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H. H. CLAYTON

2,491,088

THERMAL-MAGNETIC CIRCUIT BREAKER

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Fig. 3.

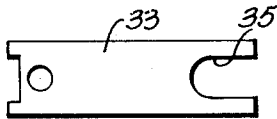


Fig. 1.

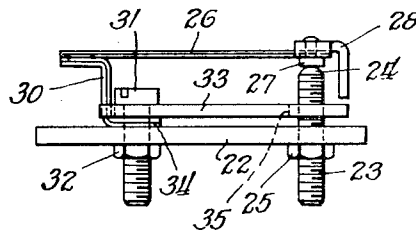
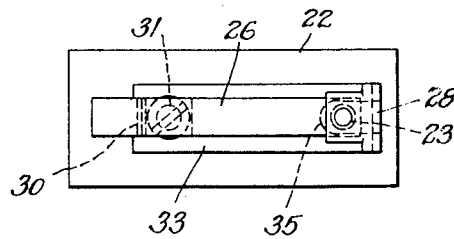


Fig. 2.



Inventor:
Harold H. Clayton
By *Thompson* *Booth* *Neuman*
Attorneys

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THERMAL-MAGNETIC CIRCUIT BREAKER

Harold H. Clayton, Logansport, Ind., assignor, by
 meane assignments, to Essex Wire Corporation,
 Logansport, Ind., a corporation of Michigan

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3 Claims. (Cl. 200—88)

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My present invention relates to an improvement in a circuit breaker, and more particularly is concerned with a device having a thermally responsive element adapted to be heated by abnormal current flow through a circuit with which the device is associated to interrupt or open the circuit.

It is old in the art to utilize a thermally responsive element such as a bimetallic strip which upon being heated by excessive current flow there-through causes separation of a pair of contacts to open a circuit, and which strip upon cooling effects closing of the contacts. In the heating and cooling of the thermally responsive element, however, there is but slight contact pressure between the contacts before opening and closing of the same which causes undesirable arcing and ultimate destruction of the contacts after a limited number of operations of the bimetal strip in the opening and closing of a circuit. Many approaches have been made to overcome this difficulty among which is the practice of providing an electromagnet which is adapted to attract an armature carried by the thermally responsive member so that the thermally responsive member is held attracted with the contacts under pressure engagement until the thermally responsive element is capable of exerting sufficient force to overcome the pull of the electromagnet whereupon the contacts are opened with a snap action. The main objection to this approach to the problem is the increased cost of the device due to the use of an electromagnet. Likewise, other known means for achieving the desired result are objectionable from the cost standpoint and complexity of the device.

It is, therefore, an object of my invention to provide an improved circuit breaker of simple and inexpensive construction having a thermally responsive element adapted to effect snap opening and closing of contacts without objectionable arcing therebetween.

In order to attain the aforesaid object I propose to provide a circuit breaker comprising a thermally responsive element such as a bimetallic strip having a contact movable with respect to a stationary contact for effecting opening and closing of a circuit dependent upon the flow of current through the thermally responsive element. In such an arrangement of parts I propose to provide a field piece adjacent the thermally responsive element so that upon flow of current through the latter a magnetic field is set up between an armature carried by the thermally responsive element and the field piece

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which is effective to bias the contacts together. The magnetic field varies in proportion to the current flowing through the temperature responsive element so that upon flow of overload current the magnetic field increases tightly holding the contacts together which offsets the normal tendency of the contact pressure from lessening by the bowing away of the thermally responsive element. When the thermally responsive element has been heated sufficiently the force exerted thereby exceeds the magnetic pull of the magnetic field so that the contacts open with a snap action. When the thermally responsive element cools off sufficiently to close the contacts, flow of current through the thermally responsive element is again established so that a magnetic field is again immediately set up between the thermally responsive element and field piece thus holding the contacts tightly closed.

It is a feature of my present invention to provide in a device of the above type a base member for supporting the thermally responsive element and field piece so that upon current flow through the thermally responsive element a magnetic field is set up between it and the field piece to attract an armature carried by the thermally responsive element to bias the contact carried by the latter into engagement with a stationary contact supported by the base member.

A further preferred feature resides in the provision of means in a device as the aforesaid for supporting one end each of the thermally responsive element and field piece element with respect to the base member so that these elements extend substantially parallel with respect to each other, and in which the other or free end of the thermally responsive element carries a contact adapted to be engaged with and disengaged from a stationary contact carried by terminal screw means associated with the base member.

A further preferred feature resides in the provision of an adjustable terminal screw means for the stationary contact by reason of which the normal contact pressure between the stationary contact and movable contact carried by the thermally responsive element may be adjusted.

A still further preferred feature resides in the provision of a device as the aforesaid in which means for mounting the thermally responsive element on the base member is of a character compensating for ambient temperature changes, and which is effective for preventing the metal of which the thermally responsive element is made from exceeding its stress point under extreme change in ambient temperature.

Other objects, advantages and features of my invention will appear from the detail description.

Now, in order to acquaint those skilled in the art with the manner of constructing and utilizing devices in accordance with my invention, I shall describe in connection with the accompanying drawings certain preferred embodiments of my invention.

In the drawings:

Figure 1 is a side elevational view of a device constructed in accordance with my invention;

Figure 2 is a plan view of the device of Figure 1; and

Figure 3 is a plan view of the field piece of the device of Figures 1 and 2.

Referring now to the drawing, the device therein shown comprises a base member 22 of suitable insulating material, such as of the known phenolic compositions provides for the support of a threaded terminal screw 23 having a stationary contact 24 at the upper end thereof, in the position of the device, as shown in Figure 1, and in which a nut 25 provides for maintaining the terminal screw 23 and stationary contact 24 in adjusted position. A thermally responsive means comprising an elongated bimetal switch blade or actuating member 26 carries a movable contact 27 which is adapted to normally engage the stationary contact 24. The free end of the bimetal switch blade 26 has suitably secured thereto, as by riveting or the like, an angle armature member 28. The other end of the bimetal member 26 is adapted to be welded or otherwise suitably secured to a bimetal hinge member 30 which is secured to the base member 22 by the terminal screw 31 with which a nut 32 has threading engagement for mounting the bimetallic hinge bracket or member 30 upon the base 22. An elongated field piece member 33 of high permeability magnetic steel is adapted to be supported by the terminal screw 31 between the headed end thereof and flange 34 of the bimetallic hinge member 30 disposed between it and the base member 22 so that the elongated field piece 33 extends substantially parallel with the bimetal member 26 with its free end being disposed in juxtaposition of and spaced from the free end of the armature 28 carried by the bimetal switch blade 26. As shown more clearly in Figure 3, the field piece 33 adjacent its free or unsupported end is cut out to provide a U-shaped slot 35 so that it may extend beyond the terminal screw 23 and out of contact therewith so that the field piece 33 is insulated from a circuit between the terminals 23 and 31.

Upon connection of the terminals 23 and 31 in the circuit to be controlled, it will be observed that the current flow through the bimetal switch blade or member 26 is effective to set up a magnetic field between the field piece 33 and the armature 28 carried by the bimetal switch blade or member 26 which attracts the armature 28 toward the field piece 33 to bias the movable contact 27 into engagement with the stationary contact 24. This magnetic flux will be in proportion to the current flowing through the bimetal switch member 26. When an overload current, or current in excess of the value at which the contacts are desired to be maintained closed, flows through the bimetal switch blade 26 the magnetic flux generated by this current tends to restrain the opening of the contacts until the force of the bimetal blade 26 exceeds the pull of the armature 24 whereupon the contacts are opened with a snap action. It will be observed that the con-

tacts 24 and 27 will always be maintained under substantial contact pressure with this pressure being increased upon initial flow of overflow current until the bimetal member 26 is heated by such current flow to exert sufficient force to overcome the force of the magnetic field and cause opening of the contacts 24 and 27 with a snap action, with the contacts just previously being held engaged under considerable force. Thus, there is no decrease in the force exerted between the contacts 24 and 27 prior to the separation thereof by the bimetal switch blade 26, which reduces arcing between the contacts to a minimum. After the bimetal switch member 26 has caused opening of the contacts, it will, upon cooling, return the contact 27 into engagement with the contact 24 reestablishing the circuit through the bimetal switch blade member 26 creating again a magnetic field between the field piece and the armature 28 to hold the contacts 27 and 24 firmly closed.

It will be observed that the terminal 23 comprises a threaded screw whereby it may be adjusted relative to the bimetal switch blade 26 so that the normal contact pressure between the stationary contact 24 and the movable contact 27 may be adjusted by turning the terminal 23 to provide a desired predetermined contact pressure between the contacts 24 and 27.

Further in the circuit breaker described it will be observed that the bimetallic hinge member 30 is arranged so that it opposes the action of the bimetal switch blade 26 with substantially the same change in ambient temperature. The bimetal hinge bracket 30 is preferably made of heavy low resistance bimetal so that the predetermined contact pressure between the movable contact 27 and the stationary contact 24 depends substantially only on the current heating effect of the current flowing through the bimetal member 26 so that the contact pressure between the fixed and movable contacts is not effected by ambient temperature changes. The bimetallic hinge member 26 in addition to providing for compensation for changes in ambient temperature also prevents the metal in the thin bimetal elongated blade member 26 from exceeding its stress point and taking a set particularly when subjected to extreme high or low ambient temperature conditions, which if this were permitted to occur would interfere with the proper subsequent operation of the device.

It will be understood that in the embodiment of my invention hereinabove described that the field piece 33 may, if desired, be made of mild magnetic steel which will gradually become charged over a period of time thus providing a more positive snap action at low current values.

While I have shown what I consider to be the preferred embodiment of my invention it will be understood that various rearrangements and modifications may be made therein without departing from the spirit and scope of the invention.

I claim:

1. In a device of the class described, the combination of a base member of insulating material, a first terminal mounted in said base member extending at right angles thereto and having a contact at its outer end, a second terminal mounted in said base member extending at right angles thereto and spaced from said first terminal, a bimetal blade member supported at one end by said second terminal and extending toward said first terminal, a contact at the other end of

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said bimetal blade and normally maintained by the latter in engagement with the contact of said first terminal, said bimetal blade being disposed so that upon current flow therethrough in excess of a predetermined amount it is adapted to flex in a direction away from said base member to separate said contacts, a field piece supported at one end by said second terminal above said base member to extend substantially in parallel relation with respect to said bimetal blade member between the latter and said base member, said field piece being slotted at its other end to project beyond said first terminal and out of contact therewith, an armature fixed to said other end of said bimetal blade at right angles thereto and normally disposed to provide a gap between it and said other end of said field piece, whereby upon current flow through said bimetal blade member a magnetic field is set up in said gap between said armature and said field piece to bias said contacts together and oppose separation thereof by flexing of said bimetal blade member in a direction away from said base member, said bimetal blade member upon current flow in excess of a predetermined amount being adapted to exert a force in excess of the force of said magnetic field whereby said contacts are separated with a snap action.

2. In a device of the class described, the combination of a base member of insulating material, a pair of terminal members disposed in spaced apart relation and carried by said base member, a bimetal blade connected to one of said terminals disposed above and extending substantially parallel with said base member toward the other of said terminals, a contact at the other end of said bimetal blade and normally maintained by the latter in engagement with said other terminal, said bimetal blade being disposed so that upon current flow therethrough in excess of a predetermined amount, it is adapted to flex in a direction away from said base member to separate

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said contact from said other terminal, a field piece secured to said base member adjacent one end thereof and having its other end disposed above said base member between the latter and said bimetal blade, said other end of said field piece being of substantially U-shape and extending around and beyond said other terminal, an armature carried at said other end of said bimetal blade and extending at right angles thereto toward the other end of said field piece and forming an air gap therewith, whereby upon current flow through said bimetal blade member a magnetic field is set up in said gap between said armature and said field piece to bias said contact into engagement with said terminal and oppose separation of said contact from said terminal by flexing of said bimetal blade member in a direction away from said base member, and said bimetal blade member upon current flow in excess of a predetermined amount being adapted to exert a force in excess of the force of said magnetic field whereby said contact is separated with a snap action from said other terminal.

3. The device of claim 2 characterized by the provision of a bimetal bracket for connecting the bimetal blade with the said one terminal carried by said base member.

HAROLD H. CLAYTON.

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