

April 21, 1942.

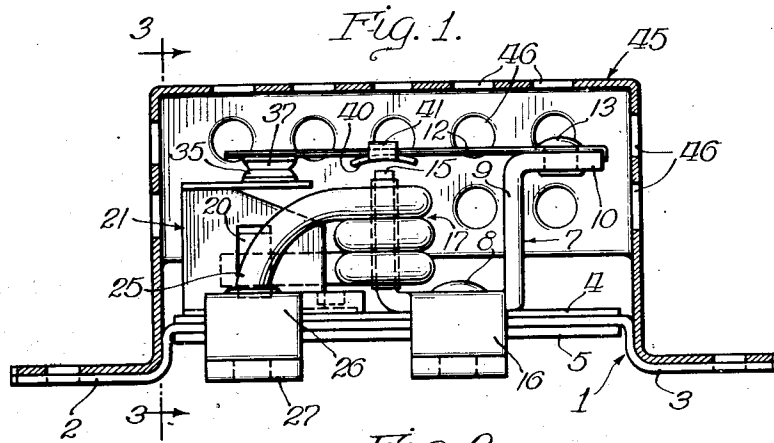
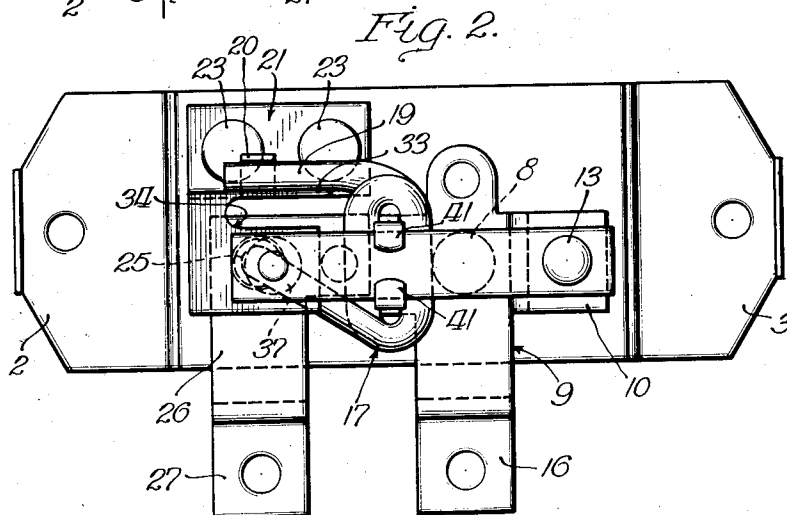
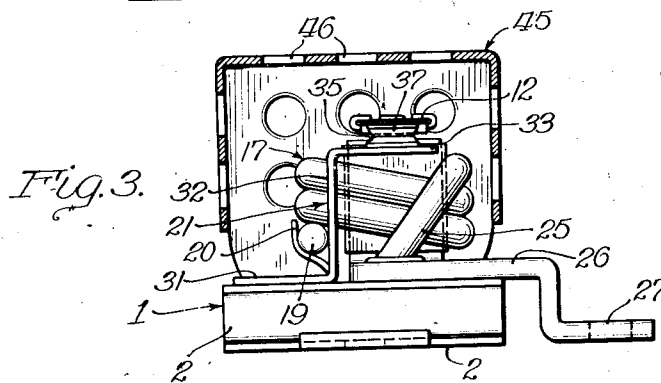
H. H. CLAYTON

2,280,281

CIRCUIT BREAKER

Filed Oct. 5, 1939

2 Sheets-Sheet 1



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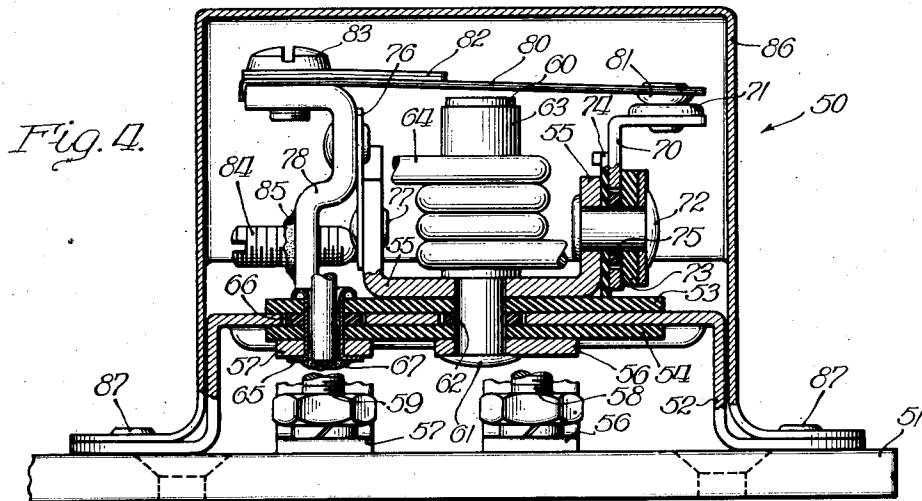
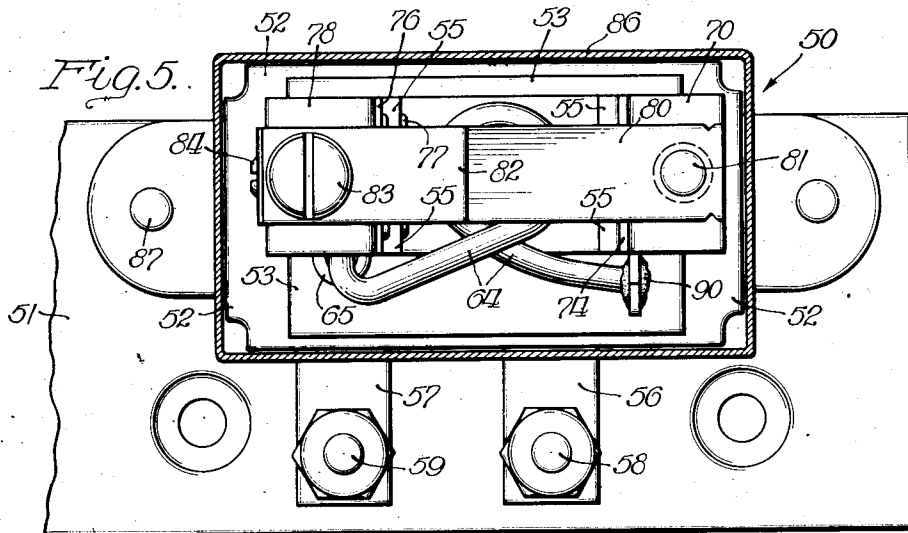
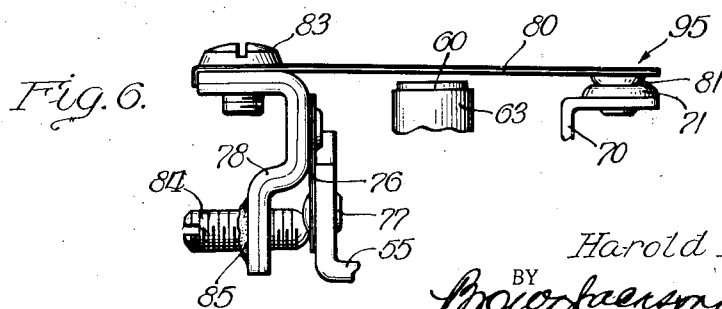
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CIRCUIT BREAKER

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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

2,280,281

CIRCUIT BREAKER

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Application October 5, 1939, Serial No. 297,995

15 Claims. (Cl. 200—88)

The present invention relates generally to devices for automatically interrupting the current through a circuit when an abnormal flow occurs, thereby protecting the device or devices to which current flowing through the circuit breaker is directed. More particularly, the present invention is concerned with the provision of a circuit breaker for automotive use, arranged to interrupt a circuit upon an overload and to automatically restore the circuit to closed position after a certain length of time.

The object and general nature of the present invention is the provision of a circuit breaker in which a thermally responsive member is operative to interrupt the circuit under abnormal conditions but is held by an electromagnet, also disposed in the circuit, against opening the circuit until the thermal element exerts sufficient force to overcome the pull of the electromagnet, thereby securing a circuit interruption at a rate that is sufficient to reduce or eliminate arcing. A further feature of this invention is the provision of a circuit breaker which includes an electromagnet operating in opposition to the thermal element so as to hold the contacts closed in a firm and positive manner, thereby preventing any tendency to open the circuit momentarily under conditions where the circuit breaker is subjected to jars and vibration.

These and other objects and advantages of the present invention will be apparent to those skilled in the art after a consideration of the following detailed description, taken in conjunction with the accompanying drawings, in which:

Figure 1 is a longitudinal section taken through a circuit breaker in which the principles of the present invention have been incorporated;

Figure 2 is a top view of the circuit breaker shown in Figure 1, with the perforated cover removed;

Figure 3 is a section taken along the line 3—3 of Figure 1;

Figure 4 is a longitudinal vertical sectional view of a modified form of circuit breaker forming another embodiment of my invention;

Figure 5 is a top plan view, partly in section, of the modified circuit breaker of Figure 4; and

Figure 6 is a side elevational view of modified thermal element mounting means.

Referring now more particularly to Figures 1 and 2, the reference numeral 1 indicates a base upon which the parts of the circuit breaker are carried, the ends of the base 1 being turned downwardly and bent outwardly, as indicated at 2 and 3, respectively, forming attaching ears by which

the circuit breaker may be mounted in place on any suitable support. The base plate 1 carries two insulating strips 4 and 5 on the inner and outer portions, respectively, of the base 1. A U-shaped core 7, formed of iron or the like, is supported on the base 1 by any suitable means, such as a rivet 8 which passes through the central portion of the U-shaped core member and through an opening in the base 1 and insulator plates 4 and 5, the mounting being such that the core 7 is out of electrical contact with the base 1. One side 9 of the member 7 is extended laterally, as at 10, to form a support for a thermally responsive member 12 which is riveted, as at 13, or otherwise secured to the end 10 and extends across the upper portion of the other side 15 of the U-shaped core member. The central part of the core member 7 is extended, as at 16, to form a terminal.

A coil 17 surrounds the core section 15, the latter forming the core proper for the coil 17, and one end of the latter, as indicated at 19, is fixed in electrical contact by a lug or tongue 20 to a bracket 21 fastened in insulated relation to the base plate 1 by any suitable means, such as rivets 23. The other end 25 of the coil 17 is fixed in any suitable manner to a plate 26 which extends laterally outwardly of the base 1 and has an end 27 formed as a terminal and lying alongside the terminal end 16 which, as best shown in Figure 2, is formed on or carried by the central portion of the U-shaped core member 9.

The bracket 21 includes a base 31, an upstanding portion 32, and a horizontal portion 33 disposed generally above the terminal plate 26, as best shown in Figure 3. A stationary contact 35 is fixed in any suitable manner to the bracket section 33. As best shown in Figures 1 and 2, the latter is formed with a rearward extension which possesses some resilience, due to the notched out construction, as indicated at 34 in Figure 2.

Preferably, the tongue 20 is punched from the vertical portion 32 of the bracket and then crimped against the coil end 19. The coil 17 may be formed of relatively heavy gage wire having an enamel or similar insulating covering, which is, of course, removed at the point where the ends 19 and 25 are connected to the bracket 21 and terminal plate 26, respectively.

The thermally responsive member 12 is preferably in the form of a bimetal strip secured at one end by the rivet 13 to the core lug 10, the other end of the strip 12 carrying a movable contact 37. An armature 40 formed of suitable material is carried by the strip 12 in axial align-

ment above the core section 15. The armature 40 preferably has ears 41 which are bent over and secured to the bimetal strip 12, as best shown in Figure 2. The ears 2 and 3 serve to support a cover 45 having a plurality of perforations 46 formed therein, and if desired the cover 45 may be riveted to the ears 2 and 3 so as to make a compact tamper-proof unit.

The operation of the circuit breaker of the present invention is substantially as follows:

The circuit breaker unit is, of course, designed to have a proper capacity for use with the system in which it is to be placed. Where the circuit breaker is adapted for automotive use, it may be inserted in the main line from the battery or generator to the various lamp, ignition, signalling circuits and the like so that normally current flows from the battery or generator through the circuit breaker unit to the various operating units. The bimetal strip 12 is constructed so that under normal conditions it exerts a spring force holding the contacts 35 and 37 in engagement. The normal current flows from the terminal 27 through the coil 17 to the bracket 21, and from thence to the contacts 35 and 37 on the bimetal strip 12, the arm section 9 and the terminal 16. The coil 17 is wound so that a normal current flow exerts an electromagnetic force against the armature 40, pulling down on the bimetal strip 12 and holding the contacts 35 and 37 firmly and positively in engagement. The heat due to a normal flow of current through the bimetal strip 12 is not sufficient to cause the strip to warp upwardly against the force of the electromagnet 17 holding the same down, but in the event of an overload, as for example a short circuit, there is sufficient flow of current through the bimetal strip 12 to cause the same to get sufficiently hot enough to warp upwardly and overcome the pull of the electromagnet 17, thus separating the contacts 35 and 37 and interrupting the circuit. Before this occurs, however, the bimetal strip 12 will be stressed an appreciable amount, otherwise it would not be possible to overcome the pull of the electromagnet 17. Hence, the moment the contacts 35 and 37 are separated and the electromagnet deenergized, the bimetal strip 12 quickly separates the contacts 35 and 37 so that little or no arcing occurs between the contacts. This is an important feature of my invention.

When the contacts 35 and 37 are separated, as described, the abnormal flow of current is interrupted, and since no current is then flowing through the bimetal strip 12, the same cools due to the circulation of air through the openings 46 in the cover 45, and gradually warps downwardly until the contacts 35 and 37 come into engagement. The moment this occurs the current flow through the unit is resumed, and the simultaneous energization of the electromagnet 17 exerts a force through the armature 40 against the bimetal strip 12 immediately pulling the contacts 35 and 37 into relatively high pressure engagement so that subsequent jars and vibration cannot produce a momentary separation of the contacts 35 and 37. If the unit was constructed so that vibrations produce momentary separations at the contacts 35 and 37, the resulting arcing at these points might soon cause them to freeze or stick, disabling the unit.

With a view of providing a circuit breaker compensated for change in ambient temperatures, the circuit breaker designated generally at 50 in Figures 4 and 5 of the drawings illustrates one

embodiment of my invention. The circuit breaker 50 comprises a base 51 on which is mounted a stamped member 52. Insulating members 53 and 54 are provided on the support member 52, and a frame 55 is carried on the top insulator 53. Terminals 56 and 57 are provided on the base 51 which turn up under the bottom insulator 54, as shown. Terminal posts 58 and 59 are provided for the terminals 56 and 57 respectively. A core 60 of an electromagnet is mounted on the center of the frame 55 and a reduced end passes through an aperture in the frame 55, insulating members 53 and 54, and support member 52, as shown. The core 60 is spun over at its lower end as shown at 61 to securely hold it in place. An insulating washer 62 insulates the core 60 from the support 52. A paper insulating tube 63 is disposed over the top of the core 60 to insulate it from the coil or solenoid 64 of the electromagnet. An eyelet 65 is provided through the insulating members 53 and 54 and the support 52 through which one terminal of the solenoid 64 may be connected to the terminal 57. The eyelet 65 is insulated from the support 52 by the insulating washer 66. The terminal of the solenoid 64 is secured to the eyelet 65 by a deposit of solder as shown at 67.

A contact support 70 carrying a contact 71 is mounted on the right upstanding arm of the frame 55 by a rivet 72 between insulating members 73 and 74. The support 70 is insulated from the rivet 72 by the insulating washer 75. A leaf spring 76 is secured to the left upstanding arm of the frame 55 by means of a rivet 77. A bracket 78 is mounted on the leaf spring 76 as shown, which carries a bimetallic thermally and magnetically responsive element 80. The bimetallic element 80 carries a second contact 81 which is adapted to cooperate with the contact 71 carried by the contact support 70. In order to compensate the bimetallic element 80 for changes in ambient temperature, a bimetallic compensating member 82 is mounted therewith as shown, while a holding screw 83 secures the bimetallic elements 80 and 82 to the bracket 78. In order to adjust the force with which the contact 81 is biased against the contact 71, an adjusting screw 84 is provided in the lower end of the bracket 78 which is adapted to bear against the center of the leaf spring 76. When the proper adjustment has been obtained by turning the adjusting screw 84 in or out as required, it may be held in place by a deposit of solder 85. In order to house the circuit breaker 50, a cover 86 is disposed thereover which may be secured to the support 52 and the base 51 by rivets 87 as shown.

In operation, the terminal posts 58 and 59 are connected in the circuit to be protected. The current flows through the solenoid or coil 64, thereby energizing the electromagnet and causing the bimetallic element 80 to be attracted to the core 60. The second terminal of the solenoid 64 is connected to the contact support member 70 by the deposit of solder as shown at 90 in Figure 5 of the drawings. The energizing current flows through the contact support member 70 through the closed contacts 71 and 81, through the bimetallic element 80, bracket 78, leaf spring 76, frame 55, lower reduced portion of the core 60, and through the terminal strip 56 to the terminal post 58. The bimetallic element 80 is adapted to bias the contact 81 against the contact 71 under normal current flow. If the current flow should exceed the predetermined safe load, the I^2R loss will heat the bimetallic ele-

ment 80 so as to cause it to turn away or upwardly and pull the contact 81 from the contact 71. The instant that the contacts 81 and 71 are separated, the circuit will be broken, thereby deenergizing the electromagnet energized by the solenoid 64, allowing the contact 81 to snap sharply from the contact 71. When the temperature of the bimetallic element 80 falls, it will again bias the contact 81 against the contact 71, thereby closing the circuit through the solenoid 64 and causing the bimetallic element 80 to be again attracted to the core 60. Instead of having the current pass directly through the bimetallic element 80, it might be passed through a heater element surrounding the bimetallic element 80.

It will be observed that not only is the bimetallic element 80 responsive to the heat due to the current, but also to any other rise in temperature. Accordingly, in order to make it substantially responsive only to the current heat, the compensating bimetallic member 82 is mounted therewith. The bimetallic compensating element 82 turns in the opposite direction of the bimetallic element 80 with the same change in temperature. In this manner changes in ambient temperature affecting the bimetallic element 80 are compensated for. The bimetallic compensating element 82 has a thin coating of oxide which tends to electrically insulate this element from the actuating element 80. Furthermore, this compensating element 82 is of high resistance material and is of short thick formation so that no appreciable current flow or resultant heating effect occurs within the compensating element.

Referring now to Figure 6 of the drawings, a modified form of mounting arrangement for the bimetallic element 80 is designated generally at 95. Instead of providing a separate compensating bimetallic element as 82 in Figures 4 and 5 of the drawings, the bracket 78, or the leaf spring 76, or both of these parts, may be of bimetallic metal. When either the bracket 78 or the leaf spring 76, or both of these parts, are composed of bimetallic metal, they are so disposed that their action opposes that of the bimetallic element 80 with the same change in ambient temperature. In this manner the biasing force with which the contact 81 is held against the contact 71 depends substantially only on the current heating effect on the bimetallic element 80. The bracket 78 and the leaf spring 76, whether made of bimetallic metal or not, are of low resistance material so as to reduce the heating effect of the current passing through these parts.

Since certain further changes may be made in the foregoing constructions, and different embodiments of the invention may be made without departing from the scope thereof, it is intended that all matter shown in the accompanying drawings or described hereinbefore shall be interpreted as illustrative, and not in a limiting sense.

I claim as my invention:

1. A circuit breaker comprising, in combination, a pair of contacts, a bimetallic element carrying one of said contacts, an electromagnet adapted to attract said bimetallic element, and a compensating bimetallic member operatively connected with said bimetallic element and adapted to compensate for the effect of change in ambient temperature on said bimetallic element, the solenoid of said electromagnet and said bimetallic element being in series circuit relationship when said contacts are closed, under normal current flow through the circuit breaker said bimetallic element and said electromagnet

biasing said contacts together, and said contacts being separated with snap action when excessive current flows causing said bimetallic element to flex so as to separate the contacts and thereby to deenergize said electromagnet and allow the contacts to spring apart.

2. A circuit breaker comprising, in combination, a pair of contacts, a bimetallic element carrying one of said contacts, electrical heating means for said bimetallic element, an electromagnet adapted to attract said bimetallic element, and a compensating bimetallic member operatively connected with said bimetallic element and acting oppositely thereto so as to compensate for the effect of change in ambient temperature on said bimetallic element, the solenoid of said electromagnet and said electrical heating means being in series circuit relationship when said contacts are closed, under normal current flow through the circuit breaker said bimetallic element and said electromagnet biasing said contacts together, and said contacts being separated with snap action when excessive current flows causing said bimetallic element to flex so as to separate the contacts and thereby to deenergize said electromagnet and allow the contacts to spring apart.

3. A circuit breaker comprising, in combination, a frame, a first contact supported from said frame and electrically insulated therefrom, a bracket supported by said frame, a first bimetallic element supported by said bracket, a second contact carried by said first bimetallic element adapted to cooperate with said first contact, a second bimetallic element mounted with said first bimetallic element and acting in opposition thereto so as to compensate said first bimetallic element for changes in ambient temperature, and an electromagnet for attracting said first bimetallic element, the solenoid of said electromagnet and said first bimetallic element being in series circuit relationship when said contacts are closed, under normal current flow through the circuit breaker said first bimetallic element and said electromagnet biasing said contacts together, and said contacts being separated with snap action when excessive current flows causing said first bimetallic element to flex so as to separate the contacts and thereby to deenergize said electromagnet and allow the contacts to spring apart.

4. A circuit breaker comprising, in combination, a frame, a first contact supported from said frame and electrically insulated therefrom, a bimetallic bracket supported by said frame, a bimetallic element supported by said bimetallic bracket, said bimetallic bracket adapted to compensate said bimetallic element for changes in ambient temperature, a second contact carried by said bimetallic element adapted to cooperate with said first contact, and an electromagnet adapted to attract said bimetallic element, the solenoid of said electromagnet and said bimetallic element being in series circuit relationship when said contacts are closed, under normal current flow through the circuit breaker said bimetallic element and said electromagnet biasing said contacts together, and said contacts being separated with snap action when excessive current flows causing said bimetallic element to flex so as to separate the contacts and thereby to deenergize said electromagnet and allow the contacts to spring apart.

5. A circuit breaker comprising, in combination, a frame, a first contact supported from said

frame and electrically insulated therefrom, a bimetallic spring supported by said frame, a bracket supported by said spring, a bimetallic element supported by said bracket, said bimetallic spring adapted to compensate said bimetallic element for changes in ambient temperature, a second contact carried by said bimetallic element adapted to cooperate with said first contact, and an electromagnet adapted to attract said bimetallic element, the solenoid of said electromagnet and said bimetallic element being in series circuit relationship when said contacts are closed, under normal current flow through the circuit breaker said bimetallic element and said electromagnet biasing said contacts together, and said contacts being separated with snap action when excessive current flows causing said bimetallic element to flex so as to separate the contacts and thereby to deenergize said electromagnet and allow the contacts to spring apart.

6. A circuit breaker comprising, in combination, a frame, a first contact supported from said frame and electrically insulated therefrom, a leaf spring supported from said frame, a bracket supported by said spring, a first bimetallic element supported by said bracket, a second contact carried by said first bimetallic element adapted to cooperate with said first contact, a second bimetallic element mounted with said first bimetallic element and adapted to compensate it for changes in ambient temperature, an adjusting screw carried by said bracket for regulating the force with which said leaf spring biases said contacts together, and an electromagnet for attracting said first bimetallic element, the solenoid of said electromagnet and said first bimetallic element being in series circuit relationship when said contacts are closed, under normal current flow through the circuit breaker said first bimetallic element and said electromagnet biasing said contacts together, and said contacts being separated with snap action when excessive current flows causing said first bimetallic element to flex so as to separate the contacts and thereby to deenergize said electromagnet and allow the contacts to spring apart.

7. In a protective circuit breaker, the combination of a stationary contact and a movable contact normally remaining in engagement, a thermally responsive element operative to move said movable contact out of engagement with said stationary contact when the temperature of said thermostatic element is raised substantially to a predetermined point, compensating means responding to ambient temperature and cooperating with said thermally responsive element, and a stationary electromagnet acting magnetically on said thermally responsive element and tending to hold said contacts in engagement, the resistance of said thermally responsive element being such that the heat generated from within said thermally responsive element by a predetermined overload current flow therethrough stresses said element with sufficient force to overcome the magnetic attraction of said electromagnet and thereby separates said contacts with a snap motion.

8. In a protective circuit breaker, the combination of a U-shaped stationary frame member, thermally responsive means including a bimetallic operator and a bimetallic compensator carried on one arm of said frame member, a stationary electromagnet carried by said frame member and acting magnetically on said bime-

tallic operator, a stationary contact, and a movable contact actuated by said bimetallic operator and normally remaining in engagement with said stationary contact, said electromagnet tending to hold said contacts in engagement, said thermally responsive means operating to move said movable contact out of engagement with said stationary contact when the temperature of said thermally responsive means is raised substantially to a predetermined point, said thermally responsive means, said electromagnet and said contacts being connected in series, whereby heat generated by a predetermined overload current flow stresses said thermally responsive means with sufficient force to overcome the magnetic attraction of said electromagnet and thereby separate said contacts with a snap motion.

9. In a protective circuit breaker, the combination of a U-shaped stationary frame member, thermally responsive means including a bimetallic element carried on one arm of said frame member, a stationary electromagnet carried by said frame member and acting magnetically on said bimetallic element, a stationary contact, a movable contact actuated by said bimetallic element and normally remaining in engagement with said stationary contact, said electromagnet tending to hold said contacts in engagement, said bimetallic element operating to move said movable contact out of engagement with said stationary contact when the temperature of said element is raised substantially to a predetermined point, said thermally responsive means, said electromagnet and said contacts being connected in series, whereby heat generated by a predetermined overload current flow stresses said bimetallic device with sufficient force to overcome the magnetic attraction of said electromagnet and thereby separate said contacts with a snap motion and a compensating element coacting with said bimetallic element to compensate for the effect of change in ambient temperature on said bimetallic element.

10. In a protective circuit breaker for series connection with a load circuit adapted normally to remain in closed circuit position in the load circuit and to move to open circuit position only upon an overload current flow in said load circuit, the combination of a U-shaped stationary frame member composed of magnetic material, a stationary contact carried on one arm of said frame member, a bimetallic strip, mounting means including a leaf spring for mounting said bimetallic strip on the other arm of said frame member, a movable contact carried by said metallic strip normally remaining in engagement with said stationary contact, said bimetallic strip flexing to move said movable contact out of engagement with said stationary contact when the temperature of said bimetallic strip is raised substantially to a predetermined point, and a stationary electromagnet comprising a magnetic core stationarily secured to said U-shaped frame member between the arms thereof and acting magnetically on said bimetallic strip tending to hold said contacts in engagement, said contacts, said bimetallic strip and said electromagnet being connected in series and the resistance of said bimetallic strip being such that the heat generated from within said bimetallic strip by a predetermined overload current flow therethrough stresses said strip with sufficient force to overcome the magnetic attrac-

tion of said electromagnet and thereby separates said contacts with a snap motion.

11. In a protective circuit breaker for series connection in a load circuit adapted normally to remain in closed circuit position in the load circuit and to move to open circuit position only upon an overload current flow in said load circuit, the combination of a U-shaped stationary frame member composed of magnetic material, a stationary contact carried on one arm of said frame member, a leaf spring carried by the other arm of said frame member, a mounting bracket carried by said leaf spring, a bimetallic strip mounted on said bracket, a movable contact carried by said bimetallic strip normally remaining in engagement with said stationary contact, said bimetallic strip flexing to move said movable contact out of engagement with said stationary contact when the temperature of said bimetallic strip is raised substantially to a predetermined point, a stationary electromagnet comprising a magnetic core stationarily secured to said U-shaped frame member between the arms thereof and acting magnetically on said bimetallic strip tending to hold said contacts in engagement, said contacts, said bimetallic strip and said electromagnet being connected in series, and the resistance of said bimetallic strip being such that the heat generated from within said bimetallic strip by a predetermined overload current flow therethrough stresses said strip with sufficient force to overcome the magnetic attraction of said electromagnet and thereby separates said contacts with a snap motion, and a compensating bimetallic member carried by one arm of said U-shaped frame member and coacting with said bimetallic strip to compensate for the effect of change in ambient temperature on said bimetallic element.

12. In a circuit breaking device, the combination of a pair of contacts, thermally responsive means operative to separate said contacts, said thermally responsive means being subjected to heating by the current flow through the device, an electromagnet acting in opposition to said thermally responsive means, said electromagnet being electrically connected to have its circuit opened when said contacts separate, and compensating means for compensating the device for ambient temperature.

13. In a circuit breaking device, the combination of a pair of contacts adapted to control a circuit, thermally responsive means operative to impart movement to one of said contacts, said thermally responsive means being electrically connected in series with said contacts whereby current flow through said contacts also passes through said thermally responsive means, an electromagnet opposing separation of said contacts, said electromagnet being electrically connected to have its circuit opened when said contacts separate, and compensating means disposed substantially out of the path of the current flow through the device for compensating said thermally responsive means for ambient temperatures.

14. In a circuit breaking device of the class described, the combination of a stationary contact and a cooperating movable contact adapted to control a circuit, a bimetallic actuating element operative to move said movable contact, said bimetallic actuating element having a circuit path therethrough so as to be heated by the current flow through the device, an electromagnet opposing separation of said contacts, the energization of said electromagnet being controlled by said contacts, and a bimetallic compensating element substantially isolated from the circuit path through said bimetallic actuating element but mechanically cooperating with said bimetallic actuating element to compensate the device for changes in ambient temperature.

15. In a circuit breaking device of the class described, the combination of a stationary contact and a cooperating movable contact adapted to control a circuit, a main bimetallic element carrying said movable contact at one end, mounting means establishing a movable hinge mounting for the other end of said main bimetallic element, magnetic means acting on an intermediate portion of said main bimetallic element and tending to retain said contacts in engagement, and a compensating bimetallic element carried by the movable hinge mounting of said main bimetallic element and compensating the device for changes in ambient temperature.

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