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CIRCUIT BREAKER

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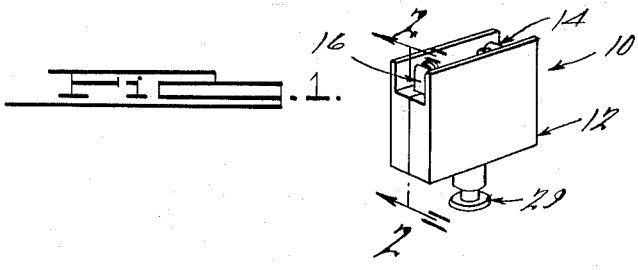


FIG. 1.

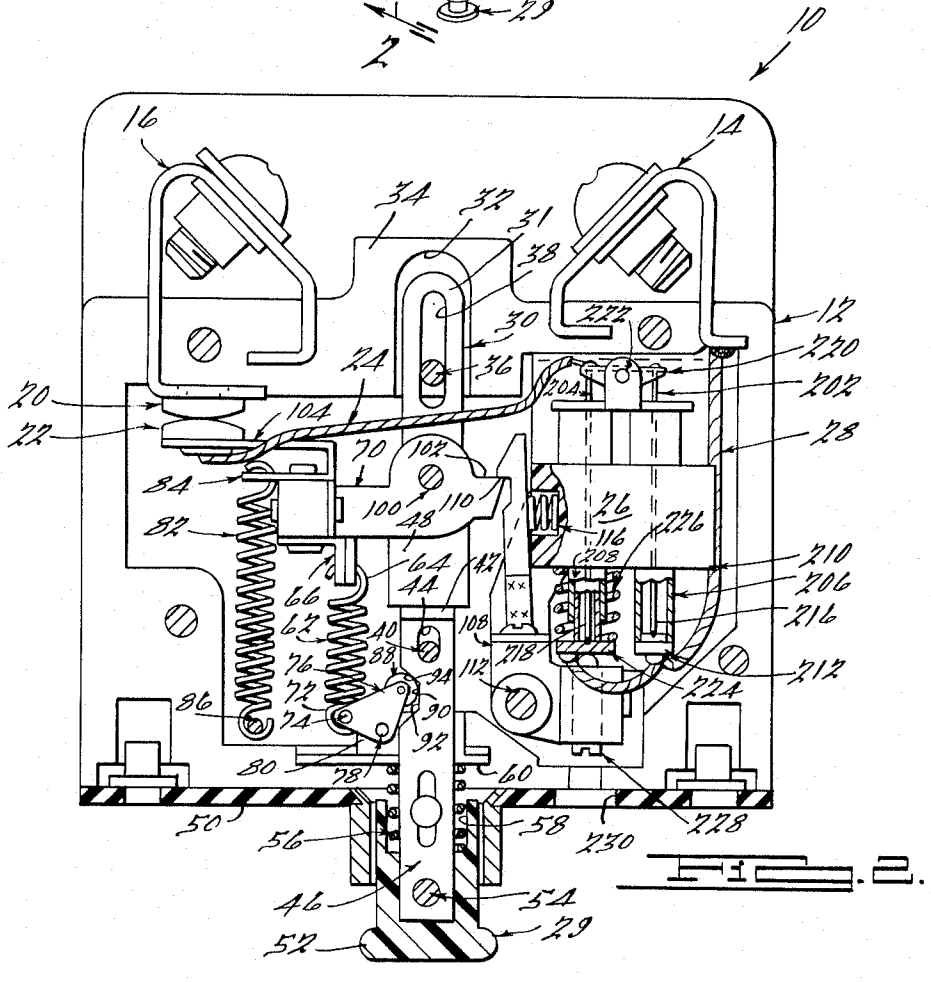


FIG. 2.

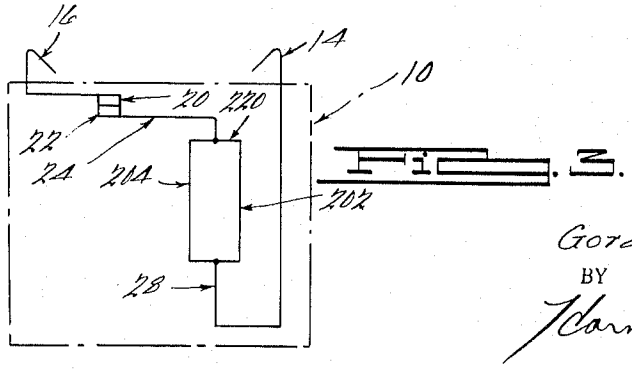


FIG. 3.

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CIRCUIT BREAKER

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This invention relates generally to electric circuit breakers and more particularly to an improved trip device for an electric circuit breaker.

Automatic electric circuit breakers generally comprise a pair of separable contacts, an operating mechanism releasable to effect separation of the separable contacts, and a trip device responsive to predetermined electrical conditions in an electrical circuit to effect release of the operating mechanism. Generally, the trip devices utilized in such circuit breakers comprise a latch mechanism and a current responsive member that effects movement of the latch mechanism to a release condition. Both of these components must satisfy certain basic requirements in order that the circuit breaker be positive in operation, durable, and consistent in performance. The latch mechanism must be extremely sensitive to relatively slight movements of the current responsive member, be of minimum complexity, yet be of maximum mechanical strength.

It is desirable that the current responsive member of the trip device be sensitive to relatively slight current variations above a specific predetermined level, yet be capable of handling relatively large normal rated currents. However, it has long been a problem to produce a relatively inexpensive and compact circuit breaker having a trip device with a current responsive member that exhibits a useable mechanical response characteristic in response to relatively small current overloads. The mechanical response characteristic of a bimetallic member is generally unsatisfactory upon the occurrence of relatively small current overloads at low ampere ratings. On the other hand, while unimetal current responsive members have a satisfactory response characteristic upon the occurrence of small overloads at low ampere ratings, the response characteristic of such unimetal current responsive members is generally obtained at the expense of an ability to withstand relatively high normal currents. In other words, unimetal members which are relatively sensitive are generally incapable of handling relatively high normal or rated currents.

Because many modern-day circuit breaker applications involve circuits wherein the circuit breakers must act quickly and positively upon the occurrence of relatively small overloads, there is presently a need for an improved unimetal trip device that will be capable of withstanding relatively large normal rated currents.

An improved trip device for a circuit breaker, in accordance with the instant invention, overcomes the above stated difficulties since it insures positive protection against relatively small overloads yet is capable of handling relatively high normal currents. A unique combination of a series connected mechanical linkage and a paralleled electrical circuit result in an extremely sensitive unimetal trip device with outstanding current carrying capacity.

The trip device of the instant invention comprises a pair of elongated electrically conductive wires having a positive temperature coefficient of expansion. The wires are mechanically connected in series, or, in other words, elongation of the wires is additive so as to maximize the sensitivity of the current responsive member. However, the wires are electrically connected in parallel so that the trip device is capable of handling relatively large rated currents.

Accordingly, one object of this invention is an improved trip device for a circuit breaker.

Another object is a trip device that is responsive to relatively small overload currents but that is inherently capable of withstanding relatively high normal rated currents.

Other objects and advantages of the present invention will become apparent from the following description taken in conjunction with the accompanying drawings, wherein:

FIGURE 1 is a side elevational view of a single pole circuit breaker having an improved trip device in according with the instant invention;

FIG. 2 is a cross-sectional view taken substantially along the line 2—2 of FIGURE 1; and

FIG. 3 is an internal circuit diagram of the circuit breaker of FIGURE 1.

As best seen in FIG. 2 of the drawings, an electric circuit breaker **10** comprises an insulating housing **12** molded from, for example, bakelite. A pair of terminals **14** and **16** extend from the housing **12** for connection to opposite sides of an external electric circuit.

The terminal **16** extends inwardly of the housing **12** for the support of a fixed contact **20**. A movable contact **22** is aligned and engageable with the fixed contact **20** to complete an electrical circuit through the circuit breaker **10** comprising the terminal **16**, the fixed and movable contacts **20** and **22**, a pigtail **24**, a current responsive trip device generally designated by the numeral **26**, a pigtail **28** and the opposite terminal **14**.

The operating mechanism for the circuit breaker **10** is conventional in construction and comprises a manual operator or plunger **29** that extends externally of and is slidably supported by the housing **12** for "in" and "out" movement. The operator or plunger **29** comprises an inner plunger portion **30** having an upper end **31** that extends into a guideway **32** formed in an upper wall **34** of the housing **12**. A transversely extending pin **36** is fixedly supported by the housing **12** and extends through a slot **38** in the inner plunger portion **30** so as to guide the inner plunger **30**.

A pin **40** is supported on a lower end portion **42** of the inner plunger **30** and extends through a slot **44** in an outer plunger portion **46** of the manual operator **29**. The pin **40** and slot **44** function as a lost motion connection between the inner and outer plunger portion **30** and **46**.

The upper and lower end portions **31** and **42** of the inner plunger **30** extend into a molded central hub portion **48** and are rigidly affixed thereto as by "potting."

The outer plunger portion **46** extends through a front wall **50** of the housing **12** and has a knob **52** secured thereto as by a pin **54**. The knob **52** is preferably formed from an insulating material, for example, Bakelite, and is shaped to facilitate manual operation of the circuit breaker **10**.

The outer plunger portion **46** is normally urged outwardly of the housing **12** by a helical compression spring **56** that extends between a seat in a complementary spring retainer recess **58** in the nob **52** and a fixed abutment plate **60** that is supported by the housing **12**.

The inner plunger **30** is normally resiliently urged outwardly of the housing **12** by a tensioned coil spring **62** having one end portion **64** connected to a bracket **66** on a contact carrier **70**. The other end **72** of the spring **62** is connected to a pin **74** on a toggle lever **76**. The toggle lever **76** is pivoted on a pin **78** journaled in an upstanding portion **80** of the abutment plate **60**. A second coil spring **82** extends between a bracket **84** on the contact carrier **70** and a pin **86** that is fixedly mounted in the housing **12**. The spring **82** functions as an auxiliary to the spring **62**, as will be described.

The toggle lever **76** carries a roller **88** that is normally biased by the spring **62** clockwise into complementary notches **90** and **92** in the inner and outer plungers **30**

and 46, respectively. The spring 62 is sufficiently strong so that when it is tensioned to the position illustrated in FIG. 2, it holds the roller 88 in the notches 90 and 92 and thereby restrains the outer plunger portion 46 of the manual operator 29 from movement outwardly of the housing 12 under the bias of the spring 56. However, the notch 90 in the outer plunger shaft 46 has an upper edge portion 94 so sloped that when tension of the spring 62 is relieved upon automatic opening of the circuit breaker 10, the roller 88 is cammed counterclockwise out of the notch 90, permitting movement of the outer plunger shaft 46 under the bias of its operating spring 56. Movement of the roller 88 outwardly of the notch 90 is also effected upon downward movement of the outer plunger portion 46 upon manual operation of the circuit breaker 10.

Downward movement of the inner plunger shaft 28 is effected upon engagement of the pin 40 on the inner shaft 30 with the upper end of the slot 44 in the outer plunger shaft 46. Thus, a lost motion connection between the two shafts 28 and 46 is provided which permits both manual and automatic operation of the circuit breaker 10.

The contact carrier 70 is pivotally supported by a pin 100 that extends through the hub 48 on the inner plunger portion 30. The contact carrier 70 has a latching surface 102 thereon that extends generally normally to a radius drawn from the pivotal axis of a trip lever 108 through a latching surface 110 thereon.

Upon disengagement of the latching surfaces 102 and 110 on the contact carrier 70 and trip lever 108, respectively, the contact carrier 70 carries the movable contact 22 into and out of engagement with the fixed contact 20, thereby to break an electrical circuit through the circuit breaker 10.

The contact carrier 70 is normally restrained against rotation responsive to the bias of the springs 62 and 82 by the trip lever 108. The trip lever 108 is supported for rotation with respect to the housing 12 as by a pin 112 and comprises what is essentially a bell crank. The arrangement is such that upon the occurrence of a current overload or fault, the trip lever 108 is rotated clockwise, as viewed in the drawings, against the bias of a spring 116, thus releasing the contact carrier 70 and tripping the circuit breaker 10.

In accordance with the instant invention, the trip device, generally designated by the numeral 26, comprises a pair of wires 202 and 204. The wires 202 and 204 are enclosed within separate glass tubes 206 and 208 that are supported in spaced relation by a support block 210. The wire 202 is fixed at one end to a conductive end plate 212 which is fitted within and rests against the lower end of the tube 206.

The upper ends of the wires 202 and 204 are fixed to opposite ends of a lever 220 which is pivoted on a fixed pin 222. The lower end of the wire 204 is fixed to a conductive member 224, which is slidably and telescopically fitted in the lower end of the glass tube 208. The member 224 is normally urged downwardly by a spring 226 that is fitted around the tube 208 and seated between a radial shoulder on the member 224 and the lower face of the mounting block 210 through which tubes 206 and 208 extend.

The pigtail 28 electrically connects the terminal 14 with the lower ends 216 and 218 of the wires 202 and 204, respectively, thus placing the wires 202 and 204 in an electrically parallel condition.

The upper end portion of the wires 202 and 204 are connected to the movable contact 22 by the pigtail 24, thereby completing an electrical circuit internally of the circuit breaker 10 when the movable contact 22 is in the closed condition with respect to its associated fixed contact 20.

The trip lever 108 carries a calibration screw 228 that is aligned with the member 224. A suitable aperture 230 is provided in the wall 50 of the housing 12 to permit manual adjustment of the screw 228 to adjust the response of the trip device 26 to a preselected current overload value.

Upon the occurrence of a predetermined overload or a short circuit condition, the wires 202 and 204 elongate, allowing the lever 220 to pivot counterclockwise about the pin 222 and permitting the conductive member 224 to move downwardly with respect to the tube 208 under the bias of the spring 226. Downward movement of the member 224 is transmitted to the trip lever 108 through the adjustment screw 228, clockwise rotation thereof retracting the latching surface 110 thereon from engagement with the complementary latching surface 102 on the contact carrier 70. The contact carrier 70 thereupon rotates counterclockwise under the bias of the springs 62 and 82, thus separating the movable contact 22 from its associated fixed contact 20. Because the bias of the springs 62 and 82 is released upon rotation of the contact carrier 70, the roll 88 on the toggle lever 76 moves outwardly of the recesses or notches 90 and 92 in the inner and outer plungers 30 and 46, permitting the plungers 30 and 46 to move outwardly of the circuit breaker 10 under the bias of the spring 56.

From the foregoing description it should be apparent that the electrical parallel but mechanical series relationship of the current responsive wires 202 and 204 is such as to maximize the sensitivity of the trip device 26 to relatively small overloads as well as to maximize the current carrying capacity thereof.

It is to be understood that the specific construction of the improved trip device for a circuit breaker herein disclosed and described is presented for the purpose of explanation and illustration and is not intended to indicate the limits of the invention, the scope of which is defined by the following claim.

What is claimed is:

In an electric circuit breaker having a pair of separable contacts and a releasable operating mechanism for effecting separation of said contacts, an improved trip device for effecting release of the operating mechanism comprising a pair of current responsive wires disposed in generally parallel relationship, an electrically conductive lever supported for rotation about an axis extending between said wires, adjacent end portions of said wires being electrically and mechanically connected to said lever on opposite sides of the pivotal axis thereof, respectively, means fixedly supporting the other end portion of one of said wires, means supporting the other end portion of the other of said wires being movable upon elongation of said wires an amount equal to the additive elongation of said wires to effect release of the operating mechanism of the circuit breaker, the adjacent end portions of said wires being connectable to one side of an electrical circuit and the other end portions of said wires being connectable to the opposite side of an electrical circuit whereby said wires are mechanically connected in series relationship to maximize the output characteristic thereof and electrically connected in parallel relationship to maximize the current carrying capacity thereof.

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