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Misencik et al.

[11] **3,760,308**

[45] **Sept. 18, 1973**

[54] **CIRCUIT BREAKER SYSTEM**

[75] Inventors: **John J. Misencik**, Shelton, Conn.; **Charles E. Nystrom, deceased**, late of Derby, Conn. by Mae Nystrom, administratrix

[73] Assignee: **Westinghouse Electric Corporation**, Pittsburgh, Pa.

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[52] **U.S. Cl.** **335/35**, 337/43, 337/46, 337/70

[51] **Int. Cl.** **H01h 75/12**

[58] **Field of Search** 337/43, 46, 48, 49, 337/50, 62, 64, 70, 71, 356; 335/8, 9, 50, 35, 37

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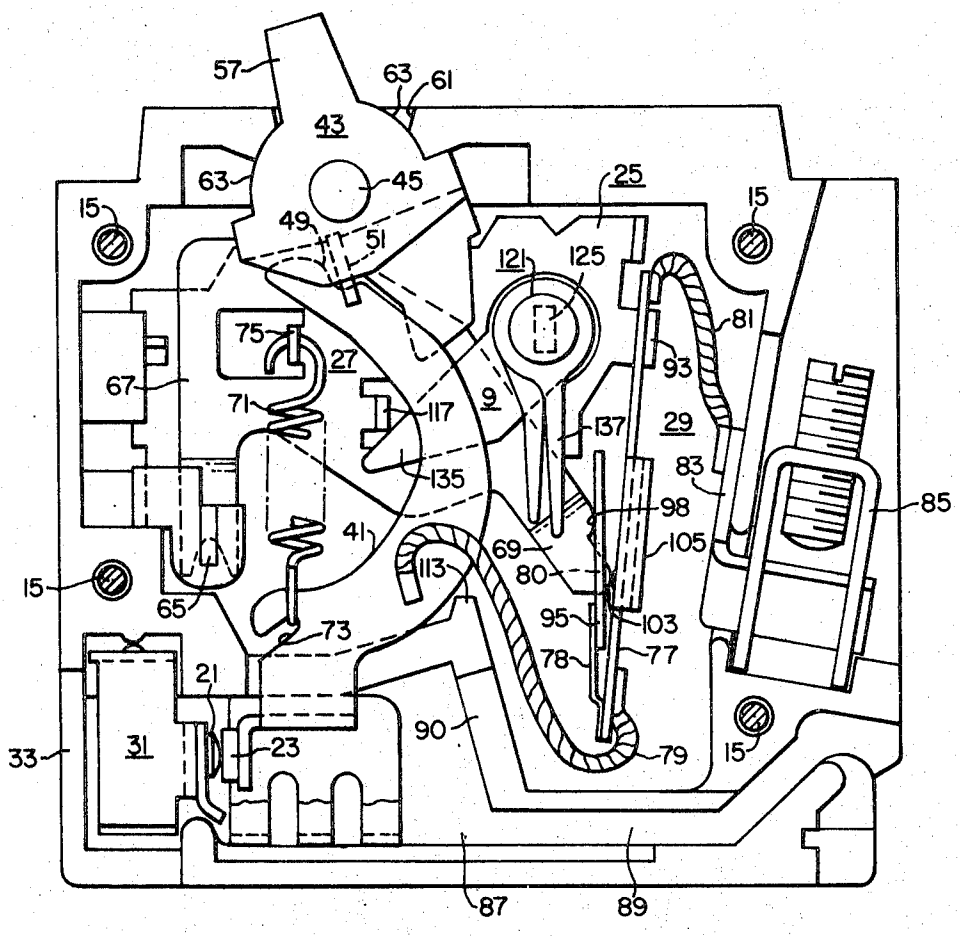
Primary Examiner—Bernard A. Gilheany
Assistant Examiner—A. T. Grimley
Attorney—A. T. Stratton et al.

[57] **ABSTRACT**

A circuit breaker system characterized by at least two circuit breakers in side-by-side relationship and having improved interconnecting trip means for automatically tripping one breaker when the other breaker is tripped in response to overload current conditions, the trip means including a trip cam having an elongated flexible member to effect direct contact with the magnetic armature on a bimetal element of the circuit breaker whereupon movement of the trip means in one circuit breaker automatically results in tripping of the adjacent circuit breaker.

9 Claims, 7 Drawing Figures



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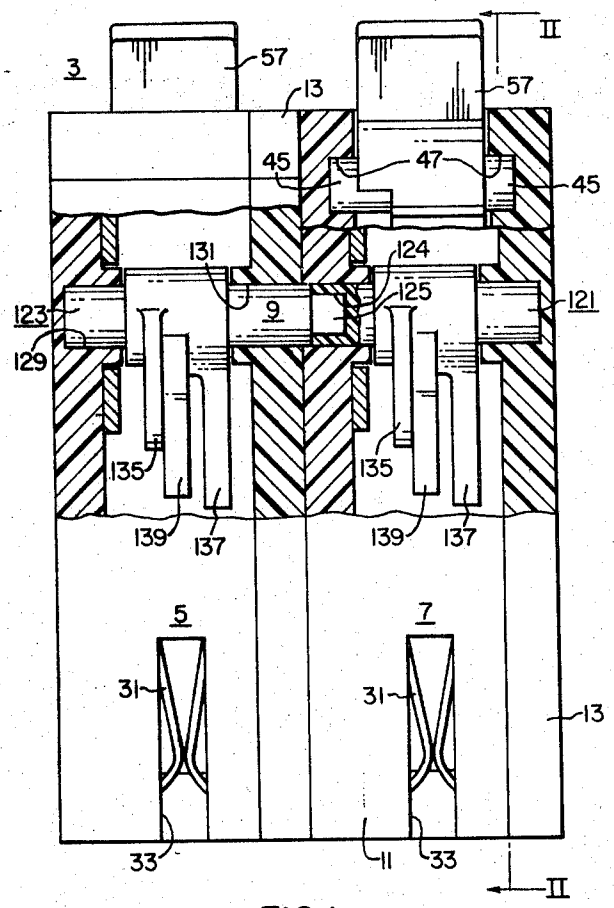

FIG. 1.

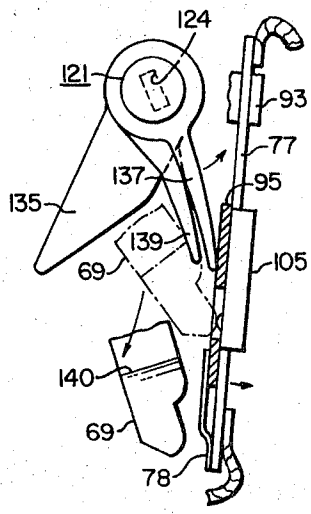

FIG. 7.

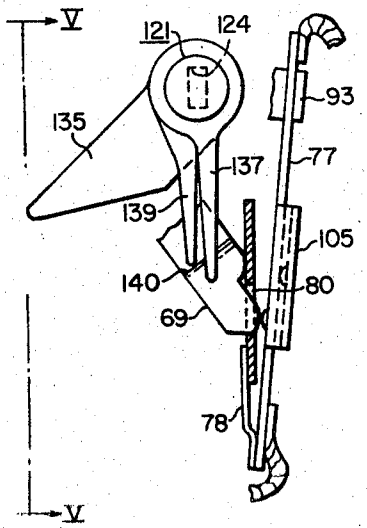

FIG. 4.

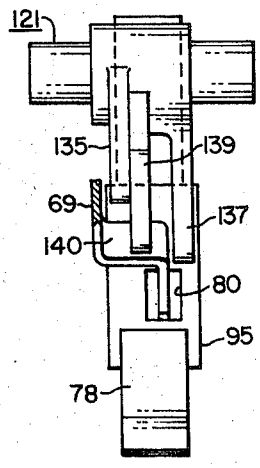

FIG. 5.

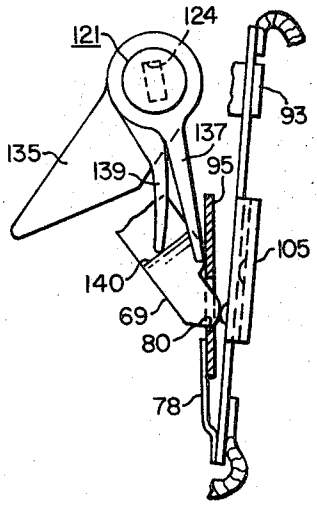

FIG. 6.

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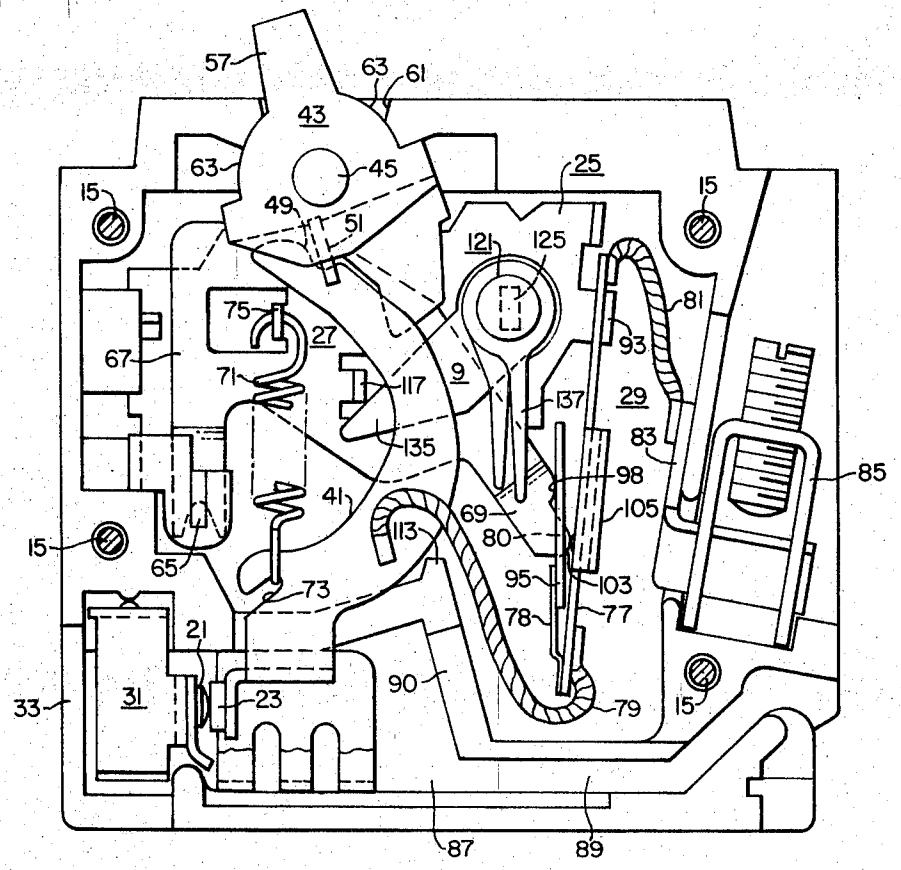

FIG. 2.

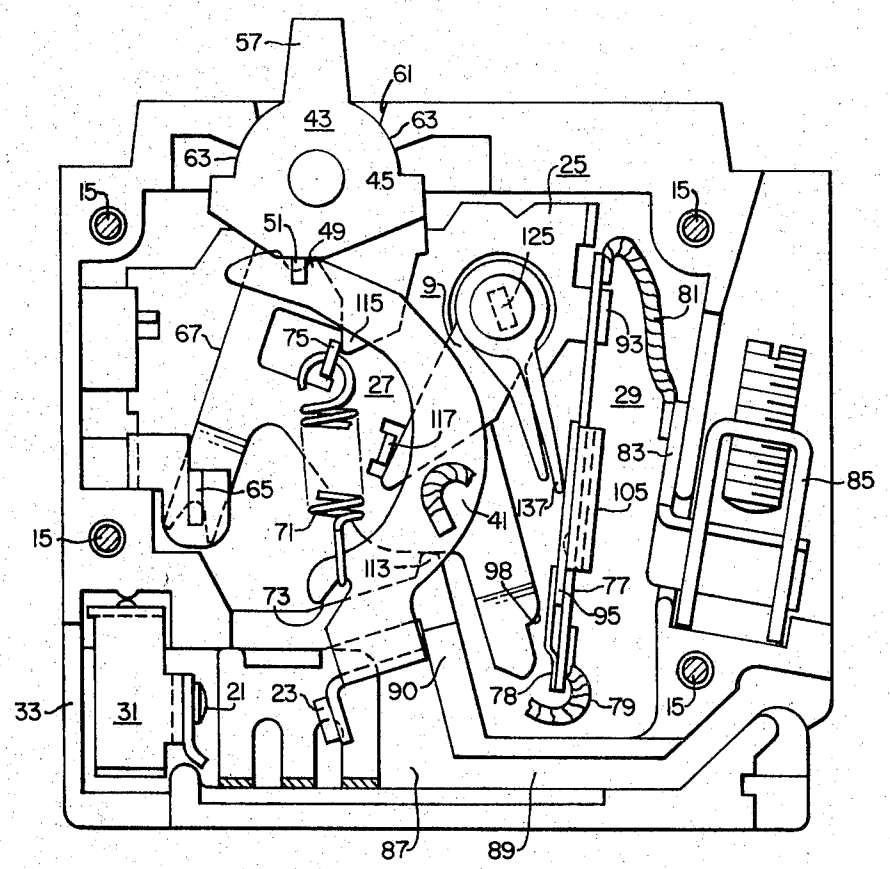

FIG. 3.

CIRCUIT BREAKER SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to circuit breakers and more particularly it pertains to a plurality of circuit breakers disposed in side-by-side relationship and having interconnecting trip cam members.

2. Description of the Prior Art

In circuit breakers of the two and three pole type a trip cam of molded thermosetting resin is employed in conjunction with a tension spring member to couple two or more suitable circuit breakers together so that a common trip action may occur. Generally, for that purpose a circuit breaker has a spring-loaded latch that is actuated by a cam. Upon an impulse from an adjacent circuit breaker, which is coupled through corresponding cams, a rotational mechanical force is applied to the cam which depresses the tension spring on the latch surface and thereby causes the latch to release and allow the breaker to common trip from the action of the adjacent breaker. A disadvantage of that construction has been an indirect linkage between the cam and the latch surface due to unnecessary intervening members which resulted in a slower and less reliable breaker design.

SUMMARY OF THE INVENTION

It has been found in accordance with this invention that the foregoing disadvantage may be overcome by providing a circuit breaker system comprising a plurality of circuit breakers which employ a direct common trip means therebetween. For that purpose at least two circuit breakers are disposed in side-by-side relationship, each breaker comprising an insulating housing having opposite side walls and a top wall, the adjacent side walls of the breakers having aligned openings, the top wall having a handle-receiving opening, a circuit breaker structure supported in each housing and comprising a pair of contacts operable to open and close an electric circuit, a handle extending through each handle receiving opening and being manually operable to open and close the contacts, a releasable member in an initial position and movable when released to a tripped position to effect automatic opening of the contacts, an elongated current-carrying bimetal element, a magnetic member on the bimetal element, a movable magnetic armature in a latching position to effect latching of the releasable member, biasing mounting means for mounting the movable magnetic armature on the bimetal in the latching position, the movable magnetic armature being movable to the magnetic member to effect unlatching of the releasable member upon the currents of overload currents in the bimetal, a trip cam in each housing, the trip cams being interconnected, each trip cam having a cam portion movable from a neutral position to a tripped position upon unlatching of the releasable member, each trip cam having a first elongated member to effect movement of the movable magnetic armature to the unlatched position, and the elongated member of the trip cam in one housing being effective for said movement in response to movement of the cam portion of the trip cam in the other housing. In one embodiment of the invention a second elongated member is provided on the tripped cam which member engages the releasable member in the latched position whereby the first elongated member is held in a spaced position with respect to the movable magnetic armature and is prevented from being overheated.

The advantage of the circuit breaker system of this invention is that it provides for a more direct tripping operation between adjacent circuit breakers by eliminating prior existing intervening parts. In addition, by providing a trip cam composed of a thermoplastic resin rather than a thermosetting resin any heat generated in the circuit breaker is non-detrimental to the trip cam; and by providing direct operation on the latch tolerances between the operating parts are less significant due primarily to the use of fewer parts.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an end view, with parts broken away, of a multi-pole breaker comprising two circuit breakers mounted in a side-by-side relationship with a common trip member interconnecting the breakers to effect tripping operation in both of the breakers or pole units when there is a tripping overload in one of the breakers or pole units;

FIG. 2 is a sectional view taken along the line II—II of FIG. 1 with the breaker being shown in the closed position;

FIG. 3 is a view similar to FIG. 2 with the breaker shown in the tripped position;

FIG. 4 is a partial view, similar to FIG. 2, illustrating the particular configuration and location of parts of the trip cam;

FIG. 5 is a view taken on the line V—V of FIG. 4;

FIG. 6 is a view, similar to FIG. 4, showing the trip cam in an intermediate position; and

FIG. 7 is a view showing the trip cam in the latch-release position.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIG. 1 of the drawings, there is shown therein a two-pole circuit breaker 3 comprising a circuit breaker 5 and a circuit breaker 7 secured to the breaker 5 in an abutting side-by-side relationship. A common trip cam 9 interconnects the breakers for common tripping in a manner to be hereinafter specifically described. The circuit breakers 5 and 7 are identical. Thus, only the circuit breaker 7 will be specifically described, it being understood that the description applies to both circuit breakers.

The circuit breaker 7 comprises an insulating housing base part 11, that comprises a back portion and four side portions extending toward an open side, and an insulating cover 13 covering the open side of the back portion 11. The housing parts of the two circuit breakers are secured together by rivets 15 (FIG. 2).

Referring to FIG. 2, a circuit breaker mechanism, supported in the housing 11, 13, comprises a stationary contact 21, a movable contact 23, a supporting metal frame 25, an operating mechanism 27, and a trip device 29. The stationary contact 21 is welded, or otherwise secured to a plug-in type line terminal structure 31 that is positioned at an opening 33 (FIG. 1) in the housing to resiliently engage a blade or stab in a panelboard or load center when the circuit breaker is mounted in the operating position.

The stationary contact 21 (FIG. 2) cooperates with the movable contact 23 that is welded or otherwise secured to a small flange portion of a flat metallic generally C-shaped contact arm or switch arm 41. Means for

operating the contact arm 41 to the open and closed positions comprise an insulating operating member indicated generally at 43 having a pair of oppositely disposed trunnions 45 (FIG. 1) which are journally mounted in sockets 47 in opposite walls of the housing. The metallic frame 25 is fixedly supported in the housing 11, 13. The operating member 43 is biased outwardly or upward, as seen in FIG. 2, by the contact arm 41. The contact arm 41 is provided with a V-notch 49 at the upper end. A metallic pivot part 51 is seated in a suitable hole in the under-surface of the member 43. When the parts are in operating position, the part 51 is disposed in the V-notch 49 of the contact arm 41 to position the operating member 43 relative to the contact arm. The operating member 43 has a handle portion 57 molded integral therewith which extends through an opening 61 in the housing to permit manual operation of the circuit breaker. Arcuate surfaces 63 on opposite sides of the handle portion 57 substantially close the opening 61 in all positions of the operating member 43. Motion is transmitted from the operating member 43 to the contact arm 41 when the breaker is manually operated and from the contact arm 41 to the operating member 43 when the breaker is automatically tripped.

The supporting frame 25 supports an insulating pivot 65. A releasable member 67 is pivotally supported at one end thereof on the pivot 65. The other end 69 of the releasable member 67 is latched by the trip means 29 in a manner to be hereinafter described. Except for the trip means, the operating mechanism 27 is more specifically described in the patent to F. L. Gelzheiser U.S. Pat. No. 3,254,176. Thus, the ends of the releasable member 67 are offset and disposed along a plane which is parallel to a plane in which the main body portion of the releasable member 67 is disposed. A spring 71 is connected, under tension, at one end in a slot 73 in the contact arm 41, and at the other end in a slot in a projection 75 that extends from the main body portion of the releasable member 67.

The contact arm 41 is electrically connected to the lower end of a bimetal 77 by means of a flexible conductor 79. The bimetal 77 is part of the trip device 29 that will be hereinafter described. A flexible conductor 81 connects the upper end of the bimetal 77 with a terminal strap 83 that extends through an opening in the end wall of the housing. A terminal connector 85 is connected to the external end of the terminal strap 83 to permit connection of the circuit breaker in a circuit in a manner well known in the art. The closed circuit through the breaker extends from the terminal 31 through the stationary contact 21, movable contact 23, contact arm 41, flexible conductor 79, current-carrying bimetal 77, flexible conductor 81, terminal strap 83, to a conducting line that would be connected to the terminal strap 83 by means of the terminal connector 85. Since the movable contact arm 41 extends downwardly from its pivot, the arc is established adjacent the bottom of the housing in an arc chamber 87 which is connected by a vent passage 89 to an opening in the end of the housing beneath the terminal connector 85.

When the releasable member 67 is in the reset or latched position shown in FIG. 2, the circuit breaker may be manually operated by the operating member 43. Movement of the operating member 43 in a clockwise direction from the ON or closed position (FIG. 2) to the OFF or open position (FIG. 3) carries the upper end of the contact arm 41 to the left of the line of action of the spring 71, causing the spring to move the contact arm 41 with a snap action to the open position. The contact arm 41 is stopped in the open position by engagement thereof with a molded projection 90. As shown in FIG. 2, the spring 71 biases the contact arm 41 frontward into engagement with the operating member 43 to bias the operating member 43 against the trunnions 45 about which the operating member 43 pivots. Movement of the operating member 43 in a counterclockwise direction from the OFF position to the ON position moves the upper end of the contact arm 41 to the right of the line of action of the spring 71 to move the contact arm 41 to the closed position seen in FIG. 2.

The trip device 29 comprises the bimetal 77 which is a flat member that is secured near the upper end thereof to an outturned projection 93 of the frame 25. The frame 25 is a flat metallic member that is secured in place in the housing between projections of the molded insulating housing, and the projection 93 extends in a direction generally normal to the plane of the flat supporting plate 25. An armature latch 95 of magnetic material is welded or otherwise fixedly secured to a flat leaf spring 78 that is secured at the lower end to the flat face of the bimetal 77. The releasable member 67 is latched in a window-opening 80 of the armature latch 95, of the releasable member 67 to latch the releasable member 67 in the latched position seen in FIG. 2. The bimetal 77 is biased to the left (FIG. 2), and a stop portion 103 at the latch end 69 of the releasable member 67 engages the bimetal 77 to limit movement of the bimetal to the left and to determine the amount of latch engagement between the releasable member 67 and the armature 97. A U-shaped magnetic member 105 is mounted on the bimetal 77 with opposite legs being positioned on opposite sides of the bimetal 77 and a stop surface 98 on the releasable member 67 engages the armature latch 95 above the window opening 80 to limit the latch engagement between the releasable member 67 and the armature 95.

The circuit breaker is shown in FIG. 2 in the closed position with the releasable member 67 being latched on the armature 95. Upon the occurrence of a sustained overload current above a first predetermined value, the current-carrying bimetal 77 is heated by the current flowing therethrough, and the bimetal deflects with the lower end thereof moving to the right to move the armature 95 out of latching engagement with the releasable member. When the releasable member 67 is released, the spring 71 rotates the releasable member 67 in a clockwise direction about the pivot 65 until the releasable member is stopped by engagement thereof with molded projection 113 of the housing part 11. During this movement, the line of action of the spring 71 moves to the right of the V-notch 49, whereupon the spring 71 biases the contact arm 41 to the open position and moves the contact arm 41 so that the line of action of the force exerted by the spring on the operating member 43 moves across the V-notch 49 and actuates the operating member 43 to the tripped position shown in FIG. 3, which tripped position is intermediate the ON and OFF positions. The operating member 43 is stopped in the intermediate position when a projection 115 thereon engages the projection 75 of the releasable member 67. Positive separation of the contacts is provided during a tripping operation by the provision of a projection 117 extending from the releasable mem-

ber 67 which engages the contact arm 41 with a swiping action if the contacts are slow in opening due to sticking or other reasons.

The circuit breaker is trip-free in that the breaker will automatically trip open even if the operating member 43 is held in the closed position.

Before the breaker can be operated following an automatic tripping operation, the releasable member 67 must be reset. This is accomplished by moving the operating member 43 from the tripped position (FIG. 3) clockwise to a position slightly beyond the full OFF or open position. During this movement, the projection 115 on the operating member 43 operates against the projection 75 of the releasable member 67 to move the releasable member 67 counterclockwise to a position wherein the latch surface at the latch end 69 moves into the window opening 80 of the armature 95, provided the bimetal 77 has cooled and straightened since no current has been flowing therethrough under the tripped condition and moved to the left until the bimetal engages the stop 103 of the releasable member 67 to thereby relatch the releasable member 67 in the position seen in FIG. 2. Thereafter, the circuit breaker can be manually operated in the same manner as was hereinbefore described.

The circuit breaker is instantaneously tripped upon the occurrence of a short circuit or severe overload current above a second predetermined value higher than the first predetermined value by operation of the electromagnetic trip of the trip means 29. As can be understood with reference to FIG. 2, the current passing through the bimetal 77 generates magnetic flux which operates through the armature 95, the air gaps between the armature 95 and the stationary magnetic member 105, and through the stationary magnetic member 105. When the current reaches the second predetermined value, this magnetic flux is strong enough to attract the armature 95 toward the stationary magnetic member 105, and the spring 91 flexes to permit movement of the armature 95 toward the stationary magnetic member 105 to the magnetically-tripped position seen in FIG. 3 to thereby release the releasable member 67. Upon release of the releasable member 67, the circuit breaker is tripped open in the same manner as was hereinbefore described with regard to the time-delay thermal tripping operation. The circuit breaker is reset and relatched following a magnetic tripping operation in the same manner as was hereinbefore described following the thermal tripping operation.

Referring to FIG. 1, it will be noted that two circuit breakers 5 and 7 are mounted in a side-by-side relationship to provide a two-pole circuit breaker. Each of the circuit breakers comprises a separate independent circuit-breaker structure. The common trip cam 9 is provided in order to provide that both breakers trip when either of the breakers is tripped. The common trip cam 9 comprises two insulating members 121 and 123 tied together for common movement by interfitting parts. Each of the members 121, 123 is supported at one end thereof in an opening 129 in the back wall of the associated housing part 11 and at the other end thereof in an opening 131 in the associated cover 13. The members 121, 123 are cylindrical at the opposite ends thereof and the openings 129, 131 are cylindrical to support the members 121, 123 for pivotal movement about the common axis of the members 121, 123. One of the members 121, 123 is provided with a rectangular socket 124, and the other member is provided with a rectangular end portion 125 that is seated snugly within the socket.

Each of the members 121, 123 is molded electrically insulating member provided with an actuating part 135 and an elongated member or finger 137 that are molded integral therewith. As can be seen in FIG. 2, each of the actuating parts 135 is positioned at the one end thereof under the associated projection 117 of the associated releasable member 67. Upon the occurrence of an overload in either of the circuit breakers, the associated releasable member 67 drops to the tripped position (FIG. 3) during which movement the projection 117 on the releasable member 67 engages the part 135 of the common trip cam 9 to rotate the common trip member 9 in a counterclockwise (FIGS. 2 and 3) direction, whereupon the finger 137 of the adjacent circuit breaker is moved to engage and move the associated armature 95 to the unlatching position. Thus, the releasable member 67 of the adjacent circuit breaker is released and the adjacent circuit breaker is tripped open in the same manner as was hereinbefore described.

In accordance with this invention, as shown more particularly in FIGS. 3 and 4, the finger 137 extends downwardly from the body portion of the trip cam 9 and alongside the armature 95, preferably at a spaced distance therefrom in the inoperative position of the finger as shown in FIG. 4. When the trip cam 9 is rotated, upon the occurrence of an overload as set forth above, the finger 137 engages and pushes the armature 95 (FIG. 6) to the right until the armature is in surface-to-surface abutment with the bimetal 77 (FIG. 7). In that position the latch end 69 is removed from the window-opening 80 (as shown by the broken line position in FIG. 7), and moves downwardly under the force of the spring 71 to the unlatched (solid line) position. Following a tripping operation of the two-pole circuit breaker the two poles be reset by simultaneous movement of the handles 57 to the reset position whereupon the projections 117 of the adjacent breakers will be moved to the position seen in FIG. 2 and the common trip cam 9 can then move to an inactive position such as the position seen in FIG. 2. Although it is not necessary for effective operation of the circuit breaker, a suitable spring means could be provided to bias the common trip member 9 to the particular inactive position seen in FIG. 2.

Another embodiment of the invention includes a reset member or second finger 139 which like the finger 137 is preferably an integral part of the trip cam 9. The second finger 139 extends downwardly from the body portion of the trip cam 9 (FIG. 5) and the lower end of said finger engages a shoulder 140 of the latch end 69 (FIG. 4). When the latch end 69 is latched in the window opening 80 of the armature 95, the second finger 139 retaining the trip cam 9 in the inoperative position of FIG. 4; that is, the finger 137 is spaced from the armature 95 with the second finger 139 resting on the shoulder 140. Thus, the second finger 139 saves the finger 137 from otherwise being damaged during contact of the finger 137 with the armature 95 which normally develops heat during operation. Where the trip cam 9 is composed of a thermosetting resin, the heat developed in the armature 95 is detrimental because heat causes such resin to embrittle and deteriorate.

As shown in FIG. 7 when the trip cam 9 rotates counterclockwise, the finger 137 moves the armature 95 to the unlatching position. To prevent the armature 95 and bimetal 77 from becoming dislodged or miscalibrated under any excessive force of the finger 137, the finger is flexible and bends in response to the resistance to movement near the end of the rotational stroke. If the finger 137 becomes embrittled due to extended contact with the heated armature 95, the finger looses its flexible property and is no longer able to bend.

Where, however, the trip cam 9 including cam portion 135 and fingers 137 and 139, are composed of a material that is unaffected by the heat, it is immaterial whether the finger 137 does or does not contact the armature 95. A material that is not affected by the heat is thermoplastic resin. Accordingly, if a thermosetting resin is used, the finger 139 may be omitted.

The use of a molded trip cam composed of a thermoplastic resin having flexible or resilient fingers that act as spring members for initiating pressure on the latch surface eliminates the need for intervening spring members and enables the use of remaining members having wider tolerances. Moreover, the use of a thermoplastic resin enables the employment of a tie bar or interfitting means between two circuit breakers to be tight fitting because thermoplastic resin does not normally become brittle and deteriorate under tension forces. A tight fit between the interconnecting members eliminates looseness and thereby increases the reliability of the assembly. Where, however, thermosetting resin is used for various other reasons such as economic two flexible fingers or extensions may be used for unlatching the release member, whereby one of the fingers holds the other from engagement with a heated latch member.

Although a two-pole circuit breaker has been described herein, it is understood that additional pole units could be mounted adjacent to the two two-pole units, and a common trip member may be provided with similar operating parts for each pole unit.

What is claimed is:

1. A circuit breaker system comprising at least two circuit breakers, each breaker comprising an insulating housing having a handle-receiving opening, a circut breaker structure supported in each housing and comprising a pair of contacts operable to open and close an electric circuit, a handle protruding through each opening and being manually operable to open and close the contacts, a releasable member in an initial position and movable when released to a tripped position to effect automatic opening of the contacts, an elongated current-carrying bimetal, a magnetic member on the bimetal, a movable magnetic armature in a latching position to effect latching of the releasable member, biasing mounting means for mounting the movable magnetic armature on the bimetal in the latching position, the movable magnetic armature being movable to the magnetic member to effect unlatching of the releasable member upon the occurrence of overload currents in the bimetal, a trip cam in each housing, the trip cams of both housings being interconnected, each trip cam having a cam portion movable from a neutral position to a tripped position upon unlatching of the releasable member, each trip cam having a first elongated member to effect movement of the movable magnetic armature to the unlatched position, and the elongated members of the trip cam in one housing being effective for said movement in response to the movement of the cam portion of the trip cam in the other housing.

2. The circuit breaker system of claim 1 in which the trip cams comprise essentially electrically insulating material.

3. The circuit breaker system of claim 2 in which the electrically insulating material is a thermosetting resin.

4. The circuit breaker system of claim 2 in which the electrically insulating material is a thermoplastic resin.

5. The circuit breaker system of claim 2 in which the first elongated member extends over a portion of the movable magnetic armature and is a flexible member.

6. The circuit breaker system of claim 2 in which the trip cam comprises a second elongated member engageable with releasable member in the latched position whereby the first elongated member is held in a spaced position of the movable magnetic armature.

7. The circuit breaker system of claim 6 in which the second elongated member is flexible.

8. The circuit breaker system of claim 1 in which the trip cams comprise mounting trunnions having interfitting end portions.

9. The circuit breaker system of claim 8 in which the circuit breaker housings comprise opposite side walls, the circuit breakers having abutting side walls provided with aligned openings, and the trunnions extending through the openings.

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