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J. TOTH ET AL

2,654,008

CIRCUIT BREAKER

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Fig.1.

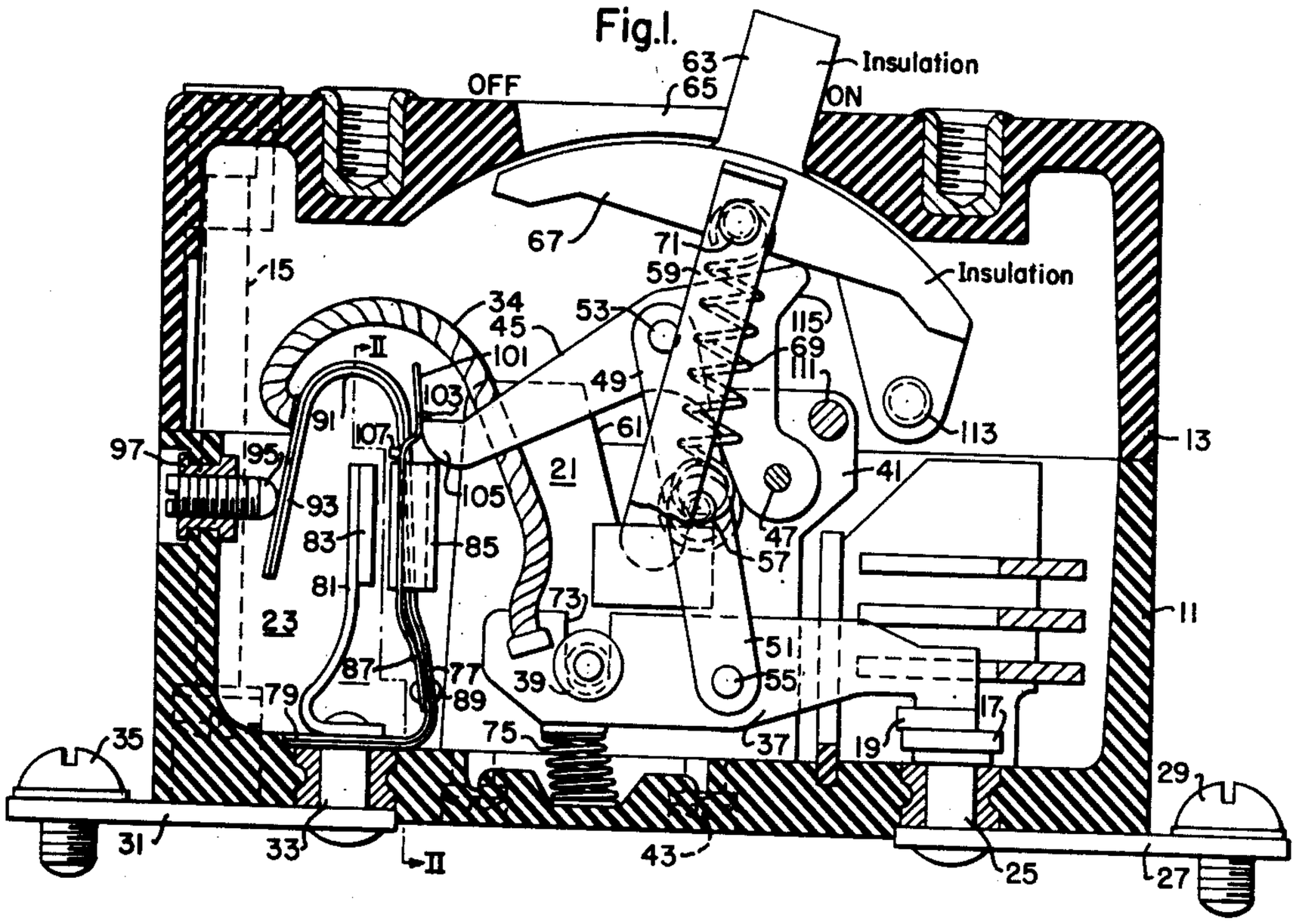


Fig.2.

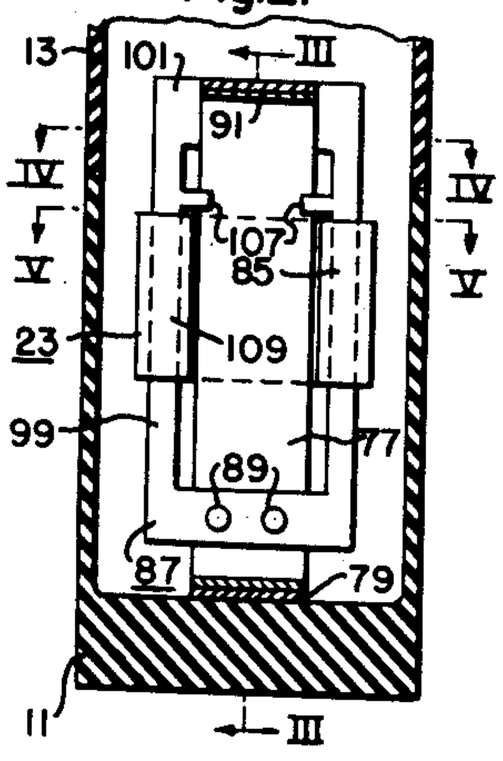


Fig.3.

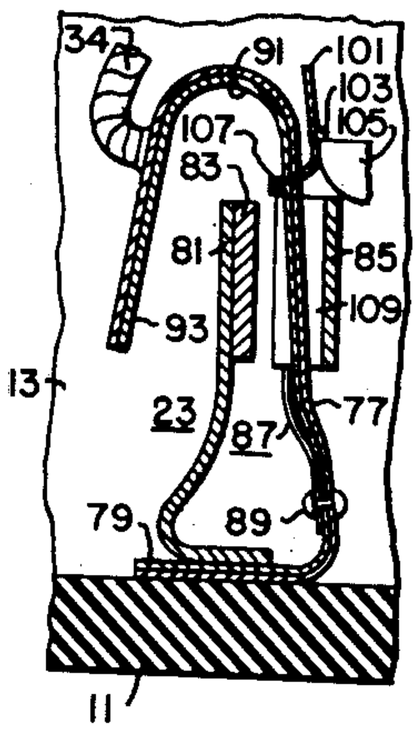


Fig.4.

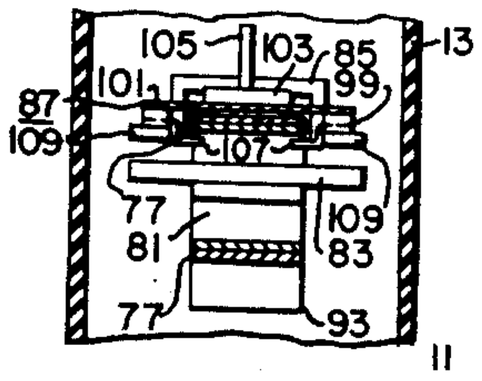
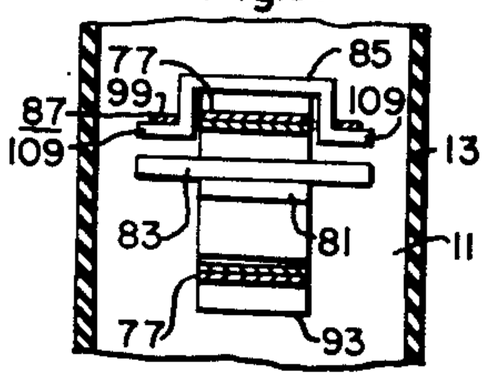


Fig.5.



WITNESSES:

H. F. Swan.

Paul H. Harlow.

INVENTORS
Julius Toth and
Francis L. Gelzheiser.
BY
Ralph H. Swingle
ATTORNEY

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CIRCUIT BREAKER

Julius Toth, Beaver, and Francis L. Gelzheiser, Pittsburgh, Pa., assignors to Westinghouse Electric Corporation, East Pittsburgh, Pa., a corporation of Pennsylvania

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8 Claims. (Cl. 200—88)

1

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

An object of the invention is to provide a circuit breaker which is simple, safe and reliable in operation, and which is inexpensive to manufacture.

Another object of the invention is to provide a circuit breaker embodying an improved thermally and magnetically responsive trip device wherein operation of the magnetically responsive element applies no bending stress to the thermally responsive element and avoids the possibility of the thermally responsive element taking a permanent set due to its being bent when in a heated condition.

Another object of the invention is to provide a circuit breaker embodying a trip device having electroresponsive means energized by current flowing through a thermally responsive element and having an armature movable against the bias of a spring other than the thermally responsive element to permit the use of a stiffer thermal element without requiring a larger magnetic force for magnetic tripping.

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 description thereof when read in conjunction with the accompanying drawing.

In said drawing:

Figure 1 is a longitudinal sectional view of a circuit breaker embodying the principles of the invention, one of the supporting plates for the breaker mechanism being removed to show the mechanism in elevation, the breaker mechanism being shown in the closed position.

Fig. 2 is an elevational sectional view taken along line II—II of Fig. 1 and looking in the direction of the arrows.

Fig. 3 is an elevational sectional view through the trip device taken along line III—III of Fig. 2 and looking in the direction of the arrows.

Fig. 4 is a horizontal sectional view taken on line IV—IV of Fig. 2 and looking in the direction indicated by the arrows.

Fig. 5 is a horizontal sectional view taken on line V—V of Fig. 2 and looking in the direction indicated by the arrows.

Referring to Fig. 1, the circuit breaker is enclosed in a housing of molded insulating material comprising a base 11 and a cover 13 secured to-

2

gether by means of bolts 15 (only one being shown), stationary contact means 17, movable contact means 19, an operating mechanism 21 and a trip device 23.

The stationary contact 17 is rigidly secured to the inner end of a rivet 25 which extends through the base 11 and serves to support a terminal 27 on the bottom of the base 11. The other end of the terminal 27 is provided with suitable connecting means 29 for connecting the terminal in an electric circuit. At the opposite end of the base 11 is a terminal 31 secured thereto by means of a rivet 33 which extends through the base and at its inner end supports the trip device 23 (to be later described). The terminal 31 is provided with a suitable connecting means 35 at its outer end for connecting the terminal in an electric circuit.

The movable contact 19 is rigidly mounted on the free end of a switch arm 37 adapted to pivot about a fixed pivot 39. The pivot 39 is supported by means of a pair of spaced plates or frames 41 (only one being shown) rigidly supported by means of screws 43 to the bottom portion of the base 11.

The operating mechanism 21 comprises a releasable member 45 mounted on a pivot pin 47 supported in the plates 41. The releasable member 45 is operatively connected to the switch arm 37 by means of a toggle comprising toggle links 49 and 51. The toggle link 49 is pivotally connected by means of a pivot pin 53 to the releasable member. The toggle link 51 is pivotally connected by means of a pivot pin 55 to the switch arm 37 and the two toggle links 49 and 51 are pivotally connected together by means of a knee pivot pin 57.

Also forming a part of the operating mechanism is a U-shaped operating lever 59, the inner ends of the two legs of which are pivotally mounted in V-shaped notches 61 formed in the plates 41, the side walls of the notches 61 forming stops for limiting the pivotal movement of the operating lever. An operating handle 63 of molded insulating material is mounted on the outer end of the operating lever 59 and extends through an opening 65 in the cover 13, the opening 65 being substantially covered in all positions of the handle 63 by means of an arcuate portion 67 molded integral with the handle. Overcenter springs 69 disposed one on each side of the releasable member 45 are connected under tension between the knee pin 57 of the toggle 49—51 and a pin 71 supported between the outer ends of the legs of the operating lever 59.

The switch arm 37 is provided with a slot 73 through which the pin 39 extends, but in the closed position of the breaker the bottom of the slot 73 does not engage the pin 39. A spring 75 compressed between a spring seat in the base 11 and a spring guide on the switch arm 37 biases the switch arm clockwise about the pin 55 and provides contact pressure in the closed position of the breaker.

The contacts are manually opened and closed by manipulation of the handle 63. In order to open the contacts, the handle 63 is moved counterclockwise from the "on" position to the "off" position during which movement the operating lever 59 moves the line of action of the overcenter springs 69 across to the left of the center line of the toggle link 49 whereupon the springs 69 bias the toggle 49—51 in a direction to cause its collapse and effect collapse of the toggle and opening of the contacts with a snap action. At the beginning of the manual opening operation the spring 75 moves the bottom of the slot 73 into engagement with the pin 39. Thereafter the switch arm pivots about the pin 39 as it moves to the open position. The contacts are closed manually by reverse movement of the handle 63, that is, clockwise from the "off" to the "on" position. During this movement the line of action of the springs 69 is moved across to the right of the center line of toggle link 49 whereupon the springs 69 straighten the toggle 49—51 and close the contacts with a snap action.

The trip device 23 comprises a bimetal element 77 having a mounting foot 79 rigidly secured to the base 11 by means of the rivet 33 and electrically connected by means of a flexible conductor 34 to the switch arm 37. Also rigidly secured to the base by means of the rivet 33 is a support member 81 which, at its upper end, rigidly mounts a stationary magnetic member 83. Cooperating with the magnetic member 83 is a U-shaped armature 85 rigidly secured to a spring member 87 by welding. The spring member 87 is secured to the left or low-expansion side of the bimetal element at a point adjacent the lower end thereof by means of rivets 89. The spring 87 is generally rectangular in shape and has a rectangular opening therein through which the bimetal element 77 extends. The upper end of the bimetal element 77 is formed downwardly with a relatively large radius as indicated at 91, the downwardly extending end 93 bearing against an adjustable stop screw or abutment 95 which threadedly engages a metal insert 97 molded in the end wall of the base 11. The high-expansion side of the bimetal element 77 is on the outside, and the proportion of the leg 93 to the main body of the bimetal element is such that when the bimetal is heated the main body 77 of the bimetal will deflect toward the left and the leg 93 will deflect toward the right a proportional amount and will, at all times, remain in contact with the abutment 97.

The two side portions 99 of the spring 87 extend upwardly and are joined at the upper end by an integral cross portion 101, the lower or inner portion of which is formed over and comprises a latch surface 103 for engaging a latching nose 105 of the releasable member 45 and restraining the releasable member in operative position. Formed inwardly from the side portions 99 of the spring member 87 at a point just above the armature 85 is a pair of projections 107 which are engaged by the body of the bimetal element 77 upon deflection thereof to disengage the latch 103 from the latch nose 105 to effect release of the member 45 and automatic opening of the contacts.

As shown in Figs. 2 and 5, the armature 85 is channel shaped and surrounds three sides of bimetal element 77 to be energized by the current flowing therethrough. The armature 85 is provided with flanges 109 to which are suitably secured, for instance by welding, the portions 99 of the spring member 87.

The circuit breaker is adapted to be tripped open after a time delay in response to overload currents below a predetermined value of, for instance, 1000% of normal rated current and instantaneously in response to overload currents above 1000% of rated current, or in response to short circuit-currents.

The bimetal element 77 is heated in response to overload currents below the predetermined value and when heated a predetermined amount deflects toward the left engaging the projections 107 and flexing the spring portions 99 to disengage the latch 103 from the nose 105 of the releasable member 45. When the releasable member 45 is released, it rotates clockwise about its pivot 47 carrying the pivot 53 for the toggle link 49 across to the right of the line of action of the springs 69 whereupon the springs cause collapse of the toggle 49—51 and opening of the contacts. A stop member 111 mounted in the frames 41 is provided to arrest the movement of the releasable member 45 in the open position.

Upon the occurrence of an overload current above the predetermined amount, or a short-circuit current, the armature 85 is energized sufficiently to be attracted to the fixed magnetic member 83 flexing the spring portions 99 and disengaging the latch 103 from the nose 105 to effect instantaneous opening of the contacts.

Before the contacts may be closed following an automatic opening operation, it is necessary to reset and relatch the mechanism. This is accomplished by moving the handle 63 counterclockwise to the "off" position during which movement a stud 113 in the arcuate portion 67 thereof engages a surface 115 on the releasable member 45 and moves the releasable member counterclockwise therewith. Near the end of the counterclockwise movement, the nose 105 wipes by the latch 103 and the inherent resilience of the spring portions 99 then move the latch 103 back to its latching position. The contacts may then be closed in the previously described manner by movement of the handle to the "on" position.

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 some of the essential features of the invention.

We claim as our invention:

1. A circuit breaker having relatively movable contact means, means releasable to effect automatic opening of said contact means, current-responsive means comprising a U-shaped bimetal element formed from a single strip of bimetallic material and having the high-expansion side disposed on the outside of the U, said bimetal element having legs of unequal length and connected in the circuit of the breaker so that the longer leg and at least a portion of the shorter leg are heated by the current of the circuit, means fixedly mounting the longer leg of said

bimetal element, an adjustable abutment at all times cooperating with the shorter leg of said bimetal element, spring means mounted on the low-expansion side of said bimetal element adjacent the fixedly mounted end thereof, said spring means having an opening therein through which the longer leg of said bimetal element extends, latch means on said spring means adjacent the high-expansion side of said bimetal element normally restraining said releasable means in operative position, and projections on said spring means engageable by said bimetal element upon thermal bending of said bimetal element to effect release of said releasable means and opening of said contact means.

2. A circuit breaker having relatively movable contact means, means releasable to effect automatic opening of said contact means, current-responsive means comprising a U-shaped bimetal element having the high-expansion side on the outside of the U and having legs of unequal length, said bimetal element being connected in the circuit of the breaker so that the longer leg and a portion of the shorter leg are heated by the current of the circuit, spring means comprising a flat spring mounted on the low-expansion side of said bimetal element and having an opening therein, the longer leg of said bimetal element extending through said opening so that the free end of said spring is disposed adjacent the high-expansion side of said bimetal element, latch operating means on said spring adjacent the free end thereof for effecting release of said releasable means, projections on said spring engageable by said bimetal element upon thermal bending of said bimetal element to effect release of said releasable member, a movable armature mounted on said spring and surrounding three sides of said bimetal element to be energized by excessive currents flowing through the bimetal element, a fixed magnetic member mounted adjacent said armature, and said armature being attracted to said fixed magnetic member when energized a predetermined amount to flex said spring and effect instantaneous release of said releasable means.

3. A circuit breaker having relatively movable contact means, means releasable to effect automatic opening of said contact means, current-responsive means comprising a U-shaped bimetal element having one end fixedly mounted, spring means having one end fixedly mounted on the low-expansion side of said bimetal element adjacent the fixedly mounted end thereof, latch means on the free end of said spring means disposed adjacent the high-expansion side of said bimetal element normally releasably restraining said releasable member in operative position, said bimetal element upon thermal bending thereof engaging and bending said spring means to effect release of said releasable member.

4. A circuit breaker having relatively movable contact means and means releasable to effect automatic opening of said contact means, current-responsive means comprising a bimetal element having one end fixedly mounted, spring means having one end fixedly mounted on the low-expansion side of said bimetal element adjacent the fixedly mounted end thereof, said spring means having an opening therein through which said bimetal element extends, latch means on the free end of said spring means disposed adjacent the high-expansion side of said bimetal element normally restraining said releasable

means in operative position, said bimetal element bending upon thermal heating thereof in response to overload currents below a predetermined value to engage and actuate said spring means to effect release of said releasable means, a fixed magnetic member, and a movable magnetic member mounted on said spring means, one of said magnetic members surrounding three sides of said bimetal element to be energized in response to overload currents flowing through said bimetal element, said movable magnetic member being operable when energized in response to overload currents above said predetermined value to actuate said spring means and instantaneously release said releasable means.

5. A circuit breaker having relatively movable contact means and means releasable to effect automatic opening of said contact means, current responsive means comprising a bimetal formed from a strip of bimetallic material and having one end fixedly mounted, spring means having a portion secured to the low-expansion side of said bimetal element adjacent the fixedly mounted end thereof, side portions extending along the edges of said bimetal element and a latching portion disposed adjacent the high-expansion side of said bimetal element, said portions of said spring means defining an opening through which said bimetal element extends, said latching portion normally restraining said releasable means in operative position, and projections on the side portions of said spring means engageable by said bimetal element upon thermal bending thereof to effect release of said releasable means.

6. A circuit breaker having relatively movable contact means and means releasable to effect automatic opening of said contact means, current responsive means comprising a bimetal element having one end fixedly mounted, spring means having a portion secured to the low-expansion side of said bimetal element adjacent the fixedly mounted end thereof, said spring means having side portions extending along the edges of said bimetal element and having a latching portion disposed adjacent the high-expansion side of said bimetal element, said portions of said spring means defining an opening through which said bimetal element extends, said latching portion normally releasably restraining said releasable means in operative position, projections on the side portions of said spring means engageable by said bimetal element upon thermal bending thereof to bend said spring means and effect release of said releasable means, a fixed magnetic member, a movable magnetic member mounted on said side portions of said spring means, one of said magnetic members surrounding three sides of said bimetal element to be energized by excessive currents, and said movable magnetic member being attracted toward said fixed magnetic member when energized to bend said spring means and effect instantaneous release of said releasable means.

7. A circuit breaker having relatively movable contact means and means releasable to effect opening of said contact means, current-responsive means comprising a bimetal element having one end supported, spring means having one end supported on the low-expansion side of said bimetal element and the other end free, said spring means having an opening therein through which said bimetal element extends, latch operating means on the free end of said spring means adjacent the high-expansion side of said bimetal element for effecting release of said releasable

means, and projections on said spring means engageable by said bimetal element upon thermal bending thereof to bend said spring means and thereby effect release of said releasable means and opening of said contact means.

8. A circuit breaker having relatively movable contact means and means releasable to effect opening of said contact means, current-responsive means comprising a bimetal element having one end supported, spring means having one end supported on the low-expansion side of said bimetal element and the other end free, said spring means having an opening therein through which said bimetal element extends, latch operating means on the free end of said spring means adjacent the high-expansion side of said bimetal element normally restraining said releasable means in operative position, projections on said spring means engageable by said bimetal element upon thermal bending thereof to bend said spring means and to effect release of said releasable means and opening of said contact means, and electromagnetic means operable in response to excessive currents to bend said spring means and effect instantaneous release of said releasable means.

JULIUS TOTH.
FRANCIS L. GELZHEISER.

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