

Nov. 3, 1942.

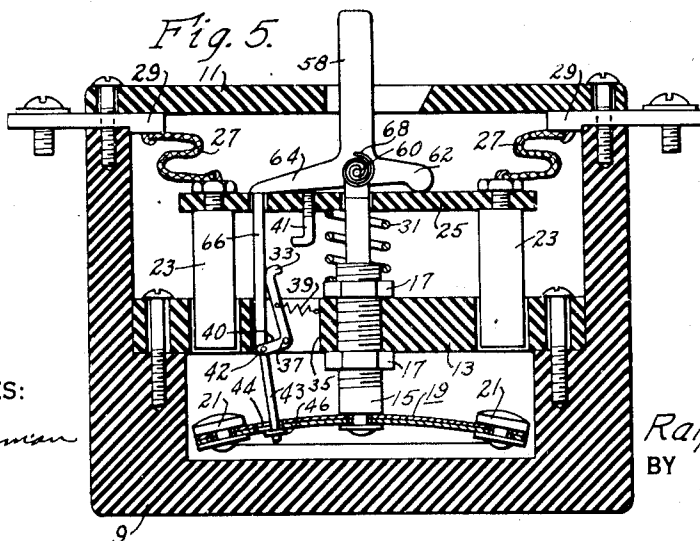
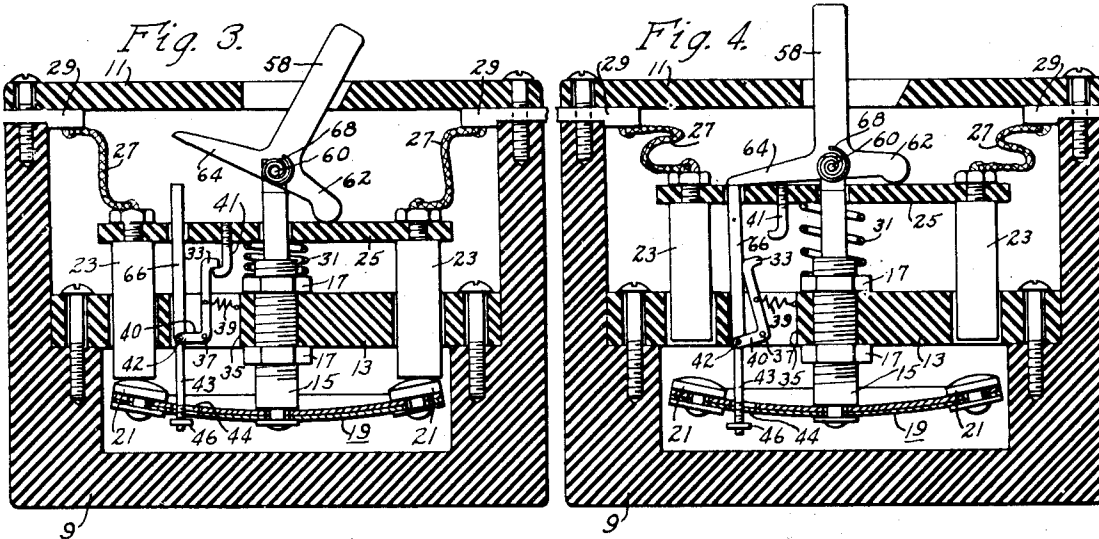
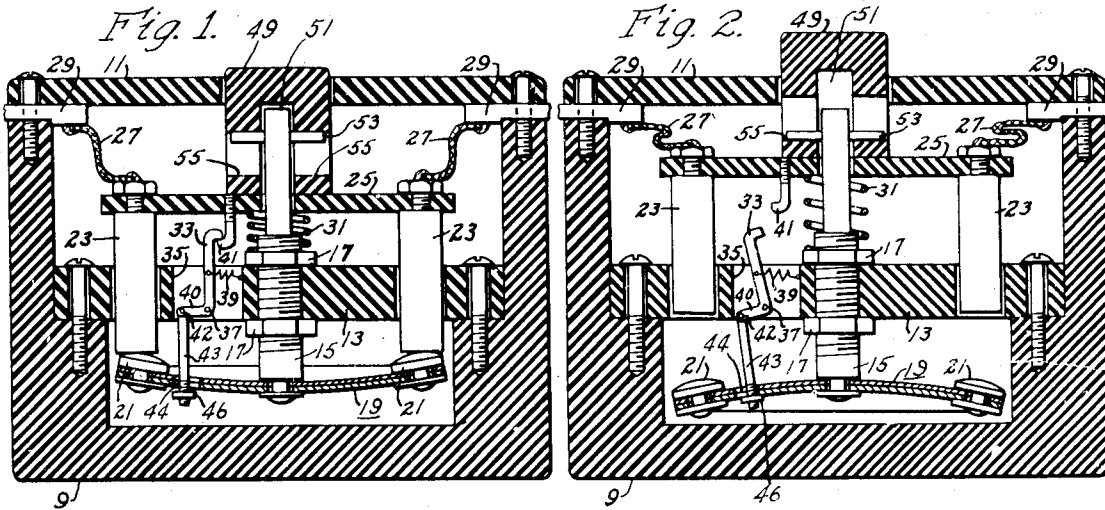
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2,300,530

CIRCUIT BREAKER

Filed Feb. 26, 1941

2 Sheets-Sheet 1



WITNESSES:

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Fig. 6.

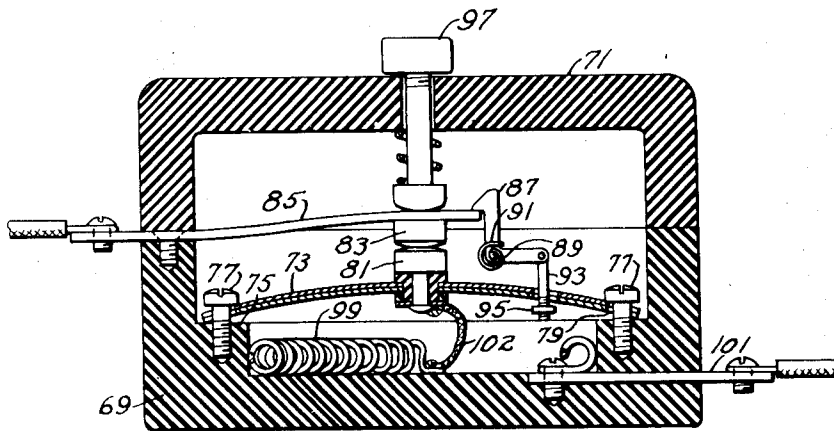
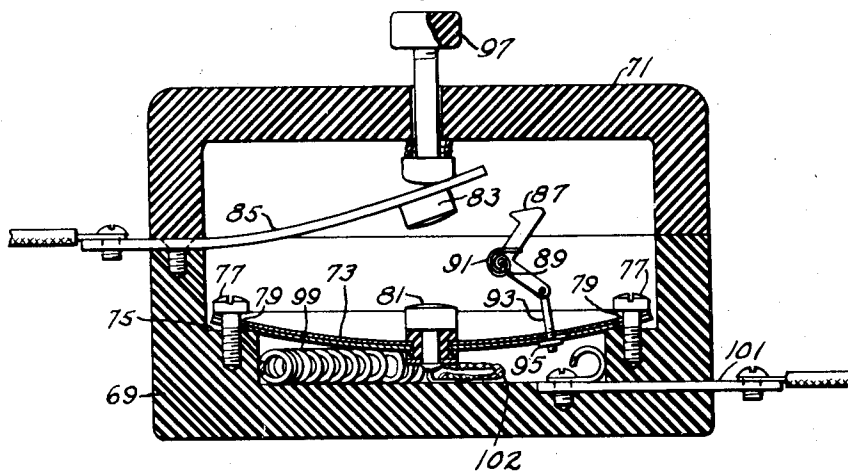


Fig. 7.



UNITED STATES PATENT OFFICE

2,300,530

CIRCUIT BREAKER

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Application February 26, 1941, Serial No. 380,637

13 Claims. (Cl. 200—122)

The invention relates to circuit interrupters of the manually resettable type having a snap-acting thermally responsive element or thermostat for automatically actuating the contacts thereof.

An object of the invention is the provision of an improved circuit breaker having relatively movable contacts which are automatically opened by a snap-acting thermostat in response to predetermined conditions and which cannot reclose until the manually operable handle is manually operated to reset the breaker.

Another object of the invention is the provision of an improved circuit breaker embodying a snap-acting thermally responsive element or thermostat which is operable to automatically open the contacts irrespective of the position of the manually operable handle.

Another object of the invention is the provision of a circuit breaker having relatively movable contacts which are automatically opened by a snap-acting thermostat and which cannot reclose until the breaker is reset by a manually operable handle, the construction being such that the thermostat is not moved by the handle at any time.

Another object of the invention is the provision of a circuit breaker having cooperating contacts, one carried by a snap-acting thermostat and the other being biased to an open position and movable by a manual operating handle to a position to be engaged by the contact on the thermostat, the thermostat being operable when heated a predetermined amount to cause movement of both of the contacts away from each other to open the circuit.

Another object of the invention is the provision of an improved circuit breaker which is simple, compact, safe and reliable in operation, and inexpensive to manufacture.

In accordance with the illustrated embodiments of the invention, the circuit breaker has a pair of cooperating contacts one of which is biased for movement away from the other and restrained by a latch and the other is carried by a snap-acting bimetal element which when heated a predetermined amount operates to move its contact to open position and also release the latch which restrains the first mentioned contact. A manually operable handle is provided for moving the first mentioned contact to latched position to reset the breaker. The operating handle may be arranged to manually open and close the breaker, in addition to resetting the breaker after it has been automatically opened by the thermostat.

The novel features that are considered charac-

teristic of the invention are set forth in the appended claims. The invention itself, however, both as to construction and operation, together with additional objects and advantages thereof will be best understood from the following detailed description of several embodiments thereof when read in conjunction with the accompanying drawings, in which:

Figure 1 is a sectional view of a circuit breaker constructed in accordance with the invention, the breaker being shown in closed-circuit position;

Fig. 2 is a view similar to Fig. 1, but showing the breaker in the tripped open-circuit position;

Fig. 3 is a sectional view of a circuit breaker constructed in accordance with a modification of the invention, the breaker being shown in the closed-circuit position;

Fig. 4 is a view similar to Fig. 3 illustrating the position of the parts when the circuit breaker is manually opened;

Fig. 5 is a view similar to Fig. 3, but showing the circuit breaker in the tripped open-circuit position;

Fig. 6 is a sectional view of another modification of the invention showing the circuit breaker in closed-circuit position; and

Fig. 7 is a view similar to Fig. 6, but showing the breaker in the tripped open-circuit position.

Referring to Figures 1 and 2 of the drawings, a circuit breaker constructed in accordance with the invention is shown mounted in a casing 9 of molded insulating material which has a cover 11 of the same material removably mounted on the open side. The casing 9 has an insulating support 13 therein upon which a stud 15 is centrally mounted. The stud 15 extends through the center of the support 13 and is retained in mounted position by lock nuts 17 which engage a threaded portion of the stud on opposite sides of the insulating support 13.

A snap-acting bimetal disc 19 is non-rotatably secured at its center to the inner end of the stud 15. The bimetal disc has a pair of contacts 21 secured thereto, adjacent the edge, on opposite sides of the center of the disc for engaging the inner ends of a pair of cylindrically shaped movable contacts 23 which movably extend through openings provided therefor in the insulating support 13. The movable contacts 23 are secured to a bar 25 of insulating material which is slidably mounted at its center on the stud 15 on the opposite side of the insulating support from the bimetal disc 19. The contacts 23 are electrically connected by flexible shunt conductors 27 to the opposite terminals 29 of the circuit breaker.

When the circuit breaker is in closed-circuit position, the current flows through the contacts 21 and 23 and through the bimetal disc 19 so that the disc is adapted to be heated in response to the current of the circuit.

The snap-acting bimetal disc 19 is composed of two united discs of sheet metal pressed into concave form, the composite piece being capable of being sprung with a snap action from either one of the other of two opposite or reversely flexed positions without having any intermediate position of stability. The metals of the united discs comprising the composite disc 19 are selected to have different coefficients of thermal expansion and the two parts are proportioned and constructed so that the disc 19 will snap from its normal flexed or concave position shown in Fig. 1 to an opposite flexed or concave position shown in Fig. 2 when the disc is heated a predetermined amount by overload current. After the disc has cooled to its normal temperature, it will automatically snap back to its normal flexed or concave position as shown in Fig. 1.

The insulating bar 25 and the movable contacts 23 are biased outwardly to an open-circuit position away from the cooperating contacts 21 by means of a compression spring 31 which encircles the stud 15 and is disposed between the insulating support 13 and the movable insulating bar 25. The insulating bar 25 and its contacts 23 are movable inwardly to a second or normal position, as shown in Fig. 1, in which the contacts 23 are adapted to be engaged by the cooperating contacts 21 of the bimetal disc 19 when the bimetal disc is in its normal flexed or concave position, and the insulating bar 25 and the movable contacts 23 carried thereby are adapted to be releasably held in this second or normal position by means of a pivoted latch 33.

The latch 33 is in the shape of a bell crank lever and is disposed in an opening 35 provided therefor in the insulating support 13. The latch 33 is pivotally mounted on a pivot pin 37 supported by the insulating support 13 and the latch is biased to a latched position by a spring 39. One arm of the bell crank latch 33 has a latch nose which is adapted to engage a projection 41 secured to the movable insulating bar 25 whereby the latch normally restrains the insulating bar and moving contacts 23 in the normal position shown in Fig. 1. The other arm 40 of the bell crank latch 33 has a link 43 pivotally connected thereto by a pivot pin 42, and the link extends through an opening 44 in an outer portion of the bimetal disc 19. A washer or collar 46 is secured to the lower end of the connecting link 43 in a position to be engaged and moved by the snap-acting bimetal disc 19 when the disc snaps from its normal flexed position, shown in Fig. 1, to the opposite flexed position shown in Fig. 2. The link 43 thus provides a connection between the bimetal disc 19 and the pivoted latch 33 whereby operation of the bimetal disc in response to predetermined overload conditions effects movement of the latch 33 to released position to release the movable contacts 23 and permit movement thereof to open-circuit position by the spring 31.

The construction of the circuit breaker is such that when the contacts are automatically opened by the operation of the bimetal disc 19, the movable contacts 23 will remain in open-circuit position, as shown in Fig. 2, even after the bimetal disc 19 has cooled to normal temperature, until

the circuit breaker is manually reset. A manual operating handle 49 of molded insulating material is provided for manually resetting the circuit breaker after a tripping operation. The operating handle 49 is slidably mounted on the outer end of the stud 15 by having a central opening 51 which slidably engages the stud. Inward and outward movement of the operating handle 49 is limited by a crosspin 53 on the outer end of the stud 15 which extends into elongated slots 55 provided in the opposite sides of the operating handle 49. The operating handle 49 extends through an opening provided therefor in the cover 11 of the circuit breaker casing and the inner end of the handle is adapted to engage and move the insulating bar 25 and the contacts 23 to the normal or latched position upon inward movement of the operating handle 49.

The operation of the circuit breaker is briefly as follows. With the circuit breaker in the closed-circuit position shown in Fig. 1, if an overload occurs on the circuit and persists for a sufficient length of time to heat the bimetal disc a predetermined amount, the bimetal disc operates to snap from its normal flexed position shown in Fig. 1 to the opposite flexed position shown in Fig. 2. This operation of the bimetal disc moves the contacts 21 carried thereby to a position away from the contacts 23 and also moves the pivoted latch 33 to released position to release the spring biased insulating bar 25. When the insulating bar 25 is thus released, the spring 31 moves the bar and its contacts 23 outwardly to open-circuit position, as shown in Fig. 2. It will thus be seen that the operation of the bimetal disc 19 causes movement of both sets of contacts 21 and 23 away from each other to open-circuit position. The movement of the insulating bar 25 and movable contacts 23 to open-circuit position effects movement of the operating handle 49 outwardly to its open position, thus indicating that the circuit breaker has been tripped. The circuit breaker is trip-free since holding the operating handle in closed position cannot prevent the bimetal disc from acting to move its contacts 21 to an open position away from the contacts 23 on the insulating bar 25.

After the bimetal disc 19 has cooled to normal temperature, it automatically snaps back to its normal flexed position. This does not reclose the circuit breaker, however, since the contacts 23 carried by the insulating bar 25 are still in their open-circuit position. To reset and reclose the circuit breaker, the operating handle 49 must be manually moved inwardly to closed position. This movement of the operating handle 49 moves the insulating bar 25 and the contacts 23 to their normal or latched position wherein they are releasably held by the pivoted latch 33. The circuit breaker cannot be reset or reclosed, however, until the bimetal disc 19 has cooled and returned to its normal flexed position, since when the bimetal disc is in its inverted position, the latch 33 is held in released position and the contacts 21 in an open-circuit position. If the bimetal disc 19 has cooled and returned to its normal flexed position, manual movement of the operating handle 49 inwardly returns the movable contacts 23 to their normal position in engagement with the cooperating contacts 21, and the movable contacts 23 are releasably held in closed position by the latch 33.

Although the bimetal disc 19 has been described as being heated in response to the current

flow in the circuit and operable in response to predetermined overload conditions, the bimetal disc may be arranged to be heated in response to the temperature of the device which it controls, instead of by the current flow through the disc. Also, the contacts 21 carried by the bimetal disc 19 may be insulated from the disc and have a heating coil connected therebetween to heat the bimetal element.

A modification of the invention is shown in Figs. 3, 4 and 5. In this modification, the construction of the circuit breaker is identical to that of the original embodiment described above except that a manual operating handle is provided which is operable to manually open and close the contacts in addition to resetting the breaker after a tripping operation. The parts of the circuit breaker which are identical to the corresponding parts of the circuit breaker shown in Figs. 1 and 2 have been indicated by the same reference characters. Referring to Figs. 3, 4 and 5, the circuit breaker is provided with an operating handle 58 of molded insulating material which is pivotally mounted on the outer end of the stud 15 by a pivot pin 60. The operating handle, in addition to having a handle portion by which it is manually operated, has an arm 62 extending on one side of the pivot 60 for engaging and moving the insulating bar 25 inwardly to its normal position to manually close or reset the circuit breaker when the operating handle is moved in a clockwise direction to its closed or "on" position. The operating handle 58 is also provided with a second arm 64 extending on the opposite side of the pivot 60, and this arm is adapted to engage and depress a rod 66 connected to the pivoted latch 33 to effect release of the insulating bar 25 and contacts 23 when the operating handle is moved in a counterclockwise direction to its open or "off" position, thus causing movement of the movable contacts 23 to open-circuit position. The rod 66 extends through an opening provided therefor in the insulating bar 25 and the lower end of the rod is pivotally connected to the arm 40 of the latch 33 by the same pivot pin 42 which connects the link 43 to the latch.

The operation of this modification of the invention is briefly as follows. Assuming the circuit breaker to be in the open-circuit position shown in Fig. 4, to manually close or reset the breaker, the operating handle 58 is moved in a clockwise direction to closed position. This movement of the handle moves the insulating bar 25 and movable contacts 23 inwardly to the normal or latched position shown in Fig. 3, wherein the contacts 23 engage the cooperating contacts 21 on the bimetal disc 19. The insulating bar 25 and movable contacts 23 are releasably held in closed position by the pivoted latch 33 against the force of the circuit opening spring 31.

To manually open the circuit, the operating handle 58 is moved in a counterclockwise direction to its open or "off" position. During this movement of the operating handle the arm 64 thereof engages and depresses the rod 66 connected to the latch 33 and thus moves the latch to released position to release the insulating bar 25. As soon as the insulating bar 25 is released, the spring 31 moves the insulating bar and its contacts 23 outwardly to open circuit position, thus opening the contacts of the breaker.

The automatic operation of the circuit breaker in response to predetermined overload conditions is substantially the same as in the original em-

bodiment previously described. When the bimetal disc 19 has been heated a predetermined amount by overload current, it operates to snap from its normally flexed position, shown in Fig. 3, to the oppositely flexed or inverted position shown in Fig. 5. This operation of the disc moves the contacts 21 to open position away from the cooperating contacts 23 and also moves the pivoted latch 33 to the released position to release the movable insulating bar 25. When the insulating bar 25 is thus released, the spring 31 moves the bar 25 and its contacts 23 outwardly to open-circuit position, as shown in Fig. 5. After the bimetal disc 19 is cooled to normal temperature, it automatically returns to its normal flexed position. This does not reclose the circuit breaker, however, since the contacts 23 carried by the insulating bar 25 are still in their open-circuit position, so that the breaker cannot be reclosed until it has been manually reset by the operating handle.

To reset or reclose the breaker, the operating handle 58 is moved in a clockwise direction to its closed or "on" position. This movement of the operating handle causes the arm 62 of the handle to engage and move the insulating bar 25 and movable contacts 23 inwardly to their normal or latched position, as shown in Fig. 3, thus reclosing the contacts of the breaker. The circuit breaker is trip-free since holding the operating handle 58 in closed position cannot prevent the bimetal disc 19 from moving its contacts 21 to open position away from the contacts 23 when the disc is heated a predetermined amount and snaps to its inverted position.

If desired, the operating handle 58 may be biased in a clockwise direction toward its closed position by a light spring 68 so as to maintain the arm 62 of the operating handle in engagement with the movable insulating bar 25. The light spring 68 resiliently maintains the operating handle 58 in closed position when the circuit breaker is in closed position. However, if the contacts are manually opened by operation of the handle 58 or automatically opened by operation of the bimetal disc 19, the outward movement of the insulating bar 25 causes the operating handle 58 to assume an intermediate indicating position to indicate that the circuit breaker is open, thus the operating handle serves to indicate the position of the breaker.

A further modification of the invention is shown in Figs. 6 and 7. In this modification, the circuit breaker is mounted in a casing 69 of molded insulating material which has a cooperating cover 71 of the same material removably secured to the open side thereof. A snap-acting disc 73 of bimetallic material is mounted within the casing 69 with its edge bearing against a circular shoulder 75 formed in the casing. A plurality of cap screws 77 threaded into the shoulder 75 serve to retain the bimetal disc in mounted position. The cap screws 77 extend through openings or slots 79 provided therefor in the edge of the bimetal disc 73, the arrangement being such as to provide a limited amount of movement of the edge of the disc relative to the cap screws 77 so as to permit the bimetal disc to snap freely from either one to the other of two oppositely flexed positions without any binding action by the screws 77. The bimetal disc 73 is composed of two united discs of sheet metal pressed into concave form, the composite piece being capable of being sprung with a snap action from one to the other of two opposite or reversely flexed

positions. The metals of the united discs comprising the composite disc 73 are selected to have different coefficients of thermal expansion and the two parts are constructed so that the disc 73 will snap from its normal flexed position shown in Fig. 6 to an opposite flexed or inverted position shown in Fig. 7 when the disc is heated a predetermined amount. After the disc has cooled to its normal temperature, it will automatically snap back to its normal flexed position. The bimetal disc 73 has a contact 81 mounted thereon at the center of the disc for engaging a cooperating contact 83 which is mounted on a spring arm 85 of conducting material. One end of the spring arm 85 is secured to the casing 69 and the end which carries the movable contact 83 is normally held down by a pivoted latch 87. The latch 87 is pivotally mounted on a pivot pin 89 supported by the casing 69 and is biased to latching position by a relatively light spring 91. One arm of the latch 87 has a latch nose which is adapted to engage the free end of the spring arm 85 and the other arm of the latch has a link 93 pivotally connected thereto which extends through an opening provided therefor in the bimetal disc 73. A washer or collar 95 is secured to the lower end of the link 93, beneath the bimetal disc 73 so that when the bimetal disc snaps from its normal position to its opposite or inverted position, it will cause movement of the latch 87 to released positions to effect release of the spring arm 85 and movable contact 83.

An operating handle or push button 97 of molded insulating material is slidably mounted in an opening provided therefor in the cover 71 of the casing for resetting or reclosing the circuit breaker after it has been automatically tripped open by the bimetal disc 73. The lower end of the push button or handle 97 is adapted to engage and move the spring arm 85 and the movable contact 83 back to the normal latched position, as shown in Fig. 6, when the handle 97 is manually depressed.

The snap-acting bimetal disc 73 is adapted to be heated in response to the current of the circuit by a separate electrical heating resistance 99 which is disposed within the casing 69 directly below the bimetal disc 73. One end of the electrical heating resistance 99 is electrically connected to a terminal 101 mounted at one end of the circuit breaker casing and the other end of the heating resistance is connected by a flexible shunt conductor 102 to the movable contact 83 which is insulatively mounted on the center portion of the bimetal disc. One end of the spring contact supporting arm 85 extends outside of the casing 69 to form the other terminal of the circuit breaker.

The operation of the circuit breaker is briefly as follows. When the circuit breaker is in the closed-circuit position, as shown in Fig. 6, and an overload occurs which persists for a sufficient length of time to heat the bimetal disc 73 a predetermined amount, the disc 73 snaps from its normal flexed position to an opposite flexed or inverted position as shown in Fig. 7. This operation of the bimetal disc 73 moves the contact 81 carried thereby to an open position away from the cooperating contact 83 and at the same time operates to move the latch 87 to released position to effect release of the spring arm 85. When the spring arm 85 is thus released, it moves outwardly to the position shown in Fig. 6 causing movement of the contact 83 to an open-circuit position. This movement of the spring arm 85

also moves the push-button operating handle 97 outwardly to open position to indicate that the circuit breaker has been automatically opened.

After the bimetal disc 73 has cooled to its normal temperature, it snaps back to its normal flexed position. This does not reclose the circuit breaker, however, since the cooperative contact 83 carried by the spring arm 85 is still in its open-circuit position and the circuit remains open. To reset the circuit breaker, the push-button handle 97 is manually moved inwardly and this movement of the handle returns the spring arm 85 and contact 83 back to their normal latched position in which the arm 85 is re-engaged and held by the latch 87 and the contact 83 engages the cooperating contact 81.

The circuit breaker is trip-free since holding the push-button handle down cannot prevent the bimetal disc 73 from moving its contact 81 to open position away from the contact 83 when the disc is heated a predetermined amount and snaps to its inverted position.

It will be noted that in each of the embodiments of the invention, the bimetal element or disc is not moved by the operating handle. This is an important advantage over prior art constructions where the bimetal disc is manually moved by the operating member. Manual movement of the bimetal element or disc is undesirable as it may strain the element and change its operating characteristic, particularly when the bimetal element is still hot and is forced overcenter.

While the invention has been disclosed in accordance with the provisions of the patent statutes, it is to be understood that various changes in the structural details and arrangement of parts thereof may be made without departing from some of the essential features of the invention. It is desired, therefore, that the invention be limited only by the reasonable construction of the language of the appended claims.

I claim as my invention:

1. A circuit breaker comprising a pair of separable contacts, operating means therefor comprising manual means for moving at least one of said contacts to close the breaker, and means including a snap acting thermally responsive element operable in response to predetermined conditions to cause movement of both of said contacts away from each other to automatically open the circuit.

2. A circuit breaker comprising a pair of separable contacts, operating means therefor comprising an operating member for moving at least one of said contacts to close the breaker, and means including a snap acting thermally responsive element operable in response to predetermined conditions to cause movement of both of said contacts away from each other to automatically open the circuit, said thermally responsive element when operated causing opening of said contacts irrespective of the position of said operating member.

3. A circuit breaker comprising a pair of separable contacts, operating means therefor comprising a snap acting thermally responsive element operable when heated a predetermined amount to cause movement of both of said contacts away from each other to automatically open the circuit, and a manual operating member operable to restore one of said contacts to a position to be engaged by the other when said thermally responsive element cools to its normal temperature.

4. A circuit breaker comprising a first movable

contact, operating means including an operating member for moving said contact, a snap acting thermally responsive element, a second contact carried by said element for engaging said first contact, said thermally responsive element when heated a predetermined amount operating to cause movement of both of said contacts away from each other to automatically open the circuit.

5. A circuit breaker comprising a pair of separable contacts, one of said contacts being biased to an open position away from the other, a latch for releasably restraining said one contact in a position to be engaged by the other contact, an operating member for moving said one contact to latched position, and a snap acting thermally responsive element operable in response to predetermined conditions to move said other contact away from said one contact and to cause said latch to release said one contact.

6. A circuit breaker comprising a pair of separable contacts, means biasing one of said contacts to an open position away from the other contact, a latch for releasably restraining said one contact in a position to be engaged by the other contact, a snap acting bimetal element heated in response to the current of the circuit for controlling said contacts, said bimetal element when heated a predetermined amount operating to move said other contact away from said one contact and causing said latch to release said one contact.

7. A circuit breaker comprising a pair of separable contacts, one of said contacts being movable to an open position away from the other contact and to a second position to be engaged by the other contact, a snap acting bimetal element carrying the other contact, said bimetal element being operable in response to predetermined conditions to cause movement of both of said contacts away from each other to automatically open said contacts, said one contact remaining in open position until manually operated to its second position.

8. A circuit breaker comprising a pair of separable contacts, one of said contacts being biased to open position away from the other and movable to a second position to be engaged by the other contact, means for releasably restraining said one contact in its second position, a snap acting bimetal element carrying the other contact, said bimetal element being heated in response to the current of the circuit and operable when heated a predetermined amount to cause movement of both contacts away from each other to automatically open the contacts, and an operating member operable to move said one contact to its second position.

9. A circuit breaker comprising a pair of spaced contacts carried by a movable insulating member, a snap acting bimetal disc supported at its center on a fixed support and having a normal flexed position, a pair of contacts carried by said bimetal disc adjacent the edge thereof for engaging the contacts on said insulating member, spring means biasing said insulating member to an open position in which the contacts thereof are away from the contacts on said bimetal disc, means for releasably restraining said insulating member in a second position in 70

which the contacts thereon are engaged by the contacts on said bimetal disc in the normal flexed position of the disc, said bimetal disc being heated in response to the current of the circuit and operable when heated a predetermined amount to snap from its normal flexed position to an opposite flexed position to move its contacts away from the contacts of said insulating member and to effect release of said insulating member, and handle means for moving said insulating member to its second position.

10. A circuit breaker comprising a pair of separable contacts, one of said contacts being mounted on a spring arm and biased thereby to an open position away from the other contact, a latch for releasably restraining said one contact in a second position to be engaged by the other contact, an operating handle for moving said one contact to its second position, a snap acting bimetal element carrying the other contact, said bimetal element when heated a predetermined amount operating to move the contact carried thereby away from said one contact and causing said latch to release said one contact.

11. A circuit breaker comprising a pair of separable contacts, operating means including an operating member manually operable to move one of said contacts to an open position away from the other contact and to a second position to engage the other contact, a thermally responsive snap acting element for moving the other contact, said thermally responsive element being operable in response to predetermined conditions to cause movement of both of said contacts away from each other to automatically open the circuit.

12. A circuit breaker comprising a pair of separable contacts, one of said contacts being biased to an open position away from the other contact, means for releasably restraining said one contact in a second position to be engaged by the other contact, a snap acting bimetal element carrying the other contact, said bimetal element being operable in response to predetermined conditions to cause movement of both of said contacts away from each other to automatically open the circuit, and an operating member manually operable to cause movement of said one contact to said open position or to said second position to manually open and close the circuit.

13. A circuit breaker comprising a pair of separable contacts, one of said contacts being biased to an open position away from the other contact, a latch for releasably restraining said one contact in a second position to be engaged by the other contact, a snap acting bimetal element carrying the other contact, said bimetal element being heated in response to the current of the circuit and operating when heated a predetermined amount to move the contact carried thereby away from said one contact and to cause said latch to release said one contact, and a movable operating handle operable to cause said latch to release said one contact to cause movement thereof to open position and operable to move said one contact to its second position to manually close the circuit.

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