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CIRCUIT BREAKER BIMETAL HEATER

Filed Aug. 25, 1959

FIG. 1.

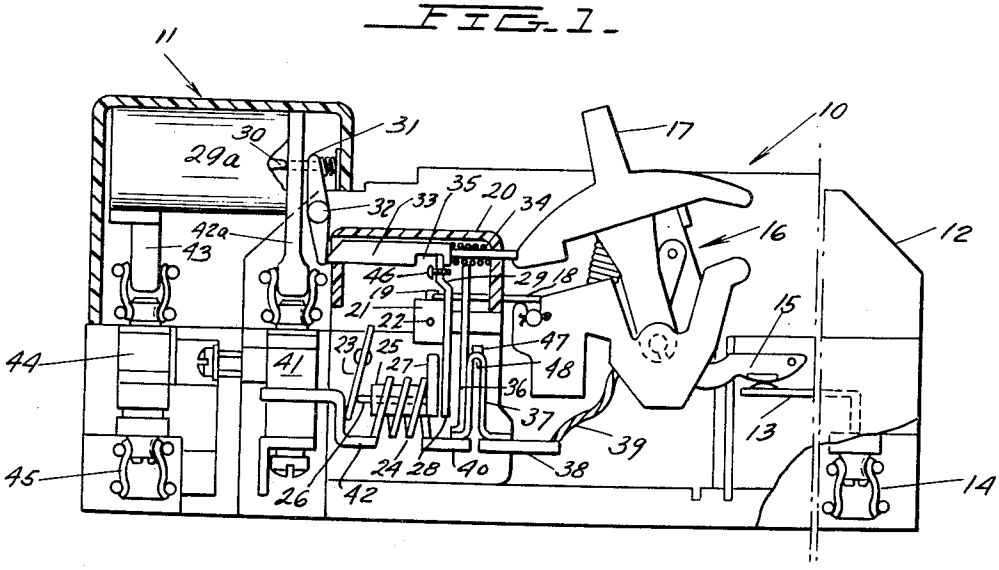


FIG. 2.

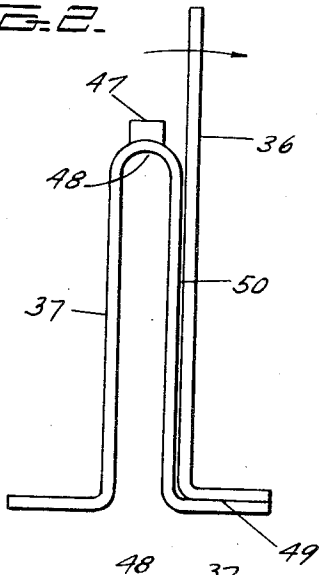
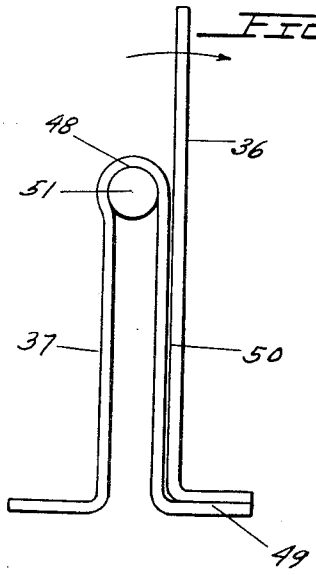


FIG. 3.



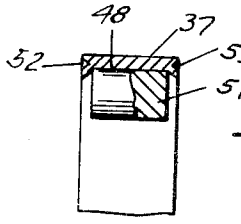


FIG. 4.

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CIRCUIT BREAKER BIMETAL HEATER

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6 Claims. (Cl. 200—116)

Our invention relates to a bimetal heater having a U-shape bend wherein the bent section is provided with a heat sink and is more specifically directed to a circuit breaker bimetal heater which has a high heat conductivity material connected at the base of the U formed by the heater.

Heaters for bimetals of the type used to operate a trip latch in a circuit breaker are generally formed of a U-shaped conductive member having one leg of the U adjacent the bimetal. The bent portion of the U is normally the weakest part of the heater because the metal normally has a reduced cross-section at the point. Furthermore, under light overload, current density at the inner surface of the U is great enough to cause fusing, while under heavy overload the current will become concentrated on the periphery by the magnetic force to produce substantial blow-off forces which will tend to rupture the weakest portion of the heater.

The essence of the present invention is to provide a heat sink at the bent portion of the bimetal heater which will thermally strengthen the heater at this critical area by permitting rapid heat absorption to decrease the rate of increase in temperature.

Accordingly, a primary object of our invention is to provide a novel bimetal heater.

Another object of our invention is to provide a novel means for increasing the thermal capacity of a bent conductor.

A further object of our invention is to increase the thermal capacity of a current conductor having a bend therein by providing a heat sink at the bend.

A still further object of our invention is to provide a heat sink at the bend of a U-shaped bimetal heater.

These and other objects of our invention will become apparent from the following description when taken in connection with the drawings, in which:

FIGURE 1 shows the manner in which an indirectly heated bimetal unit operates as a trip unit for a circuit breaker wherein the bimetal heater is modified in accordance with the present invention.

FIGURE 2 illustrates the bimetal and bimetal heater of FIGURE 1.

FIGURE 3 illustrates a second embodiment of our novel invention.

FIGURE 4 is a partial cross-sectional view of FIGURE 3 when taken across the lines 3—3.

Referring now to FIGURE 1, we have generally illustrated one type of circuit interrupter that can be equipped with an indirectly heated bimetal for automatically operating the circuit breaker. The circuit breaker construction shown in FIGURE 1 is fully disclosed in copending application Serial No. 622,042, filed November 14, 1956, entitled "End Mounting of a Current Limiting Device Associated With a Circuit Breaker," in the name of William Harold Edmunds and assigned to the assignee of the present invention, now issued as U.S. Patent Number 2,924,688 on February 9, 1960.

More specifically, FIGURE 1 shows a circuit interrupter comprised of a circuit breaker portion **10** and a current limiting portion **11** which is mechanically and electrically associated with the circuit breaker portion **10**. It is to be noted that FIGURE 1 illustrates a side

cross-sectional view of only one phase of an interrupting unit which could be a multiphase unit. The circuit breaker portion **10** is comprised of a molded housing **12** which has a stationary contact **13** connected to a disconnect terminal **14** which is adapted to plug into a cooperating disconnect of a panel board (not shown). A movable contact **15** is movable into and out of engagement with respect to stationary contact **13** under the influence of an operating mechanism generally shown as operating mechanism **16**. The operating mechanism **16** may be operated either automatically in a manner to be described hereinafter or manually under the influence of a manually operating handle **17** which protrudes through an opening in the cover of molded case housing **12**. For details of operation of this mechanism, reference is made, for example, to U.S. Patent No. 2,574,093, issued November 6, 1951, entitled "Adjustable Trip," in the name of William Harold Edmunds and assigned to the assignee of the present invention.

The circuit breaker operating mechanism **16** is normally spring biased to an open position and is held engaged through a latch means (not shown) including trip link **18** which is normally latched by latch member **19** carried in trip unit housing **20**. Latch member **19** is carried on a tripper bar **21** which is pivotally mounted at pivot **22**. To operate the circuit breaker to a disengaged position, it will be apparent that a counter-clockwise rotation of tripper bar **21** will release trip link **18** to permit automatic circuit breaker operation.

Tripper bar **21** is operable by any one of several automatic trip means. The first of these is a magnetic trip means which includes pivotally mounted armature **23** which cooperates with a solenoid formed by winding **24** which is in series with the circuit breaker current path and a magnetic core **25**. Upon the occurrence of a fault above some predetermined magnitude, winding **24** will magnetize core **25** to such an extent that armature **23** will be attracted thereto and thus engage plunger **26** which extends through core **25**. Plunger **26** is terminated by an extending member **27** which is preferably of non-magnetic material. Member **27** is movable into engagement with extension **28** which is connected to tripper bar **21** in any desired manner whereby operation of armature **23** and plunger **26** will cause a rotation of extension **28** and thus drive the tripper bar **21** in a counter-clockwise rotation to trip the circuit breaker.

A further manner in which the circuit breaker may be tripped is through a current limiting fuse system which includes current limiting fuse **29***a* which is connected in series with circuit breaker contacts. Since this operation is fully described in the above noted copending application Serial No. 622,042, it will not be more fully described hereinafter, it being sufficient to understand that the operation current limiting fuse **29***a* will permit a striker pin **30** to be ejected therefrom and into engagement with the upper portion of auxiliary tripper bar **31** which is pivotally mounted at pivot **32**. This will cause a rotation of auxiliary tripper bar **31** in a clockwise direction whereby rod **33** is permitted to move to the left under the influence of its biasing spring **34**. An upper extension **29** is connected to tripper bar **21** and this upper extension is carried within a slot **35** of rod **33**. Therefore, upon operation of fuse **29***a*, tripper bar **31** will be rotated counter-clockwise to again cause tripping of the circuit breaker.

The third automatic trip unit for the system and the trip unit to which the invention is directed is the overload trip which includes indirectly heated bimetal **36** mounted with respect to its U-shaped heater **37**. Heater **37** is electrically connected in series with the circuit breaker contacts **13** and **15** and the electrical circuit

through the combination circuit interrupter. More specifically, the complete circuit extends from disconnect contact **14**, stationary contact **13** and movable contact **15** heretofore described. The movable contact **15** is electrically connected to conductor **38** over the pigtail **39**. The opposite end of conductor **38** is then electrically connected to heater **37** and the opposite end of heater **37** is connected to one end of winding **24** through conductor **40**. The opposite end of winding **24** is connected to disconnect terminal **41** over conductor **42** and disconnect terminal **42***a* of fuse **29***a*. The other plug-in terminal **43** of fuse **29***a* is then connected to disconnect **44** which, in turn, is electrically connected to the main circuit interrupter disconnect **45** which is connectible to the other terminal of the circuit breaker panel-board previously mentioned in connection with terminal **14**. For further details of this construction, reference is again made to copending application Serial No. 622,042.

Under overload conditions, the heater **37** will heat sufficiently to cause bimetal **36** to deflect to the left until it engages adjustable screw **46** whereby continued motion of bimetal **36** will cause extension **29** which carries screw **46** to be moved to the left and thus rotate tripper bar **21** in the trip direction.

In accordance with the present invention, a heat sink **47** is connected to the bend in U-shaped heater **37** whereby the thermal strength of the heater is increased at this critical area.

This construction is best seen in FIGURE 2 wherein the U-shaped bend **48** of heater **37** is more clearly shown. The bimetal heater **37** is generally designed to provide a maximum of heat transfer to the bimetal **36**. The bimetal **36** is, therefore, supported directly at the foot of heater **37** along the surface **49** as by spot-welding so that the heat of the heater will enter the bimetal at this portion by conduction. Radiant heat is also added to the bimetal by providing a very small space **50** between the freely movable portion **36** and on the heater legs.

As will be apparent from the circuit breaker construction of FIGURE 1, in order to conserve trip unit space, the heater must return on itself and in so doing makes a sharp bend **48**. This bend **48** of the heater is normally the weakest part of the heater for several reasons. First, the metal will often have a reduced cross-section at the bend to permit the bend to be made more easily. Next, under comparatively light overload current conditions, the current will tend to have a greater current density toward the interior of the bend so that fusing begins at this portion and moves progressively outward. Finally, for comparatively high overloads or short circuits, there will be substantial magnetic blow-off forces exerted on the bend because the two conductor portions forming the legs of the U carry currents in opposite directions. Thus, as the heater weakens with increased temperatures, the magnetic forces may become strong enough to rupture the heater at the U-shaped bend.

In order to prevent the substantial increase in temperature at the U-shape bend, we provide a heat sink **47** at the bend which will operate to rapidly absorb heat under any of the above noted overload conditions. Member **47** is a material which could be copper and is characterized in having a relatively high heat conductivity and may be brazed or silver soldered to U-shape bend **48**.

Clearly, the heat sink **47** may take many various forms. One such form is illustrated in FIGURES 3 and 4 which is identical to FIGURE 2 with the exception of the heat sink construction. In FIGURES 3 and 4, however, the heat sink is formed of a conductive pin **51** which is supported or cradled in the U-shaped bend by bending it for slightly more than 180°.

As best seen in FIGURE 4, endwise dislodging of pin **51** may be achieved by staking the heater material of heater **37** at staked portions **52** and **53**. The pin **51** can additionally be silver soldered and brazed in place to give a maximum of heat conduction in the critical area while the heater wrap of greater than 180° and staked portions **52** and **53** will confine the pin while the soldering is in a molten stage.

While FIGURE 4 shows that pin **51** may be axially retained by stake portions **52** and **53**, it will be clear to those skilled in the art that pin **51** may be staked in any desired manner. For example, the staking may comprise of the peening over of a portion of the material of pin **51** with respect to heater **37**.

In the foregoing, we have described our invention only in connection with preferred embodiments thereof. Many variations and modifications of the principles of our invention within the scope of the description herein are obvious. Accordingly, we prefer to be bound not by the specific disclosure herein but only by the appending claims.

We claim:

1. A heater for an indirectly heated bimetal; said heater being formed of a substantially U-shaped member having elongated legs joined at a bent portion; said legs having confronting surfaces whose widths are materially greater than the thicknesses of said legs; one of said legs having said bimetal directly connected thereto; said bimetal being an elongated member extending substantially parallel to said leg having said bimetal connected thereto; said bimetal being deflected away from said last mentioned leg at least partially due to heat caused by the flow of electrical current through said substantially U-shaped heater; a heat conductive member; said heat conductive member being connected to said bent portion of said heater and serving as a heat sink for said heater.

2. A heater for an indirectly heated bimetal; said heater being formed of a substantially U-shaped member having elongated legs joined at a bent portion; said legs having confronting surfaces whose widths are materially greater than the thicknesses of said legs; one of said legs having said bimetal directly connected thereto; said bimetal being an elongated member extending substantially parallel to said leg having said bimetal connected thereto; said bimetal being deflected away from said last mentioned leg at least partially due to heat caused by the flow of electrical current through said substantially U-shaped heater; a heat conductive member; said heat conductive member being connected to said bent portion of said heater and serving as a heat sink for said heater; said conductive member being comprised of a pin; said pin being directly connected to said heater at the interior of said bent portion.

3. A heater for an indirectly heated bimetal; said heater being formed of a substantially U-shaped member having elongated legs joined at a bent portion; said legs having confronting surfaces whose widths are materially greater than the thicknesses of said legs; one of said legs having said bimetal directly connected thereto; said bimetal being an elongated member extending substantially parallel to said leg having said bimetal connected thereto; said bimetal being deflected away from said last mentioned leg at least partially due to heat caused by the flow of electrical current through said substantially U-shaped heater; a heat conductive member; said heat conductive member being connected to said bent portion of said heater and serving as a heat sink for said heater; said conductive member being comprised of a pin; said pin being directly connected to said heater at the interior of said bent portion; said bent portion bending for greater than 180° to substantially retain said pin; and stake means for retaining said pin within said bent portion in an axial direction of said pin.

4. In a circuit breaker; said circuit breaker including a pair of cooperable contacts movable into and out of engagement with respect to one another and an operating mechanism for controlling said movement of said contacts; an automatic trip means operatively connected to

said operating mechanism for automatically operating said contacts from said engaged position to said disengaged position; said trip mechanism including an indirectly heated bimetal and a heater associated therewith; said heater being comprised of elongated U-shape member electrically connected in series with said cooperable contacts; said bimetal being directly connected to one leg of said U-shaped heater and extending substantially parallel with said last mentioned leg of said heater; said U-shaped heater having another leg; said legs having confronting surfaces whose widths are materially greater than the thicknesses of said legs; said U-shape of said heater being defined by a bent portion; a heat conduction member; said heat conduction member being directly connected to said bent portion and defining a heat sink for said bent portion.

5. In a circuit breaker; said circuit breaker including a pair of cooperable contacts movable into and out of engagement with respect to one another and an operating mechanism for controlling said movement of said contacts; an automatic trip means operatively connected to said operating mechanism for automatically operating said contacts from said engaged position to said disengaged position; said trip mechanism including an indirectly heated bimetal and a heater associated therewith; said heater being comprised of elongated U-shape member electrically connected in series with said cooperable contacts; said bimetal being directly connected to one leg of said U-shaped heater and extending substantially parallel with said last mentioned leg of said heater; said U-shaped heater having another leg; said legs having confronting surfaces whose widths are materially greater than the thicknesses of said legs; said U-shape of said heater being defined by a bent portion; a heat conduction member; said heat conduction member being directly connected to said bent portion and defining a heat sink for said bent portion; said conductive member being comprised of a pin carried within said bent portion.

6. In a circuit breaker; said circuit breaker including a pair of cooperable contacts movable into and out of engagement with respect to one another and an operating mechanism for controlling said movement of said contacts; an automatic trip means operatively connected to said operating mechanism for automatically operating said contacts from said engaged position to said disengaged position; said trip mechanism including an indirectly heated bimetal and a heater associated therewith; said heater being comprised of elongated U-shape member electrically connected in series with said cooperable contacts; said bimetal being directly connected to one leg of said U-shaped heater and extending substantially parallel with said last mentioned leg of said heater; said U-shaped heater having another leg; said legs having confronting surfaces whose widths are materially greater than the thicknesses of said legs; said U-shape of said heater being defined by a bent portion; a heat conduction member; said heat conduction member being directly connected to said bent portion and defining a heat sink for said bent portion; said conductive member being comprised of a pin carried within said bent portion; said bent portion being bent for greater than 180°; said pin being retained within said bent portion by virtue of said greater than 180° bend; said bent portion further including a stake means for retaining said pin in an axial direction.

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