June 1, 1943. O. S. JENNINGS 2,320,437

CIRCUIT BREAKER

Filed May 7, 1941 2 Sheets-Sheet 1

Fig. 1.

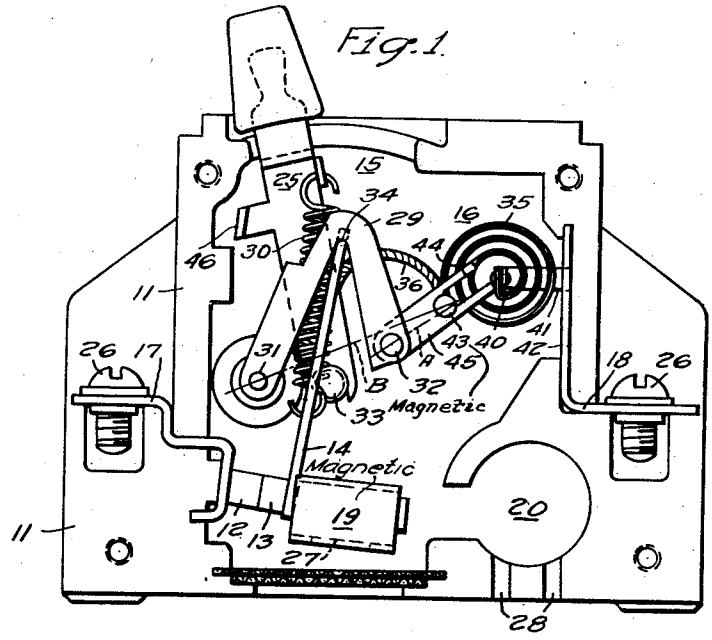

Fig. 2.

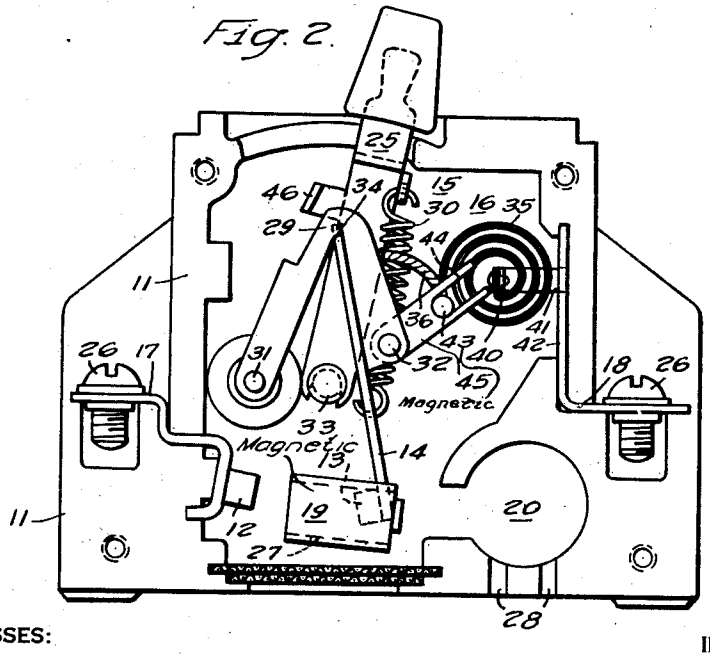

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Fig. 3

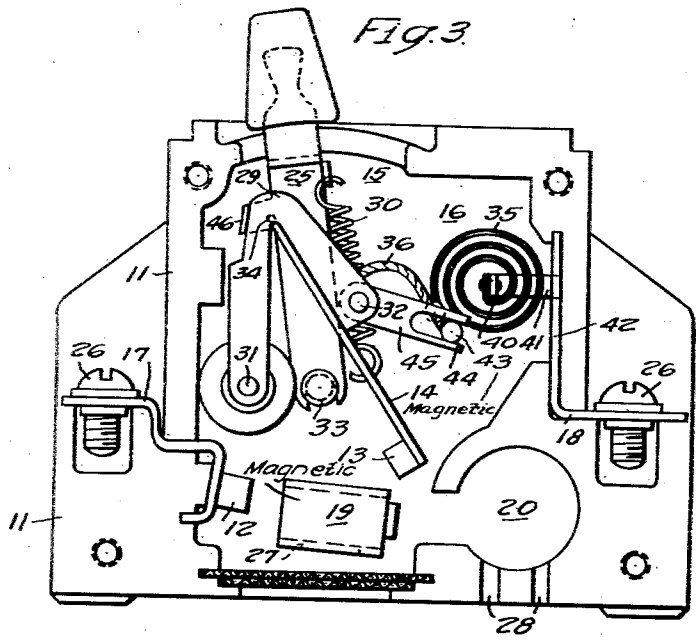
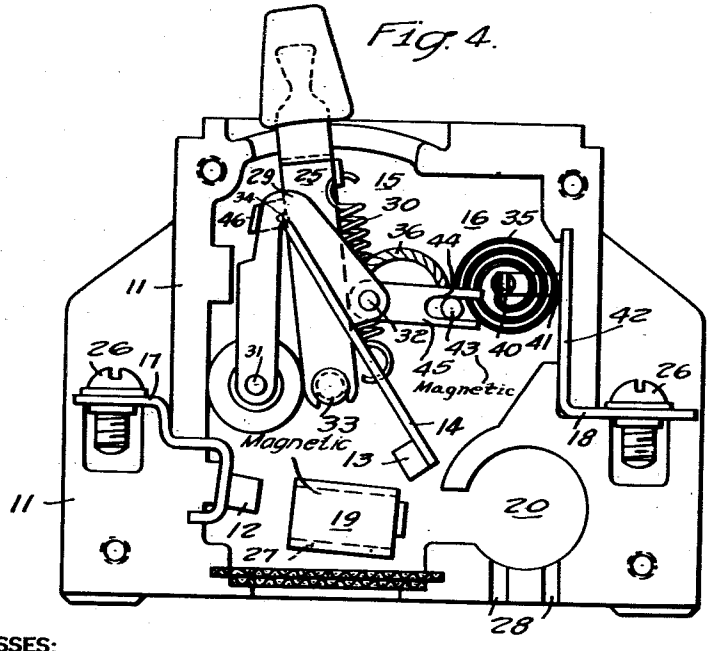


Fig. 4.



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UNITED STATES PATENT OFFICE

2,320,437

CIRCUIT BREAKER

Oliver S. Jennings, Pittsburgh, Pa., assignor to Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., a corporation of Pennsylvania

Application May 7, 1941, Serial No. 392,210

21 Claims. (Cl. 200—88)

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

One object of this invention is to provide an improved circuit breaker which shall be economical to manufacture and have a minimum number of parts.

Another object is to provide a circuit breaker having an improved combined thermally and magnetically responsive tripping device.

Another object of the invention is the provision of a circuit breaker having a combined thermally and magnetically responsive tripping means comprising a toggle which is operable in response to predetermined overload conditions to cause automatic opening of the circuit breaker.

Another object of the invention is the provision of a circuit breaker wherein one link of the holding and tripping toggle is responsive to current overloads to release the breaker mechanism.

Another object is to provide a circuit breaker having a mechanism releasable to cause automatic opening of the breaker, and a self-actuated toggle for normally holding the mechanism against release, the self-actuated toggle being operable in response to predetermined current conditions to release the mechanism.

Still another object of the instant invention is the provision of a circuit breaker embodying a thermally and magnetically responsive toggle which is self-adjusting as to position and/or length to restrain or release the breaker mechanism.

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

Figure 1 is a side elevational view of the circuit breaker with the side plate of the casing removed to illustrate the mechanism, the breaker being shown in the closed circuit position;

Fig. 2 is a view similar to Fig. 1, but showing the positions of the parts after the circuit breaker has been opened manually;

Fig. 3 is a view in side elevation similar to Fig. 1, but showing the positions of the parts just after the breaker has been tripped in response to a persistent overload current below a predetermined value;

Fig. 4 is a view similar to Fig. 1 but showing the parts in the positions they assume when the breaker is tripped in response to a sudden overload above a predetermined value, or by a short circuit.

Referring to Figure 1 of the drawings, the circuit breaker of the present invention includes a housing **11** constructed in two separable parts of molded insulating material, a stationary contact **12**, a movable contact **13** cooperating with the stationary contact, a contact arm **14**, an operating mechanism indicated generally at **15**, a thermally and magnetically responsive trip device indicated generally at **16**, a pair of terminals **17** and **18** for connecting the breaker in an electrical circuit, an arc quenching device **19** and a vapor collector **20**.

The part of the housing **11** shown in Figs. 1, 2 and 3 is open at one side and recessed to receive the various parts of the circuit breaker. The parts are assembled through the open side of the housing, and a side closure plate (not shown) which forms the other part of the housing is mounted on the open side of the section **11** to complete the housing and retain the parts in mounted position.

The entire breaker mechanism is enclosed in the housing **11** with the exception of the operating end of a manually operable lever **25** and the terminal ends of the terminals **17** and **18** which project out through openings in the end walls of the housing. Each terminal is provided with suitable means, preferably screws **26** for connecting the breaker in an electrical circuit. The stationary contact **12** is rigidly mounted on the inner end of the terminal **17**, and the movable contact is rigidly mounted on the contact arm **14**.

The arc quenching device **19** comprises a metal box made of a single piece of magnetic material into which the arc is drawn by the magnetic forces when the movable contact **13** passes into the quenching box. This lengthens and extinguishes the arc. An opening **27** is provided in the back wall of the box **19**, through which the gases may be vented. When the current interrupted is of high magnitude, such as a short circuit, the metal vapors and gases resulting from the rupture of a heavy current are collected and the metal condensed in the chamber **20** provided for that purpose in the housing **11**. Vents **28** are provided in the housing **11** through which the gases may pass to the exterior of the housing.

The operating mechanism of the circuit break-

er includes a releasable member 29 on which the contact arm 14 is pivotally supported, the manually operable lever 25, and an overcenter spring 30 connected under tension between the contact arm 14 and the operating lever 25. The releasable member 29 comprises a pair of identical arms (only one being shown) spaced apart and mounted at one end on a pivot 31 supported in the side wall of the housing. The free ends of the arms are joined by a stud 32. The pivoted end of the manual operating lever 25 is bifurcated and straddles a headed stud 33 projecting inwardly from the housing wall, the stud 33 acting as a pivot point for the lever. The contact arm 14 is bifurcated at one end to form spaced legs (only one being shown herein) the ends of which legs are notched to pivotally engage the spaced arms of the releasable lever 29 at the apex of the releasable lever as indicated at 34.

The overcenter spring 30 acting through the contact arm 14 constantly biases the releasable member 29 in a counter-clockwise direction. The lever 29, however, is normally restrained in its normal position as shown in Fig. 1 by the trip device 16.

The circuit breaker may be operated manually to interrupt the circuit by moving the operating lever 25 in a clockwise direction from the position in which it appears in Fig. 1 to the position indicated in Fig. 2. As soon as the line of action of the spring 30 passes to the right of the pivot point 34 of the contact arm 14, the spring acts to move the contact arm with a snap action to its open circuit position in which it is shown in Fig. 2. Reverse movement of the operating lever 25, that is, in a counter-clockwise direction from its position in Fig. 2 to the position in which it is shown in Fig. 1, closes the contacts. During this movement as soon as the spring 30 passes overcenter to the left of the pivot point 34 it acts to rock the contact arms 14 clockwise with a snap action to its closed circuit position (Fig. 1).

The circuit breaker is adapted to be opened automatically in response to predetermined overload conditions by the trip device 16 which forms an important feature of the invention. This trip device includes a spiral bimetal element 35 having its inner end rigidly secured to a bar 40 formed on a projection 41 of an extension 42 of the terminal 18. A stud 43 of magnetic material is rigidly secured to the free outer end of the bimetal element 35. This stud is embraced by an open slot 44 in the end of a link 45 which has its other end pivoted to the stud 32 of the releasable member 29.

The stud 43 can thus be seen to act as the knee of a toggle comprising the link 45 and the spiral bimetal 35. Under normal current conditions, the toggle 35—45 is overcenter above a line indicated at A drawn through the center of the stud 32 and the center of the spiral element 35, thus restraining the releasable member 29 in its normal position against the action of the spring 30. A second toggle is formed by the member 29 and the link 45. The stud 32 acts as the knee pin for this toggle and is normally overcenter below the center line 31—43 indicated at B. The parts appear in their normal position in Fig. 1.

The bimetal element 35 and the contacts 12—13 are connected in series so as to be traversed by the current of the circuit controlled by the breaker, the circuit extending as follows: Terminal 17, contacts 12 and 13, contact bar 14, a flexible shunt conductor 36, stud 43, bimetal element 35 to the terminal 18.

When heated in response to persistent overload currents below a predetermined value, the spiral bimetal element 35 has the characteristic of moving in a counterclockwise direction. When the bimetal element has been heated a predetermined amount by the overload current, it moves the stud 43 below the center line A. When this occurs the spring 30 acting on the member 29 aids the deflection of the bimetal 35 and moves the stud 32 above the center line B, causing the toggle 29—45 to break. After the toggle 29—45 has broken, the spring 30 acts to rock the member 29 quickly counterclockwise. During this movement, the pivot point 34 of the contact arm 14 passes the center of action of the spring 30, whereupon the spring acts to rock the contact arm 14 counterclockwise with a snap action to open the contacts 12—13 thus interrupting the circuit.

When a sudden heavy overload, say, for instance, 1000% or more of the normal current value for which the breaker is rated, or a short circuit occurs, the breaker is tripped instantaneously. Under such circumstances the coil of the bimetal element 35 exerts a powerful magnetic attraction on the stud 43 which, as above stated, is of magnetic material. This stud, therefore, acts as an armature and when attracted by the coil 35 in response to a sudden heavy overload moves substantially radially toward the center of the spiral bimetal coil 35 (Fig. 4). In addition to the attraction of the coil for the armature 43 there is an additional magnetic action of the bimetal element. The turns of the bimetal are drawn together by reason of the magnetic attraction between adjacent turns due to the current flowing in the same direction in the several turns.

It may be stated here that the stud 43 may be made of non-magnetic material in which case the bimetal coil 35 would function in somewhat the same manner to trip the breaker on overload currents above approximately 1000% of normal and on short circuits. The magnetic forces generated by the flow of current in the same direction through the adjacent turns of the bimetal element draw the turns of the bimetal element together. This would move the stud 43 radially toward the center of the coil and also impart a tangential movement to the stud toward the base of the breaker. The magnetic reaction in the coil 35 in this case would be to expand the inner turns and shrink the outer turns of the coil, but since the inner end of the bimetal is fixed to the bar 40, little expansion of the inner turns would occur. With the stud 43 constructed of non-magnetic material, tripping would occur at somewhat higher current values than it would if the stud were made of magnetic material.

When the stud 43 is thus moved by the magnetic action, the link 45 under the influence of the spring 30 will rotate clockwise about the stud 43. This permits counter-clockwise rotation of the releasable member 29 until the pivot 32 passes above the center line B, whereupon both toggles 29—45 and 45—35 are broken and the spring 30 acts to quickly rock the releasable member 29 further counter-clockwise. Then, as the pivot point of the contact arm 14 passes the center of action of the spring 30, the spring rocks the contact arm counter-clockwise with a snap action, opening the contacts 13—14.

On overload currents of low magnitude say between normal and 300% of normal, the magnetic attraction of the spiral bimetal element **35** for the stud **43** is negligible. The counter-clockwise movement of the stud **43**, as the bimetal element is heated, is gradual and acts as a time delay. On sudden heavy overloads above about 1000% of normal current value, the magnetic forces of the bimetal act to trip the breaker instantaneously.

On overload currents in the intermediate range of values, for instance, between approximately 300% and 1000% of normal, the magnetic forces of the coil **35** are stronger and aid in deflecting the bimetal element. The stud **43** is, therefore, moved radially toward the center of the bar **40** a distance depending on the magnitude of the current. This reduces the tangential distance the stud **43** is required to travel in order to trip the breaker. The movement of the stud **43** on such an intermediate overload is the resultant of the movement under the influence of the magnetic forces of coil **35** and the movement under the heating influence of the current traversing the bimetal coil. It can thus be seen that under such conditions the breaker will be tripped quicker for a given amount of heating of the bimetal than in the case of lower magnitude overloads.

Before the contacts **12—13** can be manually closed following an automatic tripping operation, it is necessary to reset the releasable member **29**. If the breaker has been tripped in response to a persistent light overload, the breaker cannot be reset until the bimetal **35** cools sufficiently to restore the stud **43** from its position in Fig. 3 to its normal position as shown in Fig. 1. Resetting of the mechanism following a tripping operation is effected by manually moving the operating lever from its tripped position (Figs. 3 and 4) clockwise to its manual open circuit position (Fig. 2). At this movement, an ear **46** projecting laterally from the operating lever engages the member **29** and moves said member clockwise about its pivot **31**. The inherent slight resiliency of the bimetal element **35** permits the link **45** to force the stud **43** radially toward the center of the bar **40** of the bimetal element a distance sufficient to permit the stud **32** to pass the center line of **43** and **40**, thus causing the toggle comprising the link **45**, stud **43** and the bimetal **35** to hold the releasable member in the normal position shown in Fig. 1.

The breaker may be reset immediately following a tripping operation effected by a heavy overload current or a short circuit. When the circuit is interrupted the magnetic forces of the coil **35** disappear permitting the stud **43** to resume its normal position (Fig. 1) immediately.

Since different embodiments of the invention may be made and departures may be made from the particular description hereof, yet still be within the scope of the invention, it is intended that all the matter contained in the above description or shown in the accompanying drawings shall be considered as illustrative and not in a limiting sense.

I claim as my invention:

1. A circuit breaker comprising relatively movable contacts, releasable operating mechanism for causing automatic opening of the contacts, and restraining means comprising a toggle including a member electrically connected in the circuit of the breaker and magnetically responsive to predetermined current values to cause release of the operating mechanism.

2. In a circuit breaker, the combination of relatively movable contacts, an operating mechanism for causing automatic opening of the contacts, and means comprising a toggle including a member electrically connected in the circuit of the breaker and responsive thermally and magnetically to predetermined circuit conditions to cause operation of the operating mechanism.

3. In a circuit breaker, the combination of relatively movable contacts, releasable operating mechanism for causing automatic opening of the contacts, means normally restraining said operating mechanism comprising a toggle having a thermally responsive portion heated in response to the current of the circuit, said portion being operable when heated a predetermined amount in response to overload currents below a predetermined value to cause release of the operating mechanism, said toggle also being magnetically responsive to overload currents above the predetermined value to cause instantaneous release of the operating mechanism.

4. In a circuit breaker, the combination of relatively movable contacts, operating mechanism for said contacts including a member releasable to cause automatic opening of the contacts, means normally restraining said releasable member comprising a toggle including a bimetal element as a portion of said toggle, said bimetal element being connected in the circuit with said contacts and operable when heated a predetermined amount to cause said toggle to release said member, said bimetal element also being magnetically responsive to the current of the circuit and operable upon overload currents above a predetermined value to cause said toggle to instantaneously release said member.

5. In a circuit breaker, the combination of relatively movable contacts, operating mechanism biased in opening direction and releasable to cause automatic opening of the contacts, means normally holding said mechanism against release comprising a thermally and magnetically responsive bimetallic coil connected by a link to the releasable part of said operating mechanism, said coil being electrically connected in the circuit with said contacts and operable in response to predetermined overload currents to cause release of the operating mechanism.

6. In a circuit breaker, the combination of relatively movable contacts, releasable operating mechanism for causing automatic opening of the contacts, a member associated with the operating mechanism, and a thermal element coacting with the member to form a toggle, said toggle being thermally responsive under certain overload circuit conditions to release the operating mechanism after a time delay and magnetically responsive under certain other overload circuit conditions to instantaneously release the operating mechanism.

7. In a circuit breaker, the combination of relatively movable contacts, operating mechanism for causing automatic opening of the contacts, and a pair of connected toggles, one of said toggles being responsive to certain circuit conditions for causing operation of the other of said toggles after a time delay to cause operation of the operating mechanism.

8. In a circuit breaker, the combination of relatively movable contacts, operating mechanism for causing automatic opening of the contacts, and a pair of toggles one element of said toggles com-

prising a bimetallic coil connected in the circuit and being thermally and magnetically responsive to certain conditions in the circuit conditions of the breaker for causing operation of the other of said toggles to cause operation of the operating mechanism.

9. In a circuit breaker, the combination of operating mechanism for causing automatic operation of the breaker, a member associated with the operating mechanism, said member being movable in two directions to cause operation of the operating mechanism, and means comprising a bimetallic coil having its free end cooperatively engaging said member, said coil being connected in the circuit with said contacts and operable when heated a predetermined amount to cause movement of said member in one direction and thereby cause an operation of said mechanism, said coil also being magnetically responsive to the current and operable magnetically in response to predetermined current conditions to cause movement of said member in another direction to cause operation of the mechanism.

10. In a circuit breaker, the combination of releasable operating mechanism for causing automatic operation of the breaker, and a toggle, one element of said toggle comprising a bimetallic coil having a core at its inner end and an armature at its outer end, said element being thermally responsive when heated a predetermined amount in response to overload currents below a predetermined value to operate the toggle to release the operating mechanism, and said element being magnetically operated in response to overload currents above a predetermined value to attract the armature and cause instantaneous release of the operating mechanism.

11. In a circuit breaker, the combination of operating mechanism for causing automatic opening of the breaker, a toggle, one element of said toggle comprising a bimetalic element electrically connected in the circuit in series with said contacts, said element being operable when heated a predetermined amount by overload currents below a predetermined value to cause operation of the operating mechanism, said element also being magnetically responsive to overload currents above the predetermined value to instantaneously cause operation of the operating mechanism.

12. In a circuit breaker, the combination of operating mechanism for causing automatic operation of the breaker, a spiral bimetal coil fixed at its inner end to a core and having an armature secured to its outer end, a link pivotally connected to the operating mechanism and coacting with the coil to form a toggle, said armature acting as the center pivot of the toggle, the bimetallic coil being responsive when heated a predetermined amount to operate the toggle and cause operation of the operating mechanism.

13. In a circuit breaker, the combination of releasable operating mechanism for causing automatic operation of the breaker, means for restraining the operating mechanism, said means comprising a toggle including an element responsive thermally or magnetically, or thermally and magnetically to cause release of the operating mechanism.

14. In a circuit breaker, the combination of releasable operating mechanism for causing automatic operation of the breaker, restraining means comprising a toggle for the operating mechanism, said toggle including a member responsive when heated a predetermined amount to cause release of the operating mechanism, said toggle member being also magnetically responsive to predetermined circuit conditions to effect release of the operating mechanism and being responsive both thermally and magnetically to certain circuit conditions to cause release of the operating mechanism.

15. In a circuit breaker, relatively movable contacts, operating mechanism including a manual operating handle movable to open and close the contacts and a member movable from a normal position to a tripping position to cause automatic opening of said contacts irrespective of the position of said handle, said member being biased to tripping position, a toggle connected to said member for normally restraining said member in normal position, said toggle including a bimetallic element as a part thereof connected in the circuit with the contacts, said bimetal when heated a predetermined amount by overload current causing said toggle to permit movement of the member to tripping position, said bimetallic element also being magnetically responsive to the current of the circuit and operable upon overloads exceeding a predetermined magnitude to permit instantaneous tripping movement of said member.

16. In a circuit breaker the combination of relatively movable contacts, operating means therefor including a tripping member movable from a normal position to a tripping position to cause automatic opening of the contacts, said tripping member being biased to tripping position, means normally restraining said tripping member in said normal position comprising a bimetal coil fixed at its inner end and a connecting link pivoted at one end to the tripping member and having a pin and slot connection with the outer end of said bimetal coil, said coil being connected in the circuit with the contacts and operable when heated a predetermined amount by overload current to cause movement of the tripping member to tripping position and being magnetically responsive to overload currents above a predetermined value to cause movement of the tripping member to tripping position.

17. In a circuit breaker, the combination of relatively movable contacts, operating means therefor including a tripping member movable from a normal position to a tripping position to cause automatic opening of the contacts, said tripping member being biased to tripping position, means normally restraining the tripping member in normal position comprising a bimetal coil fixed at its inner end and a connecting link pivoted at one end to the tripping member and having a pin and slot connection with the outer end of said bimetal coil, said coil being connected in the circuit with the contacts and operable thermally and magnetically in response to predetermined circuit conditions to cause movement of the tripping member to tripping position.

18. In a circuit breaker, relatively movable contacts, operating means therefor including an operating member movable to close said contacts and a member movable from one position to a second position to cause opening of said contacts irrespective of the position of said operating member, means normally holding said movable member in said one position comprising a thermally responsive coil of bimetallic material connected by a link to said movable member, said coil being heated in response to the current of the circuit and operable when heated a predetermined amount to permit movement of said movable member to said second position.

19. In a circuit breaker, the combination of relatively movable contacts, operating mechanism therefor including an operating handle movable to open and close the contacts and a member movable to cause automatic opening of said contacts irrespective of the position of said handle, and means comprising a toggle having a thermally responsive portion heated in response to the current of the circuit, said portion being operable when heated a predetermined amount in response to overload currents to cause operation of said movable member.

20. In a circuit breaker, the combination of separable contacts, operating mechanism therefor including an operating handle movable to open and close the contacts, and a member movable from one position to a second position to cause automatic opening of the contacts irrespective of the position of said handle, means for restraining said movable member in said one position, said means comprising a toggle including an element responsive thermally and magnetically to permit movement of said movable member to said second position.

21. In a circuit breaker, the combination of separable contacts, operating mechanism therefor including an operating handle movable to close said contacts, and a member movable from one position to a second position to cause automatic opening of said contacts irrespective of the position of said handle, means for restraining said movable member in said one position comprising a toggle having a portion connected in the circuit of the breaker, said portion being operable when heated in a predetermined amount in response to overload currents below a predetermined value to permit movement of said member to said second position, said portion of said toggle also being magnetically responsive to overload currents above said predetermined value to permit movement of said member to said second position.

OLIVER S. JENNINGS.

200-88

CERTIFICATE OF CORRECTION.

Patent No. 2,320,437. June 1, 1943.

OLIVER S. JENNINGS.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 4, first column, line 3, claim 8, after the word "circuit" strike out "conditions"; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 7th day of September, A. D. 1943.

Henry Van Arsdale,
Acting Commissioner of Patents

(Seal)

200-88

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