

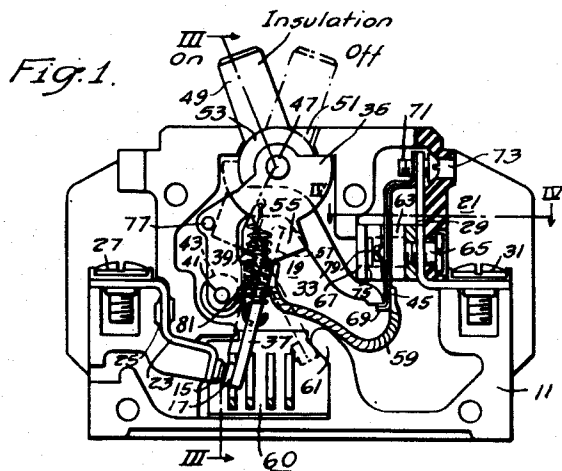
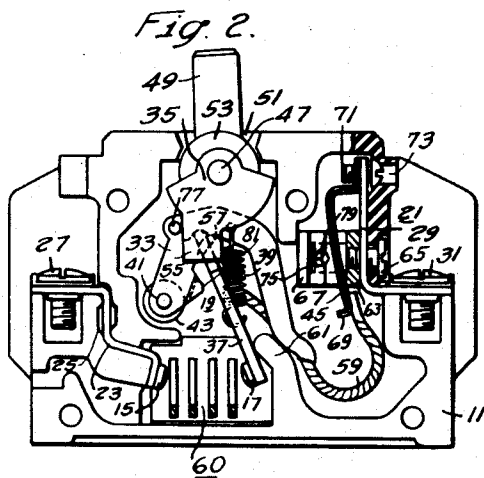
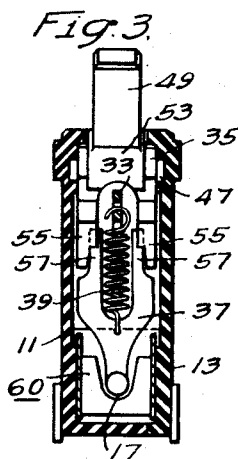
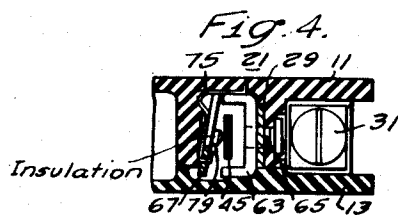
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H. S. GANO ET AL

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CIRCUIT BREAKER

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INVENTORS
Harlan S. Gano and
Gerald J. Freese.

BY
Ralph H. Swingle
ATTORNEY

UNITED STATES PATENT OFFICE

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CIRCUIT BREAKER

Harlan S. Gano and Gerald J. Freese, Beaver, Pa., assignors to Westinghouse Electric Corporation, East Pittsburgh, Pa., a corporation of Pennsylvania

Original application May 7, 1945, Serial No. 592,446, now Patent No. 2,624,815, dated January 16, 1953. Divided and this application March 19, 1952, Serial No. 277,416

14 Claims. (Cl. 200—88)

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This invention relates to circuit interrupters, and more particularly to manually and automatically operable circuit breakers for controlling lighting and other small or moderate power electric circuits.

This application is a division of our copending application Serial No. 592,446, filed May 7, 1945, now Patent No. 2,624,815 dated January 16, 1953.

An object of the invention is to provide an improved circuit breaker having few parts, which is compact, accurate and reliable in operation and inexpensive to manufacture.

Another object of the invention is to provide a circuit breaker embodying an improved thermally and magnetically responsive trip device wherein adjustment of the thermal trip does not affect the instantaneous trip characteristic.

Another object of the invention is to provide a simplified construction in which the current-carrying bimetallic trip member energizes a trip magnet mounted independently of the bimetallic member with the bimetallic member moved by the magnet to trip the breaker.

A further object of the invention is to provide a sensitive magnetic trip by having a small air gap which can be energized by current flow in a bimetal acting as a single-turn coil with the bimetal being moved magnetically to trip the breaker, and at the same time to make it possible for the bimetal to move free of the magnetic structure and not be impeded in its bending due to heating which could cause it to take a permanent set and lose its calibration.

Another object of the invention is to provide a circuit breaker in which the parts of the breaker are assembled at low cost by being laid in recesses in a two-part housing of insulating material without the use of any frame other than the housing.

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

Figure 1 is a side elevational view partly in section, of a circuit breaker embodying the principles of the invention, the cover plate having been removed more clearly to illustrate invention, the breaker mechanism being shown in the closed-circuit position;

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Fig. 2 is a side elevational view of the circuit breaker similar to Fig. 1, showing the breaker mechanism parts in the tripped-open position;

Fig. 3 is a transverse sectional view of the circuit breaker taken substantially along line III—III of Fig. 1 and looking in the direction of the arrows;

Fig. 4 is a fragmentary sectional view taken substantially along the line IV—IV of Fig. 1 and looking in the direction of the arrows.

Referring to Fig. 1 of the drawing, the circuit breaker comprises a housing 11 and a cover plate 13, both of molded insulating material, a stationary contact 15, a cooperating movable contact 17, an operating mechanism indicated generally at 19, and a trip device indicated generally at 21.

The housing 11 and the cover 13 serve as a frame for the breaker and are molded to provide various recesses, and surfaces for removably receiving and supporting all of the parts of the breaker. The parts are inserted through the open side of the housing 11 when the cover 13 is removed and are retained in mounted position in the proper relation to each other when the cover is assembled on the housing and secured thereto. The stationary contact 15 is rigidly secured to the inner end of a terminal 23 disposed in an angular transverse slot 25 in the housing. The terminal 23 extends outside the housing and has a screw 27 threaded into an opening in the terminal to provide means whereby this terminal may be connected in an electrical circuit.

At the end of the breaker opposite the terminal 23 is a terminal 29 having a screw 31 threaded into an opening therein for connecting this terminal in an electrical circuit. The terminal 29 extends through an opening in the housing into the interior of the housing where it is bent at right angles and serves to support the trip device 21 to be described later.

The operating mechanism comprises a releasable member 33, a manually operable operating lever or handle 35 of molded insulating material, a U-shaped switch arm 37 for supporting the movable contact 17 and an overcenter spring 39 connected under tension between the switch arm 37 and the releasable member 33. The releasable trip member 33 is pivotally mounted on a fixed pivot pin 41 supported in an opening in the housing 11 and in a corresponding opening in the cover 13 and is spaced from the housing and cover by means of spacers 43. The releasable trip member 33 is normally releasably restrained in the operating position by the en-

gement of the free end thereof with a bimetal element 45 rigidly secured to the upper end of the conductor 29 and forming a part of the trip device 21 which will be described later.

The insulated operating lever 35 is pivotally mounted on trunnions 47 molded integral therewith which are supported in suitable openings in the housing 11 and cover plate 13. The operating lever has a handle 49 molded integral therewith which projects through an opening 51 in the housing 13 whereby the mechanism may be manually operated to open and close the contacts. A semi-cylindrical portion 53 of the operating lever substantially closes the opening 51 in all positions of the operating lever. The inner portion of the operating lever 35 is bifurcated and the two legs 55 thereof are provided with V-shaped recesses for receiving and supporting the legs 57 of the U-shaped switch arm 37 which legs are at all times biased into said recesses by the spring 39. Thus, the insulating material of the legs 55 of the handle member directly supports the movable contact or switch member 37 for pivotal movement in opening and closing the circuit. The fact that the inner end of handle member 35 and the switch arm 37 are both U-shaped provides a balanced construction and permits the trip member to be a single flat piece movable between the legs of the two U-shaped members. This construction also permits the use of a single spring centered in the mechanism and used for supplying contact pressure, for actuating the contacts open and closed with a snap action independently of the speed of movement of the operating handle, and for biasing the trip member and moving the contacts open upon the occurrence of an overload.

The switch arm 37 is connected by means of a flexible connection 59 to the free end of the bimetal element 45, thus completing the electrical circuit through the breaker which circuit extends from the terminal 23 through the stationary and movable contacts 15-17, switch arm 37, flexible connection 59, the bimetal element 45 and the conductor 29.

The circuit breaker may be manually operated to open and close the contacts by operation of the insulating handle 49. Movement of the handle and the operating lever 35 clockwise from the full-line position (Fig. 1) to the position in which it is shown in dot-and-dash lines carries the upper end of the switch arm 37 to the left of the line of action of the spring 39 whereupon the spring acts to move the switch arm 37 with a snap action to the open position, shown in dot-and-dash lines in Fig. 1. The opening movement of the switch arm is arrested by a projection 61 molded integral with the housing 11 which acts as a limit stop for the switch member. Movement of the operating handle 49 and the operating lever 35 in a counterclockwise direction from the dot-and-dash position (Fig. 1) to the full line position moves the upper end of the switch arms 37 to the right of the line of action of the spring 39 which thereupon act to move the switch member to the closed position with a snap action. Movement of the handle 49 in either direction is limited by the member 35 striking the housing 11 at either side of the pivot 47.

In addition to the bimetal element 45, the trip device 21 also includes an electromagnet comprising a U-shaped core member 33, rigidly secured by means of a screw 65 to the conductor 29 and to the housing 11, and a movable armature 67. The bimetal element 45 from its point

of attachment with the conductor 29 is formed inwardly away from the conductor and then extends downwardly substantially parallel therewith between the two legs of the U-shaped magnet core 63. The free end of the bimetal has a latch element 69 thereon which engages and releasably restrains the member 33 under normal circuit conditions. The round head of an adjusting screw 71 which threadably engages in an opening in the conductor 29 at a point near its upper end, bears against a concave surface in the housing 11. An opening 73 through the casing provides for the insertion of an instrument to rotate the screw 71. Rotating the screw bends the conductor 29 and moves the bimetal element 45 relative to the member 33 to adjust the latch overlap to thereby vary the time delay tripping point of the breaker without affecting the magnetic air gap or changing the instantaneous tripping characteristic of the breaker.

Upon the occurrence of an overload current below a predetermined value the bimetal element 45 becomes heated, and when heated a predetermined amount, deflects in a direction to release the member 33. When the member 33 is released, the spring 39 acts to rotate it clockwise about its pivot 41 until it is arrested by striking the projection 61. During this movement the line of action of the spring 39 moves to the right of the pivot of the switch arm 37 whereupon the spring biases the switch arm in opening direction and moves it so that the line of action of the force exerted by it on operating lever 35 shifts across the pivot 47, and actuates both the switch arm 37 and the operating lever to the tripped position in which these parts appear in Fig. 2. The movements of the releasable member 33 and of the switch arm 37 are arrested by the projection 61 in order to provide an indication that the breaker has been automatically tripped open. The movement of the handle in opening direction on automatic opening operations is stopped in an intermediate position (Fig. 2) by striking a stop pin 77 projecting from the releasable member 33. The parts are shown in the tripped open position in Fig. 2. It is to be noted from Figs. 1 and 2 that the operating lever 35 is substantially in engagement with the projection 77 on the releasable member 33 in both the off and tripped positions, but is at a distance therefrom in the on position, so that holding the handle in on position cannot prevent movement of the member 33 and tripping movement of the breaker to open the contacts. This makes the breaker trip free of the handle which means that the contacts will open upon the occurrence of an overload irrespective of the position in which the handle may be held. Positive separation of the contacts is insured by the provision of a projection 81 on the releasable member or carrier 33 which projection, upon release of the carrier, strikes the switch arm 37 at a point intermediate the ends thereof and starts the switch arm in opening direction.

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 operating lever 35 clockwise from the tripped position (Fig. 2) slightly beyond the full open position in which it is shown by dot-and-dash lines in Fig. 1. This movement of the operating lever, due to the engagement thereof with the pin 77 moves the member 33 counterclockwise to reengage the free end thereof with the latch element 69 of the bimetal 45. The contacts may now be closed in

the previously described manner by movement of the handle counterclockwise to the closed position.

The circuit breaker is tripped automatically by the electromagnet 63—67 in response to overload currents above the predetermined value. The armature 67 of the electromagnet is mounted to pivot against one leg of the core member 63 and is restrained in retracted position by means of a spring 75 having one end immovably mounted between the core member and the side wall of the housing 11. The other end of the spring 75 extends through an opening in the armature for supporting the armature and biasing said armature to unattracted position.

When an overload above a predetermined value of, for instance, 1000% of normal rated current, or a short circuit occurs, the core member 63 is energized and immediately attracts the armature 67 thereto. The armature 67 is provided with an insulating button 79 which, upon operation of the armature, engages and deflects the bimetal element 45 a sufficient distance to effect the release of the releasable member 33 and opening of the contacts in the previously described manner. The breaker mechanism is reset and the contacts closed following an instantaneous tripping operation in the previously described manner.

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 thereof may be made without departing from some of the essential features of the invention. It is desired, therefore, that the language of the appended claims be given the broadest reasonable interpretation permissible in the light of the prior art.

We claim as our invention:

1. In a circuit breaker, relatively movable contacts, releasable means for effecting automatic opening of said contacts, a thermally responsive member electrically connected in series with said contacts and heated in response to the current of the circuit of the breaker, said thermally responsive member flexing when heated a predetermined amount in a direction to effect release of said releasable means, and electromagnetic means comprising a U-shaped core member embracing said thermally responsive member, said thermally responsive member acting as an energizing means for said core member, and a movable armature pivotally supported on one leg of said U-shaped member, said armature being operable by said core member in response to overload currents of predetermined value and having a portion thereon engageable with said thermally responsive member to deflect it and effect release of said releasable means.

2. In a circuit breaker, relatively movable contacts, releasable means for effecting automatic opening of said contacts, trip means normally restraining said releasable means and operable in response to overload currents to release said releasable means, said trip means comprising a core member of magnetic material, an armature pivotally supported on said core member, and a thermal element connected in the circuit of the breaker to be traversed by the current of the circuit and disposed to energize said core member, said core member when energized in response to overload currents above a predetermined value causing said armature to be attracted, said armature having a portion to engage and deflect said thermal element in a direction to instantaneously

release said releasable means, and said thermal element deflecting in the same direction when heated a predetermined amount in response to overload currents below said predetermined value and being movable independently of said armature to release said releasable means after a time delay.

3. In a circuit breaker, relatively movable contacts, releasable means for effecting automatic opening of said contacts, a trip device normally restraining said releasable means and operable in response to overload currents to release said releasable means, said trip device including a bimetallic element mounted at one end and having the other end free to move, an actuating portion rigid with said bimetallic element for movement therewith at all times and operable to cause release of said releasable means, conductors connecting said bimetallic element in circuit with said contacts to cause heating and bending of the bimetallic element, a pair of magnetic members positioned on opposite sides of said bimetallic element, one of said magnetic members being movably mounted and biased by a spring other than said bimetallic element to a position away from the other magnetic member, said spring being mounted independently of the bimetallic element and exerting a constant force on the movable magnetic member irrespective of the movement of the bimetallic element, said movable magnetic member being movable magnetically against its biasing spring in the same direction as said bimetallic element moves when heated and causing movement of the bimetallic element to move its actuating portion and cause release of said releasable means, and said bimetallic element being movable independently of said movable magnetic member after said releasable means has been released.

4. In a circuit breaker, relatively movable contacts, releasable means for effecting automatic opening of said contacts, a trip device normally restraining said releasable means and operable in response to overload currents to release said releasable means, said trip device including a bimetallic element mounted at one end and having the other end free to move, an actuating portion rigid with said bimetallic element for movement therewith at all times and operable to cause release of said releasable means, conductors connecting said bimetallic element in circuit with said contacts to cause heating and bending of the bimetallic element, a pair of magnetic members positioned on opposite sides of said bimetallic element, one of said magnetic members being movably mounted and being movable magnetically in the same direction as said bimetallic element moves when heated and causing movement of the bimetallic element to move its actuating portion and cause release of said releasable means, and said bimetallic element being movable independently of said movable magnetic member beyond the position where the said movable magnetic member engages the other magnetic member.

5. In a circuit breaker, relatively movable contacts, releasable means for effecting automatic opening of said contacts, a trip device normally restraining said releasable means and operable in response to overload currents to release said releasable means, said trip device including a bimetallic element mounted at one end and having the other end free to move, an actuating portion rigid with said bimetallic element for move-

ment therewith at all times and operable to cause release of said releasable means, conductors connecting said bimetallic element in circuit with said contacts to cause heating and bending of the bimetallic element, a pair of magnetic members positioned on opposite sides of said bimetallic element, one of said magnetic members being of U-shape and being fixedly mounted, the other of said magnetic members being movably mounted and being movable magnetically in the same direction as said bimetallic element moves when heated and causing movement of the bimetallic element to move its actuating portion and cause release of said releasable means, and said bimetallic element being movable between the legs of the U-shaped magnetic member independently of said movable magnetic member beyond the position where the said movable magnetic member engages the U-shaped magnetic member.

6. In a circuit breaker, relatively movable contacts, releasable means for effecting automatic opening of said contacts, a thermally responsive member electrically connected in series with said contacts and heated in response to the current of the circuit of the breaker, said thermally responsive member flexing when heated a predetermined amount in a direction to effect release of said releasable means, and electromagnetic means comprising a U-shaped core member embracing said thermally responsive member, said thermally responsive member acting as an energizing means for said core member, and a movable armature pivotally supported on one leg of said U-shaped member and being unattached to said thermally responsive member, said armature being operable by said core member in response to overload currents of predetermined value to engage and deflect said thermally responsive member to effect release of said releasable means, and said thermally responsive member being free of said armature to continue to deflect when heated after said armature has engaged the core member.

7. In a circuit breaker, relatively movable contacts, releasable means for effecting automatic opening of said contacts, a thermally responsive member electrically connected in series with said contacts and heated in response to the current of the circuit of the breaker, said thermally responsive member flexing when heated a predetermined amount in a direction to effect release of said releasable means, and electromagnetic means comprising a U-shaped core member embracing said thermally responsive member, said thermally responsive member acting as an energizing means for said core member, and a movable armature pivotally supported on one leg of said U-shaped core member, said armature being operable by said core member in response to overload currents of predetermined value to engage and deflect said thermally responsive member to effect release of said releasable means, and both said armature and said core member being mounted in the breaker independently of any movable part of said thermally responsive member.

8. In a circuit breaker, relatively movable contacts, releasable means for effecting automatic opening of said contacts, a trip device normally restraining said releasable means and operable in response to overload currents to release said releasable means, said trip device including a bimetallic element mounted at one end and having the other end free to move, an actuating por-

tion rigid with said bimetallic element for movement therewith at all times and operable to cause release of said releasable means, conductors connecting said bimetallic element in circuit with said contacts to cause heating and bending of the bimetallic element, a pair of magnetic members positioned on opposite sides of said bimetallic element, one of said magnetic members being a U-shaped core member mounted in the breaker on the low-expansion side of the bimetallic element and the other magnetic member being a movable armature positioned at the high-expansion side of the bimetallic element and pivotally supported adjacent one end on one end of the U-shaped core member, said armature having its other end movable toward the other end of the U-shaped core member and having a portion which engages the bimetallic element to bend it in the same direction as it bends when heated and thereby causes the actuating portion rigid with the bimetallic element to effect release of said releasable means, and said bimetallic element being free of said armature to continue moving when heated after the movable end of the armature has engaged the end of the U-shaped core member.

9. In a circuit breaker, relatively movable contacts, releasable means for effecting automatic opening of said contacts, a trip device normally restraining said releasable means and operable in response to overload currents to release said releasable means, said trip device including a bimetallic element mounted at one end and having the other end free to move, an actuating portion rigid with said bimetallic element for movement therewith at all times and operable to cause release of said releasable means, conductors connecting said bimetallic element in circuit with said contacts to cause heating and bending of the bimetallic element, a pair of magnetic members positioned on opposite sides of said bimetallic element, both of said magnetic members being mounted in the breaker independently of any movable part of the bimetallic element, one of said magnetic members being a U-shaped core member mounted in the breaker on the low-expansion side of the bimetallic element and the other magnetic member being a movable armature positioned at the high-expansion side of the bimetallic element and pivotally supported adjacent one end on one end of the U-shaped core member, said armature having its other end movable toward the other end of the U-shaped core member and having a portion which engages the bimetallic element to bend it in the same direction as it bends when heated and thereby causes the actuating portion rigid with the bimetallic element to effect release of said releasable means, and said bimetallic element being free of said armature to continue moving when heated after the movable end of the armature has engaged the end of the U-shaped core member.

10. In a circuit breaker, relatively movable contacts, releasable means for effecting automatic opening of said contacts, a thermally responsive member electrically connected in series with said contacts and heated in response to the current of the circuit of the breaker, said thermally responsive member flexing when heated a predetermined amount in a direction to effect release of said releasable means, and electromagnetic means comprising a U-shaped core member energized by the flow of current through the breaker, an armature movable to effect release of said releasable means, said armature being

pivotaly mounted at one end adjacent the end of one leg of the U of the core member and having its other end movable toward the end of the other leg of the U, said pivotal mounting including a leaf spring secured at one end adjacent one side of the leg of the U and extending around the pivot of the armature and having its other end fastened to the armature and biasing the movable end of the armature away from the core member.

11. In a circuit breaker, relatively movable contacts, a releasable means for effecting automatic opening of said contacts, a thermally responsive member electrically connected in series with said contacts and heated in response to the current of the circuit of the breaker, said thermally responsive member flexing when heated a predetermined amount in a direction to effect release of said releasable means, and electromagnetic means comprising a U-shaped core member embracing said thermally responsive member, said thermally responsive member acting as an energizing means for said core member, a movable armature pivotaly supported on one leg of said U-shaped core member, said armature being operable by said core member in response to overload currents of predetermined value to engage and deflect said thermally responsive member to effect release of said releasable means, and said pivotal support for the armature including a leaf spring secured at one end adjacent one side of the U-shaped core member and extending around the pivot of the armature and having its other end fastened to the armature and biasing one end of the armature away from the core member.

12. In a circuit breaker, relatively movable contacts, a releasable member for effecting automatic opening of said contacts, a bimetallic element mounted at one end on a conducting strip and having its other end electrically connected to one of said contacts so as to be heated in response to the current through the breaker, said bimetallic member flexing when heated a predetermined amount in a direction to effect release of said releasable member, an electromagnetic trip device including a core member secured to said conducting strip between one side of said bimetallic element and the conducting strip so as to be energized by the current flow, a movable armature on the other side of the bimetallic element, an insulating member between the movable armature and the bimetallic element, and said armature being moved magnetically toward the core member in response to overload currents of predetermined value to deflect said thermal element through said insulating member and effect release of said releasable member.

13. In a circuit breaker, relatively movable contacts, a releasable member for effecting auto-

matic opening of said contacts, a bimetallic element mounted at one end on a conducting strip and having its other end electrically connected to one of said contacts so as to be heated in response to the current through the breaker, said bimetallic member flexing when heated a predetermined amount in a direction to effect release of said releasable member, an electromagnetic trip device including a core member secured to said conducting strip between one side of said bimetallic element and the conducting strip so as to be energized by the current flow, a movable armature on the other side of the bimetallic element, said armature being pivoted at one end adjacent one end of the core member and having an air gap between its other end and the other end of the core member, an insulating member between the movable armature and the bimetallic element, said armature being moved magnetically toward the core member to reduce said air gap in response to overload currents of predetermined value to deflect said thermal element through said insulating member and effect release of said releasable member, and said bimetallic element being free to move without restraint from said armature after said air gap is closed.

14. In a circuit breaker, relatively movable contacts, a releasable member for effecting automatic opening of said contacts, a bimetallic element mounted at one end on a conducting strip and having its other end electrically connected to one of said contacts so as to be heated in response to the current through the breaker, said bimetallic member flexing when heated a predetermined amount in a direction to effect release of said releasable member, an electromagnetic trip device including a core member secured to said conducting strip between one side of said bimetallic element and the conducting strip so as to be energized by the current flow, a movable armature on the other side of the bimetallic element, said armature being moved magnetically toward the core member in response to overload currents of predetermined value to deflect said thermal element and effect release of said releasable member, and said bimetallic element being free to move when heated without restraint from said armature after the armature has engaged the core member.

HARLAN S. GANO.
GERALD J. FREESE.

References Cited in the file of this patent UNITED STATES PATENTS

Number	Name	Date
2,300,884	Gano	Nov. 3, 1942
2,312,169	Jackson	Feb. 23, 1943
2,419,125	Dorfman et al.	Apr. 15, 1947