Aug. 10, 1937. R. W. SMITH 2,089,716

CIRCUIT BREAKER

Filed Jan. 29, 1937

Fig. 1.

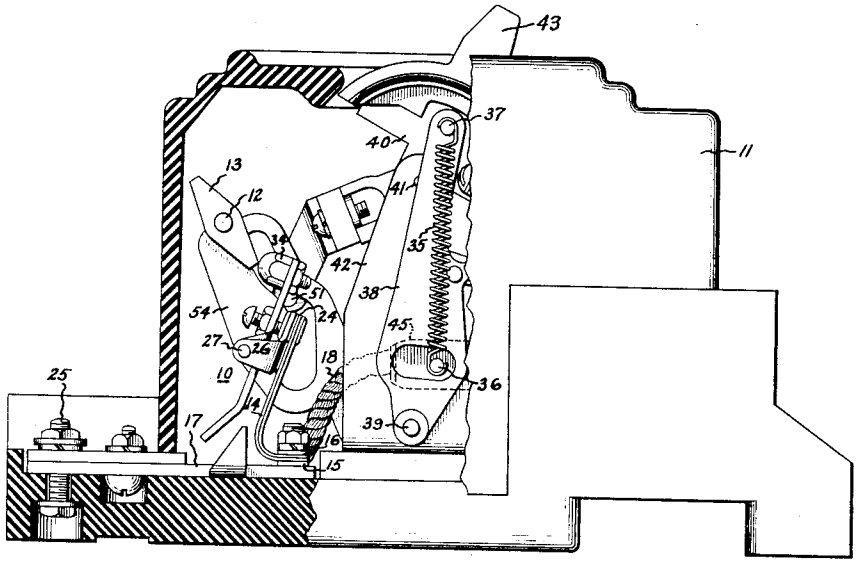
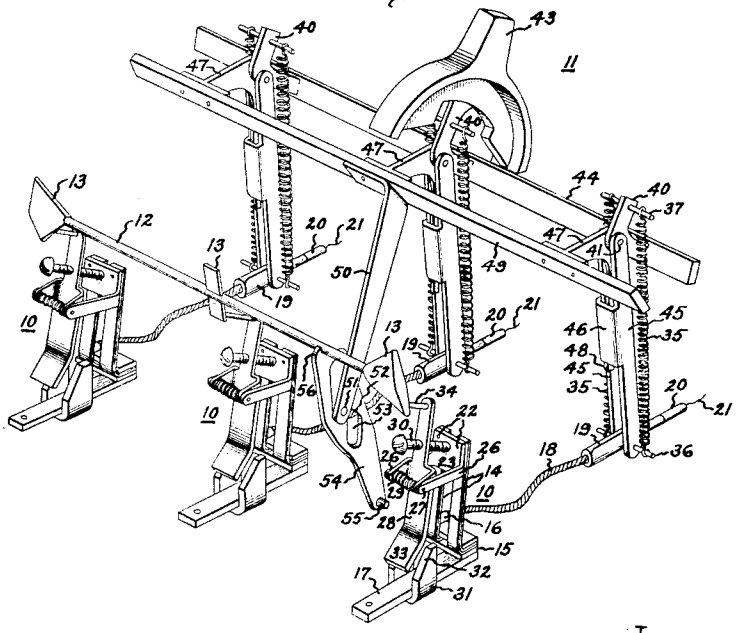


Fig. 2.



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CIRCUIT BREAKER

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Application January 29, 1937, Serial No. 122,950

8 Claims. (Cl. 200—88)

My invention relates to current responsive release devices for circuit breakers, more particularly to combined thermal and magnetic release devices for effecting automatic operation of a circuit breaker in response to predetermined current conditions and has for an object the provision of a simple, reliable, and inexpensive release device of this character.

Combined thermal and magnetic means have heretofore been provided for operating automatic circuit breakers either with a time delay in response to prolonged overloads or substantially instantaneously in response to short circuit conditions. In some cases, independent thermal devices and magnetic devices have been provided arranged to operate a common tripping member, but such arrangements are necessarily somewhat complicated and in many instances the space limitations prohibit the use of separate devices. Combined thermal and magnetic arrangements have also been proposed in which the magnetic means forcibly bends the thermal element upon the occurrence of short circuit conditions and it will be apparent that this repeated bending of the thermal element by the magnetic means may seriously affect the calibration of the thermal element.

Accordingly, something is yet to be desired in combined thermal and magnetic release devices of this character and it is a further object of my invention to provide a compact and simple release device in which the magnetic means operates independently of the thermal means without subjecting the thermal element to excessive bending forces.

In carrying out my invention in one form, I provide a pivoted armature for releasing the circuit breaker tripping means, together with electromagnetic means for quickly operating the armature about its pivot to release the tripping means in response to predetermined current conditions and thermal means for bodily moving the armature and its pivot to release the tripping means with a time delay in response to other predetermined current conditions.

More specifically, the thermal means comprises a pair of bimetallic strips, the free ends of which are connected together by a conducting crossbar on which is pivotally supported the magnetizable armature. The armature is biased for movement about its pivot and is restrained in predetermined relation to the bimetallic strips by adjustable stop means. Accordingly, flexure of the bimetallic strips effects bodily movement of the armature and its pivot, and electromagnetic means are provided for pivotally operating the armature against its bias independently of the bimetallic strips. Adjustment of the adjustable stop means is effective to vary simultaneously the time current setting of the thermal means and the instantaneous current setting of the electromagnetic means.

For a more complete understanding of my invention, reference should now be had to the drawing in which Fig. 1 is an elevational view, partly in section, of a circuit breaker provided with thermal release devices embodying my invention; and Fig. 2 is a somewhat diagrammatic view in skeleton perspective of the circuit breaker shown in Fig. 1.

Referring now to the drawing, I have shown my invention in one form as applied to a combined thermal and magnetic release device 10 in connection with a three-pole circuit breaker 11 of the type fully described in a copending application of Joseph W. Seaman Serial No. 78,179, filed May 6, 1936, entitled "Circuit breakers", which application became Patent No. 2,067,792 on January 12, 1937, assigned to the same assignee as the present invention. As will be more fully described hereinafter, the tripping means for the circuit breaker 11 includes a rotatable trip shaft 12 provided with a plurality of radially extending operating arms 13, the operating arms for the two outer poles of the circuit breaker being formed of suitable insulating material.

As shown best in Fig. 2, one of the combined thermal and magnetic release devices 10 embodying my invention is associated with each of the operating arms 13 and since these devices are identical in construction, only one will be described in detail. Each release device comprises a pair of spaced bimetallic strips 14 supported at their adjacent lower ends on suitable high resistance shunts 15 and 16, the shunt 15 being supported on a conductor bar 17 extending along the base of the circuit breaker (Fig. 1) and the shunt 16 being connected by means of a flexible conductor 18 to the associated movable contact 19. As shown somewhat diagrammatically in Fig. 2, each of the movable contacts 19 is arranged abuttingly to engage a cooperating fixed contact 20, the fixed contacts 20 being connected by suitable leads 21 to terminal members (not shown).

Extending across the free upper ends of the bimetallic strips 14 in bridging relation and secured thereto by means of suitable rivets 22 is a supporting member 23 formed of suitable conducting material. As shown in Fig. 1, suitable

washers 24 may be interposed between the cross-bar 23 and the bimetallic strips 14, if desired. It will thus be apparent that the circuit through each pole of the circuit breaker may be traced from an external terminal screw 26 (Fig. 1) by way of the conductor bar 17 to the release device 10 where the current divides, a portion of the current flowing through the bimetallic strips and the cross-bar 23 in series to the flexible conductor 18 and the remaining portion of the current flowing directly through the high resistance shunts 15 and 16 to the flexible conductor 18. From the flexible conductor 18 the current, of course, flows through the circuit breaker contacts 19 and 20 and the conductor 21 to the other terminal (not shown).

Extending outwardly from the opposite edges of the cross-bar 23 I provide a pair of arms 26 which support at their outer ends a pivot pin 27 on which is pivotally mounted a magnetizable armature 28. This armature 28 is normally biased for clockwise movement about the pivot pin 27 by a coil spring 29 which surrounds the pivot pin 27 (Fig. 2), and the armature is restrained in a predetermined position relative to the bimetallic strips 14 by a stop screw 30 which extends through and threadedly engages the armature 28 with its innermost end abuttingly engaging the cross-bar 23.

Adjacent the lower ends of the bimetallic strips 14 and partially encircling the conductor bar 17, I provide electromagnetic means comprising a U-shaped member 31 formed of magnetizable material and having sloping pole faces 32 arranged to cooperate with an angularly disposed portion 33, formed on the lower end of the armature 28, so as pivotally to move the armature against the bias of the spring 29 whenever a current of predetermined magnitude flows through the conductor bar 17. Adjustably secured to the upper end of the armature 28 is an abutment member 34 which is formed of insulating material and which is arranged to engage the associated operating arm 13 on the trip shaft 12 whenever the armature 28 is moved.

It will be apparent now that when a prolonged overload current of predetermined magnitude flows through the bimetallic strips 14, the strips will flex so that the free upper ends thereof move in a left-hand direction and thereby bodily move the armature 28 and the pivot pin 27 so that the abutment member 34 rotates the associated operating arm 13 in a clockwise direction to release the circuit breaker tripping means, as will be more fully described hereinafter. This movement of the armature 28 and the abutment member 34 is accomplished with a time delay which depends upon the magnitude of the current and upon the heating characteristics of the bimetallic strips 14.

It will be understood, of course, that current of such magnitude induces in the magnetizable member 31 a magnetic flux which tends to attract the lower end 33 of the armature 28. The air gap between the pole faces 32 and the portion 33 of the armature 28, and the force of the biasing spring 29 are so proportioned, however, that this magnetic flux is insufficient to rotate the armature against its bias. Upon the occurrence of overload conditions of short-circuit magnitude, however, the magnetic flux induced in the magnetizable member 31 is sufficiently great to attract the portion 33 of the armature 28 so that the armature is operated about its pivot against the bias of the spring 29 substantially instantaneously so as to effect clockwise rotation of the operating arm 13 independently of the bimetallic strips 14.

Adjustment of the time current setting of the bimetallic strips 14 and of the instantaneous current setting of the electromagnetic means may be accomplished simultaneously by rotating the adjustable stop 30 so as to move the upper end of the armature toward or away from the cross-bar 23. It will be apparent that if the upper end of the armature 28 is moved closer to the cross-bar 23, the abutment member 34 will be moved away from the operating arm 13 and accordingly a greater flexure of the bimetallic strips 14 will be necessary to effect rotation of the operating arm. Likewise, adjustment of the armature in this direction will increase the air gap between the portion 33 of the armature and the pole faces 32 of the magnetizable member 31 and accordingly a larger current must flow through the conductor bar 17 to effect movement of the armature 28 about its pivot.

If it is desired to adjust only the instantaneous current setting of the electromagnetic means, the abutment member 34 may of course be adjusted to compensate for the change in the position of the armature 28 due to rotation of the adjustable stop 30. Likewise, the current characteristic of the bimetallic strips 14 may be independently adjusted by substituting for the high resistance shunts 15 and 16 similar shunts having different resistivities, or by entirely eliminating the shunts 15 and 16.

In order to insure a complete understanding of my invention and its operation, the remainder of the circuit breaker shown in Figs. 1 and 2 will now be described. For the purpose of the present invention, the manual operating mechanism for each pole of the circuit breaker may be briefly described as comprising a pair of overcenter springs 35, the respective adjacent ends of which are connected to the opposite ends of a pin 36 which extends through a slot (not shown) in one end of the movable contact 19, the other ends of the springs 35 being connected to a pin 37, which, as shown in Fig. 1, is supported on the free ends of a pair of levers 38, only one of which is shown, the opposite ends of these levers being pivotally mounted on a fixed pin 39. The pin 37 which supports the upper ends of the overcenter spring 35 extends through a slot (not shown) in an operating member 40 which is pivotally mounted on a pin 41 supported between the upper ends of the U-shaped frame 42. In Fig. 2, the levers 38 have been omitted in order to simplify the diagrammatic showing and the pins 37 are shown as carried directly by the operating members 40.

As shown in Fig. 2, the operating member 40 for the middle pole is provided with an insulated handle 43 and the operating members 40 of the three poles are connected together by means of an insulated cross-bar 44 so that movement of the handle 43 is effective to move all of the operating members 40.

Also pivoted on the fixed pin 41 of each operating mechanism is a pair of spaced parallel links 45 (Fig. 2) the lower adjacent ends of which engage the pin 36, the links 45 being connected together intermediate their ends by a cross member 46. In addition, the pivot pin 41 carries a tripping member 47 having an extending portion 48, Fig. 2, arranged to engage the cross member 46 so as to move the links 45 and the movable contact 19 whenever the tripping member 47 is rotated in a clockwise direction, as viewed in the drawing.

These tripping members 47 are biased for rotation in a clockwise direction by suitable tripping springs (not shown) and are normally restrained in the position shown in the drawing by means of an insulated cross-bar 49 which connects the tripping members 47 of the three poles together for simultaneous operation and which is provided with a latch finger 50 which carries at its extending end a roller 51 (Fig. 1) arranged to engage a shoulder 52 formed in an elongate slot 53 in a pivot latching member 54.

As is more fully described in the above referred to Seaman application, this latch member 54 is pivoted on a pin 55 adjacent its lower end and is provided at its upper free end with a latching portion 56 arranged normally to engage the periphery of the rotatable trip shaft 12 which is provided with a notch (not shown) through which this latching portion moves whenever the trip shaft 12 is rotated to a predetermined position.

It will now be apparent that whenever the insulated handle 43 is operated so as to move the springs 35 overcenter relative to the pivot pin 41, all of the movable contacts 19 will be operated with a snap action between open and closed circuit positions. It will likewise be apparent that whenever one or more of my improved release devices effect rotation of the shaft 12 the latch member 54 will be released for movement in a clockwise direction about its pivot so that the roller 51 is released from the shoulder 52 for movement along the slot 53 thereby to permit movement of the tripping members 47 in a clockwise direction in accordance with their bias so as to operate the movable contacts 19 to their respective open circuit positions independently of the overcenter springs 35.

While I have shown a particular embodiment of my invention, it will be understood, of course, that I do not wish to be limited thereto since many modifications may be made and I, therefore, contemplate by the appended claims to cover any such modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A current responsive release device comprising a movable thermal element, an armature pivotally mounted on said element, means biasing said armature for pivotal movement, means for restraining said armature in predetermined relation to said thermal element whereby movement of said thermal element effects bodily movement of said armature and its pivot, and electromagnetic means for pivotally moving said armature against its bias independently of said thermal element.

2. A current responsive release device comprising a bimetallic element having a free end, an armature pivotally mounted on said free end of said bimetallic element, means biasing said armature for pivotal movement, stop means for restraining said armature in predetermined spaced relation to said free end whereby movement of said free end effects bodily movement of said armature and its pivot, and electromagnetic means for pivotally moving said armature against its bias independently of said bimetallic element.

3. A current responsive release device comprising a plurality of spaced bimetallic strips, a supporting member carried by the free ends of said strips, an armature pivotally mounted on said supporting member and biased for pivotal movement in one direction, stop means cooperating with said support and said armature normally to restrain said armature in a predetermined position relative to said bimetallic strips whereby flexure of said strips effects bodily movement of said armature and its pivot, and electromagnetic means for pivotally moving said armature against its bias independently of said bimetallic strips.

4. A current responsive release device comprising a pair of bimetallic strips, means for supporting said strips in parallel spaced relation, a cross-bar formed of high conductivity material supported on the free ends of said bimetallic strips and forming an electrical and mechanical connection therebetween, an armature pivotally mounted on said cross-bar and biased for pivotal movement in one direction, stop means carried by said armature and engaging said cross-bar remote from the pivot point of said armature for restraining said armature in predetermined relation to said bimetallic strips whereby flexure of said strips effects bodily movement of said armature and its pivot, and electromagnetic means for pivotally moving said armature against its bias independently of said bimetallic strips.

5. In a circuit breaker having normally latched tripping means operative when released to actuate the circuit breaker to open circuit position, the combination of a current responsive release device comprising a pivoted armature, electromagnetic means for quickly operating said armature about its pivot to release said tripping means in response to predetermined current conditions, and thermal means for bodily moving said armature and its pivot to release said tripping means with a time delay in response to other predetermined current conditions.

6. In a circuit breaker having normally latched tripping means operative when released to actuate the circuit breaker to open circuit position, the combination of a current responsive release device comprising a magnetizable armature, means including a thermal element for pivotally supporting said armature, and electromagnetic means for quickly operating said armature about its pivot to release said tripping means in response to predetermined current conditions, said thermal element in response to other predetermined current conditions effecting bodily movement of said armature and its pivot to release said tripping means with a time delay.

7. In a circuit breaker having normally latched tripping means operative when released to actuate the circuit breaker to open circuit position, the combination of a current responsive release device comprising a pair of bimetallic strips, means for supporting said strips in parallel spaced relation, a cross-bar formed of conducting material secured to the free ends of said strips, a magnetizable armature pivotally supported on said cross-bar, conducting means for connecting said bimetallic strips in circuit with the contacts of said circuit breaker whereby said bimetallic strips are heated to effect bodily movement of said armature and its pivot and thereby release said tripping means in response to predetermined current conditions, and electromagnetic means associated with said conductor means for quickly operating said armature about its pivot to release said tripping means independently of said bimetallic strips in response to other predetermined current conditions.

8. A current responsive release device comprising a thermal element operable with a time delay characteristic in response to predetermined current conditions, an armature pivotally mounted

on said thermal element, means biasing said armature for pivotal movement, adjustable stop means for restraining said armature in predetermined relation to said thermal element whereby movement of said thermal element effects bodily movement of said armature and its pivot, and electromagnetic means for instantaneously moving said armature about its pivot against its bias in response to other predetermined current conditions, adjustment of said stop means being effective to vary simultaneously the time-current setting of said thermal element and the instantaneous current setting of said electromagnetic means.

ROBERT W. SMITH.