

Dec. 23, 1958

M. BINGENHEIMER

2,866,026

CIRCUIT BREAKERS

Filed Sept. 22, 1954

2 Sheets-Sheet 1

Fig. 1.

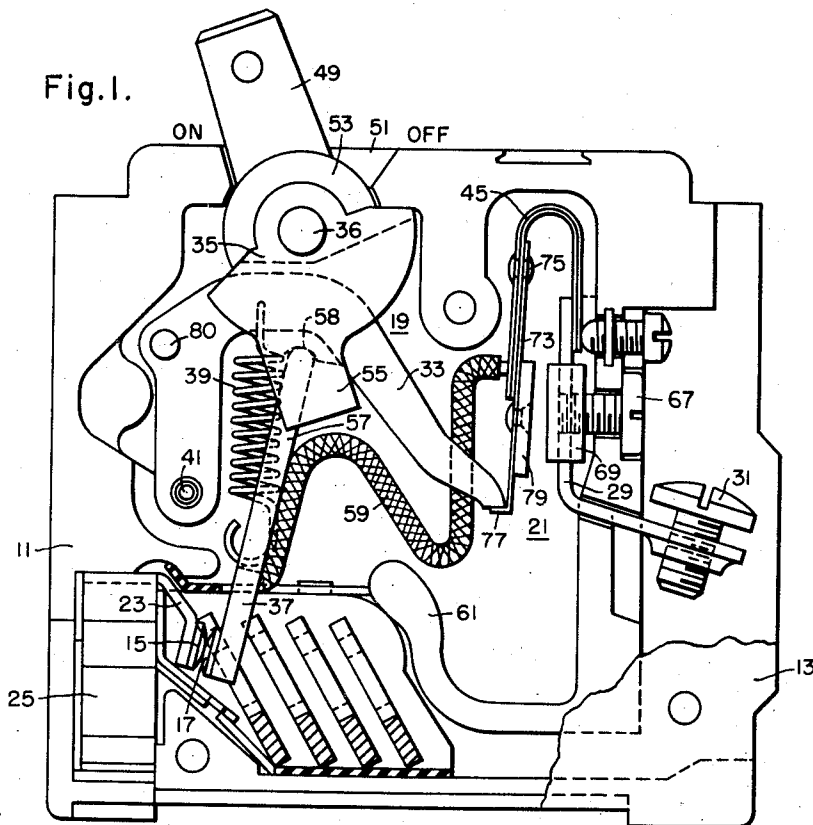


Fig. 4.

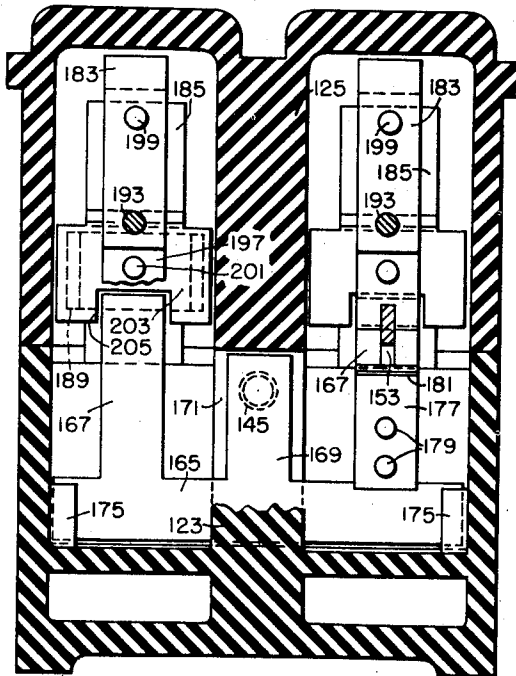


Fig. 6.

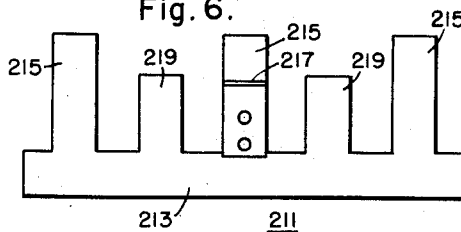
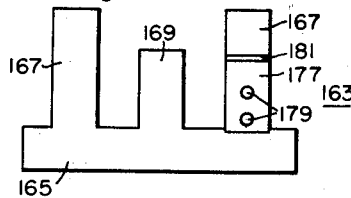


Fig. 5.



Dec. 23, 1958

M. BINGENHEIMER

2,866,026

CIRCUIT BREAKERS

Filed Sept. 22, 1954

2 Sheets-Sheet 2

Fig. 2.

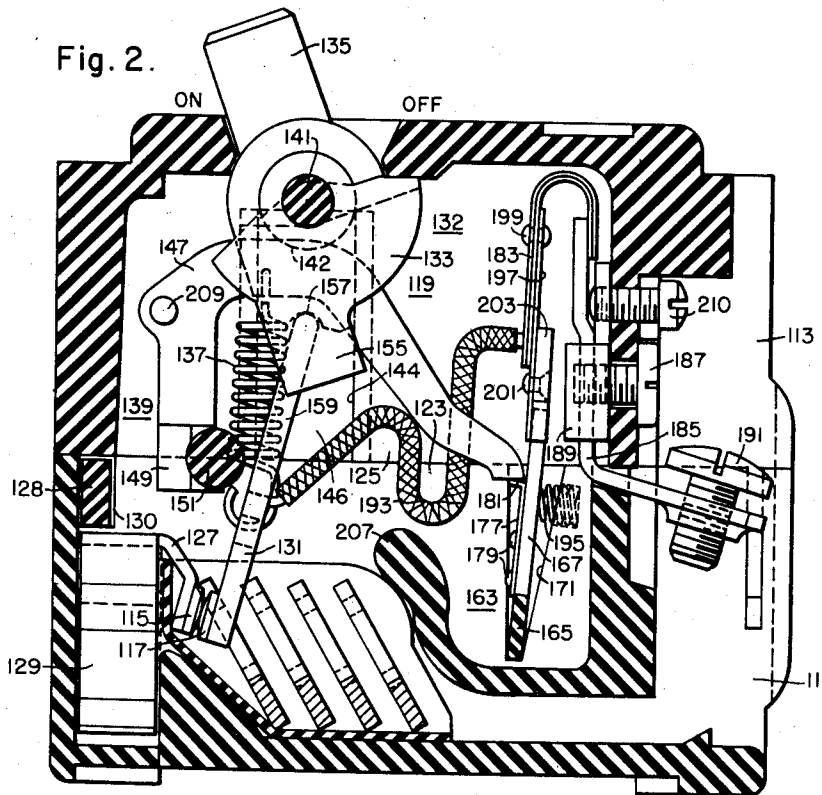
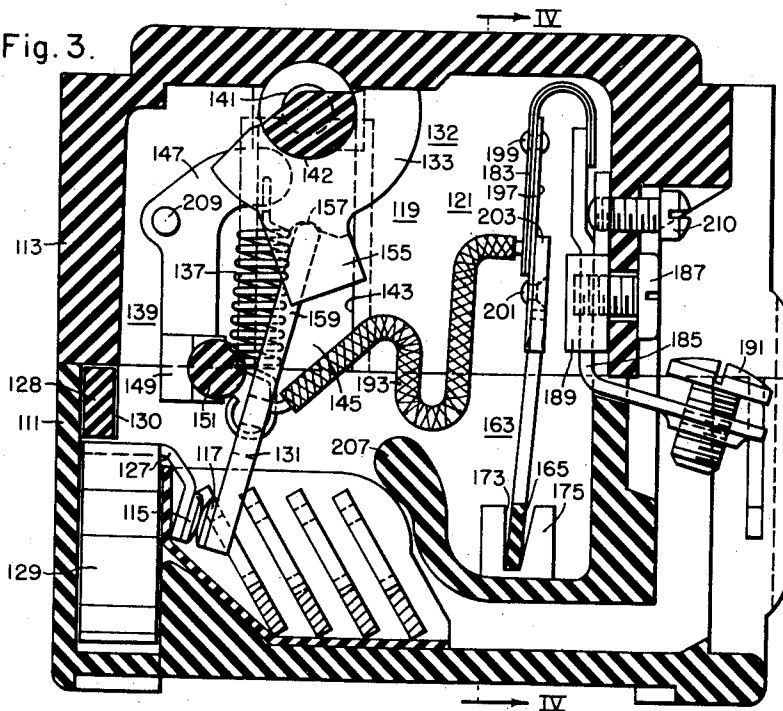


Fig. 3.



1

2,866,026

CIRCUIT BREAKERS

Melvin Bingenheimer, Beaver, Pa., assignor to Westinghouse Electric Corporation, East Pittsburgh, Pa., a corporation of Pennsylvania

Application September 22, 1954, Serial No. 457,699

27 Claims. (Cl. 200—88)

This invention relates to circuit breakers and, more particularly, to circuit breakers which are manually opened and closed and which are opened automatically upon the occurrence of an overload current.

An object of the invention is to provide a circuit breaker embodying an improved trip mechanism.

Another object of the invention is to provide a circuit breaker embodying an improved thermally and magnetically responsive trip device having an armature movable against the bias of a spring other than the thermal element, so that a stiffer thermal element may be used without requiring a large magnetic force for magnetic tripping. It is further an object to use in a multipole breaker a plurality of such armatures which are individually movable each against the bias of a separate spring.

Another object of the invention is to provide a multipole circuit breaker having an operating handle extending into each of the poles of the breaker with the contact arms for the several poles individually supported on the handle.

Another object of the invention is to provide a multipole circuit breaker having a plurality of pivoted releasable trip members connected together by an insulating cross bar with a single latch holding all of said trip members, and a common trip bar extending across the poles of said breaker having a single latch thereon releasably holding all of said trip members.

Another object of the invention is to make a multipole breaker small in size and low in cost by assembling the operating mechanism on the cover of the housing with the contact arms extending downwardly into the base to engage contacts on opposite sides of barrier portions in the base with an opening through the barrier portions in the base for the insulated trip bar and in which it is movable by any one of independently movable downwardly extending current responsive elements to trip the breaker.

The invention 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 conjunction with the accompanying drawings.

In said drawings:

Figure 1 is a vertical sectional view through a single-pole circuit breaker with the cover plate broken away and embodying the principles of the invention;

Fig. 2 is a vertical sectional view through one pole of a two-pole circuit breaker showing the trip mechanism applied to a multipole circuit breaker;

Fig. 3 is a vertical sectional view through another pole of a multipole circuit breaker;

Fig. 4 is a vertical sectional view taken on line IV—IV of Fig. 3 and showing the trip mechanism;

2

Fig. 5 is an elevational view of the trip bar for a two-pole circuit breaker shown in Fig. 2; and

Fig. 6 is an elevational view of a trip bar similar to the trip bar shown in Fig. 5 but modified for use in a three-pole circuit breaker.

Referring to Fig. 1 of the drawings, the circuit breaker comprises generally a two-piece housing of molded insulating material including an open-sided base 11 and a cover plate 13, a stationary contact 15 and a movable contact 17, an operating mechanism 19 and a trip device 21. The parts are laterally assembled in the base 11 and are held in place by the other part of the housing 13.

The stationary contact 15 is rigidly mounted on the inner end of a conducting member 23 integral with a plug-in connector 25 supported in the base 11 by the cover 13. The moving contact 17 is rigidly secured to a U-shaped switch or contact arm 37 having its legs 57 supported in recesses 58 in the legs 55 of a U-shaped operating lever 35 of molded insulating material. The operating lever 35 is pivotally supported by trunnions 36 molded integral therewith and mounted in companion openings in the housing member 11 and in the cover 13. An over-center operating spring 39 is connected under tension between the bight of the switch member 37 and a releasable carrier or trip member 33 pivoted on a pin 41 supported in the housing 11 and cover 13. At the opposite end of the housing from the plug-in connector 25 is disposed a conducting strip 29 which at its inner end supports the trip device 21 and which at its outer end is provided with a terminal connecting means, such as a screw 31, for connecting the circuit breaker in an electric circuit.

The operating lever 35 is provided with a handle 49 molded integral therewith and extending outwardly through an opening 51 in the base 11. The operating lever 35 is also provided with an arcuate portion 53 cooperating with the base 11 to substantially close the opening 51 in all positions of the operating handle. The switch member 37 is electrically connected by a flexible conductor 59 to one end of a bimetal element 45 forming part of the trip device 21 which is suitably secured to and supported by the inner end of the conducting strip 29.

The switch arm 37 is operated to manually open and close the contacts by manipulation of the lever 35 by means of the handle 49. Movement of the handle 49 in a clockwise direction from the position shown in Fig. 1 carries the legs 57 of the switch member 37 across to the left of the line of action of the operating spring 39, which spring then biases the switch member to the open position and causes movement of the switch member to the open position with a snap action.

The contacts are manually closed by reverse movement of the operating lever 35. Counterclockwise movement of the lever 35 from the "off" position to the "on" position moves the pivoted ends of the legs of the switch member 37 across to the right of the line of action of the spring 39, which then acts to close the contacts with a snap action.

The circuit breaker is tripped open after a time delay in response to overload currents below a predetermined value, and instantaneously in response to overload currents above said predetermined value or a short-circuit current, by means of the trip device 21 which will be hereinafter described in detail. Operation of the trip device 21 causes release of the releasable trip member 33, whereupon the operating spring 39 moves the trip member 33 clockwise about its pivot 41. This moves the line of action

of the spring 39 across to the right of the center line of the switch arm 37 and the spring 39 then acts to move the switch arm to the open position with a snap action. The movement of the trip member 33 is stopped by engagement with a projection 61 molded integral with the base 11.

The trip device comprises the bimetal element 45 having one end rigidly mounted on the inner end of the conducting strip 29. The bimetal element 45 has a reverse loop therein and the high expansion side of the bimetal element is on the outside of the loop. The conducting strip 29 is secured to the end wall of the base 11 by means of a screw 67 which also serves to mount a U-shaped magnet yoke 69. The upper end of a light leaf spring 73 is secured by means of a rivet 75 to the inside face or low-expansion side of the bimetal element 45 at a point just below the loop and extends downwardly along the inside of the bimetal element. The lower end of the spring 73 has actuating or latch means 77 thereon which engage the latch end of the trip member 33 and releasably restrain this member in operative position. An armature 79 is rigidly secured to the spring 73 by suitable means, such as riveting or welding, for cooperating with the magnet yoke 69. The magnet yoke 69 is mounted by means of the screw 67 between the end wall of the cover 13 and the conductor 29 and embraces three sides of the conductor.

Upon the occurrence of an overload current of, for example, up to 1000% of normal rated current, the bimetal element 45 bends in a direction to close the loop, since the high expansion side thereof is on the outside of the loop, and moves the free end of the bimetal element toward the right to disengage the latch means 77 from the releasable trip member 33 and effect automatic opening of the breaker contacts as previously described.

Upon the occurrence of an overload current of, for example, 1000%, or more of normal rated current, or a short-circuit current, the armature 79 is attracted to the magnet yoke 69. This flexes the spring 73 and disengages the latch 77 to instantaneously trip the breaker, without it being necessary to bend the stiffer bimetal, and giving a more sensitive magnetic trip.

Before the contacts can be closed following an automatic opening operation, it is necessary to reset and re-latch the mechanism. This is accomplished by moving the handle 49 and the operating lever 35 to a position slightly beyond the "off" position. During this movement, the legs 55 of the lever 35 engage a pin 80 in the trip member 33 and restore this member to the latched position. The contacts are then closed in the previously described manner by movement of the handle 49 to the "on" position.

As illustrated in Figs. 2 and 3, there is provided a two-pole circuit breaker embodying a modification of the mechanism and the trip device shown in Fig. 1.

Referring to Figs. 2 and 3 of the drawings, the circuit breaker comprises generally a two-piece housing of molded insulating material consisting of a base 111 and a cover 113, stationary contacts 115 and movable contacts 117 for each pole of the breaker, operating mechanism 119 and a trip device 121. In this modification, some of the parts are assembled in the cover, and other parts are assembled in the base, and are held in proper position when the base and cover are secured together. The housing is divided into separate compartments for separately housing the poles of the breaker by means of matching barriers 123 and 125 molded integral respectively with the base 111 and the cover 113 (see also Fig. 4). While a two-pole breaker is illustrated and specifically described, the invention may be utilized in a three-pole breaker by adding an outer compartment and the parts therein, such as is shown in Fig. 3, and extending the common elements into the third compartment.

The stationary contacts 115 for each compartment are mounted on the inner ends of conductor strips 127 which are integral with plug-in connectors 129 supported in

recesses in the base 111 of the breaker and held in place by insulating bars 128 seated in matching recesses 130 in the barrier 123 and in the side walls of the base 111, the bars 128 being held in place by the lower edge of the cover 113. The moving contact 117 for each pole is rigidly secured to a U-shaped switch or contact arm 131, the contact arms being mounted at their upper ends within the cover and being operated to open and closed positions by the operating mechanism 119 to open and close the contacts.

The operating mechanism 119 is assembled on the cover 113 and comprises an operating member 132 having an operating lever 133 for each pole of the breaker and a single operating handle 135, an overcenter spring 137 and a releasable trip member 139. The operating member 132 including the handle 135 and the operating levers 133 for the several poles comprises a single member of molded insulating material, so that operation of the handle 135 simultaneously moves all of the levers 133. Molded on the ends of the operating member 132 are bearing surfaces 141 for pivotally supporting the member on the side walls of the cover 113. The side walls of the cover are provided with slots 143 (only one being shown) for receiving and positioning the operating member 132. After the operating member is mounted in the slots 143, support and closure members 145 of insulating material are inserted in the slots 143 and suitably secured thereon. Similarly, a bearing portion 142 (Fig. 3) is molded on the central portion of the operating member 132, and the barrier 125 (Fig. 2) in the cover 113 is provided with a slot 144 for receiving the bearing portion 142. A support and closure member 146 is inserted and suitably secured in the slot 144 after the operating member is in place. When the base 111 is applied to the cover 113, the members 145 and 146 are secured in place by the upper edge of the base. The upper ends of the support members have semi-circular notches therein engaging and supporting the lower sides of the bearing portions 141 and 142.

The releasable trip member 139 comprises a spring support lever or trip arm 147 for each pole of the breaker, each of the spring support or trip levers being secured adjacent its pivot axis on a tie rod or cross bar 149 of molded insulating material for unitary movement. The tie rod is provided with bearing portions 151 for supporting the releasable trip member on the barrier 123 and on other portions of the housing. The spring support lever 147 (Fig. 2) for one of the poles of the breaker extends toward the right and has a latch end 153 which is normally engaged and releasably held by a single latch of the trip device (to be later described) to releasably hold all of the trip arms of the releasable trip member in operative position.

Each of the levers 133 (Figs. 2 and 3) is bifurcated and the spaced legs 155 thereof are provided with notches 157 in which are seated the legs 159 of the U-shaped switch member 131. The switch members 131 are held in place by the overcenter springs 137 which are connected under tension between the switch members 131 and the corresponding spring supports 147 of the releasable member 139. In the position shown in Figs. 2 and 3, the springs 137 bias the switch members 131 to the closed position.

The circuit breaker is opened manually by moving the operating member 132 by the handle 135 (Fig. 2) clockwise from the "on" position to the "off" position. During this movement, the inner ends of the switch arms 131 are carried overcenter to the left of the line of action of the overcenter springs 137, whereupon the springs move the switch arms 131 to the open position with a snap action. The contacts are closed by reverse movement of the operating member 132; that is, from the "off" to the "on" position. During this movement, the inner ends of the switch members 131 for the several poles are moved over to the right of the line of action of the overcenter

springs 137 which then act to move the switch members 131 to the closed position with a snap action.

The circuit breaker is tripped open automatically in response to overload currents by operation of the trip device 121. The trip device comprises a trip bar 163 (Figs. 2, 3, 4, and 5) formed from a flat piece of insulating material and extending across both poles of the breaker. The trip bar 163 comprises a body portion 165, an upwardly extending arm 167 for each pole of the breaker and a central arm 169 which is somewhat shorter than the arm 167. The central arm 169 of the trip member is in line with the barrier 125 in the cover which prevents upward movement of the trip bar when the cover is in place. The body portion 165 of the trip bar is pivotally supported at the center in the bottom of a V-shaped opening 171 (Fig. 2) in the barrier 123 of the base 111. The ends of the body portion 165 are pivoted in notches 173 (Fig. 3) in bosses 175 (Figs. 3 and 4) molded integral with the base 111 and extending inwardly from the side walls thereof. One of the arms 167 has a latch member 177 secured thereon by means of rivets 179. The latch member 177 is provided with a formed-over latch 181 at its upper end which engages the single latch end 153 of the plurality of releasable trip members 147 to releasably restrain the entire releasable member 139 and the springs 137 for each of the poles in operative position. The trip bar 163 is biased to a latching position by a spring 195 compressed between a spring seat in the barrier 123 of the base 111 and the center arm 169 of the trip bar.

The trip device 121 for each pole also includes a bimetal element 183 having a reverse loop therein and having one end rigidly mounted on the inner end of a conducting strip 185, the high expansion side of the bimetal element 183 being on the outside of the loop. The conducting strip 185 for each pole is secured to the end wall of the cover 113 by means of a screw 187 which also serves to mount a U-shaped magnet yoke 189. The conducting strip 185 for each pole extends out through an opening in the base 11 below the cover 113 and has a terminal connector 191 on its outer end. The free end of the bimetal element 183 is electrically connected to the switch member 131 by means of a flexible conductor 193. The upper end of a leaf spring 197 is secured by means of a rivet 199 to the bimetal element 183 at a point just below the loop and extends downwardly along the inside or low-expansion side of the bimetal element. Secured to the lower end of the leaf spring 197 by means of a rivet 201 is an armature 203 having a notch 205 (Fig. 4) in the lower edge thereof into which the upper end of the arm 167 of the trip bar 163 extends. The U-shaped magnet yoke 189 is mounted by means of the screw 187 between the conductor 185 and the end wall of the cover, and surrounds three sides of the conductor 185 to be energized thereby.

Upon the occurrence of an overload current in the associated pole of the breaker of, for example, up to 1000% of normal rated current, the high expansion side of the bimetal element being on the outside of the loop, the bimetal bends in a direction to close the loop moving the free end of the bimetal, together with the spring 197 toward the right. This movement causes the lower end or actuating portion of the leaf spring 197 to engage the upper end of the corresponding arm 167 of the trip bar 163 and move the trip bar clockwise to disengage the latch 181 from the releasable trip arm or spring support lever 147. Upon release of the spring support lever 147, the entire releasable trip member 139 is rotated clockwise about its pivot 151 until the latch end 153 of the spring support lever 147 (Fig. 2) is stopped by engagement with a projection 207 molded integral with the base 111. The clockwise movement of the releasable trip structure 139 carries the lines of action of the springs 137 for both poles of the breaker across to the right of the pivoted ends of the switch members 131. The springs 137 then move all of the switch members to the open position with a snap action.

Upon the occurrence of an overload current of, for example, 1000% or more of rated current, or a short-circuit current, the armature 203 is instantaneously attracted to the magnet yoke 189. This flexes the spring 197 without placing undue strain on the bimetal element, and actuates the trip bar 163 to disengage the latch 181 thereby instantaneously tripping the breaker.

Before the contacts can be closed following an automatic opening operation of the breaker, it is necessary to reset and relatch the mechanism. This is accomplished by manually moving the handle 135 (Fig. 2) and the operating member 132 to a position slightly beyond the "off" position. During this movement, the legs 155 of the levers 133 engage pins 209 in the member 147 and restore the entire releasable structure 139 (Figs. 2 and 3) to the latched position. As the latch end 153 of the elongated lever 147 (Fig. 2) approaches the reset position, the nose thereof wipes by the latch 181 slightly compressing the spring 195 which restores the trip bar 163 and the latch 181 to latching position when the latch end 153 has cleared the latch. The contacts are then closed in the previously described manner by counterclockwise movement of the handle 135 and the levers 133 to the "on" position.

The latch overlap and, hence, the thermal tripping time for each pole of the breaker is adjusted by means of a screw 210 which threadably engages the end wall of the cover 113. The rounded inner end of the screw 210 applies a pressure to the inner end of the conductor 185. Turning the screw 210 varies the pressure applied to the conductor which varies the position of the bimetal element and, through the leaf spring 197 varies the position of the trip bar 163 and the latch 181 with respect to the latch end 153 of the releasable trip lever 147.

While a two-pole circuit breaker has been specifically described, a three-pole breaker is readily provided by making a housing having three compartments instead of the two compartments shown and adding another pole unit like the pole unit shown in Fig. 3 to the right of the right-hand pole, as viewed in Fig. 4. The extended trip arm 147 (Fig. 2) would then be in the center pole. The operating lever 132 and the releasable trip member 139 would be extended into the third pole to include an operating lever 133 and a spring support or releasable trip member 147 in the third pole. Fig. 6 illustrates a trip bar for use in a three-pole breaker. This trip bar indicated generally at 211 comprises a body portion 213 and three actuating arms 215 with the latch 217 on the center arm for cooperating with the latch end of the releasable trip lever in the center pole. Two short arms 219 are provided for cooperating with notches in the barriers between poles.

There is provided a multipole circuit breaker in which a one-piece operating lever is mounted in the cover and extends into each compartment of the housing for supporting and operating the several switch members. The releasable structure extends into each compartment to support, and when released, to actuate the overcenter springs and effect automatic opening movement of the several switch members. The trip bar, formed from a flat piece of insulating material, is pivotally supported in the base and extends into each of the compartments to be operated by any one of the trip devices to release the releasable structure.

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.

I claim as my invention:

1. In a circuit breaker having relatively movable contacts, a housing comprising a base and a cover, means releasable to effect automatic opening of said contacts, a latch portion normally engaging and retaining said releasable means, a trip device for effecting release of

said latch portion comprising a bimetal element having one end supported on said cover and the other end free, a resilient member having one end rigidly secured to said bimetal element and having the other end free, said resilient member extending along the low-expansion side of said bimetal element and beyond the free end of said bimetal element, adjusting means on said cover adjacent the supported end of said bimetal element for applying a force to said support means supporting said bimetal element to thereby vary the position of said free end of the bimetal element, and said resilient member being movable by thermal bending of said bimetal element and transmitting the force exerted by the bimetal element to said latch portion and applying force to overcome the latch friction so as to initiate release of said releasable means.

2. A circuit breaker comprising a casing, separable contact means and means releasable to effect separation of said contact means, a conducting member extending into said casing at the end wall thereof and extending upwardly in the casing along the end wall thereof, a trip device operable to effect release of said releasable means comprising a bimetal element having one end rigidly secured to the inner end of said conducting member, a magnet yoke rigidly supported between the end wall of said casing and said conducting member, said bimetal element and conducting member providing a current path in the form of a single loop with the high expansion side of said bimetal element on the outside of said loop, a straight resilient member having one end rigidly secured to said bimetal element on the inside of said loop and at a point spaced from the free end of said bimetal element, said resilient member being disposed along the low-expansion side of said bimetal element and extending beyond the free end of said bimetal element, thermal bending of said bimetal element causing said resilient member to apply a force to initiate release of said releasable means after a time delay, an armature rigidly secured to said resilient member adjacent the free end of said bimetal element, and said armature being operable by said magnet yoke to cause said resilient member to instantaneously initiate release of said releasable means.

3. In a circuit breaker having relatively movable contacts and means releasable to effect automatic opening of said contacts, a trip device for effecting release of said releasable means comprising a conducting terminal strip and a bimetal element having one end supported on the conducting terminal strip and the other end free, said bimetal element and conducting terminal strip being traversed by current and forming a single loop with the high expansion side of said bimetal element on the outside of said loop, the free end of said bimetal element moving when heated by current toward said conducting terminal strip to initiate release of said releasable means, electromagnetic means comprising a magnetic member mounted on said conducting terminal strip outside of said loop and an armature positioned between the free end of the bimetal element and said conducting terminal strip opposite said magnetic member, and said electromagnetic means being operable to move its armature toward said conducting terminal strip to initiate quick release of said releasable means.

4. In a circuit breaker having relatively movable contacts and means releasable to effect automatic opening of said contacts, a housing comprising a base and a cover, a conducting member entering through one end wall of said housing and extending along the inside of one end wall of the cover, a trip device for effecting release of said releasable means comprising a bimetal element having one end supported on said conducting member and the other end free, said bimetal element being connected to be traversed by current and having its free end portion extending along and spaced from said conducting member with the high expansion side of said bimetal

element at the side of its free end portion more remote from the conducting member, a magnetic yoke mounted between said conducting member and the end wall of the cover, an armature biased against magnetic attraction by said yoke toward said conducting member, said armature being movable toward said conducting member by said bimetal when the bimetal is heated by the current, said armature being movable magnetically against its bias by attraction to said yoke mounted at the opposite side of the conducting member, and an actuating portion movable with said armature for causing release of said releasable means upon movement of the armature.

5. In a circuit breaker having separable contacts and means releasable to effect separation of said contacts, a trip device for effecting release of said releasable means comprising a bimetal element having one end supported and the other end free, said bimetal element having a reverse bend about a transverse axis parallel to its faces to form a loop, latch means biased to a position normally restraining said releasable means, a resilient member having one end rigidly secured to said bimetal element at the inside of said loop, said resilient member lying flat along said bimetal element and terminating at a point beyond the free end of said bimetal element and said resilient member being moved by thermal bending of said bimetal element and applying the bending force of the bimetal element to said latch means to move it against its latch friction and effect release of said releasable means, and an armature portion mounted on said resilient member at the free end of the bimetal element, said armature portion being magnetically movable and actuating said latch means against its bias to also effect release of said releasable means.

6. In a circuit breaker, a housing of insulating material having therein relatively movable contacts, means releasable to effect automatic opening of said contacts, a handle projecting through the top of the housing to manually actuate said contacts, a conducting terminal strip extending into the housing at one end thereof and extending upwardly in the housing along the end wall thereof, a bimetal element secured at one end to the upper end of the conducting terminal strip, said bimetal element having a free end extending downwardly in the housing spaced from the conducting terminal strip, a magnetic yoke portion positioned between the conducting terminal strip and the end wall of the housing, a fastening member extending through the end wall of the housing and into both the conducting terminal strip and the yoke portion for securing them to the end wall of the housing, an armature portion in the space between the free end of the bimetal element and the conducting terminal strip, means biasing said armature portion toward the free end of the bimetal element, said armature portion being movable in the direction opposite the direction of its bias by the force exerted by said bimetal element upon heating thereof and also being movable against its bias by magnetic attraction of said yoke portion to effect release of said releasable means and automatic opening of said contacts.

7. In a circuit breaker, a housing of insulating material having therein relatively movable contacts, means releasable to effect automatic opening of said contacts, a handle projecting through the top of the housing to manually actuate said contacts, a conducting terminal strip extending into the housing at one end thereof and extending upwardly in the housing along the end wall thereof, a bimetal element having a reverse bend therein with one leg secured at one end to the upper end of the conducting terminal strip, said bimetal element having at its other leg a free end extending downwardly in the housing spaced from the conducting terminal strip, a magnetic yoke portion positioned between the conducting terminal strip and the end wall of the housing, an armature portion in the space between the free end of the bimetal

element and the conducting terminal strip, means biasing said armature portion toward the free end of the bimetal element, said armature portion being movable in the direction opposite the direction of its bias by the force exerted by said bimetal element upon heating thereof and also being movable against its bias by magnetic attraction of said yoke portion, and a latch portion movable with the armature portion to effect release of said releasable means and automatic opening of said contacts.

8. A multipole circuit breaker comprising a housing, separable contact means for each pole, means common to all of said poles, releasable to effect separation of said contact means, a conducting member for each pole extending into said housing and rigidly secured thereto, a trip device for each pole operable to effect release of said common releasable means and separation of said contact means, each of said trip devices comprising a bimetal element having one end rigidly secured to the corresponding conducting member and the other end free, said bimetal element having a reverse bend therein forming a loop with the high expansion side of said bimetal element on the outside of said loop, latch means normally restraining said common releasable means and movable to release said releasable means, a flat spring mounted on said bimetal element inside said loop and at a point adjacent said loop, said spring extending along the low-expansion side of said bimetal element and extending longitudinally beyond the end of said bimetal element, and thermal bending of the bimetal element of any pole of the breaker causing the spring mounted thereon to actuate said latch means and effect release of said common releasable means.

9. A multipole circuit breaker comprising a housing, separable contact means for each pole, means common to all of said poles releasable to effect separation of said contact means, a conducting member for each pole extending into said housing and rigidly secured thereto, a trip device for each pole operable to effect release of said common releasable means and separation of said contact means, each of said trip devices comprising a bimetal element having one end rigidly secured to the corresponding conducting member and the other end free, said bimetal element having a reverse bend therein forming a loop with the high expansion side of said bimetal element on the outside of said loop, latch means normally restraining said common releasable means and movable to release said releasable means, a flat spring mounted on said bimetal element inside said loop and at a point adjacent said loop, said spring extending along the low-expansion side of said bimetal element and extending longitudinally beyond the end of said bimetal element, a trip member formed from a flat piece of insulating material extending across all of the poles of the breaker, a projection on said trip member for each pole of the breaker, and thermal bending of the bimetal element for any pole of the breaker causing the spring mounted thereon to engage the associated projection and move said trip member to thereby cause said trip bar to move said latch means.

10. A multipole circuit breaker comprising a housing, separable contacts for each pole, means common to all of said poles releasable to effect separation of said contacts, a conducting member for each pole extending into said housing at the end wall thereof and rigidly supported on said end wall, a U-shaped magnet for each pole yoke surrounding three sides of said conducting member and rigidly supported between the end wall of said housing and said conducting member, a trip device for each pole of the breaker operable to effect release of said common releasable means, each of said trip devices comprising a bimetal element having one end supported on said conducting member and the other end free, said bimetal element having a reverse bend therein forming a loop with the high expansion side of said bimetal element on the outside of said loop, a straight resilient member having one end mounted on said bimetal element inside

said loop and at a point adjacent said loop and having the other end free, said resilient member extending along the low-expansion side of said bimetal element and having its free end extending beyond the free end of said bimetal element, an armature mounted on said resilient member adjacent the free end thereof, a trip member formed from a flat piece of insulating material extending across all of the poles of the breaker, a projection on said trip member for each pole of the breaker, latch means on one of said projections normally engaging and restraining said common releasable means, the bimetal element when heated a predetermined amount in response to overload currents below a predetermined value bending in a direction to cause the resilient member mounted thereon to actuate said trip member and effect release of said common releasable means, and the armature for any pole of the breaker being attracted to the associated magnet yoke by energization of the latter in response to overload currents above said predetermined value to cause the resilient member for the associated pole to instantaneously actuate the trip member.

11. A multipole circuit breaker having relatively movable contacts for each pole, means common to all of said poles releasable to effect automatic opening of said contacts, a trip device for each pole of the breaker, each of said trip devices comprising a bimetal element having a reverse bend therein forming a loop, the high expansion side of said bimetal element being on the outside of said loop, a straight spring mounted on said bimetal element inside said loop and extending along the low-expansion side of said bimetal element, a trip member common to all of the poles of the breaker, an arm on said trip member for each pole of the breaker having their ends disposed adjacent the ends of said springs to be operated thereby, latch means on the arm for only one pole of the breaker operable to effect release of said common releasable means, and thermal bending of the bimetal element for any pole of the breaker causing the spring mounted thereon to engage the associated arm of said trip member and operate said trip member to effect release of said common releasable means.

12. In a multipole circuit breaker, an enclosing housing comprising a base having upwardly extending walls and a cover having downwardly extending walls, separable contacts for each pole, means common to all of said poles releasable to effect automatic opening of said contacts, a trip member mounted in said base and having a portion for each pole extending upwardly toward said cover, latch means on one only of said portions normally engaging and restraining said common releasable means, a trip device for each pole for actuating said trip member comprising a bimetal element having one end supported on said cover and the other end free, the free end of said bimetal element extending downwardly toward said base, a flat resilient member having one end rigidly secured to said bimetal element and the other end free, said resilient member extending along the low-expansion side of said bimetal and beyond the free end of said bimetal element toward said base, and said resilient member being moved by thermal bending of said bimetal element to actuate said trip member and effect release of said common releasable means.

13. In a multipole circuit breaker, an enclosing housing of molded insulating material comprising a base having upwardly extending walls and a cover having downwardly extending walls, the walls cooperating to divide said housing into compartments, relatively movable contacts in each compartment, means extending across all of said compartments releasable to effect automatic opening of said contacts, a trip member extending across all of said compartments, means molded integral with said base defining notches for receiving and pivotally supporting said trip member on said base, said trip member having a projection in each compartment extending upwardly toward said cover, a portion of said

trip member extending toward said cover in line with one of the walls in said cover which prevents upward movement of said trip member, latch means on the projection in one only of said compartments normally engaging and restraining said releasable means, a trip device in each compartment for actuating said trip member comprising a bimetal element having one end supported on said cover and the other end free, said free end of said bimetal element extending downwardly toward said base, and thermal bending of said bimetal element actuating said trip member to initiate release of said releasable means.

14. In a circuit breaker having relatively movable contacts, means releasable to effect automatic opening of said contacts, an enclosing housing of molded insulating material comprising a base having upwardly extending side walls, a cover having downwardly extending side walls, a latch member mounted in said base and extending toward said cover normally engaging and restraining said releasable means, means molded integral with said base defining spaced notches for receiving and pivotally supporting said latch member on said base, a trip device comprising a bimetal element having one end supported on said cover and the other end free, the free end of said bimetal element extending downwardly toward said base, and thermal bending of said bimetal element causing movement of said latch member to initiate release of said releasable means.

15. In a circuit breaker having relatively movable contacts, means releasable to effect automatic opening of said contacts, a housing comprising a base having upwardly extending side walls and end walls, a cover having downwardly extending side walls and end walls, a trip member pivotally mounted on said base and extending upwardly toward said cover normally engaging and restraining said releasable means, a conducting member extending into said housing and secured to one end wall of said cover, a trip device operable to move said trip member to effect release of said releasable means comprising a bimetal element having one end rigidly supported on the inner end of said conducting member and the other end free, the free end of said bimetal element extending downwardly toward said base, a straight resilient member having one end rigidly secured to said bimetal element, said resilient member extending along the low-expansion side of said bimetal element and beyond the free end thereof, thermal bending of said bimetal element causing said resilient member to apply a force to said trip member to initiate release of said releasable member, electromagnetic means comprising a magnet yoke rigidly supported between said end wall of said cover and said conducting member, an armature rigidly secured to said resilient member adjacent the free end of said bimetal element, said resilient means being moved against its bias by said electromagnetic means to cause said trip member to initiate release of said releasable means.

16. In a multipole circuit breaker, an enclosing housing comprising a base having upwardly extending walls and a cover having downwardly extending walls, separable contacts for each pole, means common to all of said poles releasable to effect automatic opening of said contacts, a trip member mounted in said base and having a portion for each pole extending upwardly toward said cover, latch means on one only of said portions normally engaging and restraining said common releasable means, a trip device for each pole for actuating said trip member comprising a bimetal element having one end supported on said cover and the other end free, the free end of said bimetal element extending downwardly toward said base, to effect movement of said trip member and release of said common releasable member, an armature for each pole each positioned adjacent the free end of one of the bimetal elements, a magnetic yoke for each pole mounted on said cover each attracting one of

the armatures and moving the trip bar to effect release of said releasable common member.

17. In a multipole circuit breaker, an enclosing housing comprising a base having upwardly extending walls and a cover having downwardly extending walls, a terminal strip extending upwardly in the cover along one end wall thereof, separable contacts for each pole, means common to all of said poles releasable to effect automatic opening of said contacts, a trip member mounted in said base and having a portion for each pole extending upwardly toward said cover, latch means on one only of said portions normally engaging and restraining said common releasable means, a trip device for each pole for actuating said trip member comprising a bimetal element having one end supported on said terminal strip on said cover and the other end free, the free end of said bimetal element extending downwardly toward said base, to effect movement of said trip member and release of said common releasable member, an armature for each pole each positioned adjacent the free end of one of the bimetal elements, a magnetic yoke for each pole each being positioned between one of said terminal strips and the end wall of the cover and attracting one of the armatures and moving the trip bar to effect release of said common releasable member.

18. In a multipole circuit breaker having a set of relatively movable contacts in each pole and means releasable to effect automatic opening of all of said sets of contacts, a trip device for each pole for effecting release of said releasable means comprising a conducting terminal strip for each pole and a bimetal element having one end supported on each conducting terminal strip and the other end free, each said bimetal element and conducting terminal strip being traversed by current and forming a single loop with the high expansion side of said bimetal element on the outside of said loop, a trip member common to all of said poles, the free ends of said bimetal elements moving when heated by current toward said conducting terminal strips to move said trip member and initiate release of said releasable means, electromagnetic means for each pole comprising a magnetic member for each pole mounted on each said conducting terminal strip outside of said loop and on armature position between the free end of each bimetal element and its said conducting terminal strip opposite said magnetic member, and each said electromagnetic means being operable to move its armature toward its said conducting terminal strip to move said trip member and initiate quick release of said releasable means.

19. In a multipole circuit breaker having a set of relatively movable contacts for each pole and means releasable to effect automatic opening of all of said sets of contacts, a housing comprising a base and a cover, a conducting member for each pole entering through one end wall of said housing and extending along the inside of one end wall of the cover, a trip bar common to all poles, a trip device for each pole for moving said trip bar to effect release of said releasable means comprising a bimetal element having one end supported on said conducting member and the other end free, each said bimetal element being connected to be traversed by current and having its free end portion extending along and spaced from its said conducting member with the high expansion side of said bimetal element at the side of its free end portion more remote from the conducting member, a magnetic yoke for each pole mounted between each said conducting member and the end wall of the cover, an armature for each pole biased against attraction by its yoke, each said armature being movable in the direction toward its yoke by said bimetal when the bimetal is heated by the current, each said armature being movable magnetically against its bias by attraction to its said yoke mounted at the opposite side of the conducting member, and an actuating portion movable with each said armature for moving said trip

13

14

bar and causing release of said releasable means upon movement of the armature.

20. In a multipole circuit breaker, a housing of insulating material having therein a set of relatively movable contacts for each pole, means releasable to effect automatic opening of all of said sets of contacts, a handle projecting through the top of the housing to manually actuate said sets of contacts, a conducting terminal strip for each pole extending into the housing at one end thereof and extending upwardly in the housing along the end wall thereof, a bimetal element for each pole having a reverse bend therein with one leg secured at one end to the upper end of one of the conducting terminal strips, each said bimetal element having at its other leg a free end extending downwardly in the housing spaced from its conducting terminal strip, a magnetic yoke portion positioned between the conducting terminal strip for each pole and the end wall of the housing, an armature portion in the space between the free end of each of the bimetal elements and the associated conducting terminal strip, means biasing said armature portions toward the free ends of the bimetal elements, said armature portions being movable in the direction opposite to the direction of their bias by the forces exerted by said bimetal elements upon heating thereof and also being movable against their bias by magnetic attraction of their associated yoke portions, and a trip bar common to all of said poles movable upon movement of one or more of the armature portions to effect release of said releasable means and automatic opening of all of said sets of contacts.

21. In a multipole circuit interrupter, a pair of relatively movable contacts for each pole, a single member releasable to effect automatic opening of said contacts for all of the poles, a housing of insulating material enclosing said contacts and said releasable member, a plurality of conducting terminal strips extending into one end of the housing and extending vertically along one end wall of said housing, a plurality of bimetal elements each having one end fixedly mounted on and electrically connected to the inner end of one of the conducting terminal strips and the other end of each bimetal element being movable, a plurality of conductors each having a flexible portion and each electrically connecting one of said movable contacts to a movable portion of one of said bimetal elements, a plurality of magnetic members each adjacent the movable end of one of the bimetal elements and energized by the current flow through one pole, a plurality of armature members each having a portion of magnetic material positioned adjacent the movable end of one of the bimetal elements and opposite one of said magnetic members, each of said armature members being movable independently of movement of any other armature member, a separate spring biasing each armature member against magnetic attraction to its magnetic member, each of said bimetal elements when heated bending and moving its armature member, a trip bar of insulating material extending across the plurality of poles, a single latch portion movable with the trip bar and normally engaging and retaining said single releasable member, said trip bar being movable by movement of any one of said armature members due to thermal bending of its bimetal element and also due to magnetic attraction by its magnetic member, and movement of said trip bar causing releasing movement of said single latch portion and simultaneous opening movement of all of the contact members.

22. In a multipole circuit interrupter, a pair of relatively movable contacts for each pole, a single member releasable to effect automatic opening of said contacts for all of the poles, a housing of insulating material enclosing said contacts and said releasable member, said housing comprising a base and a cover each having one or more barrier portions to provide a plurality of pole spaces, a plurality of conducting terminal strips extend-

ing into one end of the housing and extending upwardly adjacent one end wall of the cover toward the top of the cover, a plurality of bimetal elements each having one end fixedly mounted on an electrically connected to the inner and upper end of one of the conducting terminal strips and the other end of each bimetal element extending downwardly and being movable at its lower end, a plurality of conductors each having a flexible portion and each electrically connecting one of said movable contacts to a movable portion of one of said bimetal elements adjacent its lower end, a plurality of magnetic members each energized by the current flow through one pole, a plurality of armature members each having a portion of magnetic material positioned adjacent the lower movable end of one of the bimetal elements and opposite one of said magnetic members, each of said armature members being movable independently of movement of any other armature member, a separate spring biasing each armature member against magnetic attraction to its magnetic member, each of said bimetal elements when heated bending and moving its armature member, an opening through each of the one or more barrier portions in the base of the housing, a trip bar of insulating material extending across the plurality of poles through the opening in each of the one or more barrier portions in the base, a single latch portion movable with the trip bar and normally engaging and retaining said single releasable member, said trip bar being movable by movement of any one of said armature members due to thermal bending of its bimetal element and also due to magnetic attraction by its magnetic member, and movement of said trip bar causing releasing movement of said single latch portion and simultaneous opening movement of all of the contact members.

23. In a multipole circuit breaker, an enclosing housing of molded insulating material comprising a base having upwardly extending walls and a cover having a handle opening in its top and downwardly extending walls engaging the upwardly extending walls of the base, one or more barrier portions in both the base and cover, a plurality of contacts positioned in said base at opposite sides of one barrier portion therein, a plurality of contact arms mounted at their upper ends in the cover and having contact portions at their lower ends movable to engage and disengage the contacts in the base, an operating mechanism for said contact arms assembled on the cover and having a handle member extending through said opening in the top of the cover, said operating mechanism including a single releasable member movable to cause opening of all of the contacts, an opening through the one or more barrier portions in the base, a trip bar of insulating material extending across the base through the opening in the one or more barrier portions in the base, a latch portion movable with the trip bar normally engaging and holding the end of said releasable member of the operating mechanism assembled on the cover, a plurality of bimetal elements each having a downwardly extending movable end for operating said trip bar at spaced points upon bending of the bimetal elements, and said trip bar being movable in said opening through the one or more barrier portions in the base upon movement of the lower end of any one of the bimetal elements to move said latch portion to disengage the end of the single releasable member and cause opening of the contacts of all poles of the breaker.

24. In a multipole circuit breaker, an enclosing housing of molded insulating material comprising a base having upwardly extending walls and a cover having a handle opening in its top and downwardly extending walls engaging the upwardly extending walls of the base, one or more barrier portions in both the base and cover, a plurality of contacts positioned in said base at opposite sides of one barrier portion therein, a plurality of contact arms mounted at their upper ends in the cover and having contact portions at their lower ends movable to engage

and disengage the contacts in the base, an operating mechanism for said contact arms assembled on the cover and having a handle member extending through said opening in the top of the cover, said operating mechanism including a single releasable member movable to cause opening of all of the contacts, an opening through the one or more barrier portions in the base, a trip bar of insulating material extending across the base through the opening in the one or more barrier portions in the base, a latch portion movable with the trip bar normally engaging and holding the end of said releasable member of the operating mechanism assembled on the cover, a plurality of bimetal elements each having a downwardly extending movable end for operating said trip bar at spaced points upon bending of the bimetal elements, a plurality of magnetic members each energized by the current flow through one pole of the breaker, a plurality of armature members each having a portion of magnetic material positioned adjacent the lower movable end of one of the bimetal elements and opposite one of said magnetic members, each of said armature members being movable independently of movement of any other armature member, a separate spring biasing each armature member against magnetic attraction to its magnetic member, and said trip bar being movable in said opening through the one or more barrier portions in the base upon movement of the lower end of any one of the bimetal elements and upon independent movement of any one of the armature members to move said latch portion to disengage the end of the single releasable member and cause opening of the contacts for all poles of the breaker.

25. In a multiple circuit breaker, an enclosing housing of molded insulating material comprising a base having upwardly extending walls and a cover having a handle opening in its top and downwardly extending walls engaging the upwardly extending walls of the base, a plurality of contacts positioned in said base, a plurality of contact arms mounted at their upper ends in the cover and having contact portions at their lower ends movable to engage and disengage the contacts in the base, an operating mechanism for said contact arms assembled on the cover and having a handle member extending through said opening in the top of the cover, said operating mechanism including a single releasable member movable to cause opening of all of the contacts, a trip bar of insulating material extending across the base, a latch portion movable with the trip bar normally engaging and holding the end of said releasable member of the operating mechanism assembled on the cover, a plurality of conducting terminal strips extending into one end of the housing and mounted on the end of the cover, a plurality of bimetal elements mounted on the cover by each being connected at one end to the inner end of one of the terminal strips mounted on the cover and each having its other end movable and extending downwardly in the housing, means including a flexible conductor electrically connecting the downwardly extending lower movable end portion of each bimetal element to one of the movable contact arms, a plurality of magnetic members each energized by the current flow through one pole of the breaker, a plurality of armature members each having a portion of magnetic material positioned adjacent the movable lower end of one of the bimetal elements and opposite one of said magnetic members, each of said armature members being movable independently of movement of any other armature member, a separate spring biasing each armature member against magnetic attraction to its magnetic member, said magnetic members and armature members and springs being all assembled on said cover with said bimetal elements and conducting terminal strips, each of said bimetal elements when heated bending and moving the armature member adjacent its lower end, and said trip bar extending across the base being movable upon movement of any one of said armature members due to thermal

bending of its bimetal element and also due to magnetic attraction by its magnetic member to cause releasing movement of said latch portion and opening movement of all of said contact arms.

26. In a multipole circuit breaker, a housing of insulating material including a base and cover, said base having a cavity extending down therein, said cover having a cavity extending up therein from its under side and having a handle opening in its top, and lower edge portions of the cover engaging upper edge portions of the base to form the housing, stationary contact members inserted in the cavity in the base from the top thereof adjacent an end of the base and having their contact surfaces facing generally toward the other end of the base, movable switch arms and releasable operating mechanism therefor inserted in the cavity in the cover from the under side thereof and said operating mechanism including a handle projecting upwardly through the opening in the top of the cover, said movable switch arms being supported at their upper ends within the cavity in the cover and having contact surfaces adjacent their lower ends within the cavity in the base with said contact surfaces facing generally toward the end of the base having the stationary contacts, each said movable switch arm in one of its positions having the direction of its length extending generally normal to the direction of the joint between the lower edges of the cover and the upper edges of the base, a trip bar of insulating material positioned in the cavity in said base and extending across a plurality of poles, a single latch portion movable with said trip bar and normally engaging and retaining said releasable operating mechanism, current responsive tripping means for each pole positioned adjacent the end of the breaker opposite the stationary contacts and operable to move said trip bar in the base and cause the operating mechanism to move the switch arms to disengage the stationary contacts, and said base and cover when positioned together holding said operating mechanism up in the cover and holding said stationary contacts down in said base.

27. In a multipole circuit breaker, a housing of insulating material including a base and cover, said base having a cavity extending down therein, said cover having a cavity extending up therein from its under side and having a handle opening in its top, and lower edge portions of the cover engaging upper edge portions of the base to form the housing, stationary contact members inserted in the cavity in the base from the top thereof adjacent an end of the base and having their contact surfaces facing generally toward the other end of the base, movable switch arms and releasable operating mechanism therefor inserted in the cavity in the cover from the under side thereof and said operating mechanism including a handle projecting upwardly through the opening in the top of the cover, said movable switch arms being supported adjacent their upper ends within the cavity in the cover and each having a contact surface adjacent its lower end within the cavity in the base with said contact surface facing generally toward the end of the base having the stationary contacts, each said movable switch arm in one of its positions having the direction of its length extending generally normal to the direction of the joint between the lower edges of the cover and the upper edges of the base, a trip bar of insulating material positioned in the cavity in said base and extending across a plurality of poles, a single latch portion movable with said trip bar and normally engaging and retaining said releasable operating mechanism, current responsive tripping means for each pole positioned adjacent the end of the breaker opposite the stationary contacts and supported within the cavity of the cover and operable to move said trip bar in the cavity of the base and cause the operating mechanism to move the switch arms to disengage the stationary contacts, a plurality of magnetic members each energized by

the current flow through one pole, a plurality of armature members each positioned adjacent the movable end of one of said bimetal elements and opposite one of said magnetic members, said magnetic members when energized each attracting its armature and moving the trip bar in the cavity of the base to effect release of said releasable operating mechanism and opening of said contacts, and said base and cover when positioned together holding said operating mechanism up in the cover and holding said stationary contacts down in said base.

2,114,845
2,294,838
2,328,458
2,360,684
2,376,759
2,568,423
2,590,663
2,624,815
2,638,519
2,654,008
2,656,440
2,666,828
2,673,264
2,673,908
2,677,025
2,692,926
2,795,670

References Cited in the file of this patent

UNITED STATES PATENTS

2,027,238 Lindstrom Jan. 7, 1936 15
2,053,934 Atwood Sept. 8, 1936
2,089,716 Smith Aug. 10, 1937

Kubik Apr. 19, 1938
Dorfman Sept. 1, 1942
Jackson et al. Aug. 31, 1943
Jennings Oct. 17, 1944
Dyer et al. May 22, 1945
Walker et al. Sept. 18, 1951
Walker Mar. 25, 1952
Gano et al. Jan. 6, 1953
Jackson May 12, 1953
Toth et al. Sept. 29, 1953
Dorfman Oct. 20, 1953
Dyer et al. Jan. 19, 1954
Cole Mar. 23, 1954
Brumfield Mar. 30, 1954
Dyer Apr. 27, 1954
Cole Oct. 26, 1954
Cellerini et al. June 11, 1957