

July 6, 1943.

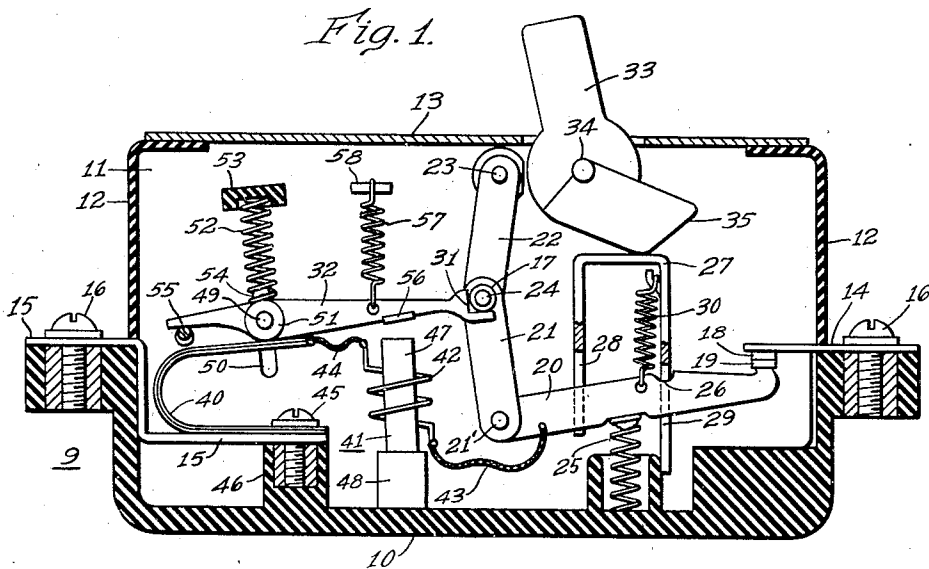
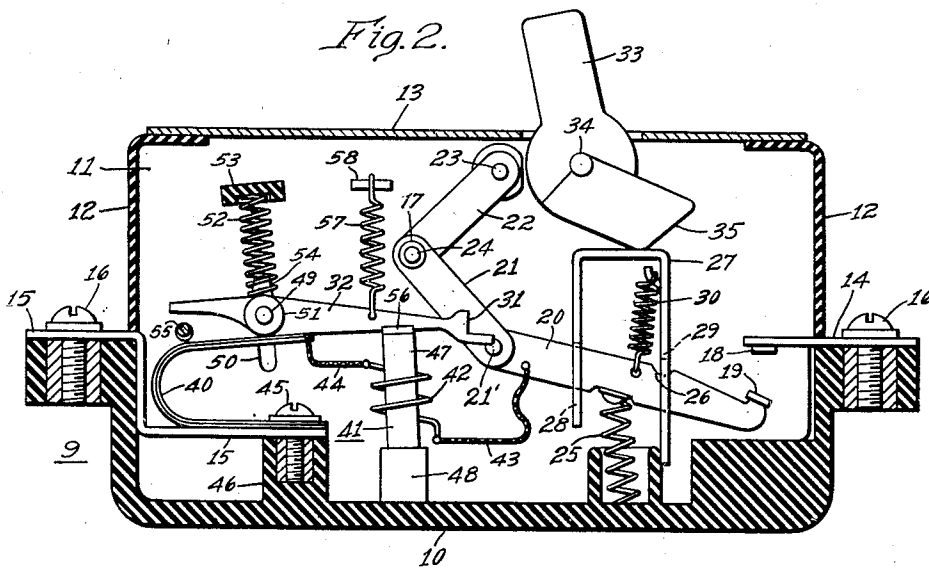
H. G. BAXTER ET AL

2,323,784

CIRCUIT BREAKER

Filed Feb. 26, 1941

2 Sheets-Sheet 1



WITNESSES:

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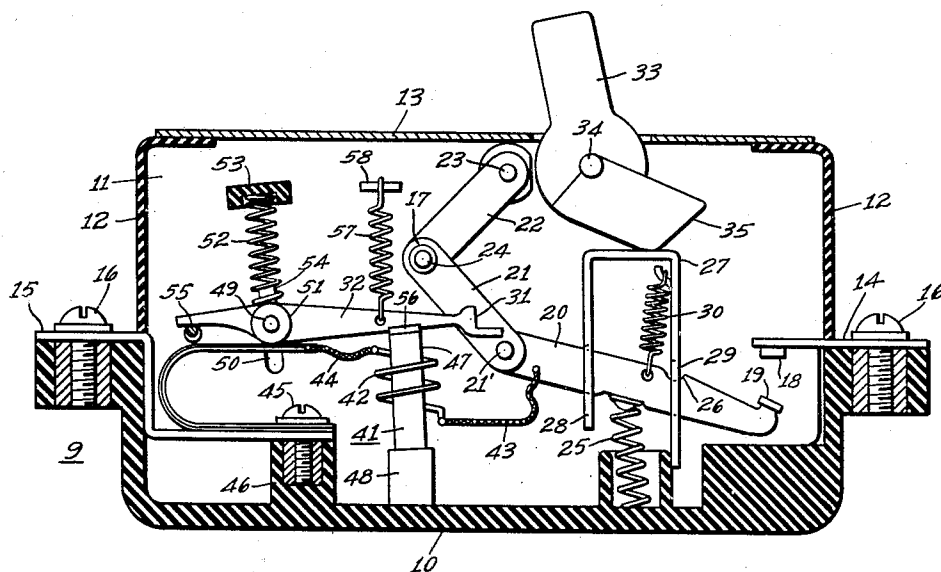
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Fig. 3.



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2,323,784

CIRCUIT BREAKER

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Application February 20, 1941, Serial No. 380,644

18 Claims. (Cl. 200—88)

This invention relates to circuit breakers, and more particularly to circuit breakers of the type which are operated substantially instantaneously on overload currents approaching short circuits and after a time delay on lesser overloads.

An object of the instant invention is the provision of a circuit breaker including a tripping device in which the point of rotation of a tripping element is variable from one position to another, depending on the value of the overload current in the circuit controlled by the breaker.

Another object of the invention is to provide an improved circuit breaker mechanism having a thermal and a magnetic trip device wherein the thermal element does no work in tripping the breaker and does not oppose operation of the magnetic tripping means.

Another object of the invention is to provide an improved circuit breaker embodying a thermal and magnetic trip device in which the thermal element and the magnet act jointly at times and independently at other times to trip the breaker.

Another object is the provision of a circuit breaker embodying a thermal and magnetic tripping device wherein a tripping member is provided with a plurality of centers of rotation, the member being operable about one or another of the centers in accordance with the magnitude of the current.

Another object of the invention is the provision of a circuit breaker in which a latch is operated about one point in response to operation of a thermal element, about a second point by a magnetic tripping means, and around both points in response to the combined action of the thermal magnetic elements.

A further object of the invention is the provision of a circuit breaker including a latch having a pivot which is bodily movable laterally under the control of a thermal element to cause operation of the breaker.

Another object is the provision of a circuit breaker wherein a latch member is operable about a pair of spaced pivots, one of the pivots being displaceable laterally to cause operation of the breaker and the other of said pivots being adjustable to vary the tripping time of the breaker.

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 sectional view of the circuit breaker with the several parts shown in closed circuit position;

Fig. 2 is a sectional view illustrating the position of the parts when the breaker is tripped over magnetically; and

Fig. 3 is a sectional view with the parts in their tripped positions when the breaker has been tripped in response to the operation of the thermal element.

The illustrative embodiment of the invention includes a casing 9 of insulating material having a base 10, side walls 11 (only one being shown), end walls 12 and a removable cover plate 13. A pair of terminals 14 and 15 is provided, one disposed at each end of the base 10. These terminals extend into the interior of the casing and each terminal is provided with a terminal screw 16 whereby the breaker may be connected in an electrical circuit. A stationary contact 18 is secured on the inner end of the terminal 14. A movable contact 19 mounted on one end of a floating contact bar 20 of conducting material cooperates with the stationary contact 18 to open and close the circuit through the breaker. The other end of the contact bar 20 is pivotally connected to one end of a toggle link 21 which together with a link 22 forms a complete toggle. The link 22 is supported on a pivot 23 secured to the casing and the links 21 and 22 are pivotally joined by a knee pin 24. An operating spring 25 is compressed between the base 10 and the lower edge of the contact bar 20 intermediate its ends. This spring biases the contact bar 20 in a clockwise direction about its point of contact 26 with a U-shaped member 27 slidably movable in the direction of its length in guides in the casing 10. The member 27 is provided with slots 28 and 29 which straddle and guide the contact bar 20. A spring 30 having one end anchored to the bar 20 and the other end hooked over a projection of the U-shaped member 27 resiliently holds these parts together.

The toggle 21—22 is maintained in its straightened position (Fig. 1), i. e., in a slightly under set position, by the cooperation of an anti-friction roller 17 rotatably mounted on the knee pin 24, with a shoulder 31 formed on one end of a latch lever 32. The latch lever 32 is adapted to be rocked clockwise by a thermal magnetic trip device (to be hereinafter described) and when so rocked frees the knee pin 24, permitting the tog-

gle 21—22 to collapse. When this occurs, the spring 25 rocks the contact bar 20 clockwise about its point of contact 26 with the U-shaped member 27 opening the contacts 18—19. The mechanism is shown in the tripped open position in Figs. 2 and 3.

After the breaker has been automatically tripped open, the mechanism is manually reset by manual operation of an operating lever 33 mounted on a pivot 34 in the breaker housing. Upon manual movement of the operating lever 33 in a clockwise direction (Fig. 1) the cam shaped inner end 35 of the lever acting on the outer portion of the U-shaped member 27 cams the latter inwardly rocking the contact bar counterclockwise about its contact end which bears against the base of the casing. This straightens the toggle 21—22 until the roller 17 passes the shoulder 31 of the latch lever 32, which in the meantime has returned to latching position. As soon as the roller clears the shoulder 31, the latching lever 32 relatches the roller 31 to hold the toggle in operative position.

To close the contacts of the breaker the operating lever 33 is rocked counterclockwise to its closed position (Fig. 1). This movement of the operating lever to closed position allows the spring 25 to rotate the contact bar 20 counterclockwise about its pivot 21' which connects the bar to the toggle link 21, to effect closing of the contacts.

To manually open the contacts of the breaker, the operating lever 33 is rotated in a clockwise direction to open position. Movement of this lever in a clockwise direction from the position in which it appears in Fig. 1 cams the U-shaped member 27 inwardly and rocks the contact bar 20 clockwise about its point of connection 21' with the toggle link 21, thus separating the contact 19 from the stationary contact 18. The flat surface of the inner end 35 of the operating lever seats itself on the outer portion of the U-shaped member 27 and retains the contacts in open position.

The thermal-magnetic trip device includes the latch lever 32, a thermally responsive U-shaped bimetal element 40 and an electromagnet 41. The winding 42 of the magnet and the bimetal element 40 are electrically connected in series relation in the circuit controlled by the breaker, the circuit extending from the terminal 14, contacts 18 and 19, contact bar 20, a flexible shunt conductor 43, magnet winding 42, a flexible shunt conductor 44, bimetal element 40, to the terminal 15.

The terminal 15 projects into the interior of the housing and the bimetal 40 is secured to the inner end thereof by a screw 45 which also serves to secure both the bimetal 40 and the inner end of the terminal 15 to a boss 46 projecting from the base 10. The core 47 of the electromagnet is mounted on a projection 48 of the base 10.

The latch lever 32 is provided with a pivot 49, the ends of which project beyond the sides of the lever and into guide slots 50 in the side walls 11 of the casing. Bosses 51 integral with the lever 32 disposed one on each side of the lever concentric with the pivot 49, are biased against the outer side of the free end of the bimetal element 40 by a compression spring 52 having its one end seated in a recessed cross bar 53 and the other end surrounding a spring pilot 54 projecting from the lever 32. A second or auxiliary pivot 55 rotatably mounted in the side walls 11 of the casing is provided for the lever 32 at the end opposite the latch end. This pivot is eccentric and

forms a convenient means for manually adjusting the air gap between the magnet core 47 and an armature 56 mounted on the latch lever 32. By adjusting the eccentric pivot 55, the tripping point of the breaker may be varied.

A spring 57 having one of its ends anchored to a projection 58 of the side wall 11 and its other end connected to the latch lever 32 biases the latter to latching position.

Under normal circuit conditions the spring 52 which presses the latch lever 32 against the bimetal 40 does not influence the latch lever to rotate in either direction about its pivot 49 since the line of action of the spring 52 passes through the center of the pivot 49. The latch lever 32 is therefore free to rotate in unlatching direction about its pivot 49 except for the biasing force exerted thereon by the spring 57 and the very slight latch friction of the roller 24.

Upon the occurrence of an overload current above a predetermined value, for example an excess of approximately 10 times rated current, or a short circuit, the magnet 41 is energized a sufficient amount to rotate lever 32 about the pivot 49 and release the operating mechanism practically instantaneously to effect automatic opening of the contact (see Fig. 2). As soon as the circuit is opened, the spring 57 restores the latch lever 32 to latching position. The breaker mechanism may then be manually reset in the manner previously described.

When a light overload of between normal rated current and approximately three times normal persists for a predetermined length of time, the bimetal 40 becomes heated and the free end thereof flexes toward the fixed end. When this occurs, the compression spring 52 overcomes the spring 57 and causes the bosses 51 to follow the bimetal. During this operation the latch lever 32 pivots in a clockwise direction about the pivot 49 being guided by the movement of the pivot 49 in the slots 50. At a predetermined point the latch shoulder 31 releases the toggle and the operating spring 25 causes operation of the contact bar 20 to interrupt the circuit. The parts are shown in this position in Fig. 3. As the bimetal 40 cools following the interruption of the current, it forces the pivot point 49 of the latch lever 32 outwardly during which movement the spring 57 rocks the lever counterclockwise about the pivot 55 to latching position.

On light overloads up to approximately 300% of normal rated current, the pull of the magnet 41 is practically negligible. However, on overload currents of an intermediate nature, for instance, between approximately 300% of normal and 1000% of normal, the pull of the magnet increases with a corresponding increase in current value. Also the air gap of the magnet decreases as the bimetal is heated. Consequently, the breaker will be tripped quicker for a given amount of heating of the bimetal element or for a predetermined current value. In this case the flexing of the bimetal 40 first causes the latch 32 to be partially rotated about the pivot 55. This decreases the air gap between the armature and the core of the magnet so that the pull of the magnet increases, and finally the pull of the magnet rotates the latch about the pivot 49 to trip the breaker.

When the latch lever 32 is operated by the magnet 41, it moves unrestrained by the bimetal 40 or the spring 52, the magnet having only to overcome the tension of the spring 57. Also the spring 52 when operating the latch lever 32 un-

der the control of the bimetal 40 need overcome only the tension of the spring 57 to trip the breaker. The latch roller 17 reduces the friction at the latching point to a minimum.

Having described the preferred embodiment of the invention in accordance with the patent statutes, it is to be understood that various changes and modifications may be made in the particular embodiment disclosed without departing from some of the essential features of the invention. It is, therefore, desired that the language of the appended claims be given as reasonably broad interpretation as the prior art permits.

We claim as our invention:

1. In a circuit breaker, the combination of relatively movable contacts, operating mechanism for the contacts, a releasable member movable to cause automatic opening of the contacts, an electromagnet having a pivoted unitary armature operable to release said member, and a thermally responsive element cooperating with the armature pivot to yieldingly restrain said pivot and operable to cause lateral movement of the armature pivot to release the releasable member.
2. In a circuit breaker, the combination of relatively movable contacts, operating mechanism for automatically opening the contacts, means operable to release the operating mechanism comprising an electromagnet having an armature provided with a plurality of pivots and biased against operation, the electromagnet being operable to actuate the armature about one of said pivots to effect release of said mechanism, means biasing the armature for actuation about the other of said pivots, and thermally responsive means yieldingly restraining said one pivot and operable in response to overload currents to permit the biasing means to operate the armature about said other pivot to effect release of said mechanism.
3. In a circuit breaker, the combination of relatively movable contacts, operating means to cause automatic operation of the contacts, restraining means operable to release the operating means, a latch operable to release the restraining means, said latch having dual pivots, means biasing the latch in releasing direction about one of the pivots, thermal means yieldingly opposing movement of the latch and operable in response to overload currents to cause operation of the latch by the biasing means, and electromagnetic means operable in response to overload currents above a predetermined value to operate the latch about the other of said pivots.
4. In a circuit breaker, the combination of relatively movable contacts, operating means for the contacts, a trip member comprising a single armature operable to cause automatic opening of said contacts, said trip member being provided with a fixed pivot and a movable pivot, magnetic means responsive to overload currents above a predetermined amount to operate the trip member about its movable pivot to automatically open the contacts, means biasing the trip member for tripping movement about its fixed pivot, and a thermal element at all times opposing movement of the trip member about the fixed pivot and operable in response to overload currents below the predetermined amount to cause the biasing means to operate the trip member about said fixed pivot.
5. In a circuit breaker, the combination of relatively movable contacts, releasable operating mechanism for causing automatic opening of the

contacts, a latch operable to release the operating mechanism, said latch having a movable pivot and being movable rotatably about said pivot and also being movable so that said pivot is displaced, either movement effecting release of said operating mechanism, an electromagnet responsive when energized by currents above a predetermined value to rotatably actuate the latch to cause opening of the contacts, and a bimetal element yieldingly opposing movement of said latch, said bimetal element being responsive when heated by currents below said predetermined amount to effect movement of the latch which displaces the pivot and causes opening of the contacts.

6. In a circuit breaker, the combination of relatively movable contacts, releasable operating mechanism for causing automatic opening of the contacts, a latch operable to release the operating mechanism, said latch being provided with a plurality of pivots, electromagnetic means responsive to overload currents above a predetermined value to operate the latch about one of the pivots, and a thermal element responsive when heated a predetermined amount to effect operation of the latch about another pivot, said other pivot being adjustable to vary the air gap of the magnetic means to vary the tripping characteristic of the breaker.

7. In a circuit breaker, the combination of relatively movable contacts, operating mechanism for causing automatic operation of the contacts, restraining means operable to release the operating mechanism, said restraining means having a plurality of fulcrums, and means including a thermal element and an electromagnet operable at times to conjointly effect operation of the restraining means about both of said fulcrums.

8. In a circuit breaker, the combination of relatively movable contacts, releasable operating mechanism for causing automatic opening of the contacts, a trip member operable to release the operating mechanism, a pair of pivots for the trip member, and electroresponsive and thermally responsive means operable independently to effect operation of the trip member about one or the other of said pivots, and operable conjointly to operate the trip member about both of said pivots depending on the value of the current of the circuit.

9. In a circuit breaker, the combination of relatively movable contacts, releasable operating mechanism for automatically opening the contacts, a latch comprising a single armature operable to release the operating mechanism, a pair of pivots for the latch, thermal means yieldingly cooperating with one of said pivots and operable to cause lateral movement of said pivot to permit the latch to operate about the other of said pivots, and electromagnetic means to operate the latch about the laterally movable pivot.

10. In a circuit breaker, the combination of relatively movable contacts, releasable operating mechanism for causing automatic opening of the contacts, a latch operable to release the operating mechanism, a pivot for the latch, said pivot being disposed for lateral displacement, an adjustable pivot for the latch, thermally responsive means for causing displacement of the movable pivot to permit operation of the latch about the adjustable pivot, and electromagnetic means to operate the latch about the displaceable pivot, said adjustable pivot being operable to vary the operating point of the electromagnetic means.

11. In a circuit breaker, the combination of

relatively movable contacts, releasable operating mechanism for causing automatic operation of the contacts, a latch comprising a single element operable to release the operating mechanism, said latch having a plurality of fulcrums, and a plurality of means operable conjointly in response to overload currents to vary the operation of the latch from one of said fulcrums to another of said fulcrums according to the magnitude and duration of the overload current.

12. In a circuit breaker, the combination of relatively movable contacts, releasable operating mechanism for causing automatic opening of the contacts, a latch operable to release the operating mechanism, said latch having a pair of pivots, resilient means to cause operation of the latch about one of the pivots, a bimetal element disposed at all times to engage one of said pivots to control the operation of the latch by the resilient means, and an electromagnet to operate the latch about the other pivot.

13. In a circuit breaker, the combination of relatively movable contacts, operating mechanism for automatically opening the contacts, means operable to release the operating mechanism comprising an electromagnet having an armature provided with a plurality of pivots, means biasing said armature against rotation about either of said pivots, the electromagnet being operable to rotate the armature about one of said pivots to effect release of said mechanism, and thermally responsive means yieldingly opposing rotation of said armature about the other pivot and operable in response to overload currents to effect rotation of the armature about said other pivot to effect release of said mechanism.

14. In a circuit breaker, the combination of relatively movable contacts, operating mechanism for automatically opening the contacts, a trip member biased against operation and having a laterally displaceable pivot intermediate its ends, means biasing said pivot for lateral displacement, a thermal element disposed to engage said laterally displaceable pivot and responsive to predetermined circuit conditions to permit movement of the trip member and lateral displacement of the pivot to trip the breaker, and an electromagnet operable to rotate the member about the laterally displaceable pivot to trip the breaker.

15. In a circuit breaker, the combination of relatively movable contacts, operating mechanism for automatically opening the contacts, a trip member having a laterally displaceable pivot, a bimetal element disposed to yieldably oppose

movement of said laterally displaceable pivot and responsive to predetermined circuit conditions to effect movement of the trip member and lateral displacement of the pivot to trip the breaker, and an electromagnet operable to rotate the member to trip the breaker, said bimetal element being operable when heated to cause reduction of the air gap of said electromagnet.

16. In a circuit breaker, the combination of relatively movable contacts, operating means for the contacts, a trip member having a laterally displaceable pivot intermediate its ends, a fixed fulcrum engaging one end of the member and an armature on the other end of the member, a spring biasing the trip member for tripping movement, a bimetal element responsive to predetermined circuit conditions to permit movement of the trip member about the fulcrum and lateral displacement of the displaceable pivot to trip the breaker, and an electromagnet operable to rotate the trip member about the displaceable pivot to trip the breaker.

17. In a circuit breaker, the combination of relatively movable contacts, releasable operating mechanism for causing automatic operation of said contacts, a trip member comprising a single lever operable to release said operating mechanism, said lever having a plurality of pivots, and current responsive means operable in response to overload currents to effect rotation of said lever about one or another of said pivots in accordance with the magnitude of the overload current, said current responsive means including a bimetal element disposed in cantilever manner to at all times engage one of said pivots.

18. In a circuit breaker, the combination of relatively movable contacts, releasable operating mechanism for causing automatic operation of the contacts, a latch comprising a single element operable to release said operating mechanism, said latch having two fulcrums, electroresponsive means operable after a time delay in response to overload current conditions to cause operation of said latch about one of said fulcrums, other electroresponsive means operable in response to overload currents above a predetermined value to instantaneously cause operation of said latch about the other of said fulcrums, said electroresponsive means operating conjointly in response to certain overload conditions to cause said latch to be moved first about said one fulcrum and then instantaneously about said other fulcrum.

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