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[73] Assignee **Federal Pacific Electric Company**

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[54] **MOLDED-CASE CIRCUIT BREAKER HAVING IMPROVED OVERCURRENT RELEASABLE LATCH**
4 Claims, 3 Drawing Figs.

[52] **U.S. Cl.** **337/71,** 335/37
[51] **Int. Cl.** **H01h 71/16,** H01h 71/64, H01b 75/12
[50] **Field of Search** 335/37, 43; 337/67, 70, 71, 73, 75, 110

[56] **References Cited**

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ABSTRACT: A circuit breaker of the molded case type incorporating an overcurrent releasable latch including a low-profile armature return spring which is better able to withstand hot arc-generated gasses without damage.

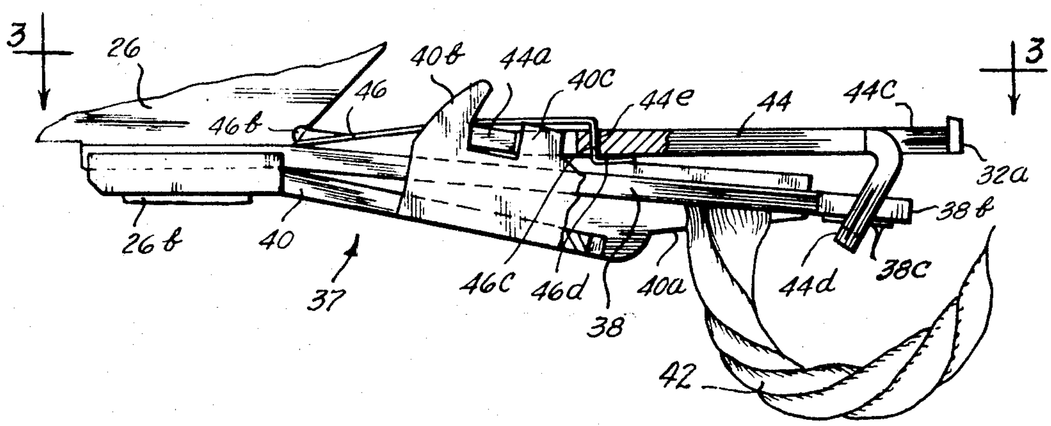

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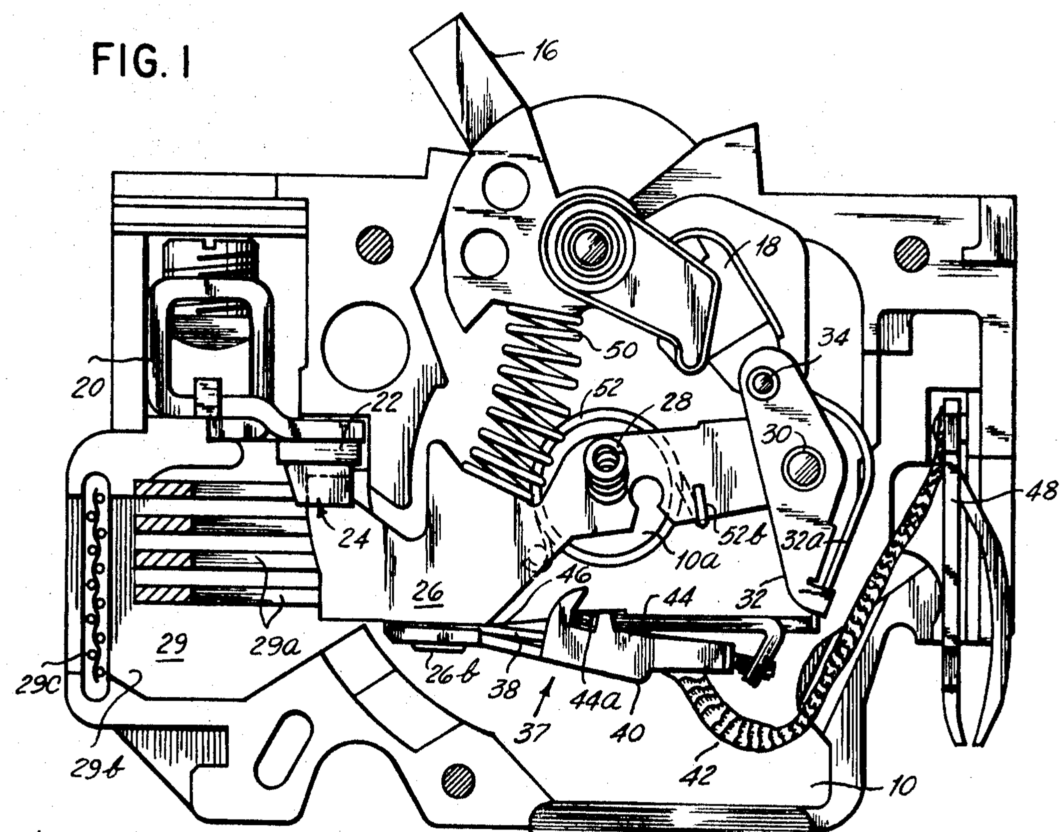
FIG. 1



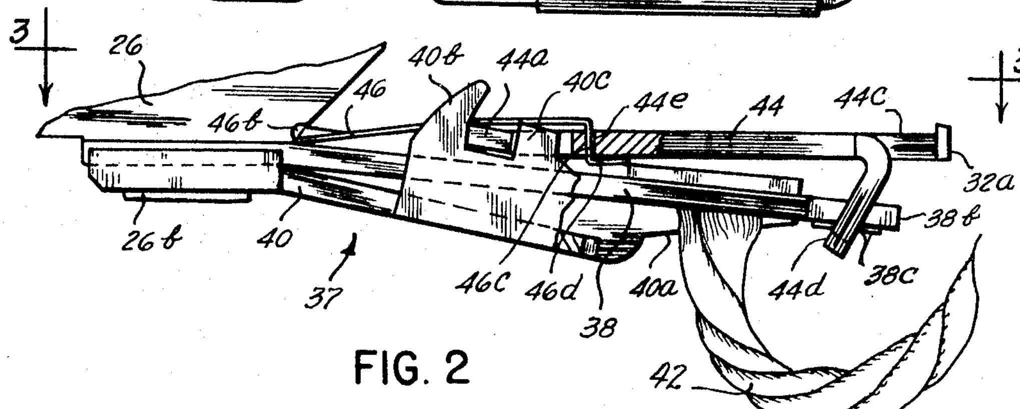


FIG. 2

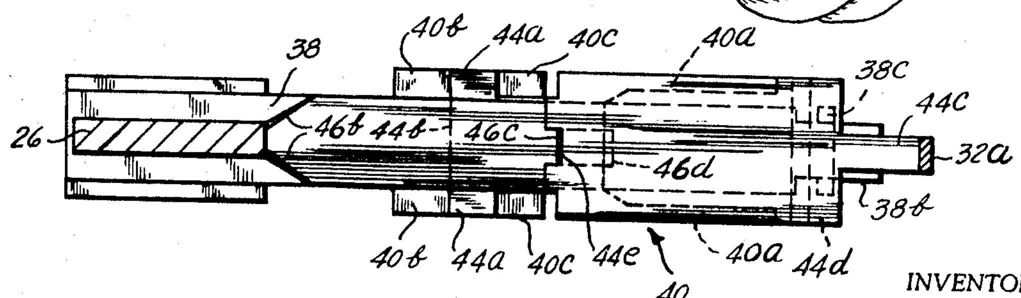


FIG. 3

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MOLDED-CASE CIRCUIT BREAKER HAVING IMPROVED OVERCURRENT RELEASABLE LATCH

This invention relates to circuit breakers and more particularly to improvements in molded case circuit breakers.

As more and more electricity has been used in homes, offices and factories the capacity of the electric power distribution system serving these places has been increased to keep up with the increased demand. The increase in capacity has been accomplished by installation of additional and larger transformers and conductors. With the increased capacity has come an increase in the available short-circuit current.

Molded case circuit breakers have been widely employed in the distribution and control of electricity and their popularity continues to increase. In the past the standard circuit breakers which had a short-circuit current-interrupting capacity of 5,000 amperes have been satisfactory. However, in view of the increased short-circuit currents available now, and the even greater currents which, it is expected, will be available in the future, it is important that the interrupting capacity of the circuit breakers be increased. Additionally, from an economic viewpoint the improved circuit breakers must be interchangeable with, and if possible externally identical to, the prior units so as to allow continued use of the unchanged panelboards, accessories and the like and to permit improvement or "upgrading" of existing installations.

Therefore, it is an object of this invention to improve the short-circuit current interruption rating of molded case circuit breakers. It is another object of the invention to improve the interrupting rating of prior available circuit breakers with minimum exterior changes therein.

The invention is illustrated, in certain of its aspects, as applied to a multipole molded case circuit breaker. Such a circuit breaker is illustrated and described in detail in U.S. Pat. No. 2,923,795 and that description is incorporated herein by reference.

The nature of the invention and its further objects and features of novelty will be better appreciated from the following detailed description of the illustrative embodiment which is shown in the accompanying drawing forming part of this disclosure. In the drawings:

FIG. 1 is a side view of an end pole of a three-pole circuit breaker embodying certain aspects of the novel overcurrent releasable latch with the cover removed and certain parts being shown in fragmentary section. The mechanism is shown in the contacts-closed (closed-circuit) position;

FIG. 2 is a side view of the overcurrent releasable latch of FIG. 1 on a greatly enlarged scale; and

FIG. 3 is a plan view of the overcurrent releasable latch as viewed along the line 3–3 therein.

Referring to the drawings there is shown one end pole of a three-pole circuit breaker of the type described in detail in U.S. Pat. no. 2,923,795. The circuit breaker case has an inner wall **10** that cooperates with an outer wall not shown to form an internal cavity. This cavity and the other like cavities (not shown), contain a complete circuit breaker mechanism, including a pair of contacts, a contact-operating linkage, an overload release means; and a common release means which forms a part of each pole of the three-pole circuit breaker. Common operating means, including externally projecting handle **16**, is provided for simultaneous operation of all of the poles. A common trip-bar mechanism **18** is operatively connected to all of the poles.

The mechanism of each pole is the same as the mechanism for each of the other poles and only one is shown in detail. Each pole includes a first terminal **20** rigidly carrying a stationary contact **22**. Movable companion contact **24** engages contact **22** when the circuit breaker is closed, movable contact **24** being supported on elongated contact-carrying member **26**. Contact-carrying member **26** is pivoted near its center on a transverse coil spring **28**. The contacts engage and disengage within a well-known type of arc chute **29** that includes metallic arc-splitter plates **29*a***, venting passage **29*b*** and metallic vent screen **29*c***. Carried on pivot **30** in an insulating bearing (not shown) at the end of contact member **26** remote from contact **24**, is an actuator **32** having a bearing **34** which receives a portion of the trip-bar mechanism **18**. An ambient temperature compensating bimetal **32*a*** has its upper end curved about bearing **34** and its lower end, which constitutes its latched end, is slidably guided by a formed portion of actuator **32** so that the lower tip of bimetal **32*a*** is projected to a variable extent in dependence of the ambient temperature.

The overcurrent releasable latch **37** includes a current-responsive bimetal **38** that is united at one end to the contact arm **26**, providing electrical connection and a rigid mechanical connection at this point. The elongated contact member **26** constitutes a conductive support that carries and unites bimetal **38** and the magnetic pole structure **40** of a tripping electromagnet. The pole structure **40** is also united to bimetal **36** and to contact arm **26** by a rivet **26*b*** that extends integrally through the bimetal and the pole structure from contact arm **26**. Pole structure **40** is wider than the bimetal **38** and extends all the way across the bimetal except for a cutout portion to accommodate a conductor **42** of flexible conductive braid that is united to the bimetal adjacent its right-hand end as viewed in the drawings. A magnetic armature **44** is positioned on the side of bimetal **38** opposite from pole structure **40** and has lateral pivots **44*a*** retained in notches in the pole structure as shown. Armature **44** is wider than bimetal **38** at the right of pivot **44*a*** and extends into latching engagement with actuator **32**. Armature **44** terminates to the left of the pivots **44*a***. A low-profile spring **46** biases the armature counterclockwise about pivots **44*a***.

Referring to FIGS. **2** and **3** the illustrated embodiment of the novel overcurrent releasable latch will now be described in greater detail. The pole structure **40** includes a pair of spaced-parallel poles **40*a*** that extend beneath the armature **44** and provide access between them for the braid **42**. A pair of arms **40*b***, **40*c*** cooperate with the armature **44** and its pivots **44*a*** to retain and guide the armature. Each of the arms **40*b*** is bent over slightly toward its companion arm **40*c*** to trap the armature pivots **44*a*** therebetween. Armature **44** has one end **44*b*** in line with its pivots **44*a***. Its other end **44*c*** cooperates with the actuator tip **32*a*** as will be described. A loop **44*d*** formed from the body of the armature for cooperation with bimetal **38**, as will be explained below, is provided adjacent the terminal end **44*c*** (FIG.. **2**).

One end of a low-profile spring **46** is anchored vertically by the junction of the elongated moving contact member **26** and bimetal **38** which meet at an acute angle. Horizontal anchoring is provided by a pair of upturned spring ears **46*b*** that engage opposite faces of the member **26** to provide lateral stability for the spring **46**. Spring **46** has a reversely bent portion **46*c*** which passes through a slot **44*e*** intermediate the bends. Spring end **46*d*** bears against the underside of the armature **44**. The portion of spring **46** above the armature is substantially flat providing a low profile. Spring **46** is relatively stiff but is resiliently bowed between its ends with the result that end **44*c*** of the armature is urged away from the pole structure **40** in a counterclockwise direction as the armature moves about its pivots **44*a***. Spring **46** may advantageously be made from phosphor bronze strip material by well-known fabrication techniques.

As noted above bimetal **38** is secured to the contact-carrying member **26**, between the member **26** and pole piece **40**, by means of the rivet **26*b***. The free end **38*b*** of the bimetal passes through the armature loop **44*d***. A layer of insulation **38*c***, interposed between the bimetal and the armature, prevents the current flowing through the braid **42** from bypassing the bimetal **38**. Bimetal **38** deflects on sustained overloads causing armature end **44*d*** to release actuator end **32*a***.

In the event of a severe short circuit the current passing through the bimetal causes the armature **44** to be attracted toward the pole pieces **40*a***. In moving toward the pole pieces the armature overcomes spring **46** and the end of the armature **44***c* releases the actuator tip **32***a* initiating the opening of the circuit breaker. When the contacts part under such circumstances a large amount of hot gasses are generated by the arc between the contacts and the hot gasses expand within the casing. Ideally such gasses should pass through the arc chute **29** to the exterior of the casing. However, it has been found that a certain amount of the hot gasses blow back toward the overcurrent releasable latch **37**. The gasses are hot enough for a long enough period of time that damage to the armature spring **46** could result but for the novel construction described. Loss of restorative force due to loss of temper of the spring stock could result in the armature not returning to the actuator-engaging position and the consequent inability of the circuit breaker to be closed. The low profile of spring **46** in the direction of movement of hot arc-generated gasses reduces the exposure of the spring to said gasses and increases the reliability of the circuit breaker.

Flexible braid **42** has one end connected to bimetal **38** and its opposite end is joined to terminal **48**, of a form suitable for panelboard plug-in installation as disclosed in U.S. Pat. No. 2,647,225. An electrical circuit may be traced through the circuit breaker from terminal **20** across contacts **22** and **24**, into elongated contact member **26**, via bimetal **38** and braid **42** to terminal **38**. There is no current bypass path bridging bimetal **38** by virtue of the insulated pivot **30** which is more fully disclosed in U.S. Pat. No. 2,647,186.

Transverse coil spring **28**, which serves a pivot for contact arm **26**, is housed in a pair of cylindrical bosses **10***a* and **12***a* that extend inwardly toward one another within the cavity **14**. Spring **28** provides contact pressure between the contacts **22** and **24** and permits overtravel of the contact-carrying member **26** as more fully explained in U.S. Pat. No. 2,681,396.

A compression spring **50** is interposed between respective projections on contact-carrying member **26** and handle **16** biasing both the contact member and the handle to their "open" position when the circuit breaker is open. As shown in FIG. **1** this compression spring provides strong contact-opening bias when the breaker is closed. In the closed configuration of the mechanism shown in FIG. **1**, actuator **32** is latched by armature **44** and the counterclockwise spring bias applied to contact-carrying member **26** is resisted by an overset toggle consisting of trip bar **18** and pivoted handle **16**. Counterclockwise motion of handle **16** is limited by the casing **10**. In this configuration, spring **50** provides a limited bias for operating handle **16** in the contact-opening direction.

In part, the speed of opening of the contacts upon occurrence of an overload determines the interrupting rating of the circuitry breaker. The speed of opening is largely dependent upon the force of compression spring **50**. An increase in force of spring **50** could produce faster opening. However, spring **50** and pivot spring **28** are in opposition and therefore an increase in force of spring **50** will result in a reduction in contact pressure. An increase of force in spring **50** is therefore not suitable as a way of increasing the speed of opening. In order to increase the opening speed of the circuit breaker a torsion spring **52** is positioned about the boss **10***a*. One end **52** engages a stop on the wall **10** (shown in dotted lines, FIG. **1**) and the other end of the spring **52** is formed as a hook **52***b* for engagement with the contact-carrying member **26**. Spring **52** is positioned so that it reacts between the casing wall **10** and the contact arm to pivot the contact arm **26** counterclockwise about spring **28** as viewed in FIG. **1**. Torsion spring **52** acts on the elongated contact-carrying member **26** in the same direction as pivot spring **28** when the contacts are closed and, therefore, spring **52** actually increases the contact pressure. Upon release of the contact-carrying member, spring **52** accelerates the movement of contact **24** to the open-circuit position.

The toggle comprising handle **16** and trip bar **18** lock the contacts closed, under the control of armature **44** of the overcurrent releasable latch **37**. Upon downward deflection of the armature magnetically or by pressure from current-responsive bimetal **38**, elongated contact-carrying member **26** is driven counterclockwise by spring **50** and by spring **52**, as actuator **32** swings clockwise about its pivot **30**. Springs **50** and **52** are now free to accelerate the separation of the contacts **22, 24**. The addition of spring **52** contributes to increased contact pressure and increased speed of opening of the contacts with only a small, barely noticeable to the operator of handle **16**, increase in the force required to close the circuit breaker.

The molded case circuit breaker illustrated and described above is a three-pole, 70a., 240v. unit and is fully compatible with presently installed panelboards. Although shown and described as a three-pole breaker it will be readily apparent to those skilled in the art that certain aspects of the invention are equally applicable to circuit breakers having one, two or more poles. Molded case circuit breakers, fabricated according to the teachings of this invention, have been successfully tested at 10,000 a. interrupting capacity.

The resetting and reclosing of the aforedescribed circuit breaker is shown and described in detail in U.S. Pat. No. 2,923,795 and is incorporated herein by reference.

While only one embodiment of the invention has been shown and described in detail it will be readily apparent to those skilled in the art that various changes and modifications may be made herein without departing from the spirit and scope of the invention.

What we claim is:

1. A molded case circuit breaker having a stationary contact, an elongated movable contact member supported on a pivot between its ends, said elongated movable contact member having a contact at one end engageable with and disengageable from said stationary contact, and having an actuator pivoted at its opposite end and having an overcurrent releasable latch normally restraining said actuator, and a pivoted handle and a link connected to said handle forming a toggle for operating said actuator and for thereby operating said elongated movable contact member to close the contacts, said overcurrent releasable latch being carried by and movable with said elongated movable contact member, said overcurrent releasable latch including a current-responsive bimetal, a magnetic pole structure adjacent said bimetal, an armature pivoted at one end on said pole structure and engaging said actuator at the other to thereby latch said actuator, and resilient means reacting between said contact member and said armature for biasing said armature into an actuator-latching position, said resilient means having a low profile in the direction of movement of hot arc-generated gasses when said circuit breaker opens whereby the exposure of said resilient means to said gasses is minimized.

2. A circuit breaker according to claim **1** wherein said resilient means is a substantially flat spring member.

3. A circuit breaker according to claim **2** wherein said overcurrent releasable latch is joined to said elongated movable contact member at an acute angle, said flat spring member having one end thereof engaged with said joint whereby said flat spring member is provided with a reaction point.

4. A circuit breaker according to claim **3** wherein said flat spring member has a pair of formed portions in engagement with said elongated movable contact portion to provide lateral stability for said flat spring member.