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ELECTRIC CIRCUIT BREAKER WITH MAGNETIC TRIPPING MEANS

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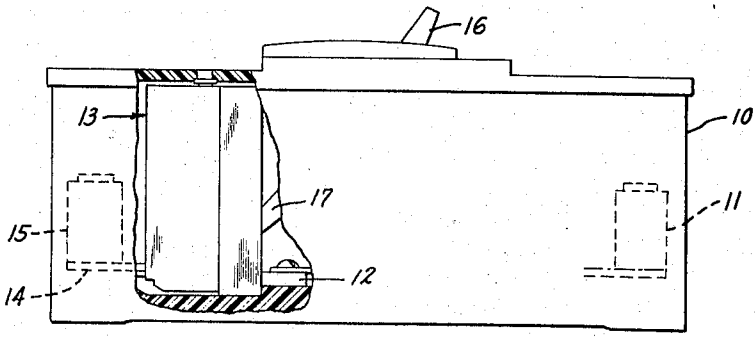

FIG. 1

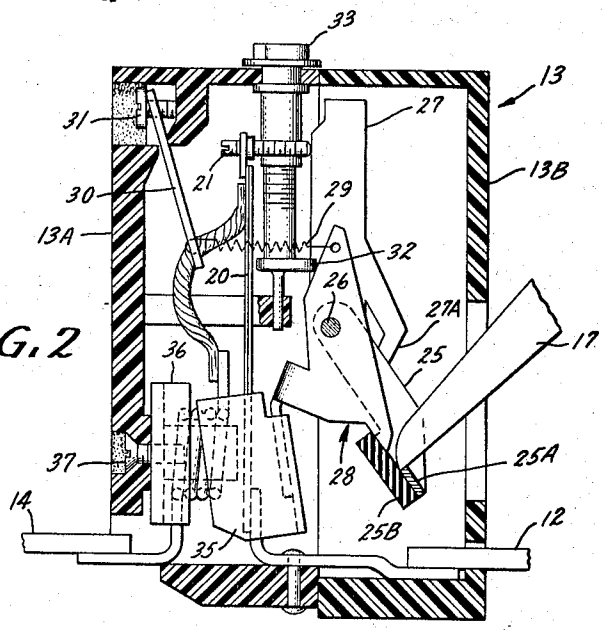

FIG. 2

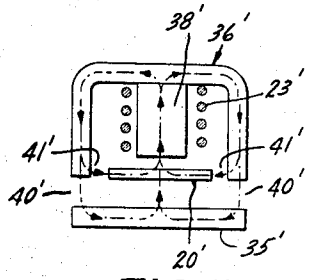

FIG. 5

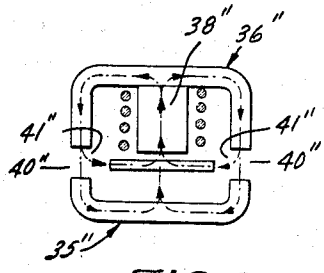

FIG. 6

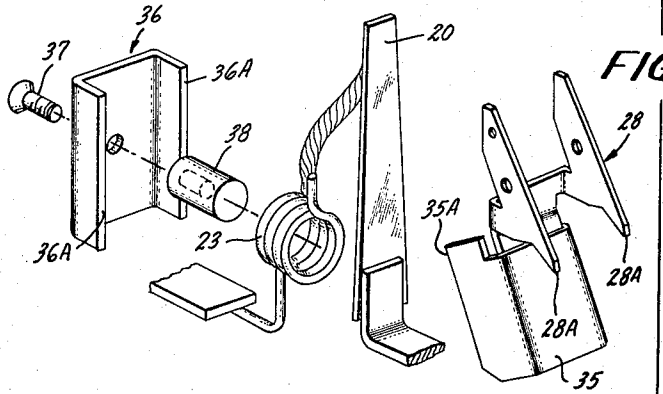

FIG. 3

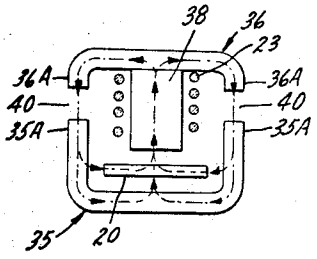

FIG. 4

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ELECTRIC CIRCUIT BREAKER WITH MAGNETIC TRIPPING MEANS

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Int. Cl. H01h 75/12; H01h 77/04; H01h 81/00

ABSTRACT OF THE DISCLOSURE

A latch-trip type electric circuit breaker, including a thermal-magnetic current responsive tripping device; the tripping device includes a generally channel-shaped field piece, a confronting generally channel-shaped armature, a cylindrical core member carried by the field piece between the two members, and an energizing coil surrounding the core; a bimetallic strip extends between the end of the core member and armature and is so located with respect to the air gaps between the field piece and the armature that although some leakage flux goes through the bimetallic member, all the flux, including such leakage flux, goes across the working air gaps of the magnetic assembly, whereby to provide a compact and sensitive thermal-magnetic trip assembly.

Background of the invention

Field of the invention.—The present invention relates to latch-trip type electric circuit breakers, and more particularly, to electric circuit breakers of the type including combined thermal and magnetic current responsive means for causing releasing of the latch and automatic opening of the circuit breaker upon the occurrence of predetermined current conditions therethrough.

Description of the prior art.—An electric circuit breaker of the general type referred to is shown in prior Patent 3,162,739, K. W. Klein et al., issued Dec. 22, 1964 (Class 200—88) and assigned to the same assignee as the present invention. In circuit breakers of the latch-trip type, thermal means comprising an elongated bimetallic strip is provided for causing unlatching or "tripping" of the circuit breaker upon the occurrence of current conditions above the nominal rating of the circuit breaker which persist for a predetermined length of time such as to cause sufficient heating and warping of the bimetallic strip to cause it to engage and actuate a trip member. In addition, magnetic actuated means is provided for causing substantially instantaneous latch release upon the occurrence of high excess currents such as short-circuit currents if they are in the range of about 6 to 12 times the nominal rating of the circuit breaker.

In circuit breakers of medium and high capacity, the magnetic tripping structures can be extremely simplified, such, for example, as comprising a generally U-shaped magnetic field piece and a generally flat plate type armature with a single current carrying conductor passing therebetween providing, in effect, a single turn winding. The current carrying conductor may be a bimetallic strip, or a conductor acting as a heater for the bimetallic strip, as in the above-mentioned patent. Such simplified structure is possible because in these current ranges, the amount of current in the 6 to 12 times range at which the devices are required to operate is sufficiently high (400 amperes or more) to provide substantial force even with such simplified magnetic structures. In lower ampere ratings, however, such, for example, as 15 through 50 amperes, more sensitive devices are required, such as devices capable of operating as low as 90 amperes. Such sensitive magnetic tripping devices require multi-turn

rather than single-turn windings. If the turns on the windings are of substantial number, a conflict arises with the space requirements, since such devices are also required to be extremely compact.

Summary of the invention

It is an object of the present invention to provide an electric circuit breaker of the latch-trip type including combined thermal and magnetic tripping means which is both sensitive and extremely compact.

It is a further object of the invention to provide a circuit breaker of the type described including a combined thermal-magnetic trip device in which the bimetallic strip is directly heated and is also used to form a portion of a turn of the magnetic device winding without detracting from the magnetic efficiency of the magnetic trip device.

In accordance with the invention in one form, an electric circuit breaker of the latch-trip type is provided including a trip member which is normally held by a trip bar, the trip bar being actuated by tripping means located in each of three poles of the circuit breaker. A tripping mechanism in each pole of the circuit breaker includes a stationary magnetic field piece having a back wall which supports a generally cylindrical core member extending at right angles thereto and carrying a multi-turn energizing winding. A movable armature is included of generally U-shaped cross-section and includes side portions extending on either side of the coil and core assembly so that current through the coil sets up magnetic lines of force which emanate from one end of the cylindrical core member, pass through the armature member, and thence back through the sides of the armature member across the pair of air gaps between the ends of the side wall and the stationary field piece. A bimetallic strip is mounted in cantilever fashion adjacent the magnetic assembly and passes between the armature and field piece. The side walls of the armature accordingly extend substantially beyond the bimetallic strip before terminating to form air-gaps with relation to the field piece. Because of this arrangement, although some leakage flux passes transversely through the bimetallic strips, this does not detract from the sensitivity of the assembly since all flux including such leakage flux goes across the air gaps to cause actuation.

Brief description of the drawings

FIGURE 1 is a side elevation view of an electric circuit breaker incorporating the invention, a portion of the side wall of the casing being broken away to show the internal parts and particularly the trip unit assembly;

FIGURE 2 is a side elevation view of the trip unit assembly of the circuit breaker of FIGURE 1, the side of the enclosing casing of the trip unit nearest the observer being removed to show the internal parts;

FIGURE 3 is an exploded perspective view of a portion of the trip unit device of FIGURE 2;

FIGURE 4 is a sectional view of the parts of the assembly shown in FIGURE 3 but illustrated in assembled relation, and

FIGURES 5 and 6 are illustrations of other alternate possible arrangements, shown for purposes of discussion.

Description of one embodiment

The invention is shown as incorporated in an electric circuit breaker including a generally rectangular insulating casing **10**. (For purposes of simplification, only a single pole chamber is illustrated. It should be appreciated, however, that the embodiment disclosed is a three-pole cuircuit breaker and that each pole thereof includes a current path and current tripping parts similar to those to be described in connection with the selected pole.) The pole chamber illustrated includes a power incoming terminal **11** supported in the insulating casing **10** by suitable means,

not shown. The current flows from the incoming power terminal **11** through separable contacts (not shown) to the incoming terminal strap **12** of the trip unit **13**, and from the outgoing terminal strap **14** of the trip unit **13** to an outgoing or load terminal **15**. The circuit breaker contacts (not shown) are operated by suitable operating mechanism (not shown) which may be actuated by an actuating handle member **16** projecting from the top wall of the circuit breaker casing **10**. The operating mechanism includes a releasable trip member **17** which is normally held from tripping action by latch means included in the trip unit **13** to be described.

The trip unit **13** includes an insulating casing comprising two generally cup-shaped parts **13A** and **13B**. A rigid conducting strap **18** is mounted on the insulating base portion **13A** by suitable means such as by rivet **19** and is connected to the terminal member **12** at one end and supports a rigid upstanding bimetallic member **20** at the other end. The upper or movable end of the bimetallic strip **20** carries a "calibrating" or actuating screw **21**, and has connected thereto a flexible conductor member **22** which extends to and is connected to an energizing coil **23**, which in turn is connected to the outgoing terminal **14**.

The releasable trip member **17** is normally held by a latch member **25** which is pivotally supported at **26** in the insulating casing part **13B**. The latch member **25** is biased counterclockwise to the position shown by suitable biasing means, not shown, and includes a latch projection **25A** which engages and restrains the tip of the trip member **17**. The latch member **25** also includes a "magnetic" common trip bar portion **25B** which permits actuation of the latch member **25** by the magnetic tripping means of any of the poles of the breaker in a manner to be described. A "thermal" common trip bar **27** is also provided and is pivoted on the same pivot axis as the latch member **25**. The "thermal" trip bar **27** extends across all the poles of the circuit breaker to permit actuation by any of the thermal trip members of any of the poles. The "thermal" trip bar **27** includes a projection **27A** which engages the latch member **25** to cause rotation of the latch member **25** in clockwise direction upon clockwise rotation of the trip bar **27**.

For the purpose of causing movement of the latch member **25** in releasing direction by the magnetic actuating means to be described, a generally H-shaped intermediate actuating member **28** is provided (see FIGURE 3) which is also pivotally supported on the same pivot pin **26** as the latch **25**. The actuating member **28** includes a pair of projecting portions **28A** which overlay portions of the magnetic trip bar **25B**. The actuating member **28** is biased counterclockwise at all times by the adjustable tension spring member **29**. The tension spring member **29** is adapted to be adjusted by rocking movement of an adjusting lever **30** which is retained in desired position by an adjusting screw **31** threadedly engaged in the insulating casing part **13A**. The actuating member **28** is biased by the spring **29** against a cam member **32** as a stop. The cam members **32** forms a part of a rotatable adjusting assembly which is adapted to be rotated by an externally accessible adjusting knob **33**.

The actuating member **28** has attached thereto a generally channel-shaped magnetic armature member **35**, which is adapted to be moved thereby toward and away from a generally channel-shaped stationary magnetic field piece **36**. (As used in this application, the term "magnetic" refers to a metallic material having a permeability substantially better than that of air.) The member **36** has its side portions **36A** bent up to provide pole portions to cooperate with the pole portions **35A** of the armature **35**.

A cylindrical core member **38** of material of high magnetic permeability, is mounted on the field piece **36** by means of the screw **37** which passes through the casing wall **13A** and through the field piece **36**, threading into the core member **38**. The energizing coil **23** surrounds the core member **38**, as shown in FIGURE 2. The core member **38** is preferably covered with a thin insulating covering not shown. Likewise, the conductor forming the coil **23** also is coated with an insulating coating.

Operation of the thermal tripping means

Upon the occurrence of excess currents in the range of 125%–200% of the nominal rating of the circuit breaker, the bimetallic strip **20** is heated and warps so as to move the upper end thereof to the right as viewed in FIGURE 2, causing the calibrating screw **21** to engage the "thermal" trip bar **27**, rotating it clockwise as viewed and causing the projection **27A** to engage the latch member **25**. This engagement rotates the latch member **25** also in clockwise direction to disengage the retaining portion **25A** from the trip member **17** to cause tripping.

Operation of the magnetic tripping means

Upon the occurrence of excess currents in the range of 6 to 12 times the nominal rating of the circuit breaker, the coil **23** is energized so as to draw the armature **35** toward the field piece **36**, rotating the actuating member **28** clockwise as viewed and causing the projections **28A** to engage the magnetic trip bar **25B**, thereby rotating the latch member **25** in clockwise direction to release the latch projection **25A** from the trip member **17**.

Referring to FIGURE 4, a diagram is shown illustrating what is believed to be the magnetic flux flow in the invention. Assuming the current conditions to be in a direction to cause flux in the direction illustrated through the core member **38**, it will be observed that the flux divides and passes through the field piece **36** in opposite directions and thence across the working air gaps **40** to the side wall portions of the armature **35**, and thence from the central portion of the back wall of the armature **35** through the bimetallic strip **20** returning to the core member **38**. Also, it is believed that a portion **41** of the magnetic flux which may be designated as "leakage" flux, flows from the side wall portions of the armature **35** edgewise through the bimetallic strip **20** returning to the core member **38**. It will be observed, nevertheless, that all of the flux, including the leakage flux **41** is required to pass across the working air gaps **40**, thus providing a very highly efficient assembly, and minimizing the number of turns required in the coil **23**.

This arrangement may be contrasted to other possible arrangements, such, for example as illustrating in FIGURES 5 and 6. Thus, in FIGURE 5, it will be observed that flux flowing upwardly through the core member **38'** divides and passes through the side wall portions of the stationary magnetic field piece **36'**, and that while a portion thereof passes across the working air gaps **40'**, a second portion **41'** passes through the bimetallic member **20'** and returns to the core member **38'** without passing across the air gaps **40'**. In FIGURE 6, the bimetallic strip **20''** is positioned in the space intermediate the stationary field piece **36''** and the armature **35''**. It will be observed that in this form also, the leakage flux **41''** is free to pass through the bimetallic strip **20''** without having first bridged the working gaps **41''**. In accordance with the invention, however, by positioning the portion of the bimetallic strip which extends between the magnetic members **35**, **36**, entirely within the space defined by the back wall and side walls of the magnetic member **35**, it is assured that virtually all the flux which passes laterally through the bimetallic strip will also be required to pass across the working gaps **40**.

While the term "field piece" and "armature" have been used in referring to the members **36**, **35** respectively, it will be readily appreciated that the member **35** could, if desired, be made a stationary member and the member **36** could be the movable member.

While the invention has been described in one particular embodiment, it will be readily apparent that many modifications thereof can readily be made, and it is therefore intended by the appended claims to cover all such

modifications as fall within the true spirit and scope of the invention.

What we claim as new and desire to secure by Letters Patent of the United States is:

1. An electric circuit breaker comprising:
(a) an insulating casing;
(b) at least two relatively movable contacts in said insulating casing;
(c) operating means in said insulating casing for moving said contacts between open and closed circuit positions, said operating means including a releasable member releasable to cause automatic opening of said contacts and a trip member movable to cause release of said releasable member;
(d) trip means in said insulating casing for causing tripping movement of said trip member upon the occurrence of predetermined current conditions through said circuit breaker, said trip means including magnetic tripping means and thermal tripping means;
(e) said magnetic tripping means comprising a pair of magnetic members supported in spaced apart relation;
(f) a generally cylindrical magnetic core member having one end thereof mounted on a first one of said magnetic members and having its free end spaced from the second of said magnetic members;
(g) a winding on said core connected electrically in series with said contacts;
(h) an elongated bimetallic strip extending between said free end of said core and said second magnetic member;
(i) said second magnetic member being generally channel-shaped and including a back wall and side wall portions extending therefrom;

(j) the portion of said bimetallic strip which extends between said magnetic members being positioned within the space defined by said back wall and said side walls of said second magnetic member.

2. An electric circuit breaker as set forth in claim 1 wherein said circuit breaker also includes means connecting said bimetallic strip electrically in series with said winding.

3. An electric circuit breaker as set forth in claim 1 wherein said portion of said bimetallic strip which extends between said magnetic members is spaced from a line interconnecting the end portions of said side wall portions of said second magnetic member.

4. An electric circuit breaker as set forth in claim 1 wherein said circuit breaker also comprises means fixedly mounting one end of said bimetallic strip in said casing closely adjacent said magnetic trip assembly.

5. An electric circuit interrupter as set forth in claim 1 wherein said circuit breaker comprises a plurality of pole chambers, each of said pole chambers containing current responsive means similar to said trip means for causing tripping movement of said trip member.

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