United States Patent

Hopkinson

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[54] CIRCUIT BREAKER HAVING THERMAL AND MAGNETIC ACTUATION WITH IMPROVED MAGNETIC TRIP

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[52] **U.S. Cl.** **335/35,** 335/279

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

[58] **Field of Search** 335/35, 37, 18, 23, 279; 337/37, 44, 16

[56] **References Cited**

UNITED STATES PATENTS

2,412,304	12/1946	Staley	335/279
2,989,605	6/1961	Leonard	337/16
3,088,008	4/1963	Gelzheiser	335/44
3,110,786	11/1963	Gelzheiser	335/37
3,254,176	5/1966	Gelzheiser	335/37
1,761,772	6/1930	Carpenter et al.	335/279
2,172,460	9/1939	Warrick	335/279

OTHER PUBLICATIONS

" Secondary Circuit Breakers for Oem' s" Marketing Info. Letter No. CDT- 15, Feb. 10, 1969 by General Electric Company.

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[57] **ABSTRACT**

An electromagnetic circuit breaker having a bimetal operating member combined with a magnetic trip member. The bimetal member is provided with a steel assembly which acts as a trip extension member and also provides a low-reluctance flux path for the magnetic circuit. A magnetic armature of three layers of laminated steel is pivotally mounted below and parallel to the bimetal member and has a push rod which is connected to the latch plate to trigger the latch plate and open the circuit breaker contacts when sufficient short circuit current is present to attract the armature toward the bimetal.

5 Claims, 4 Drawing Figures

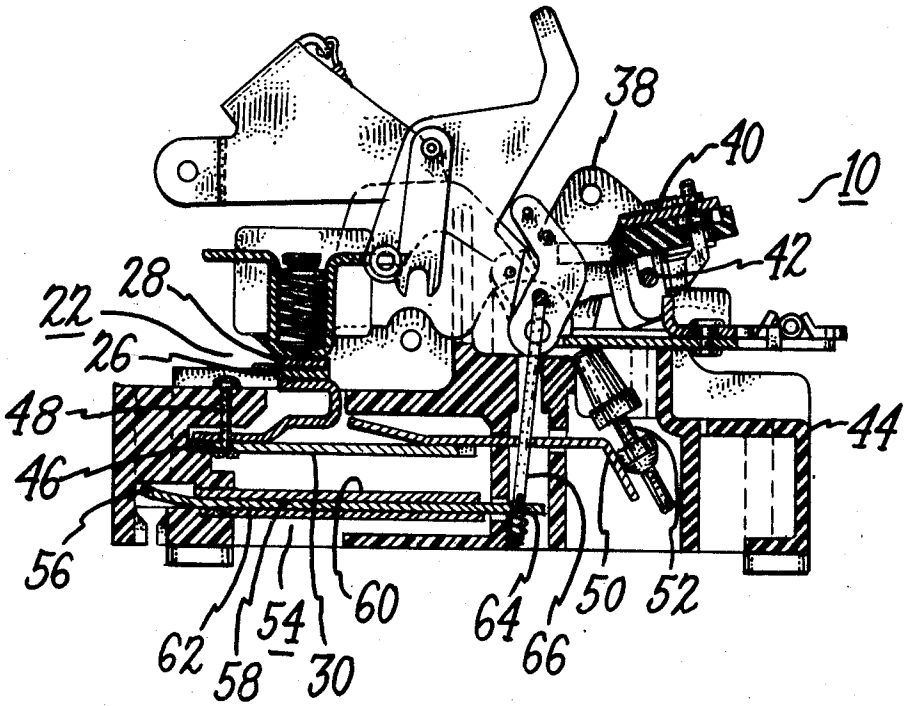


Fig. 1.

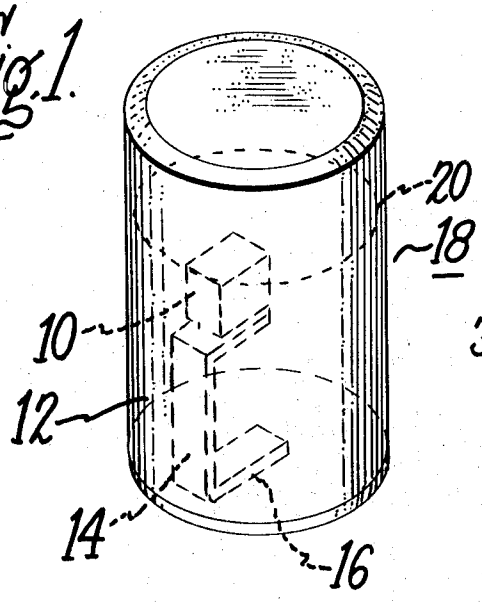


Fig. 4.

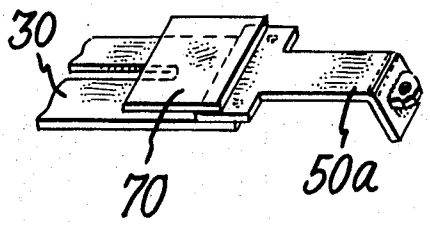
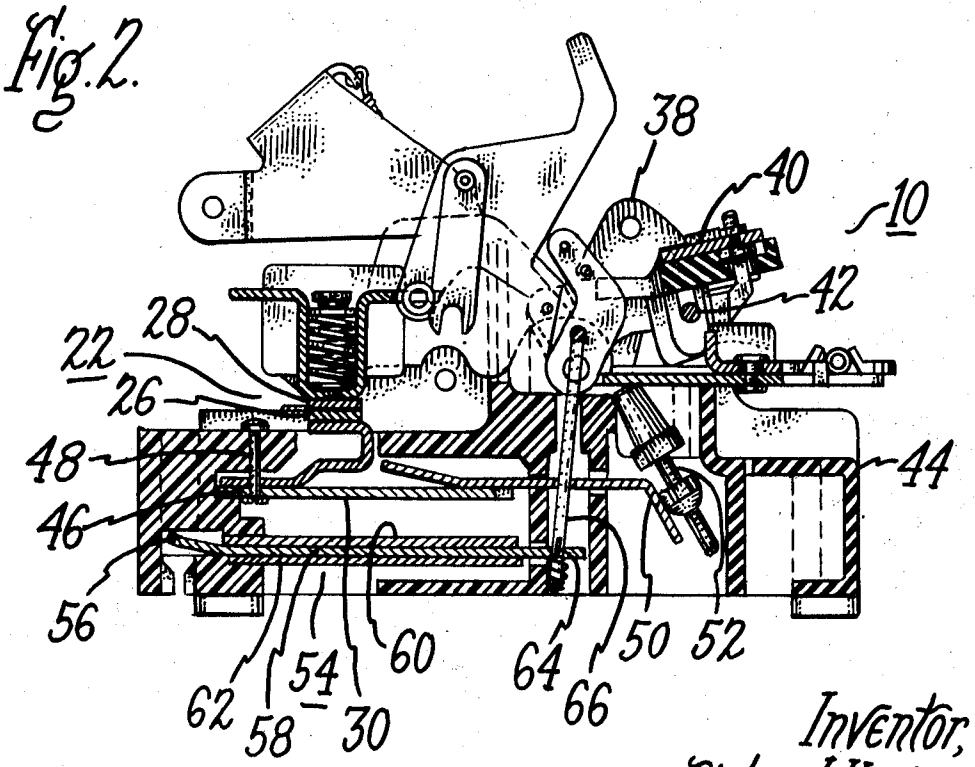


Fig. 2.



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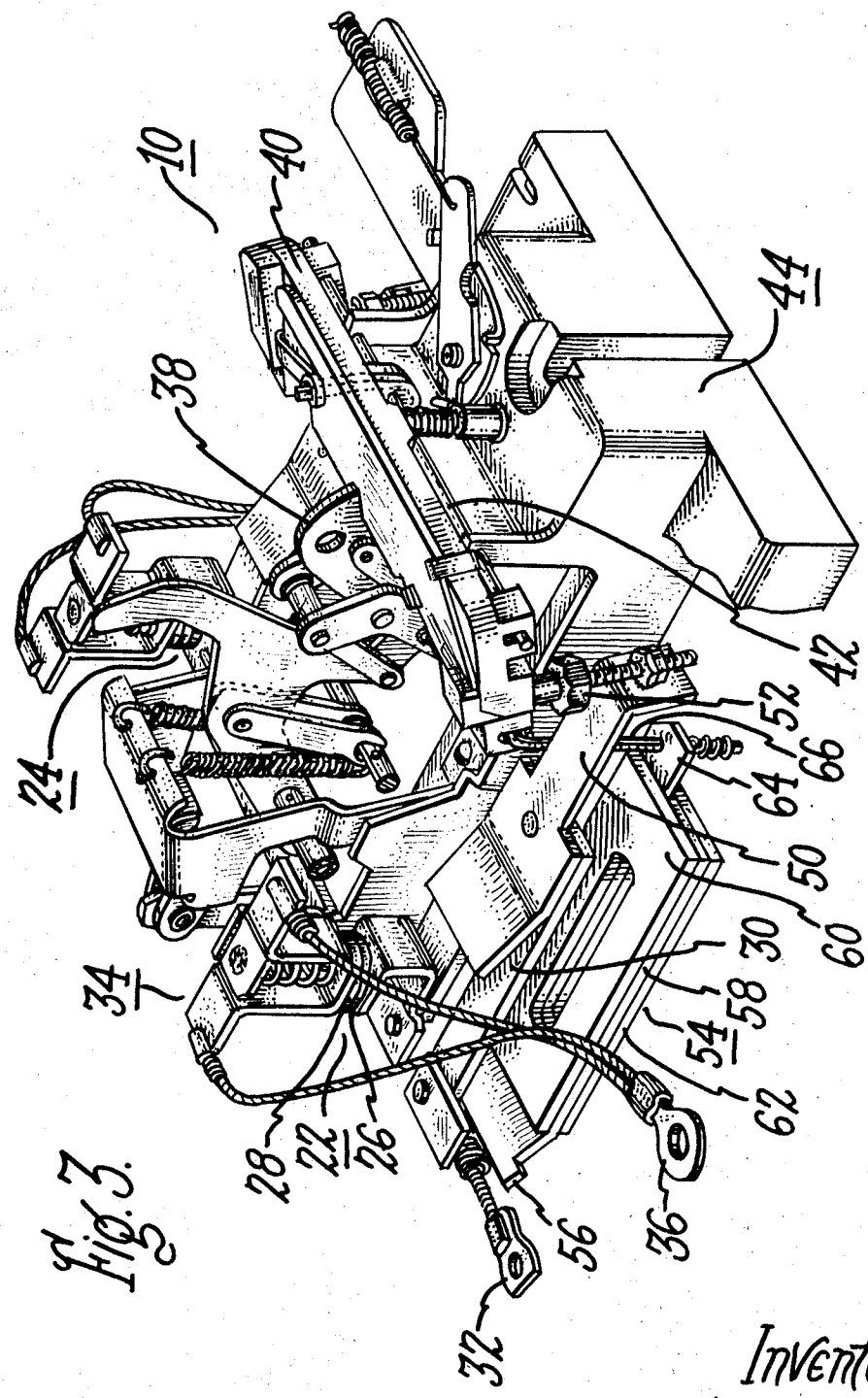


Fig. 3.

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CIRCUIT BREAKER HAVING THERMAL AND MAGNETIC ACTUATION WITH IMPROVED MAGNETIC TRIP

BACKGROUND OF THE INVENTION

This invention relates to circuit breakers and, more particularly to a thermal and magnetic circuit breaker having improved magnetic tripping action.

Thermal and magnetic circuit breakers for electrical apparatus are well known in the art. In these circuit breakers the thermal portion generally includes a bimetal element through which the current of the electrical apparatus flows. As overcurrent conditions are experienced, the bimetal member becomes heated causing it to bend in a direction to unlatch or open the contacts of the circuit breaker. As the circuit breaker opens, it removes the electrical power to the protected circuit, as is well understood. Magnetic trips have been provided to trip the circuit breaker rapidly in the event of excessive overload current which would damage the electrical apparatus being protected. As is well known, bimetal members require a substantial period to become heated sufficiently to actuate the trip mechanism regardless of the amount of overcurrent flowing. However, on excessive overload currents, that is 10 or more times rated load current, it is generally desired to trip the circuit breaker rapidly and remove the overcurrent condition. When a magnetic trip is provided, it is attracted by the magnetic flux generated by the overcurrent condition thereby causing the breaker to trip open.

While many types of magnetic trip devices are presently available, they have not been able to provide the desire accuracy for overcurrent conditions or sufficient speed of clearing or tripping on overcurrent conditions. Where the magnetic circuit is sufficiently rapid in opening the contacts, it often operates at low overcurrent conditions. When it is sufficiently accurate to act only at desired high overcurrent conditions, then usually it will not trip sufficiently rapidly to prevent damage to the protected apparatus, or prevent operation of other safety devices in the circuit, such as, for example, fuses. Also, many available magnetic circuit breakers are not able to operate to clear a high overcurrent fault condition a plurality of times, As is known, the contacts often become welded when closed after the first operation, thereby preventing further operation of the breaker.

It is, therefore, one object of this invention to provide a thermal and magnetic circuit breaker which will consistently operate on magnetic trip within a cycle of highest overcurrent condition.

A further object of this invention is to provide a magnetic and thermal circuit breaker where the magnetic circuit will only operate at an overload current which is equal to or greater than 10 times the full load current.

A still further object of this invention is to provide a thermal and magnetic circuit breaker where the magnetic circuit will be able to operate a plurality of times at high overload currents such as 20 to 30 times full load current.

SUMMARY OF THE INVENTION

Briefly, in one form, this invention comprises a thermally and magnetically actuated circuit breaker. The magnetic circuit of the breaker comprises a plurality of steel laminations having the central lamination pivotally mounted beneath and parallel to the bimetal member of the breaker. Top and bottom laminations are provided over the central lamination to form the magnetic armature so as to provide better flux coupling with the bimetal member and also providing increased armature inertia which will prevent tripping of the magnetic circuit on low overload currents.

The invention which is sought to be protected will be particularly pointed out and distinctly claimed in the claims appended hereto. However, it is believed that this invention and the manner in which its various objects and advantages are obtained, as well as other objects and advantages thereof, will be better understood by reference to the following detailed description of a preferred embodiment thereof, particularly when considered in the light of the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic, perspective view showing the circuit breaker of this invention installed in an oil filled electrical apparatus;

FIG. 2 is a sectional side view of a preferred form of thermal and magnetic circuit breaker according to this invention;

FIG. 3 is a perspective view of the thermal and magnetic circuit breaker shown in FIG. 2; and

FIG. 4 is a detailed perspective view of an alternate form of bimetal assembly according to this invention.

DESCRIPTION OF PREFERRED EMBODIMENT

As is well known to those skilled in the art, circuit breakers are provided in electrical apparatus to give overcurrent protection for such apparatus. FIG. 1 shows one means of mounting a circuit breaker within the casing of an oil-filled, electrical apparatus, such as, for example, a distribution transformer. As is shown in FIG. 1, a circuit breaker 10 is mounted on a metal plate member 12 which may be attached to the sidewall, as at 14, or the bottom wall, as at 16, of a tank 18 of an electrical apparatus. As is well known, the tank 18 is normally substantially filled with oil or other liquid dielectric, for example, up to line 20, while the remainder of the tank 18 is filled with dry air or some inert gas.

In this invention, a circuit breaker is provided that has both thermal trip and magnetic trip means. Reference will now be made to the drawings for a more detailed description of the present preferred embodiment of the invention. Like numerals will be used to indicate like parts throughout the various views.

Referring now to FIGS. 2 and 3 of the drawing, there is shown a circuit breaker 10 provided with two poles as shown by the contacts 22 and 24 in FIG. 3. As both poles are provided with similar actuating means, which are connected together as is well understood, only the pole with contacts 22 will be described. As shown, contacts 22 include the fixed contact 26 and the movable contact 28. The fixed contact 26 is fixed to one side of a U-shaped bimetal member 30. The opposite side of the U-shaped bimetal member 30 is connected to terminal 32 as most clearly appears in FIG. 3 of the drawing. The movable contact 28 is spring mounted in a movable portion 34 of the circuit breaker 10 and is electrically connected to a terminal 36. As is well known, when closed in the manner shown in FIGS. 2 and 3, an electrical circuit is established through the terminal 32, the U-shaped bimetal member 30, the contacts 26,28 and the terminal 36. Contacts 26,28 are held in the closed position through the latching mechanism which includes a latch member 38 and a latch plate 40. Latch member 38 is connected to movable portion 34 of circuit breaker 10 in a well-known manner, while the latch plate 40 is pivoted about a pin 42 which is mounted in the fixed base 44 of the circuit breaker 10.

As is well understood by those skilled in this art, overcurrent flowing in bimetal 30 causes heating of the bimetal. As it becomes hot, the bimetal 30 pivots counterclockwise about the ends 46 which are fixed to the base 44 as shown in FIG. 2 such as, for example, by rivets 48. Extension 50 of bimetal 30 carries a trip member 52 which engages the latch plate 40. Counterclockwise movement of the bimetal 30 pivots the latch plate 40 clockwise about the pivot pin 42 thereby releasing latch 38. Release of latch 38 allows portion 34 to snap open movable contacts 28 from the fixed contacts 26. The above description is essentially a conventional thermal circuit breaker well known in the art such as, for example, as disclosed in U.S. Pat. No. 2,435,432.

In addition to the above described thermal operation, a magnetic actuation is also provided in the circuit breaker 10. As is shown, a magnetic armature 54 is provided, pivotally mounted in the base 44, as shown as pivot 56 (see FIG. 2).

The armature 54 is composed of three separate steel laminations, a central lamination 58 having the pivot portion 56, and top and bottom laminations 60,62 respectively. Central lamination 58 also carries an extended portion 64, which has spring mounted therein a push rod 66, which is connected to the latch plate 40, as shown. The armature 54 is spaced from the bimetal 30 a sufficient distance such that the inertia of the armature 54 and the other mechanical forces of breaker 10 will prevent actuation on current less than approximately 10 times full load current. However, due to the three lamination construction, at currents of 10 times full load or greater, the armature rapidly moves toward bimetal 30 due to the improved flux coupling provided by the three lamination armature.

As will be apparent fro the above description, as the armature 54 is attracted to bimetal 30, it pivots in base 44 about pivot 56. The opposite end 64 of armature 54 moves in a counterclockwise direction forcing push rod 66 upwardly. The push rod 66 pivots the latch plate 40 clockwise about pivot pin 42 thereby releasing latch 38. As latch 38 is released the contacts 26, 28 are opened with a snap action.

In the preferred embodiment shown, extension arm 50 is a steel member and the portion over bimetal 30 is substantially the same width as bimetal 30. This portion of the steel extension arm 50 provides a low reluctance flux path across the bimetal 30 providing better coupling of the magnetic flux with magnetic armature 54.

In an alternate embodiment, shown in FIG. 4, the bimetal 30 has an extension 50*a* secured to the free end of bimetal 30, as shown. A steel member 70 is welded or otherwise secured to extension arm 50*a* and extends over a portion of bimetal member 30, as shown. The steel member 70 in a manner similar to that of the steel portion of extension arm 50 provides a low reluctance path for magnetic flux across the bimetal 30 thereby providing better flux coupling to the magnetic armature 54.

In order to provide the desired magnetic pickup current together with the desired clearing time, it has been found necessary to use a three lamination armature member as shown and described. When only two laminations are used, if the armature is sufficiently close to the bimetal to give desired clearing time, the armature is actuated at such low overload current, such as four to six times full load current, that many false openings of the circuit breaker are made. When the two lamination armature is moved far enough from the bimetal to obtain the desired magnetic pickup current, it is found that the speed of actuation is much too slow to provide the necessary clearing time for circuit breakers.

As will be understood from the above description, should the circuit breaker 10 be closed on a fault current, such as 10 or more times rated load current, the magnetic trip of this invention will immediately open contacts 26,28, preventing welding of such contacts. The positioning of the magnetic armature 54 and the use of three laminations 58, 60, 62 provide that the magnetic trip will open or trip the circuit breaker contacts in one cycle at the highest or limiting current that can be obtained in the electrical apparatus to which it is attached.

While there has been shown and described the present preferred embodiment of this invention, it will of course be apparent to those skilled in the art that various changes may be made in many of the details of the circuit breaker without departing from the spirit and scope of the magnetic pickup of this invention as it is defined by the appended claims.

What is new and which it is desired to secure by Letters Patent of the United States is:

1. A thermal and magnetic circuit breaker for an electrical apparatus, said circuit breaker comprising at least one pole with a U-shaped bimetal member fixed in the base of said circuit breaker and connected between a terminal on one side of the U-shaped member and a fixed contact on the other side of said U-shaped member, a movable contact connected to a second terminal and secured to a movable portion of said circuit breaker such that on actuation of said bimetal on current overloads the movable contact is moved away from said fixed contact, a magnetic armature member pivotally mounted on said fixed base of said circuit breaker and extending substantially parallel to and below said bimetal member, a push rod connected to said armature for actuating the circuit breaker, said armature having exactly three laminations of steel which are attracted to said bimetal on overloads of 10 or more times rated current of the electrical apparatus.

2. A circuit breaker as claimed in claim 1 in which said bimetal member includes a steel portion across the free end of said bimetal for providing a low reluctance flux path across said bimetal.

3. A thermal and magnetic circuit breaker comprising at least one pole, a U-shaped bimetal member connected to a fixed portion of the circuit breaker and having a fixed contact connected to one side of said U-shaped member and a terminal member connected to the other side of said U-shaped member, a movable contact connected to a movable portion of said circuit breaker and movable into and out of contact with said fixed contact member, a latch member and a latch plate, said bimetal connected by means of a trip member to said latch plate for pivoting said latch plate on low overload currents, a magnetic armature member having exactly three steel laminations, said central steel lamination having an extended portion with a pivot member thereon, said pivot member being pivotally mounted in said fixed portion of said circuit breaker to pivotally mount said three member magnetic armature on said fixed portion extending substantially parallel to and below said bimetal, a push rod connected to said armature and in contact with said latch plate for actuating said latch plate on high overload currents, said three lamination armature being attracted to said bimetal on high overload currents.

4. A circuit breaker as claimed in claim 3 in which said bimetal member includes a steel extension carrying said trip member, said steel extension having a portion extending over a part of said bimetal member and being substantially the same width as said bimetal member to establish a low reluctance flux path across said bimetal member.

5. A circuit breaker as claimed in claim 3 in which a separate steel member is secured to the free end of said bimetal member to provide a low reluctance flux path across said bimetal.

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