July 16, 1963 H. I. STANBACK ETAL 3,098,136

CIRCUIT BREAKER

Filed June 9, 1955 2 Sheets-Sheet 1

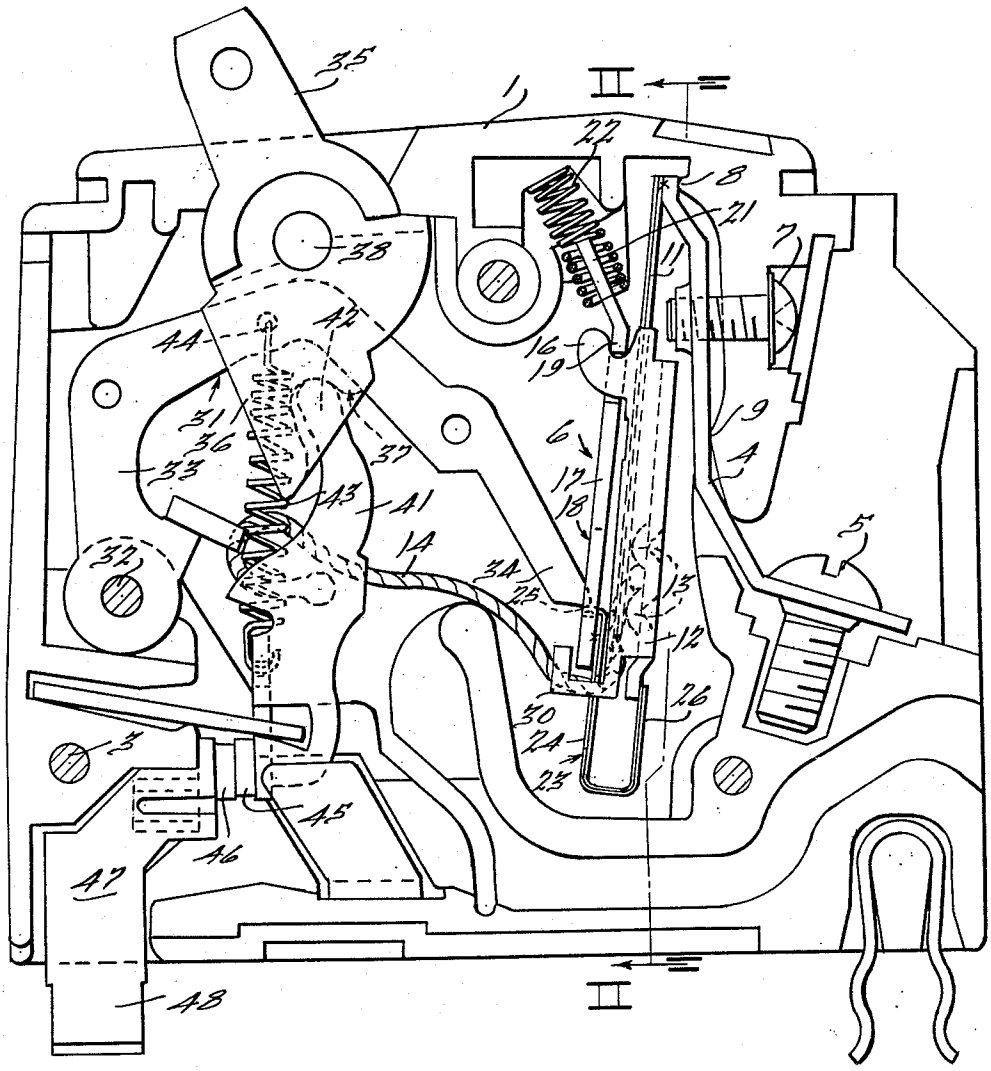

FIG. 1.

INVENTORS.
Harris I. Stanback.
Ralph H. Kingdon.
BY
Myron J. Seibold
ATTORNEY.

July 16, 1963 H. I. STANBACK ETAL 3,098,136

CIRCUIT BREAKER

Filed June 9, 1955 2 Sheets-Sheet 2

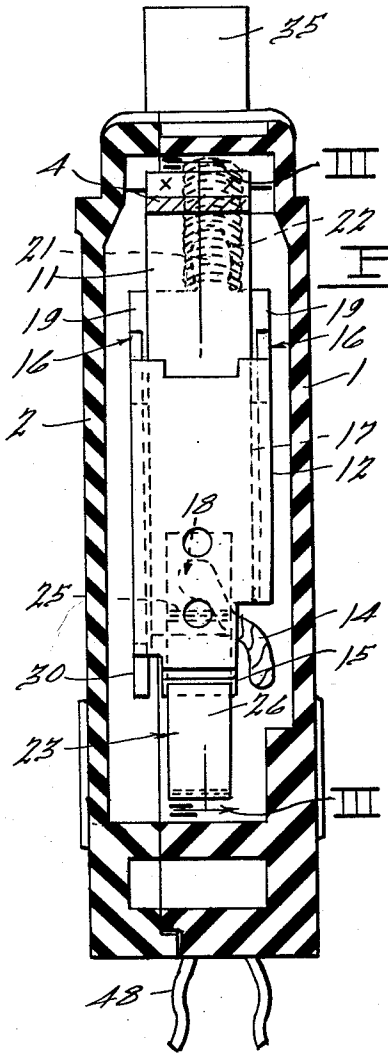

FIG. 2.

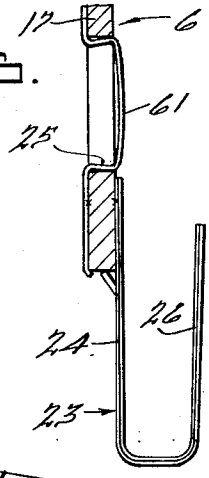

FIG. 5.

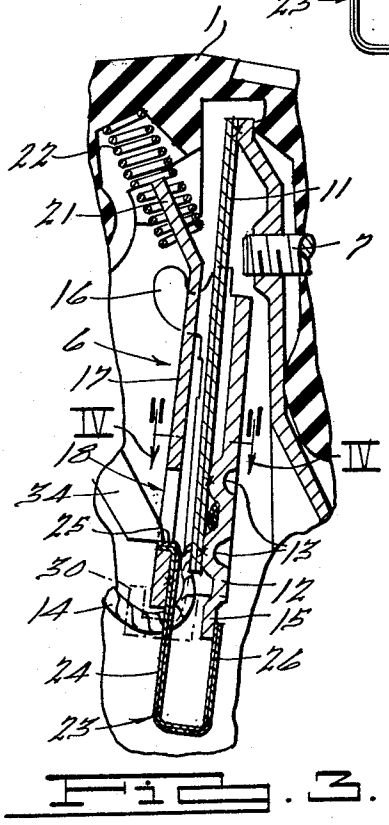

FIG. 3.

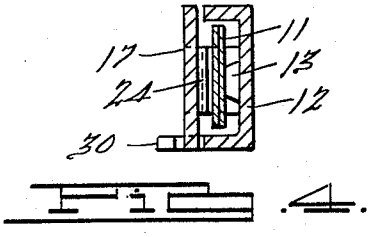

FIG. 4.

INVENTORS
Harris I. Stanback
Ralph H. Kingdon.
BY
Myron J. Zeibold
ATTORNEY.

United States Patent Office 3,098,136 Patented July 16, 1963

3,098,136
CIRCUIT BREAKER

Harris I. Stanback and Ralph H. Kingdon, Birmingham, Mich., assignors to Square D Company, Detroit, Mich., a corporation of Michigan

Filed June 9, 1955, Ser. No. 514,222
24 Claims. (Cl. 200—88)

This invention relates to apparatus for making and breaking electrical circuits, particularly circuit breakers automatically operable in response to current overloads, and more particularly to the current responsive trip devices incorporated within the circuit breaker.

An object of the present invention is to provide an improved current responsive trip unit for an automatic electric circuit breaker of simple and economical construction.

A further object of the present invention is to provide an improved ambient temperature compensation arrangement within the current responsive trip section of an automatic electric circuit breaker.

A further object of the present invention is to provide an improved magnetic trip mechanism for an automatic electric circuit breaker.

A further object of the present invention is to provide a trip mechanism for an automatic electric circuit breaker wherein parts of the trip mechanism constitute a latching surface for the circuit breaker mechanism so as to present a smooth durable latching surface for the mechanism without additional machining operations.

A further object of the present invention is to provide an ambient temperature compensation limiting device for an automatic electric circuit breaker whereby the circuit breaker will be compensated for ambient temperature in its normal range of operation, but wherein the compensation mechanism will be restricted from operation when the surrounding atmosphere has caused the circuit breaker to attain a predetermined temperature.

Further objects and features of the invention will be readily apparent to those skilled in the art from the following specifications and appended drawings illustrating a certain preferred embodiment of the invention in which:

FIGURE 1 is a side view of the circuit breaker with the side cover removed and showing the operating mechanism in the ON position.

FIGURE 2 is a vertical sectional view of the circuit breaker taken along the lines II—II of FIGURE 1.

FIGURE 3 is a vertical sectional view of the trip mechanism of the circuit breaker taken along the lines III—III of FIGURE 2.

FIGURE 4 is a sectional view through the trip mechanism of the circuit breaker taken along the lines IV—IV of FIGURE 3.

FIGURE 5 is a sectional view through the trip mechanism of the circuit breaker showing the latch window insert modification of the present invention.

The circuit breaker, as shown, comprises an open sided casing 1 of molded insulating material having molded recesses and ribs for the support of the circuit breaker mechanism and contacts therein. A cover 2 of molded insulating material, providing complementary recesses and barriers, closes the open side of the casing 1 and is mounted thereon by means of a plurality of rivets 3. Both the base and side cover are provided with top and bottom openings through which extend the operating and connecting members of the circuit breaker mechanisms now to be described.

In one end of the insulating base 1, and supported on barriers established by portions of the base, is a conducting terminal strap 4 provided at its outside end with a terminal screw 5 and having secured thereto, at its inside end, the current responsive trip mechanism 6 of the circuit breaker. An adjustment screw 7 extends through a slot in the base 1 and threadedly engages the conducting strap 4 in the interior of the base 1 with the head thereof operating against the slotted portion of the base 1 to provide an adjustment for the calibration of the automatic circuit breaker. The adjustment screw, in cooperation with the engagement of the strap 4 with the barriers of the base 1, also serves the additional purpose of maintaining the strap within the base, thereby eliminating the need for a separate supporting stud or screw.

The conducting strap 4 bears at one end against a nib 8 in the insulating base 1 and substantially at its mid point against a shoulder 9 on a portion of the insulating base so that rotation of the adjustment screw 7 operates to determine the angular position of the trip mechanism 6 within the interior of the base 1. The terminal end of the conducting strap 4 is suitably supported between support ribs molded into the base and cover as generally shown in FIGURE 1.

The current responsive trip mechanism 6 supported on the interior end of the conducting strap 4 constitutes a bimetallic member 11 attached by suitable means, such as welding, to the strap 4 at one end and has fixed thereto at its other end, by a means such as welding, a magnetic yoke member 12 of a generally U shape. The magnetic yoke member is provided with a pair of vertically disposed nibs 13 at which the weld to the bimetallic member is made and between which there is welded to the bimetallic member 11 and yoke 12, at the same time, a braided conductor or pigtail 14. The magnetic yoke member is provided with an offset lower extension 15 centrally thereof and, at the uppermost ends thereof, the arms of the U are formed into supported pivot arms 16 disposed on the opposite side of the bimetal member 11 from that side on which the yoke member and bimetal are welded together. A movable magnetic armature member 17 having a central cutout 18 is pivotally supported on the pivot arms 16 of the magnetic yoke 12 by outwardly extending shoulders 19 with the armature body formed so as to extend toward the lower end of the circuit breaker. The armature is formed to provide an arm 21 extending beyond the bimetallic member 11 toward the upper end of the circuit breaker at an offset angle away from the bimetallic member 11 and a helical coil spring 22 engages the magnetic armature member 17 at the shoulders 19 and about the arm 21 at one end and, at the other end, operates against the insulating base member 1 in a suitable recess provided therein. To the lower end of the armature member 17 there is secured a U-shaped ambient temperature responsive bimetal 23 having the upper portion of one end 24 thereof extending along the inner side of the magnetic armature member 17 and bent over at its extreme end at 25 to extend along the lower surface of the cutout 18 in the armature. The other leg 26 of the U-shaped bimetal 23 extends into cooperating relationship with the offset extension 15 at the lower end of the magnetic yoke member 12. An ambient temperature compensator limiter is provided in the trip mechanism 6 and

constitutes a hook shaped extension 30 formed on the lower end of one leg of the U of magnetic yoke 12. The hook shaped extension passes around the lower end of the magnetic armature 17 allowing operating space between the hook and armature and armature and yoke, but limiting clockwise pivotal movement of the armature on its support and operates in a manner to be more fully described hereinafter.

The operating mechanism of the circuit breaker constituting those parts which open and close the contacts of the circuit breaker to make and break the circuit through the device include a generally U-shaped cradle member 31 pivotally supported at one end of a leg 33 thereof on a hub 32, formed during the molding of base 1. The cradle 31 cooperates at the extremity of the other leg 34 with the bent over portion 25 of the bimetal member 23 within the cutout 18 of the magnetic armature 17. A manual operator 35 having a handle portion at one end thereof extending outwardly of the circuit breaker insulating base 1 and a body portion extending inwardly into the central recess of the base 1 provides a pair of legs 36 surrounding the cradle member 31 substantially at the center thereof. Each of the legs 36 is provided with inward recesses 37 for support of a movable contact member, as will be described. The manually operable handle 35 is provided with a central trunnion 38 for cooperation with suitable bearing recesses in the base 1 and case 2 for the pivotal support thereof.

Pivotally supported to the manual operator 35 is a movable contact member 41 having a generally U-shaped cross section providing two upwardly extending legs 42 cooperating with the internal recesses 37 in the legs 36 of the operator 35. To the base of the U-shaped cross section of the movable contact member 41, a helical coil spring 43 is secured with the opposite end of the spring hooked to substantially the midpoint of the cradle member 31 so that the tension of the spring maintains the legs 42 spring biased into engagement with the recesses 37 in the manual operator 35. The spring 43 at the same time biases the leg 34 of the cradle 31 onto the latch surface 25 in the window 18 in the armature 17. A contact 45 is secured at the lowermost extremity of the movable contact member 41 and at the opposite end of the base of the U-shaped cross section thereof from the sides defining the legs 42. Movable contact 45 cooperates with a stationary contact 46 secured to the base of a U-shaped spring jaw clip 47 having the lower end 48 thereof extending beyond the base 1 of the circuit breaker. The flexible conductor or pigtail 14 secured at one end, as has been described, to the bimetallic member 11, is also secured by means such as welding at its other end to the movable contact member 41 so that when the movable contact 45 engages stationary contact 46 a circuit is complete from the spring clip jaw 48 through the circuit breaker current responsive overload mechanism to the terminal 5.

In the trip section latch modification, as shown in FIGURE 5 of the drawings, a latch piece 61 is inserted in the window 18 of the magnetic armature 17 so as to produce a smooth, hard latch surface for the cradle member 31. The latch piece 61 is of double ended construction with each end formed similarly so that during assembly of the circuit breaker the insert may be positioned without concern for selection of ends. When mounted in the window 18 and fixed as by welding to the armature 17, the lower end of the insert wraps around the lower end of the armature 17 and provides at that point a smooth, hard surface for cooperation with the face of the cradle 31 at the latch end 34 as it moves to released position and, particularly, as it is moved back to latched position in relatching movement. With the modification of this figure, the wear on the latch end 34 of the cradle 31 is greatly reduced so as to maintain the latching areas in desirable operating condition throughout the useful life of the circuit breaker.

The current responsive overload trip mechanism 6 operates to open the circuit breaker contacts in response to a sustained moderate overload and in response to an instantaneous extreme overload in the manner which will now be described.

The path of current through the circuit breaker is such that current flows through the current responsive bimetallic member 11 so that, upon sustained moderate overload, the bimetallic member 11 deflects about its fixed engagement with the conducting strap 4 so as to move the free end of the bimetallic member in a counterclockwise fashion with respect to its fixed end. Movement of the bimetallic member 11 carries with it the magnetic yoke member 12 moving the offset extension 15 and the bimetal 23 due to the cooperation with leg 26 of the U-shaped bimetal 23. The opposite end of the bimetal 23 is secured to the magnetic armature member 17 so that the armature is moved on sustained moderate overloads to move the latching surface 25 from its cooperating engagement with the leg 34 of the cradle member 31. Upon release of the cradle member 31 from the latching surface 25, the cradle 31 is moved in a clockwise fashion about its pivot 32 to carry the end of the coil spring 43 attached to the cradle 31 at 44 to the other side of the pivotal engagement of the legs 42 within the recesses 37 of the operating handle 35. Once the spring 43 has moved through this line of pivot, the bias of the spring 43 becomes operative to rotate the movable contact member 41 in a counterclockwise fashion about its pivot in the recesses 37 of the operating handle 35 to open the contacts 45 and 46 with a snap action. In the same manner and upon the occurrence of an extreme overload, the flow of current through the bimetallic member 11 sets up a magnetic force in the magnetic yoke 12 which operates to attract the armature 17 to instantaneously release the cradle member 31 from its engagement with the latching surface 25, thereby causing the same movements of the spring 43 and movable contact carrier 41 to open the circuit of the contacts 45 and 46. It should be noted that the contacts 45 and 46 will be separated upon overload in the manner described, regardless of whether the manual operator 35 is held in its ON position or allowed to move with trip action making the circuit breaker trip free in action.

Ambient temperature compensation is provided in the current responsive trip mechanism 6 of the circuit breaker through the construction of the U-shaped member 23 of a bimetallic material so arranged that its leg 26 moves away from the leg 24 on high ambient condition and toward the leg 24 on lower ambient condition. The movement of the ambient temperature responsive bimetal 23 permits the latching surface 25 to remain substantially in the same position at all ambient temperatures by letting the leg 26 move substantially the same distances as the free end of the current responsive bimetal 11 will move due to an increase or decrease in ambient temperature. An ambient temperature compensation limiter 30 is provided to insure operation of the circuit breaker under extremely high ambient conditions, it being apparent that when an extremely high ambient temperature exists, the ambient temperature bimetal 23 may bend to an extreme angle such that the passage of overload current through the current responsive bimetal 11 while causing flexure thereof will not cause enough movement to ensure cooperation of extension 15 of the magnetic yoke member 12 with the leg 26 of the ambient temperature bimetal 23. Under a condition of this sort, an overload condition could continue through the circuit breaker until damage had occurred in the protected load. To insure against such a condition, the magnetic yoke 12 is provided with a hook shaped extension 30 cooperating with the magnetic armature 17 at the side thereof away from the current responsive bimetal. The extension 30, under normal conditions, allows the armature to operate in the manner as has previously been described; however, when a high ambient and overload current exists, the movement of the current responsive bimetal entail-

ing like movement of the magnetic yoke brings the hook extension 30 into operative relation with the armature 17 and, should the extension 15 of the yoke not engage the leg 26 of the bimetal 23, the armature will be moved by the hook extension to trip the breaker.

The construction of the U-shaped member 23 from bimetallic material provides an additional feature in the trip mechanism 6 of the circuit breaker in that the end of the leg 24 bent over and cooperating with the cutout portion 18 in the magnetic armature 17 to form the latch surface 25 provides at the latch surface an extremely smooth and hard latching surface for the leg 34 of the cradle 31. In this manner an additional manufacturing step of hardening and machining the latch surface in the magnetic armature 17 is eliminated and a uniform latch surface is provided in all circuit breakers as manufactured.

While certain preferred embodiments of the invention have been specifically disclosed, it is understood that the invention is not limited thereto, as many variations will be readily apparent to those skilled in the art, and the invention is to be given its broadest possible interpretation within the terms of the following claims:

What is claimed is:

1. In an automatic electric circuit breaker having separable contacts and means releasable to effect separation of said contacts, current responsive means for effecting the release of said releasable means upon the passage of an overload current through said circuit breaker comprising a bimetallic member fixed at one end within said circuit breaker and adapted to be heated in response to the flow of current through said circuit breaker, a magnetic yoke supported near one end upon the free end of said current responsive bimetallic member, said magnetic yoke having a body portion extending toward the fixed end of said current responsive bimetallic member, a magnetic armature member supported upon said yoke member and extending generally parallel to said yoke, an ambient temperature responsive bimetallic member fixed to the unsupported end of said armature member and extending beyond the said armature at the unsupported end thereof, said ambient temperature responsive bimetallic member being movable in response to movement of said current responsive bimetallic member to effect release of said releasable means.

2. In an automatic electric circuit breaker having separable contacts and means releasable to effect the separation of said contacts, current responsive means for effecting release of said releasable means upon the passage of an overload current through said circuit breaker comprising a bimetallic member fixed at one end within said circuit breaker and adapted to be heated in response to the flow of current through said circuit breaker, a magnetic yoke supported near one end upon the free end of said current responsive bimetallic member and having its body portion extending toward the fixed end of said current responsive bimetallic member, a magnetic armature member supported upon said yoke member and extending substantially parallel to said yoke, an ambient temperature responsive bimetallic member fixed to the unsupported end of said armature and extending beyond said armature at the unsupported end thereof, said ambient temperature responsive bimetallic member cooperating with a portion of said magnetic yoke near said supported end whereby movement of said yoke causes movement of said ambient temperature responsive bimetallic member to effect release of said releasable means.

3. In an automatic electric circuit breaker having separable contacts and means releasable to effect separation of said contacts, a current responsive means for effecting the release of said releasable means upon the passage of an overload current through said circuit breaker comprising a bimetallic member fixed at one end within said circuit breaker and adapted to be heated in response to the flow of current through said circuit breaker, a magnetic

yoke supported near one end upon the free end of said current responsive bimetallic member and having its body portion extending toward the fixed end of said current responsive bimetallic member, a magnetic armature member supported at one end on said yoke member and extending substantially parallel to said yoke, said armature member having a latching surface formed thereon for said releasable means, and an ambient temperature responsive bimetallic member fixed to the unsupported end of said armature member, said ambient temperature responsive bimetallic member being movable in response to movement of said current responsive bimetallic member to move said armature member to release said releasable means to effect separation of said contacts in response to current overloads through said circuit breaker.

4. In a trip unit for an automatic electric circuit breaker having separable contacts and means releasable to effect separation of said contacts, a current responsive bimetal, a current responsive magnetic yoke supported upon said bimetal, a magnetic armature supported upon said magnetic yoke, an ambient temperature responsive bimetal having one end fixed to said armature and its other end movable by movement of said current responsive bimetal, said fixed end of said ambient temperature responsive bimetal cooperating with said armature to form a smooth, hard latching surface for said releasable means.

5. In an automatic electric circuit breaker having separable contacts and means releasable to effect separation of said contacts, current responsive means for effecting the release of said releasable means upon the passage of an overload current through the circuit breaker comprising a bimetallic member fixed at one end within said circuit breaker and adapted to be heated in response to the flow of current through said circuit breaker, a magnetic yoke supported near one end upon the free end of said current responsive bimetallic member and having its body portion extending toward the fixed end of said current responsive bimetallic member, a magnetic armature member supported upon said yoke and extending generally parallel to said yoke, said armature being formed to provide a latching area for said releasable means, an ambient temperature responsive bimetallic member fixed to the unsupported end of said armature, said ambient temperature responsive bimetallic member having a portion of its fixed end extending into said latching area to form a latch surface and having its free end extending beyond said armature at the unsupported end thereof, said ambient temperature responsive bimetallic member being movable in response to the movement of said current responsive bimetallic member to release said releasable means to effect separation of said contacts in response to current overloads through said circuit breaker.

6. In an automatic electric circuit breaker having separable contacts and means releasable to effect separation of said contacts, current responsive means effecting the release of said releasable means upon the passage of an overload current through said circuit breaker comprising a bimetallic member fixed at one end within said circuit breaker and adapted to be heated in response to the flow of current through said circuit breaker, a magnetic yoke supported near one end upon the free end of said current responsive bimetallic member and having its body portion extending toward the fixed end of said current responsive bimetallic member, a magnetic armature member supported upon said yoke member and extending generally parallel to said yoke member, said armature being formed to provide a latching area for said releasable means, an ambient temperature responsive bimetallic member fixed at one end to the unsupported end of said armature, said ambient temperature responsive bimetallic member having a portion of its fixed end extending into said latch area to form a latch surface and its free end extending beyond said armature at the

unsupported end thereof, said ambient temperature responsive bimetallic member cooperating with a portion of said magnetic yoke near said fixed end whereby movement of said yoke causes movement of said ambient temperature responsive bimetallic member to release said releasable means to effect separation of said contacts in response to current overloads through said circuit breaker.

7. An automatic electric circuit breaker comprising a current responsive bimetallic element and circuit controlling parts controlled thereby, a current responsive magnetic yoke, said magnetic yoke having a pair of nibs on one surface thereof disposed with respect to each other and defining a valley therebetween, and a flexible conductor, said conductor being connected at one end to said circuit controlling parts, said current responsive bimetal, magnetic yoke and other end of said flexible conductor being fixed together with said flexible conductor between said yoke and said bimetal and in said valley defined by said nibs.

8. An automatic electric circuit breaker comprising a current responsive bimetal element and circiut controlling parts controlled thereby, a current responsive magnetic yoke, said magnetic yoke having a pair of nibs on one surface thereof disposed with respect to each other and defining a valley therebetween, a flexible conductor, said conductor being connected at one end to said circuit controlling parts, said current responsive bimetal, magnetic yoke and other end of said flexible conductor being fixed together with said flexible conductor between said yoke and said bimetal and in said valley defined by said nibs, a magnetic armature member supported upon said yoke, an ambient temperature responsive bimetal having one end fixed to said armature and its other end movable by movement of said current responsive bimetal, said fixed end of said ambient temperature responsive bimetal cooperating with said armature, and forming a smooth, hard latching surface within said circuit breaker for said circuit controlling parts.

9. In an automatic electric circuit breaker having separable contacts and means releasable to effect separation of said contacts, current responsive means for effecting release of said releasable means upon the passage of an overload current through said circuit breaker comprising a bimetallic member fixed at one end within said circuit breaker and adapted to be heated in response to the flow of current through said circuit breaker, a U-shaped magnetic yoke fixed at one end upon the free end of said current responsive bimetallic member and having its body portion extending toward the fixed end of said current responsive bimetallic member with the legs of said yoke surrounding said bimetallic member, said legs of said yoke member at said extended end presenting hinge posts on the opposite side of said bimetallic member from the side on which said yoke is fixed thereto, a magnetic armature member pivotally supported at said hinge posts and extending generally parallel to the said bimetallic member and the legs of said U-shaped yoke, and an ambient temperature responsive bimetallic member fixed to the unsupported end of said armature and extending beyond said armature at the unsupported end thereof, said ambient temperature responsive bimetallic member being movable in response to movement of said current responsive bimetallic member to release said releasable means to effect separation of said contacts in response to overload current flow through said circuit breaker.

10. In an automatic electric circuit breaker having separable contacts and means releasable to effect separation of said contacts, current responsive means for effecting the release of said releasable means upon the passage of an overload current through said circuit breaker comprising a bimetallic member fixed at one end within said circuit breaker and adapted to be heated in response to the flow of current through said circuit breaker, a U-shaped magnetic yoke fixed near one end upon the free end of said current responsive bimetallic member

and having its body portion extending toward said fixed end of said current responsive bimetallic member with the legs of said yoke surrounding said bimetallic member, said legs of said yoke member at said extending end presenting posts on the opposite side of said bimetallic member from the side on which said yoke is fixed thereto, a magnetic armature member pivotally supported at said hinge posts and extending generally parallel to said bimetallic member and to the ends of said legs of said U-shaped yoke, an ambient temperature responsive bimetallic member fixed to the unsupported end of said armature and extending beyond said armature at the unsupported end thereof, said ambient temperature responsive bimetallic member cooperating with a portion of said magnetic yoke near said fixed end whereby movement of said yoke causes movement of said ambient temperature responsive bimetallic member to release said releasable means to effect separation of said contacts in response to current overloads through said circuit breaker.

11. In an automatic electric circuit breaker having separable contacts and means releasable to effect separation of said contacts, current responsive means for effecting the release of said releasable means upon the passage of an overload current through said circuit breaker comprising a bimetallic member fixed at one end within said circuit breaker and adapted to be heated in response to the flow of current through said circuit breaker, a U-shaped magnetic yoke supported near one end upon the free end of said current responsive bimetallic member and having its body portion extending toward the fixed end of said current responsive bimetallic member with the legs of said yoke surrounding said bimetallic member, said legs of said yoke member at said extended end presenting hinge posts on the opposite side of said bimetallic member from the side on which said yoke is mounted thereto, a magnetic armature member pivotally supported at said hinge posts and extending generally parallel to said bimetallic member and to the ends of the legs of said U-shaped yoke, said armature being formed to provide a latch area for said releasable means, an ambient temperature responsive bimetallic member fixed to the unsupported end of said armature, said ambient temperature responsive bimetallic member having a portion of its fixed end extending into said latch area to form a latch surface therein and having its free end extending beyond said armature at the unsupported end thereof, said ambient temperature responsive bimetallic member being operable in response to movement of said current responsive bimetallic member to release said releasable means to effect separation of said contacts in response to overload current flow through said circuit breaker.

12. In an automatic electric circuit breaker having separable contacts and means releasable to effect separation of said contacts, current responsive means for effecting the release of said releasable means upon the passage of an overload current through the circuit breaker comprising a bimetallic member fixed at one end within said circuit breaker and adapted to be heated in response to the flow of current through said circuit breaker, a U-shaped magnetic yoke supported near one end upon the free end of said current responsive bimetallic member and having its body portion extending toward said fixed end of said current responsive bimetallic member with the legs of said yoke surrounding said bimetallic member, said legs of said yoke member at said extended end presenting hinge posts on the opposite side of said bimetallic member from the side on which said yoke is mounted thereto, a magnetic armature member pivotally supported at said hinge posts and extending generally parallel to said bimetallic member and to the end of said legs of said U-shaped yoke, an ambient temperature responsive bimetallic member fixed to the unsupported end of said armature and extending beyond said armature at the unsupported end thereof, said ambient tem-

perature responsive bimetallic member cooperating with a portion of said magnetic yoke near said fixed end whereby movement of said yoke causes movement of said ambient temperature responsive bimetallic member to release said releasable means to effect separation of said contacts in response to overload current flow through said circuit breaker.

13. A trip unit for an automatic electric circuit breaker having separable contacts and means releasable to effect separation of said contacts, said trip unit comprising a current responsive bimetal, a current responsive magnetic yoke supported on said bimetal, a magnetic armature supported on said magnetic yoke, an ambient temperature responsive bimetal having one end fixed to said armature and its other end operable by movement of said current responsive bimetal, said ambient temperature responsive bimetal having its high expansion side facing the high expansion side of said current responsive bimetal and mounted so that substantially all of said ambient temperature bimetal is disposed away from said current responsive bimetal, said fixed end of said ambient temperature responsive bimetal cooperating with said armature to form a smooth, hard latching surface for said releasable means.

14. In an automatic electric circuit breaker having separable contacts and means releasable to effect the separation of said contacts, current responsive means for effecting the release of said releasable means upon the passage of an overload current through said circuit breaker comprising a current responsive bimetallic member fixed at one end within said circuit breaker and adapted to be heated in response to the flow of current through said circuit breaker, a magnetic yoke supported near one end upon the free end of said current responsive bimetallic member, said magnetic yoke having a body portion extending toward the fixed end of said current responsive bimetallic member, a magnetic armature member supported on said magnetic yoke and extending generally parallel to said yoke, and said magnetic armature member being arranged to provide a latching surface for said releasable means and being movable in response to current overload through said circuit breaker to effect release of said releasable means, means for compensating said circuit breaker current responsive means for ambient temperature and operatively related with said magnetic armature and bimetallic member to restrict relative movement between said magnetic armature and bimetallic member through one range of ambient temperature, and means operatively related with said magnetic armature and bimetallic member to restrict relative movement between said magnetic armature and bimetallic member upon the occurrence of temperatures higher than said one range of temperature.

15. In an automatic electric circuit breaker having separable contacts and means releasable to effect separation of said contacts, current responsive means for effecting the release of said releasable means upon the passage of an overload current through said circuit breaker comprising a bimetallic member fixed at one end within said circuit breaker and adapted to be heated in response to the flow of current through said circuit breaker, a magnetic yoke supported near one end upon the free end of said current responsive bimetallic member, said magnetic yoke having a body portion extending toward the fixed end of said current responsive bimetallic member, a magnetic armature member supported upon said yoke member and extending generally parallel to said yoke, an ambient temperature responsive bimetallic member fixed to the unsupported end of said armature member and extending beyond said armature at the unsupported end thereof, said ambient temperature responsive bimetallic member being movable in response to movement of said current responsive bimetallic member to effect release of said releasable means, and means integral with said yoke and adapted to engage said magnetic armature member so as to eliminate said ambient temperature compensation above a preselected ambient condition.

16. In an automatic electric circuit breaker having separable contacts and means releasable to effect separation of said contacts, current responsive means for effecting the release of said releasable means upon the passage of an overload current through said circuit breaker comprising a bimetallic member fixed at one end within said circuit breaker and adapted to be heated in response to the flow of current through said circuit breaker, a magnetic yoke supported near one end on the free end of said current responsive bimetallic member, said magnetic yoke having a body portion extending toward the fixed end of said current responsive bimetallic member, a hook extension on the fixed end of said magnetic yoke, a magnetic armature member supported upon said yoke member and extending generally parallel to said yoke, said magnetic armature member being arranged to provide a latch surface for said releasable means, an ambient temperature responsive bimetallic member fixed to the unsupported end of said armature member and extending beyond said armature at the unsupported end thereof, said ambient temperature responsive bimetallic member being movable in response to movement of said current responsive bimetallic member to move said magnetic armature member to effect release of said releasable means, said hook extension being in cooperating alignment with said magnetic armature at the unsupported end thereof and at the side away from the said yoke and movable with said current responsive bimetallic member to effect release of said releasable means so as to eliminate said ambient temperature compensation.

17. In an automatic electric circuit breaker having separable contacts and means releasable to effect separation of said contacts, current responsive means for effecting the release of said releasable means upon the passage of an overload current through said circuit breaker comprising a bimetallic member fixed at one end within said circuit breaker and adapted to be heated in response to the flow of current through said circuit breaker, a magnetic yoke supported near one end upon the free end of said current responsive bimetallic member, said magnetic yoke having a body portion extending toward the fixed end of said current responsive bimetallic member, a magnetic armature member supported upon said yoke member and extending generally parallel to said yoke, a hook extension on the fixed end of said magnetic yoke, said hook being in cooperating alignment with said magnetic armature at the unsupported end thereof and at the side thereof away from said yoke, an ambient temperature responsive bimetallic member fixed to the unsupported end of said armature member and extending beyond said armature at the unsupported end thereof, said ambient temperature responsive bimetallic member being movable in response to the movement of said current responsive bimetallic member to move said magnetic armature member to effect release of said releasable means, said hook extension being movable with said current responsive bimetallic member to move said magnetic armature member to effect release of said releasable means so as to eliminate said ambient temperature compensation.

18. In an automatic electric circuit breaker having separable contacts and means releasable to effect separation of said contacts, current responsive means for effecting the release of said releasable means upon the passage of an overload current through said circuit breaker comprising a bimetallic member fixed at one end within said circuit breaker and adapted to be heated in response to the flow of current through said circuit breaker, a U-shaped magnetic yoke fixed near one end upon the free end of said current responsive bimetallic member and having its body portion extending toward the fixed end of said current responsive bimetallic member with the legs thereof surrounding said bimetallic member, said legs of said yoke member at said extended end present-

ing hinge posts on the opposite side of said bimetallic member from the side on which said yoke is fixed thereto, a magnetic armature member pivotally supported on said hinge posts and extending generally parallel to said bimetallic member and the legs of said U-shaped yoke, an ambient temperature responsive bimetallic member fixed to the unsupported end of said armature and extending beyond said armature at the unsupported end thereof, said ambient temperature responsive bimetallic member being movable in response to movement of said current responsive bimetallic member to effect release of said releasable means to effect separation of said contacts in response to overload current flow through said circuit breaker, and means on one of said legs of said magnetic yoke extending into engageable alignment with said magnetic armature at the unsupported end thereof and at the side thereof away from said yoke, said means being movable with said magnetic yoke and being spaced from said armature at normal ambient condition whereby said means engages said armature at high ambient conditions so as to limit said ambient temperature compensation and effect release of said releasable means.

19. In an automatic electric circuit breaker having separable contacts and means releasable to effect separation of said contacts, current responsive means for effecting the release of said releasable means upon the passage of an overload current through said circuit breaker comprising a bimetallic member fixed at one end within said circuit breaker and adapted to be heated in response to the flow of current through said circuit breaker, a magnetic yoke supported near one end upon the free end of said current responsive bimetallic member and having its body portion extending toward the fixed end of said current responsive bimetallic member, a magnetic armature member supported at one end on said yoke member and extending substantially parallel to said yoke, said armature member having a latching surface formed thereon for said releasable means, a latch piece overlying said latching surface, an ambient temperature responsive bimetallic member being fixed to the unsupported end of said armature and extending beyond said armature at the unsupported end thereof, said ambient temperature responsive bimetallic member being movable in response to movement of said current responsive bimetallic member to move said armature member to release said releasable means to effect separation of said contacts in response to current overloads through said circuit breaker.

20. In an automatic electric circuit breaker having separable contacts and means releasable to effect separation of said contacts, current responsive means for effecting the release of said releasable means upon the passage of an overload current through said circuit breaker comprising a bimetallic member fixed at one end within said circuit breaker and adapted to be heated in response to the flow of current through said circuit breaker, a magnetic yoke supported near one end upon the free end of said current responsive bimetallic member and having its body portion extending toward the fixed end of said current responsive bimetallic member, a magnetic armature member supported at one end on said yoke member and extending substantially parallel to said yoke, said armature member having a latching recess formed thereon for said releasable means, a latch piece inserted in said latching recess, said latch piece being fixed to said armature and having one end thereof extending beyond said armature, an ambient temperature responsive bimetallic member being fixed to the unsupported end of said armature and extending beyond said armature at the unsupported end thereof, said ambient temperature responsive bimetallic member being movable in response to movement of said current responsive bimetallic member to move said armature member to release said releasable means to effect separation of said contacts in response to current overloads through said circuit breaker.

21. In an automatic electric circuit breaker having separable contacts and means releasable ot effect separation of said contacts, current responsive means for effecting the release of said releasable means upon the passage of an overload current through the circuit breaker comprising a bimetallic member fixed at one end within said circuit breaker and adapted to be heated in response to the flow of current through said circuit breaker, a magnetic yoke supported near one end upon the free end of said current responsive bimetallic member and having its body portion extending toward the fixed end of said current responsive bimetallic member, a magnetic armature member supported upon said yoke member and extending generally parallel to said yoke, said armature being formed to provide a latching recess for said releasable means, a resilient latch piece inserted in said latching recess and having an extending end bent over around the free end of said armature, said releasable means resting upon said latch piece in latched condition and riding on said extending end in movement to latched condition, an ambient temperature responsive bimetallic member fixed at one end to the unsupported end of said armature, said ambient temperature responsive bimetallic member having a portion of its fixed end extending into said latching recess to form a latch surface and having its free end extending beyond said armature at the unsupported end thereof, said ambient temperature responsive bimetallic member being movable in response to the movement of said current responsive bimetallic member to release said releasable means to effect separation of said contacts in response to current overloads through said circuit breaker.

22. In an automatic electric circuit breaker having separable contacts and means releasable to effect the separation of said contacts, current responsive means for effecting the release of said releasable means upon the passage of an overload current through said circuit breaker comprising a bimetallic member fixed at one end within said circuit breaker and adapted to be heated in response to the flow of current through said circuit breaker, a magnetic yoke supported near one end upon the free end of said current responsive bimetallic member, said magnetic yoke having a body portion extending toward the fixed end of said current responsive bimetallic member, a magnetic armature member supported on said yoke member and extending generally parallel to said yoke, a cutout window in said magnetic armature defining a latch surface, a latch piece inserted in said window and adapted to cooperate with said releasable means to provide a hard latch surface therefor, said magnetic armature being movable in response to current overload through said circuit breaker to effect release of said releasable means, means for compensating said circuit breaker for ambient temperature, and means on said yoke adapted to cooperate with said magnetic armature for limiting said ambient temperature compensation.

23. The method of joining a bimetal, flexible conductor and magnetic yoke in an automatic electric circuit breaker by welding to provide good electrical contact and to prevent fatigue failure due to flexing, comprising expressing at least a pair of nibs from said magnetic yoke to define a valley therebetween, placing said flexible conductor between said nibs and within said valley, assembling said bimetal, flexible conductor and magnetic yoke with said flexible conductor between said yoke and said bimetal and in said valley, squeezing said assembly to press said nibs into the associated surface of said bimetal, and passing a welding current through said assembly to fuse said bimetal, flexible conductor and yoke.

24. A circuit breaker having separable contacts, a movable trip member having an opening therein, means on one side of said trip member releasable to effect separation of said contacts, said releasable means having a latch portion extending into said opening in said trip member, an ambient temperature responsive bimetal element mounted

on said trip member on the side thereof opposite said releasable means and having a latching surface extending into said opening in said trip member for engaging said latch portion to releasably restrain said releasable means, a trip device comprising a current responsive bimetal element for moving said trip member in response to overload currents, and said ambient temperature responsive bimetal element flexing to compensate said trip device for changes in ambient temperature.

References Cited in the file of this patent

UNITED STATES PATENTS

2,568,423	Walker et al.	Sept. 18, 1951
2,619,561	Swingle	Nov. 25, 1952
2,624,816	Bingenheimer	Jan. 6, 1953
2,656,437	Allen	Oct. 20, 1953
2,703,351	Hulbert	Mar. 1, 1955
2,813,167	Bingenheimer et al.	Nov. 12, 1957