, which moves slowly in accordance with the movement of the bimetal 103, has cleared the end of the latch 65. The two halves of the trip unit housing 125 are sealed together at 126 to prevent tampering with the adjustments, though other sealing means to prevent tampering may be used.

The fact that the tripping point of the breaker is independent of the amount of overlap between the trip unit latch 65 and the end of the tripping member 61 gives the advantage that the calibration of the breaker will not be affected by the removal and replacement of the tripping member 61 by one which might be of slightly different length or which might seat differently in the notches 64 in the barriers 39.

After the breaker has been tripped open and before the contacts can be closed, it is necessary first to relatch the tripping arm 61 with the latch

member 65. This is accomplished by rotating the operating handle 27 clockwise to the "off" position. During the movement, as previously described, the arm 95 moves the spring 89 overcenter to the left (Fig. 3) of the pivot 87 of the lever 83 whereupon the spring 89 acts to move the lever 83 and the cam member 75 toward the right to the "off" position. During this movement the cam slot 77 acting through the pin 75 and rollers 76 thrusts the lever 67 downwardly and at the same time rotates the lever in a clockwise direction. The downward movement of the lever 67 rotates the tripping arm 61 counterclockwise engaging the free end of the arm with a cross portion 143 on the latch member 65 and rotates the latch member in a clockwise direction. The downward movement of the lever 67 carries the arm 61 slightly beyond normal latching position, thereby moving the left-hand end of the latch member slightly above the end of the latch 131. A spring (not shown) then restores the trip bar 121 and the latch 131 to latching position in which it restrains the operating arm 61 in the closed contact position.

During the relatching movement the pin 71 travels downwardly and toward the left in the slots 73 causing clockwise rotation of the lever 67. At the end of the relatching operation, the cam 79 is in the "off" position with the pin 75 in the vertical portion of the cam slot 77 and the pin 71 is near the lower or left-hand end of the slot 73 with the switch members 15 in the open position, against the limit stop 101 as shown in Fig. 6. The contacts are then closed in the previously described manner by movement of the manual operating handle 27 in a counterclockwise direction to the "on" position.

When the breaker is closed, the contacts are locked in the closed position and cannot be blown open as the result of the electrodynamic effect of a short circuit before the breaker is tripped open. This locked condition is due to the angular relation of the slots 73 (Fig. 2) in the center pole switch arm 15 with the center line of the lever 67, which angle is less than 90°. Consequently, the bias of the switch member 15 to open position by the spring 99 tends to rotate the lever 67 in a counterclockwise direction and holds the rollers 72 against the right-hand end of slots 73. It will be obvious that this arrangement of parts will also hold the contacts in closed position when the cover 25 is opened and the cam member 79 is separated from the rollers 76 on the upper end of the lever 67.

The side walls of the cam slot 77 diverge near the bottom of the cam member 79 to obviate the necessity of extreme accuracy in alignment of the cam slot 77 with the rollers 76 when the cover is closed.

It will be obvious from an inspection of Figs. 2 and 6 that the cover 25 may be opened when the contacts and the operating mechanism is in either the closed position or the manually opened position.

A locking cup 145 (Fig. 4) secured to the cover by welding or in any other suitable manner is provided with notches in alignment with holes in the handle 27 for receiving a lock for the purpose of locking the handle in the "off" position.

The breaker is trip-free of the operating mechanism when the contacts are closed with an abnormal circuit condition prevailing. Under such condition, the trip device will function to immediately release the arm 61 and the spring 99 will move the contacts to open position, the roller 76 traveling toward the end of the cam slots 77 as previously described.

The circuit breaker disclosed is most desirable for use in industrial plants where the equipment is under the care of skilled maintenance electricians. The parts which are subject to wear or damage are readily removable from the front of the base by merely opening the cover 25 of the metal enclosure, and without removing the base of the breaker from the housing, and such removal and renewal of the parts does not affect the calibration of the breaker.

Having described the invention in accordance with the patent statutes, it is to be understood that various changes and modifications may be made in the structural details disclosed without departing from some of the essential features of the invention. It is, therefore, desired that the language of the appended claims be given as reasonably broad interpretation as the prior art permits.

I claim as my invention:

1. A circuit interrupter comprising relatively movable contacts, a housing including an openable cover for enclosing the interrupter, operating mechanism including an operating handle mounted on said cover, a cam member mounted on the cover and operable by said operating handle and movable relative thereto for causing opening and closing of the contacts, and means comprising an overcenter spring between the cam member and said handle for causing movement of the cam member relative to the handle with a snap action.

2. A circuit interrupter comprising relatively movable contacts, a housing including an openable cover for enclosing the interrupter, operating mechanism including an operating handle mounted on the cover, an operating member mounted on the cover and operable by said operating handle and movable relative thereto for causing opening and closing of the contacts, an overcenter spring between the handle and the operating member for moving said member relative to the handle with a snap action, and means operable by the operating member for operating the contacts to open and closed positions with a snap action.

3. A circuit interrupter comprising relatively movable contacts, a switch member movable to an open and to a closed position for opening and closing the contacts, an openable cover for enclosing the interrupter, operating mechanism for said switch member including an operating handle mounted on said cover for movement therewith, an operating member mounted on the cover, an overcenter spring between the handle and said operating member, said spring being operable upon movement of the handle to open and closed positions to move the operating member to open and closed positions with a snap action, and a member between the operating member and the switch member operable by said operating member to move the switch member to open and closed positions.

4. A circuit interrupter comprising relatively movable contacts, a switch member operable to cause opening and closing of said contacts, a housing including an openable cover for enclosing the interrupter, operating mechanism for said switch member including a manually operable handle mounted on the cover and movable therewith, an operating member mounted on the cover, and means comprising an overcenter spring operatively connecting the handle and the

operating member and operable by said handle for moving the operating member relative to the handle to cause operation of the switch member with a snap action.

5. A circuit breaker comprising a switch member movable to open and closed positions for opening and closing the circuit, a housing including an openable cover for enclosing the breaker, a trip member operable to cause movement of the switch member to open position, a lever mounted on said trip member and operatively connected to the switch member, operating mechanism mounted on the cover and movable therewith, said operating mechanism including an operating member separably engageable with said lever and operable to actuate the lever to cause movement of the switch member to open and closed positions, and a trip device for said trip member operable in response to predetermined circuit conditions to cause opening movement of the switch member irrespective of the position of the operating member.

6. A circuit breaker comprising a switch member biased to open position and operable to open and closed positions for causing opening and closing of the circuit, a housing including an openable cover for enclosing said breaker, a trip member operable to cause movement of the switch member to open position, means pivotally mounted on the trip member and operatively connected to the switch member, operating mechanism mounted on the cover and movable therewith, said operating mechanism including an operating handle, a cam member separably engageable with the pivoted means, and an overcenter spring operable by the handle to cause the cam member to actuate the pivoted means to thereby operate the switch member to open and closed positions.

7. A circuit breaker comprising a pivoted switch member biased to open position, a housing including an openable cover for enclosing the breaker, a releasable member, a lever pivotally mounted on the releasable member and cooperating with the switch member when in its closed position to restrain the switch member in closed position, said lever being operable to cause movement of the switch member to open and closed positions, operating mechanism mounted on the cover and movable therewith including a cam member separably engageable with the lever and movable to open and closed positions for actuating said lever, said cam member being effective upon release of the releasable member to cause operation of the lever to move the switch member to open position irrespective of the position of the cam member.

8. A circuit breaker comprising a switch arm biased to open position, a housing including an openable cover for enclosing the breaker, a releasable member, a lever pivotally mounted on the releasable member and cooperating with the switch member to releasably restrain said switch member in closed position, a trip device operable in response to predetermined circuit conditions to release said releasable member and cause movement of the switch member to open position, and operating mechanism mounted on the cover including an operating handle, a cam member separably engageable with the lever and operable to cause movement of the switch member to open and closed positions, and an overcenter spring between the handle and the cam member for actuating said cam member with a snap action.

9. A circuit interrupter comprising relatively movable contacts, a housing including an openable cover for enclosing the interrupter, operating mechanism for said contacts including a manually operable member rotatably mounted on said cover, a cam member movable in opening and closing directions by said manual member to cause opening and closing of the contacts, said cam member being movable relative to said manual member, and means comprising an overcenter spring for moving the cam member relative to said manual member in opening and closing directions to cause opening and closing of the contacts with a snap action.

10. A circuit interrupter comprising a pivoted switch member biased to open position, a housing including an openable cover for enclosing said interrupter, a pivoted lever having one end operatively connected to the switch member and operable to move the switch member to open and closed positions, operating mechanism mounted on the cover and including a movable cam member separably engaging the other end of the lever, and means including an overcenter spring for causing said cam member to operate the lever with a snap action.

11. A circuit breaker comprising a pivoted contact member movable to open and close the circuit, a normally stationary trip member, means biasing said contact member to move to open position without movement of said trip member, a rigid lever pivotally mounted at a point intermediate its ends on the trip member and operatively connected adjacent one end to the contact member to actuate the contact member to open and closed positions, an operating member having a connection with said lever adjacent its other end by which said lever is normally movable upon movement of the operating member to actuate the contact member to open and closed positions without movement of the trip member, means responsive to a predetermined circuit condition to cause movement of said trip member to move said lever and cause movement of the contact member to open position, and said connection between said lever and said operating member permitting the last said movement of said lever and opening movement of the contact member even though said operating member may be held against movement.

12. A circuit breaker comprising a contact member movable to open and close the circuit, a normally stationary trip member, means biasing said contact member to move to open position, a lever pivotally mounted at a point intermediate its ends on the trip member, said lever having a pin and slot connection adjacent one end to actuate the contact member to open and closed positions, an operating member having a connection with said lever adjacent its other end by which said lever is normally movable upon movement of the operating member to actuate the contact member to open and closed positions without movement of the trip member, means responsive to a predetermined circuit condition to cause movement of said trip member to move said lever and cause movement of the contact member to open position, said connection between said lever and said operating member permitting the last said movement of said lever and opening movement of the contact member even though said operating member may be held against movement, and said operating member being operable to move said connection and lever to return said trip member to the position in which it is normally stationary.

13. A circuit breaker comprising a pivoted switch member, a pivoted trip member, means responsive to a predetermined current condition normally holding said trip member against movement about its pivot, a lever pivoted intermediate its ends on said trip member and operatively connected adjacent one end to said switch member to actuate said switch member, means separate from said lever biasing said switch member to move to open circuit position while said current responsive means holds said trip member against movement, an operating member, a connection between said operating member and said lever adjacent its other end by which said lever is normally movable about its pivot on the trip member to actuate the switch member to open and closed positions while said trip member is held by the current responsive means, and said connection permitting movement of said other end of the lever and movement of the switch member to open position by said biasing means upon release of the trip member even though said operating member may be held against movement.

14. A circuit breaker comprising a contact movable to open and close the circuit, a member movable in one direction to normally move said contact to open position and in the opposite direction to normally move said contact to closed position, means separate from said movable member biasing the contact in opening direction, operating means for said movable member including a member having an open slot within which a part of said contact moving member is positioned and one side of which slot is engageable with the contact moving member to apply a force to move it in said one direction and the other side of which slot is engageable with the contact moving member to apply a force to move it in said opposite direction, said slot having a space into which said part of the contact moving member is movable to permit the contact to move to open the circuit while said operating member is held stationary, and electro-responsive means for controlling movement of said part of the contact moving member into said space.

15. A circuit breaker comprising a contact movable to open and close the circuit, a member movable in one direction to normally move said contact to open position and in the opposite direction to normally move said contact to closed position, operating means for said movable member including a slotted member within which a part of said contact moving member is positioned and one side of which slot is engageable with the contact moving member to apply a force to move it in said one direction and the other side of which slot is engageable with the contact moving member to apply a force to move it in said opposite direction, said slot having a space into which said part of the contact moving member is movable to permit the contact to move to open the circuit while said slotted member is held stationary, electro-responsive means for controlling movement of said part of the contact moving member into said space, and one side of said slot comprising a cam surface for camming said part of the contact moving member out of said space and resetting said electro-responsive means upon movement of the slotted member.

16. A circuit breaker comprising a contact movable to open and close the circuit, a member movable in one direction to normally move said contact to open position and in the opposite direction to normally move said cntact to closed position, operating means for said movable member including a handle member, snap-acting spring means separate from said contact moving member and operated by said handle member and a trip-free connection between said snap-acting spring means and said contact moving member, said trip-free connection including a slot having one portion in which a part of said contact moving member is operable during normal opening and closing movement of the contact and having a second portion into which said part of the contact moving member is movable to cause opening movement of said contact under abnormal circuit conditions, and electro-responsive means for controlling movement of said part of the contact moving member into said second portion of the slot.

17. In an enclosed circuit breaker, a metal housing having an openable cover; a base of insulating material mounted in said housing; a stationary contact, a movable switch member, a trip member and tripping means operatively associated with said trip member for causing movement of the trip member and opening movement of said switch member upon the occurrence of a predetermined circuit condition, all mounted on said base of insulating material for ready removal therefrom while said base is mounted in said housing; said tripping means having its tripping point sealed and independent of the relative positions of said trip member and said tripping means so that the tripping point of the breaker is unaffected by the removal and replacement of the aforesaid parts which are readily removable from the base; and a handle member mounted on said cover outside of the enclosure and having a separable connection with said switch member to prevent opening of said cover, said handle being operable to move said switch member between open and closed positions.

18. In an enclosed circuit breaker, a metal housing having an openable cover; a base of insulating material mounted in said housing; a stationary contact, a movable switch member, a trip member and tripping means operatively associated with said trip member for causing movement of the trip member and opening movement of said switch member upon the occurrence of a predetermined circuit condition, all mounted on said base of insulating material for ready removal therefrom while said base is mounted in said housing; said tripping means having its tripping point sealed and independent of the relative positions of said trip member and said tripping means so that the tripping point of the breaker is unaffected by the removal and replacement of the aforesaid parts which are readily removable from the base, and a handle member mounted on the outside of said cover and connected to operate said switch member between open and closed positions by separable means to permit opening of said cover and access to said readily removable parts.

19. In a multi-pole circuit breaker, means of insulating material forming a base and one or more barriers defining a plurality of separate pole compartments, a plurality of switch members connected together for movement in unison, said switch members being positioned one in each of said pole compartments and being removably journaled for pivotal movement solely on said one or more barriers of insulating material, a trip member removably journaled for pivotal movement solely on said barriers, tripping means

removably mounted on said means of insulating material and having latch means for engaging and normally holding said trip member, said tripping means having its tripping point sealed and independent of the amount of overlap between said trip member and said latch means so that the tripping point of the breaker is unaffected by the removal and replacement of the aforesaid parts which are removably mounted on said means of insulating material, and a handle member operable to normally open and close said switch members but incapable of holding said switch members in closed position upon release of said trip member by said latch means.

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