United States Patent [19]

Misencik

[11] **3,858,130**

[45] **Dec. 31, 1974**

[54] **GROUND FAULT CIRCUIT BREAKER WITH COLD TEMPERATURE BIMETAL CONSTRICTION**

[75] Inventor: **John J. Misencik**, Shelton, Conn.

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

[22] Filed: **Dec. 4, 1973**

[21] Appl. No.: **421,573**

[52] **U.S. Cl.** **335/18**, 337/55

[51] **Int. Cl.** **H01h 83/02**

[58] **Field of Search** 335/18, 37; 337/55, 57

[56] **References Cited**

UNITED STATES PATENTS

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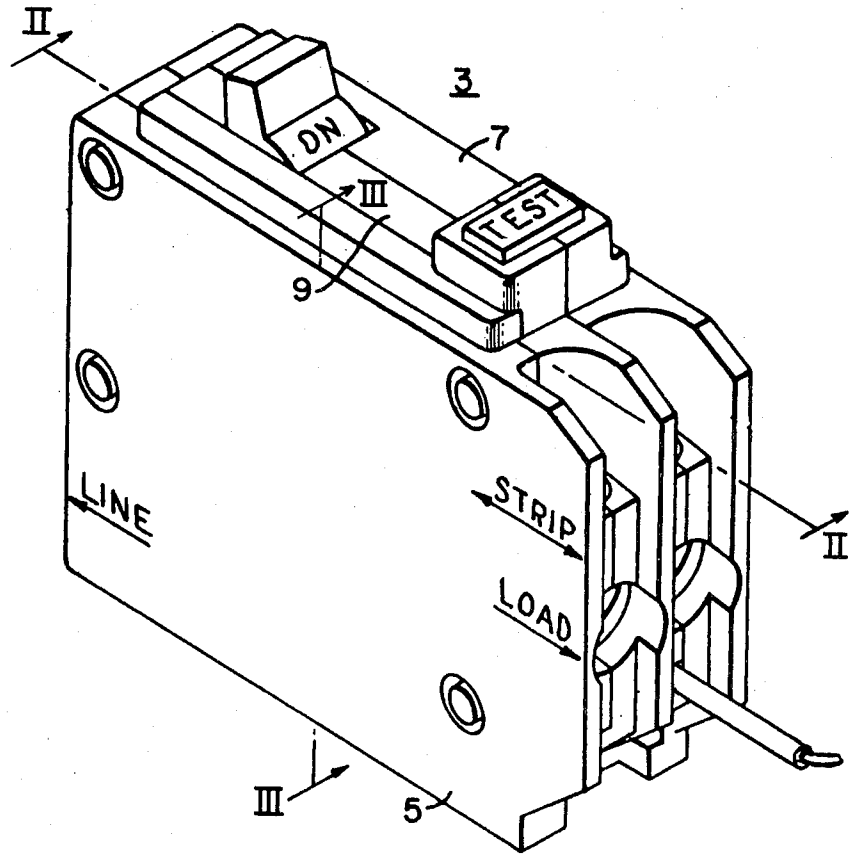
Primary Examiner—Harold Broome
Attorney, Agent, or Firm—L. P. Johns

[57] **ABSTRACT**

A ground fault circuit interrupter characterized by a circuit breaker and a ground fault detector contained within an insulating housing. The circuit breaker comprises an elongated current-carrying bimetal element for tripping a pair of cooperable contacts from the closed to the open position, one end portion of the bimetal element being fixedly mounted and the other end being free to move in one direction in response to an increase in temperature. A bi-metal stop projection within the housing to prevent movement of the bimetal element from its latched position to the other direction in response to extremely cold ambient temperatures.

5 Claims, 3 Drawing Figures



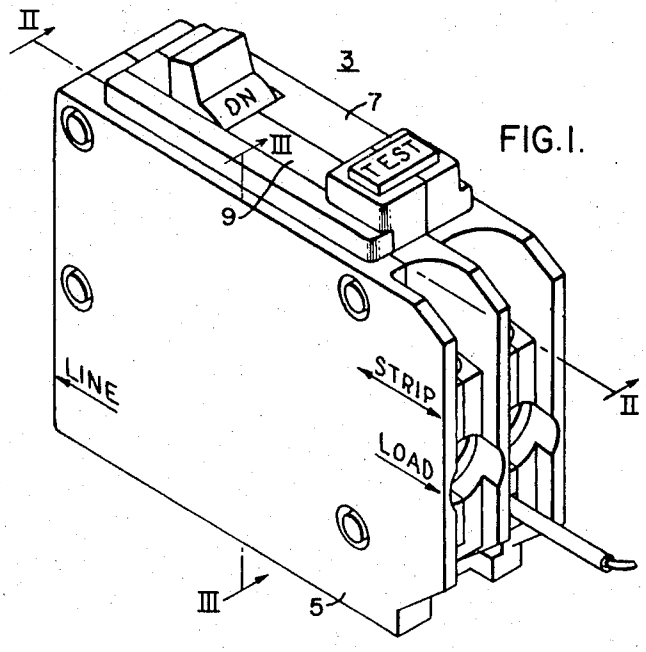


FIG. 1.

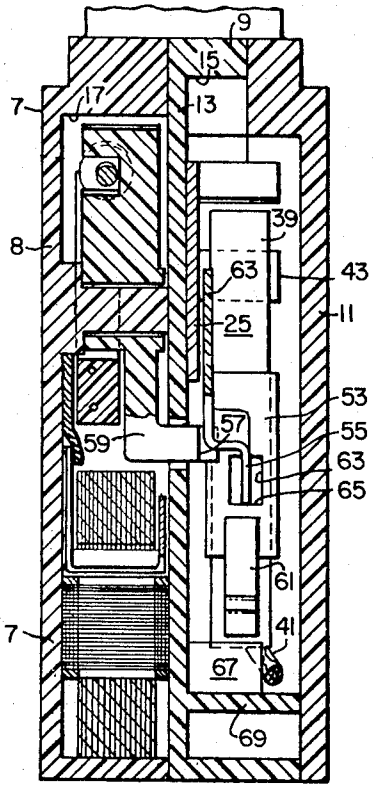
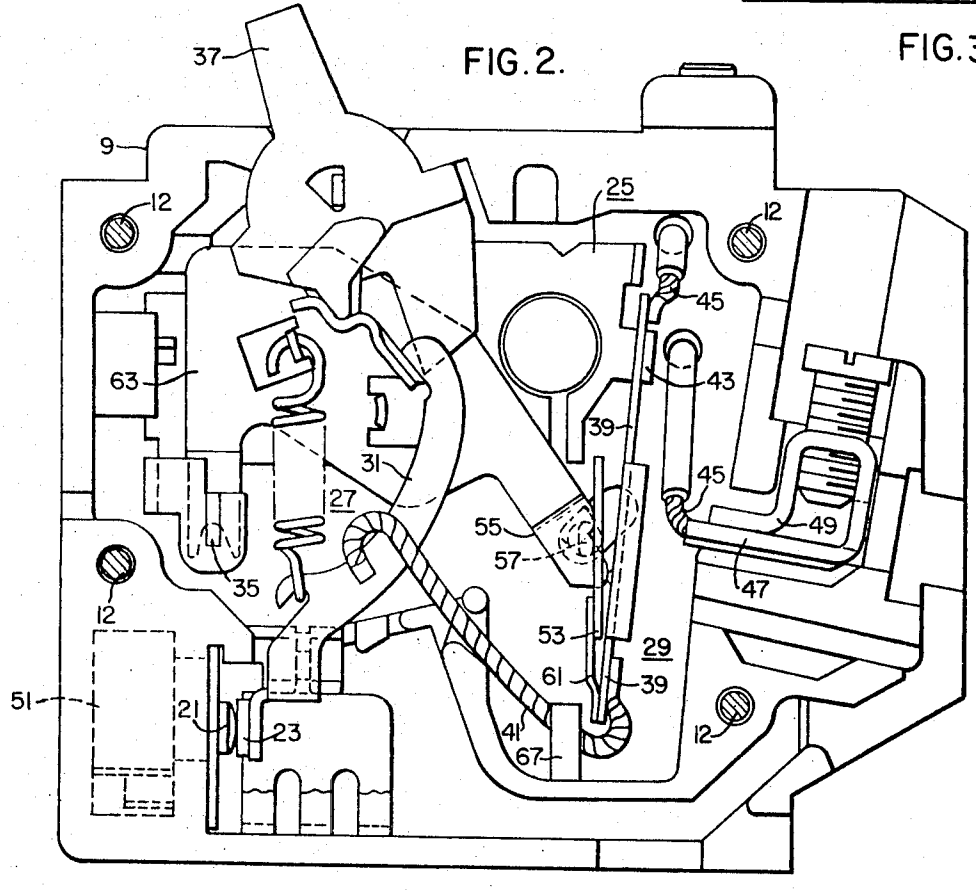


FIG. 3.

FIG. 2.



GROUND FAULT CIRCUIT BREAKER WITH COLD TEMPERATURE BIMETAL CONSTRICTION

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a circuit breaker and more particularly it pertains to a ground fault circuit interrupter having restriction means for preventing movement of a bimetal element when subjected to inordinately cold temperatures.

2. Description of the Prior Art

A standard circuit breaker includes elements for sensing current overloads and consist primarily of a straight bimetal element and a latch assembly. When thermal overloads occur the bimetal element deflects in one direction by a distance which is a function of the amount of current overload and thereby releases the spring loaded latch to trip the circuit breaker to the open position. This uncompensated bimetal arrangement is an economical method for general circuit breaker usage.

In a ground fault circuit breaker a standard circuit beaker is utilized but it can be inadequate because only temperature ranges above 0°C are important. Building code restrictions govern the circuit breaker usage in cold ambient environments. The specific temperature range for ground fault circuit breakers is −35°C to about 66°C which offers maximum protection. It is important to aid the bimetal element for the following reasons: (*a*) severe cold temperature causes opposite movement of the normal bimetal element thereby causing excessive deflection in the wrong direction; (*b*) resultant movement in the wrong direction (toward the latch assembly) causes undue and inconsistent latch spring release pressures; and (*c*) ability to repeat the normal circuit breaker action and maintenance of accurate calibration are impaired.

SUMMARY OF THE INVENTION

Generally, in accordance with this invention, it has been found that the foregoing difficulties may be overcome by providing a ground fault circuit interrupter comprising a circuit breaker and a ground fault detector within an insulation housing, the circuit breaker comprising a pair of cooperable contacts operable between open and closed positions, 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 for tripping the releasable member when a predetermined current overload effects a deflection of said bimetal element in one direction from a latched position, a bimetal stop means such as a projection integral with the insulating housing for preventing the bimetal element from moving in the other direction from the latched position when subjected to excessively low ambient temperatures, the ground fault detector comprising a current-monitoring core and a plurality of primary windings on the core, each being one of a line and a neutral conductor of an A.c. electrical distribution system, a secondary winding sensing current imbalance between the primary windings, means responsive to a predetermined sensing signal to open said line conductors, the means responsive to the predetermined sensing signal including a pivotally movable member movable against the bimetal element to unlatch the releasable member, and the pivotally movable member being adjacent to the bimetal element on the side of the stop means.

The advantage of the device of this invention is that the stop means for constriction insures reliable operation of the ground fault circuit breaker when subjected to excessively cold temperatures, and when the bimetal element is restricted. The force required by an intermittent duty solenoid in the ground fault detector is minimized.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of a ground fault circuit breaker structure of this invention;

FIG. **2** is a vertical sectional view taken on the line II—II of FIG. **1** and showing the circuit breaker side of the invention in the closed position; and

FIG. **3** is a sectional view taken along the line III—III of FIG. **1.**

DESCRIPTION OF THE PREFERRED EMBODIMENT

In FIG. **1** a ground fault circuit breaker structure is generally indicated at **3** and it comprises a housing **5** which is composed of electrically insulating material such as a thermosetting resin. The housing **5** includes a pair of box-like containers or tray portions **7** and **9** and a side cover **11,** which are secured in place by suitable means such as rivets **12** (FIG. **2**) in a conventional manner.

Inasmuch as a detailed description of both the ground fault detector portion and the circuit breaker portion is set forth in the application of Kenneth R. Coley and John J. Misencik, Ser. No. 287,921, filed Sept. 11, 1972, the description of those portions is limited to the parts that are essential to the operation of the invention disclosed herein.

As shown in FIG. **3** the tray portion **7** comprises a back wall **8** and the tray portion **7** comprises a back wall **13** that serves as a single partition wall between compartments **15** and **17** formed between the back walls **8** and **13** and the side cover **11.** A circuit breaker mechanism is disposed within the compartment **15** and a ground fault circuit interrupter is disposed within the compartment **17.**

Briefly, the circuit breaker structure comprises a stationary contact **21,** a movable contact **23,** a supporting metal frame **25,** an operating mechanism **27,** and a trip device **29.** Among other things the operating mechanism **27** comprises a contact arm **31** and a releasable member **33** which is pivotally supported at one end thereof on a pivot **35** when the circuit breaker is opened manually a handle **37** is rotated from the "on" to the "off" position, whereby the contact arm **33** moves the movable contact **23** away from the stationary contact **21** in a conventional manner.

The contact arm **31** is electrically connected to the lower end of an elongated bimetal element or bimetal **39** by a flexible conductor **41.** The bimetal **39** is part of the trip device **29** and is secured at its upper end to a flange **43** of the frame **25.**

A flexible conductor **45** connects the upper end of the bimetal **39** with a terminal strap **45** having a terminal connector **47.** Thus, the closed circuit through the circuit breaker extends from a terminal **51** through the stationary contact **21,** the movable contact **23,** the contact arm **31,** the flexible conductor **41,** the bimetal

39, the flexible conductor 45, the terminal strap 47 to the terminal connector 49.

The trip device 29 comprises the bimetal 39, an elongated rigid magnetic armature or latch member 53, an end portion 55 of the releasable member 33, and a projection 57 of a lever 59 (FIG. 3). The latch member 53 was mounted on the upper end of a flexible metal strip 61 the lower end of which is secured to the lower end of the bimetal 39 in a suitable manner such as a spot weld.

As shown in FIG. 3 the latch member 53 has an opening 63 which includes a latch surface 65 at the base of the opening in the reset position of the circuit breaker as shown in the drawings. The end portion 55 of the releasable member 33 is latched in the opening 63 of the latch member 53, and more particularly is lodged upon the latch surface 65. Upon the occurrence of a sustained overload current above a first predetermined value the bimetal 39 which is heated by the current flowing therethrough, deflects from the position shown in FIG. 2 to a thermally tripped position to the right of that shown in FIG. 2, whereupon the end portion 55 drops from its position on the latch surface 65.

In accordance with this invention bimetal stop means or construction or a projection 67 is provided to prevent the bimetal 39 from moving to the left of the latched position (FIG. 2) such as when the bimetal is exposed to severely cold ambient temperature conditions such as of the order of −35°C. The projection 67 is preferably a molded part of the tray portion 9 and extends outwardly from the back wall 13 as well as a bottom wall 69. However, the projection 67 would function satisfactorily if it were part of the cover 11. In the position shown in FIG. 3 the upper end of the projection 67 extends slightly above the lower end of the bimetal 39 so as to prevent the bimetal from moving to the left in response to severely cold ambient temperatures. The projection 67 however may be located at another position along the length of the bimetal so long as it is suitably disposed to prevent the bimetal from moving unduly to the left beyond the latched position of FIG. 2. In effect a thermal restriction is produced within the compartment 15 so that upon a limited movement of the bimetal 39 when subjected to cold temperature, a motion takes place where the lower free end of the bimetal engages the projection 67 to restrict further deflection. As a result a binding effect between the spring loaded end portion 55 of the releasable member 33 and the latch surface 65 is avoided and the bimetal 39 is free to operate in a conventional manner.

Where a ground fault occurs and is detected in the ground fault detector 71 in the compartment 17 as set forth in the above mentioned application the lever 59 is actuated to cause the projection 67 at the lower end thereof to move the latch member 53 to the right and thereby disengage the end portion 55 of the releasable member 33 from the latch surface 65. In ground fault circuit breakers where the unit has been subjected to a temperature of as low as −35°C for a period of hours or days the circuit breaker must nevertheless be able to trip free in 0.25 milliseconds or less when subjected to 260 milliampere ground fault circuits which are unable to heat the bimetals to cause deflection. A ground fault circuit breaker mechanism is activated on a ground fault by the use of a toroid sensor, electronic amplifier and power device, and a solenoid, as disclosed in the above indicated patent application. The solenoid is the action member which depresses the spring latch to effect disconnection. If the bimetal 39 is deflected in the direction to cause latch interference, the solenoid is unable to depress the latch sufficiently to overcome the excessive deflection caused by cold temperature on the bimetal and thereby causing an inoperative device.

According the device of this invention satisfies problems existing in prior art devices and results in an improved ground fault circuit breaker.

What is claimed is:

1. A circuit breaker comprising an electrically insulating housing and including a box-like container and a cover therefor, a circuit breaker structure within the housing and comprising a pair of separable contacts operable between open and closed positions, a releasable member in an initial position and movable when released to a tripped position to effect automatic opening of the contacts and comprising an elongated current-carrying bimetal for tripping the releasable member when a predetermined current overload effect deflection of said bimetal in one direction from a latched position, the bimetal being mounted at one end portion and disposed in an unbiased position, bimetal stop means for preventing said bimetal from moving in the other direction from said latched position when the bimetal is subjected to extremely cold ambien temperature, and the container and the cover being molded members one of which comprises an integral molded projection at the other end of the bimetal.

2. A ground fault circuit interrupter for use in a load center and comprising a circuit breaker, a ground fault detector, and an insulation housing therefor; the circuit breaker comprising a pair of cooperable contacts operable between open and closed positions, 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 for tripping the releasable member when a predetermined current overload effects deflection of said bimetal element in one direction from a latched position, the bimetal being mounted at one end portion and disposed in an unbiased position, bimetal stop means for preventing said bimetal element from moving in the other direction from said latched position when the bimetal is subjected to extremely cold ambient temperature; the ground fault detector comprising a current monitoring core, a plurality of primary windings on the core, each being one of a line and a neutral conductor of an A.C., electrical distribution system, a secondary winding sensing current imbalance between the primary windings, means responsive to a predetermined sensing signal to open said line conductors, the means responsive to a predetermined sensing signal including a pivotally movable member movable against said bimetal element to unlatch the releasable member, and the pivotally movable member being adjacent to the bimetal element on the side of the bimetal stop means.

3. The ground fault circuit breaker of claim 2 in which the bimetal stop means comprises a projection extending into a position on the side of the bimetal element opposite the direction of deflection thereof.

4. The ground fault circuit breaker of claim 3 in which the projection is an integral portion of one of the container and cover.

5. The ground fault circuit breaker of claim 4 in which the bimetal element is fixedly mounted at one end portion and the other end portion is unattached, and in which the projection is a portion of the container and located at said other end portion thereof.

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