

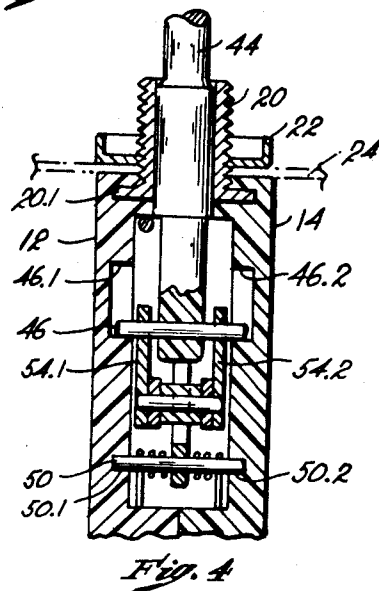
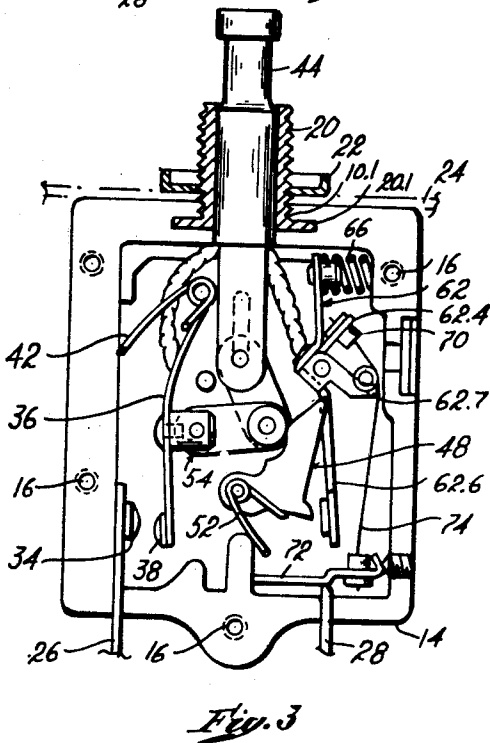
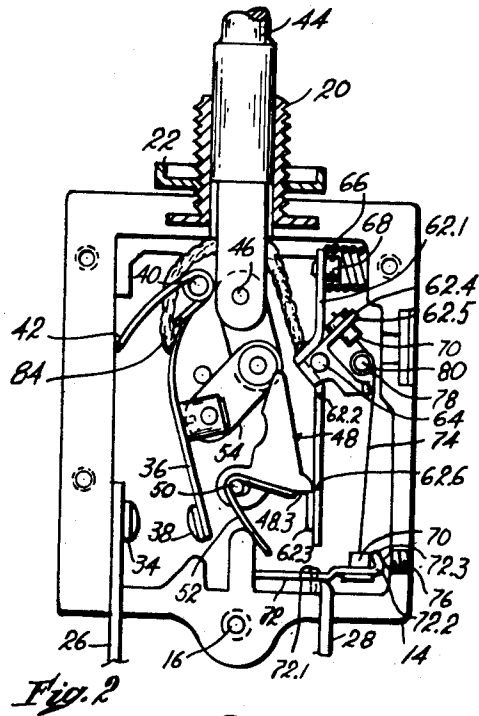
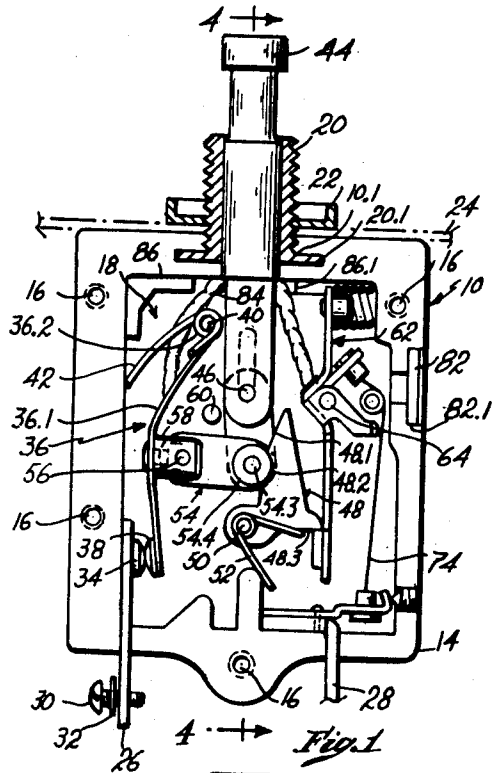
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HEAT RESPONSIVE WIRE CIRCUIT BREAKER

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HEAT RESPONSIVE WIRE CIRCUIT BREAKER
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The field of this invention is that of manually operable circuit breakers which are also automatically operable for opening circuits in response to current overload circuits.

Objects of this invention are to provide a manually operable circuit breaker which is also automatically operable to open a circuit in response to current overload in the circuit; and to provide such a circuit breaker of the trip-free type which is highly resistant to shocks and vibrations, which is adapted to open a circuit rapidly and with a minimum of sparking, and which is simple and inexpensive to manufacture. Other objects of this invention are to provide such a circuit breaker which can be conveniently and accurately adjusted over a wide range to open a circuit automatically in response to a specific degree of current overload, and to provide such an adjustable circuit breaker in which breaker adjustment will not be subject to random variation in spite of extensive use.

The substance of the invention can be briefly summarized as to characteristic aspects thereof as follows.

The circuit breaker comprises, in a principal aspect, fixed contact means disposed within an insulating casing, movable contact means cooperable with the fixed contact means for closing a circuit, and means for biasing the movable contact means to open circuit position. An operating member, such as a push button, is extended from the breaker casing and a cam member is pivotally mounted within the casing. Actuating means pivotally connected to the operating member are engaged with the movable contact means and are adapted slidably to engage the cam member, whereby when the cam member is held in actuating position, movement of the operating member between open and closed circuit positions correspondingly urges the movable contact means to open and close the breaker circuit, and whereby, when the cam member is released from actuating position, the contact member biasing means automatically urges the movable contact means to open the breaker circuit and to keep it open regardless of the position of the operating member.

In another aspect, a pivotally mounted latch is normally adapted to hold the cam member in actuating position, and biasing means are provided which are adapted to rotate the latch for releasing the cam member from actuating position. Heat expansible means are normally adapted for restraining said latch biasing means to prevent latch rotation, but are adapted to expand for releasing restraint of the latch biasing means in response to overload current in the breaker circuit. According to this invention, the circuit breaker has two, cooperable means for adjusting the degree of expansion of said heat expansible means which is necessary for releasing the cam member from actuating position, whereby the circuit breaker can be conveniently and accurately adjusted over a wide range to open a circuit automatically in response to a specific degree of current overload. Also according to this invention, the latch is located relative to said cam member so that only radial forces will be exerted on the latch in holding the cam member in actuating position, thereby to prevent fatiguing stress of said heat expansible means during manual circuit breaker operation.

In the preferred embodiment of this invention the cam member is biased to return to actuating position after automatic tripping of the circuit breaker, whereby, when

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the heat expansible means is no longer conditioned by current overload, the cam member will be automatically relatched and the circuit breaker will be reset for manual operation.

In a practical embodiment of this invention, the pivotal latch has two lever arms, one of which is adapted to engage the cam member for holding the cam member in actuating position, and the other of which is engaged by means biasing the latch to move around its pivot for releasing cam engagement. In this embodiment, the heat expansible means, preferably comprising a length of Nichrome wire which is interposed in the breaker circuit, is adjustably secured at one end to the latch and at its other end to spring means fixed within the casing, and screw means are provided for adjusting the biasing force exerted on the heat expansible means by the spring means. In this construction, the heat expansible means can be adapted to hold the latch in cam engagement against the latch bias, and expansion of the heat expansible means in response to current overload in the breaker circuit will remove opposition to the latch bias for permitting release of the cam member from actuating position. Since the heat expansible means is adjustably secured to adjustable spring means, the effective length and tension of the heat expansible means can be conveniently adjusted over a wide range, thereby to set the circuit breaker for automatic tripping in response to the specific degree of current overload.

These and other objects and aspects of the invention will appear from the following description and a preferred practical embodiment thereof illustrating its novel characteristic.

The description refers to the drawings in which:

FIG. 1 is a side elevational view of the circuit breaker provided by this invention in closed circuit position;

FIG. 2 is a side elevational view similar to FIG. 1, showing the breaker in open circuit position;

FIG. 3 is a side elevational view similar to FIG. 1, showing the breaker in automatically tripped position before the breaker has automatically reset for manual operation; and

FIG. 4 is a sectional view along the lines 4-4 of FIG. 1.

Referring to the drawings FIGS. 1 to 4, one embodiment of the circuit breaker provided by this invention includes an insulating casing 10 which is made in two parts, 12 and 14, and which is held together by screws 16 for enclosing the breaker operating mechanism 18. A threaded sleeve 20 having a flanged end 20.1 is clamped between the casing parts in a casing recess 10.1, and, with a nut 22, serves to mount the breaker upon an instrument panel, as at 24, in conventional manner.

The circuit breaker has terminals 26 and 28 which extend exteriorly of the insulating casing for connecting the breaker in a circuit to be protected, and preferably each terminal is provided with a screw 30 and a washer for facilitating electrical connection thereto. The terminals can be held in place by being clamped between the casing parts as shown or can be cemented or riveted to the casing in any suitable manner. Within the casing, a fixed contact 34 is secured to the terminal 26.

A movable contact member 36 carrying a contact 38 is pivotally mounted within the casing on a pin 40 so that the movable contact 38 is cooperable with the fixed contact 34 for closing a circuit through the breaker. The movable contact member preferably comprises a strip 36.1 of stiffly resilient conductive material having a rolled end 36.2 engaging the pin 40, and is biased by a spring 42, also mounted on the pin 40, to move the contact 38 away from the fixed contact 34 to open the breaker circuit. The pin 40 is mounted within the casing

by being fitted within recesses (not shown) in respective casing parts, 12 and 14.

An operating member 44 made of insulating material and carrying a pin 46 is slidably disposed within the breaker mounting sleeve 20 so that the pin 46 slides within aligning grooves 46.1 and 46.2 in respective casing parts, 12 and 14, and a cam member 48 having the cam surface 48.1 and the cam surface recess 48.2 is pivotally mounted upon the pin 50 substantially in alignment with the axis of the operating member. The cam member is biased by a spring 52, also mounted upon the pin 50, to pivot in a counterclockwise direction as shown in FIG. 1. The pin 50 is mounted within the casing by being fitted within recesses 50.1 and 50.2 in respective casing parts, 12 and 14.

An actuating means 54, preferably comprising a toggle linkage as shown, including parallel toggles 54.1 and 54.2 of insulating material, a common knee pivot 54.3, and a roller 54.4 rotatably mounted on the knee pivot, is pivotally connected at one end to the operating member pin 46 and at the other end, by means of a pin 56, to a boss 58 carried by the movable contact member 36. The actuating means roller 54.4 is adapted slidably to engage the cam surface 48.1 so long as the cam 48 is held in actuating position as shown in FIG. 1. Preferably a pin 60 is mounted within the casing in a manner similar to the pin 50 for preventing reversal of the knee action of the toggle linkage.

A latch lever 62 having the lever arms 62.1 and 62.2 and pivotally mounted upon a pin 64 carries a latch plate 62.3 which is engageable with a shoulder 48.3 on the cam 48 for normally holding the cam in actuating position as shown in FIG. 1. However, a coil spring 66 fitted between the latch arm 62.1 and the casing 10 and secured in position by a locating pin 68 carried by the latch lever biases the latch lever to rotate in a counterclockwise direction as shown in FIG. 1 for releasing latch engagement with the cam 48. The latch lever is further provided with a control arm 62.4 having a bore 62.5 for receiving a split tapered sleeve 70 of readily deformable conductive material. The latch lever is also slotted as at 62.6 for a purpose to be explained below. A stiffly resilient conductive member 72 is fastened to the terminal 28 by rivets 72.1 and is bored at 72.2 for receiving a second split tapered sleeve 70. A heat-expansive member 74, for example a length of Nichrome wire, is extended over the roller 78 mounted upon the pin 80 and is inserted through and gripped within said split sleeves 70, whereby the latch lever is normally restrained from rotating on its pivot in response to bias of the spring 66, thereby to hold the latch lever in engagement with the cam 48. Preferably the resilient conductive member has a cam surface 72.3 which is engageable by a screw 76 in the breaker casing by means of which the tension in the heat expansive member 74 can be adjusted. Preferably, also, the breaker casing is provided with a threaded opening 82 normally closed by a screw 82.1, through which the length of the heat-expansive member between the split sleeves 70 can be conveniently adjusted.

As shown in the drawings, the latch pivot pin 64 is located so that the forces exerted on the latch through the latch plate 62.3 are radial forces. That is, the forces tend to draw the latch away from its pivot and do not tend to rotate the latch. The purpose of this relationship of the latch and cam will be explained below.

A flexible conductive member 84, preferably comprising a length of braided copper wire, is connected between the latch lever 62 and the movable contact member 36 for completing the breaker circuit. If desired the flexible member 84 can also be secured to a bus bar 86, suitably apertured at 86.1, for receiving the operating member 44, thereby to reduce twisting of the flexible member during breaker operation. In this construction, it can be seen in FIG. 1 that the breaker circuit leads

from the terminal 26, through the contacts 34 and 38, to the flexible member 84, to the latch 62, to the heat-expansive member 74, to the resilient member 72, to the terminal 28.

The operation of this embodiment of the circuit breaker provided by this invention is as follows. FIG. 2 illustrates the circuit breaker in open circuit position with the operating member extended from the casing to its fullest extent and with the movable contact member biased to open circuit position by the spring 42. The breaker can be moved to closed circuit position as shown in FIG. 1 by depressing the operating member 44, thereby to urge the actuating means roller against the cam surface 48.1. Since the cam 48 is normally engaged by the releasable latch 62 and is thereby held in actuating position, the actuating means swing the movable contact means 36 about its pivot into cooperation with the fixed contact 34 for closing the breaker circuit. After the breaker circuit has been closed further pressure on the operating member bends the movable contact member slightly for loading the breaker contacts and for permitting the actuating means roller 54.4 to snap into the cam surface recess 48.2 for holding the circuit breaker in closed circuit position.

The circuit breaker can be manually moved to open circuit position by raising the operating member with sufficient force to draw the actuating means roller 54.4 from the cam surface recess 48.2, whereby the spring 42 will rapidly move the movable contact member to open circuit position as shown in FIG. 2.

The circuit breaker is also automatically operable to open the breaker circuit in response to current overload in the breaker circuit in the following manner. An overload current in the breaker circuit heats and expands the heat-expansive member 74 thereby removing restraint from the latch lever 62 which accordingly is rotated by the spring 66 until the latch plate 62.3 disengages the cam 48. Preferably the latch lever is provided with a stop arm 62.7 for limiting the extent to which the latch will rotate in response to bias of the spring 66. The bias of the spring 42 then moves the actuating means to the right as shown in FIG. 3 rotating the cam 48 against the bias of the spring 52 until the actuating means roller 54.4 is released from the cam surface recess. The cam is adapted to move through the slot 62.6 in the latch lever to permit the desired degree of cam rotation. The spring 42 simultaneously moves the movable contact member to open circuit position as shown in FIG. 3. Thereafter the bias of the spring 52 returns the cam 48 to the actuating position shown in FIG. 2, the actuating means riding up the cam surface 48.1 for forcing the operating member to open circuit position as shown in FIG. 2.

It can be seen that the circuit breaker automatically resets the cam and operating member for manual operation after automatic overload tripping of the breaker but that so long as the heat-expansive member is conditioned by the current overload, the cam 48 will not be re-latched and the breaker cannot be returned to closed circuit position even though the operating member 44 is manually depressed. Thereafter, as the heat-expansive member contacts until it is no longer conditioned by said current overload, the latch lever is rotated in a clockwise direction as shown in FIG. 2 against the bias of the spring 66 and the latch plate 62.3 is re-engaged with the cam 48.

It will be understood that the heat-expansive member will normally exert substantial force for restraining unlatching rotation of the latch lever 62 so that the circuit breaker provided by this invention will be highly resistant to shocks and vibrations. Further, by proper relation of the length of the latch lever and control arms 62.1, 62.2 and 62.4 the latch can be provided with secure engagement of the cam member 48 to prevent inadvertent tripping of the breaker, but can be rotated to release cam engagement in response to a very small degree of expansion of the heat-expansive member. Since considerable

latching force is available in the heat-expansible member, the circuit breaker provided by this invention can be finely adjusted over a wide range to operate automatically in response to a specific degree of current overload. This wide range of accurate adjustment is achieved by adjusting both the effective length and the tension in the heat-expansible member 74. Thus, when the tension in the heat-expansible member is released, the sleeve 70 can be loosened in the bore 62.5, for example with a tool inserted through the casing opening 82, and the effective length of the heat-expansible member can be adjusted.

Since the forces exerted on the latch by the cam member are arranged so that they do not tend to rotate the latch, the heat-expansible member will not be flexed or stressed during manual operation of the circuit breaker and therefore will not be subjected to fatigue or random variation of its heat-expansion characteristics.

It should be understood that although particular embodiments of this invention have been described for the purpose of illustration, this invention includes all modifications and equivalents which fall within the scope of the appended claims.

I claim:

1. A circuit breaker comprising: fixed contact means; movable contact means cooperable with the fixed contact means for closing a circuit; means biasing the movable contact means to open circuit position; an operating member; a pivotally mounted cam member; actuating means pivotally connected to the operating member and to the movable contact means, said actuating means being adapted slidably to engage the cam member for urging the movable contact means to closed circuit position in response to movement of the operating member while said cam member is maintained in actuating position; an elongate latch mounted on a pivot and normally adapted to hold the cam member in actuating position; biasing means adapted for rotating the latch to release the cam member from actuating position; a roller adjacent to said pivot; and a heat expansible wire extending along said latch and deflected by said roller to engage the latch, said wire being normally adapted for restraining said latch biasing means to prevent latch rotation, and being also adapted to expand in response to overload current in the breaker circuit for releasing restraint of said latch biasing means, thereby releasing the cam member from actuating position for permitting the contact biasing means to move the movable contact means to open the breaker circuit and to keep said

circuit open regardless of the position of the operating member.

2. A circuit breaker comprising: an insulating casing; a fixed contact within the casing; a movable contact member cooperable with the fixed contact for closing a circuit; means biasing the movable contact member to open circuit position; a push button operating member slidably mounted within the casing; a pivotally mounted cam member, toggle means pivotally connected to the operating member and to the movable contact member and adapted slidably to engage the cam member for urging the movable contact member to closed circuit position in response to movement of the operating member while the cam member is held in actuating position; a pivotally mounted latch having a first lever arm which normally extends parallel to the direction of movement of the operating member tangentially to engage the cam member for holding the cam member in actuating position and a second lever arm extending in the opposite direction; biasing means bearing against said second lever arm and adapted to rotate the latch for releasing cam engagement; a flat spring secured at one end relative to the casing and having a cam surface at its other end; a roller; a length of heat expansible Nichrome wire adjustably secured to the latch and spring for normally preventing latch rotation, said wire extending parallel to said first lever arm for most of its length and then turning around said roller to engage said latch and being adapted to expand in response to overload current in said circuit to permit latch rotation for releasing the cam member from actuating position, thereby permitting the contact biasing means to move the movable contact member to open the breaker circuit and to keep it open regardless of the position of the operating member; and adjusting screw means mounted in the casing engageable with said spring cam surface for wedging said flat spring to adjustably tension said wire.

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