Nov. 13, 1962 W. H. EDMUNDS 3,064,101

COMPOUNDED THERMAL BIMETAL FOR AMBIENT COMPENSATION

Filed Dec. 8, 1958

FIG. 1

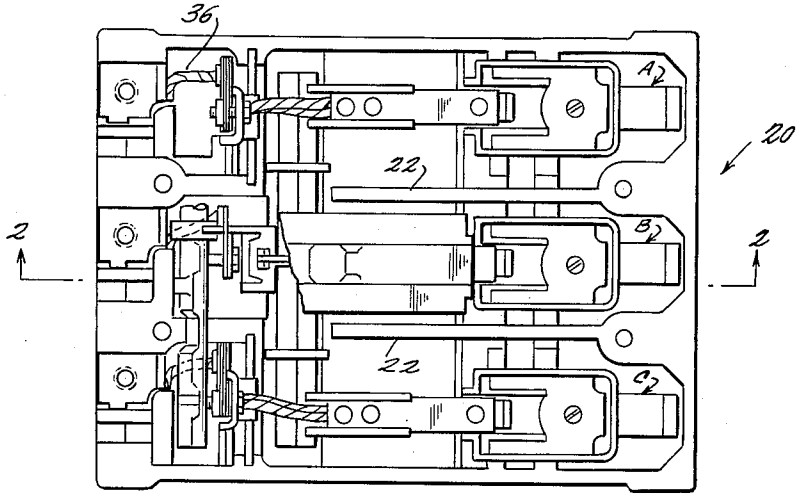
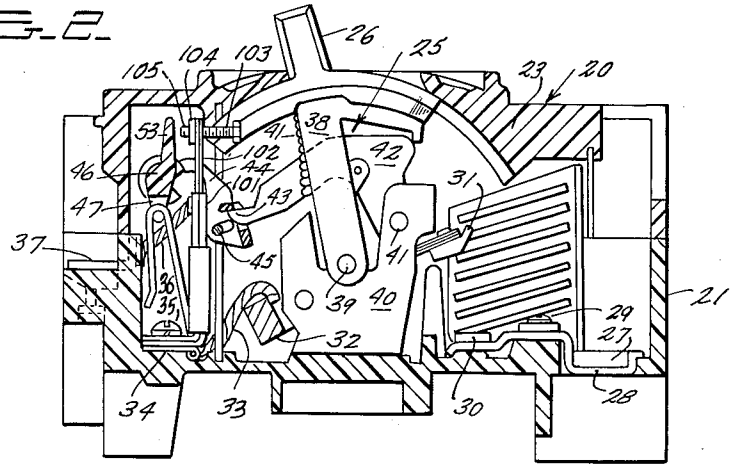


FIG. 2



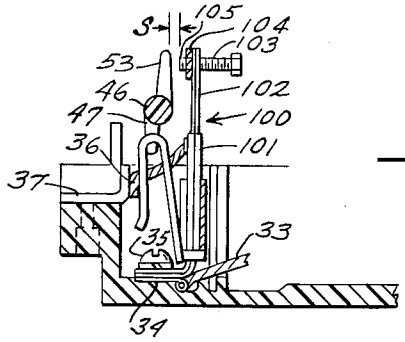


FIG. 3

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COMPOUNDED THERMAL BIMETAL FOR AMBIENT COMPENSATION

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The instant invention relates to circuit breakers in general and more particularly to a novel arrangement for an ambient temperature compensation means which will enable the thermal time delay tripping element of the circuit breaker to trip the circuit breaker at a constant predetermined current overload condition regardless of changes in ambient temperatures.

Circuit breakers, and more particularly molded case circuit breakers, are usually provided with a bimetal element which introduces a time delay in the interruption of the circuit breaker on the occurrence of an overload. Thus, for example, a circuit breaker may be calibrated at 25 C. to carry rated current for an indefinite length of time and to trip after a predetermined time interval if subjected to a predetermined overload current during that period. However, in the event that the ambient temperature of the circuit breaker environment goes above the calibrating temperature, for example to 50 C., the initial calibration is now in error. Hence, the circuit breaker will trip before the predetermined time delay expires. Thus, it is necessary to provide ambient temperature compensation means to insure that the circuit breaker will retain the characteristics of this initial calibration regardless of changes in the ambient temperature.

The most important feature of ambient calibration is illustrated by considering a circuit breaker which is calibrated to carry a normal load current, for example 100 amperes at 25 C. indefinitely without tripping. That is, the 100 amperes represents a normal load which is not injurious to the electrical line or equipment protected by the circuit breaker. In the event that the ambient temperature goes above the 25 C. for example 50 C., the bimetal will deflect more at 50 C. than at 25 C. even though normal load current is flowing therethrough under both ambient temperature conditions. Hence, it is possible that this rise in ambient temperature will sufficiently deflect the bimetal to trip the circuit breaker thereby causing obvious abnormal interruption.

In single pole circuit breakers of the prior art, wherein the bimetal acts directly on the latch, ambient temperature compensation usually takes the form of an auxiliary bimetal which deflects in a direction opposite to the deflection of the main circuit breaker bimetal and thereby adds a load to the main bimetal in the event that the ambient temperature is above the calibration temperature. Hence, even when the main bimetal is subjected to the high ambient temperature, it will neverthless overcome this additional load before the circuit breaker can trip.

In multi-pole molded circuit breakers of the prior art, wherein a tripper bar is used, the latch is usually an integral part of the tripper bar with the deflection of the bimetal merely rotating the tripper bar to release the latch. In this type of arrangement the bimetal may even be spaced from the tripper bar or raised against a protrusion thereon. It is the degree of deflection of the bimetal which eventually results in tripping of the circuit breaker.

In this type of an arrangement, ambient compensation is achieved by placing a load on the tripper bar which is in opposition to the force exerted thereon by the main bimetal. This loading is usually achieved by means of an auxiliary bimetal.

The instant invention achieved ambient compensation by providing a compounded thermal bimetal. Essentially this is a standard overcurrent bimetal on to which is brazed, or otherwise secured, an ambient compensating bimetal. The ambient compensating bimetal may be much lighter in construction than the overcurrent bimetal since the former is not required to carry load current. Further, the ambient compensating bimetal will have entirely different deflection characteristics than those of the overcurrent bimetal in that the former will be more sensitive to changes in ambient temperature.

The ambient temperature compensating bimetal extends upwardly from the free end of the overcurrent bimetal and is arranged to deflect in a direction opposite to the deflection of the overcurrent bimetal. It is the free end of the ambient temperature compensating bimetal which is engageable with the tripper bar for tripping of the circuit breaker.

As the ambient temperature rises the overcurrent bimetal deflects in a direction which will cause tripping of the circuit breaker. However, at the same time the ambient compensating bimetal deflects in the opposite direction thereby maintaining the calibration of the circuit breaker. That is, the latch bite or the distance between the free end of the compounded thermal bimetal and the tripper bar may be maintained substantially uniform regardless of any changes in ambient temperature. It should be realized that the ambient temperature compensating bimetal will be effected to a limited extent by heat generated in the overcurrent bimetal by current flowing through the circuit breaker. This effect may readily be compensated for in the original calibration of the circuit breaker.

The compensated thermal bimetal according to the instant invention may be used in any type of circuit breaker whether it be of a directly or indirectly heated bimetal overcurrent construction. A compounded thermal bimetal has considerable advantages over ambient compensating devices of the prior art in that the compound thermal bimetal is a compact unit and the raw material of which the unit is comprised can be furnished in strip stock and blanked out to the desired configuration.

Accordingly, a primary object of the instant invention is to provide a circuit breaker having novel ambient compensating means.

Another object is to provide a compound thermal bimetal which is utilized as a temperature compensating device.

Still another object is to provide a circuit breaker in which the bimetal of the time delay tripping means comprises a compounded strip-like unit one portion of which is primarily deflected by heating caused by current flowing through the circuit breaker and another portion of which is primarily deflected by changes in ambient temperature with the deflections of these two portions being in opposite directions thereby maintaining the calibration of the circuit breaker regardless of changes in ambient temperature.

These as well as other objects of the instant invention shall become readily apparent after reading the following description of the accompanying drawings in which:

FIGURE 1 is a plan view of a circuit breaker, with the cover removed, which includes my novel compounded thermal bimetal.

FIGURE 2 is a cross-section of a circuit breaker of FIGURE 1 taken through the center phase thereof.

FIGURE 3 is a detail view of the circuit breaker taken in the region of the time delay trip means.

Now referring to the figures, circuit breaker **20** is of the type which is fully described in U.S. Patent 2,673,-908 to J. C. Brumfield entitled "Instantaneous Trip Cir-

cuit Breaker." Circuit breaker **20** is a three pole device including molded case consisting of a base **21**, with suitable barrier formations **22** between the phases, and a removable molded cover **23**. A single operating mechanism **25**, including manual operating handle **26**, is utilized to achieve simultaneous operation of all three phases.

The current path through the circuit breaker for each of the three phases A–C is identical, so for the sake of brevity only the current path of the center phase B will be described, it being understood that the current paths through the other phases A and C are identical to the current path through phase B. This current path comprises line terminal **27** which is secured to one end of formed strap **28** mounted to base **21** by means of screw **29** with stationary contact **30** being secured to the other end of strap **28**. Movable contact **31** is mounted to one end of pivoted contact arm **32** and is engageable with fixed contact **30**. Braid **33** is secured to the other end of contact arm **32** and extends to conductor **34** secured to base **21** by screw means **35**. Compounded bimetal **100** extends upwardly from conductor **34** and at a point between the ends of compounded bimetal **100** braid **36** is affixed. Braid **36** extends to load terminal **37** which is suitably secured to base **21** to complete the current path.

Operating mechanism **25** includes an arm **38** which is pivotally mounted at **39** to frame **40** and is operatively connected by means of spring **41** and suitable linkages (not shown) to contact arm **32**. Mechanism **25** further includes a latchable cradle **42** pivoted at **41** to frame **40**. Cradle **42** includes a latch tip **43** which is engageable with latch member **44**, pivotally mounted at **45** to base **21**. Latch member **44** in turn cooperates with common tripper bar **46** which extends through all three phases A–C. In FIGURE 2, cradle **42** is latched in the reset position awaiting operation of handle **26** to the right with respect to FIGURE 2 to move contact **31** into engagement with contact **30**.

Common tripper bar **46** includes a downward extension **47** in each phase to which a U-shaped armature **48** is connected. Armature **48** cooperates with magnet **49**, mounted near the bottom end of compounded bimetal **100**, to provide an instantaneous tripping means for circuit breaker **20**. That is, upon the occurrence of a severe overload, armature **48** will be pivoted about end **50** thereof in a clockwise direction, with respect to FIGURE 3, thereby causing tripper bar **46** to rotate in a counterclockwise direction, with respect to FIGURE 3, to free latch member **44** which in turn frees latch tip **43** and trips the circuit breaker **20**.

The time delay trip means comprises compounded bimetal **100** which includes a first strip-like portion **101** designated the overcurrent bimetal and, extending upwardly therefrom, a second portion **102** designated the ambient temperature compensating bimetal. Portions **101** and **102** are rigidly secured to one another as by brazing.

The lower end of compounded bimetal **100** is fixedly secured by means of screw **35** while the upper or free end thereof is provided with an adjusting screw **103**, passing through a threaded opening (not shown), and a lock nut **104**. Common tripper bar **46** is provided in each of the phases with an upwardly projecting extension **53** which is engageable by end **105** of adjusting screw **103** when compounded bimetal **100** has been deflected due to the occurrence of overload conditions in the particular phase. Heating of ambient compensating bimetal **102** will cause its upper end to deflect to the right with respect to FIGURE 3, while heating of overcurrent bimetal **101** will cause its upper end to deflect to the left with respect to FIGURE 3.

It is to be noted that circuit current, while flowing through overcurrent bimetal **101**, does not flow through ambient temperature compensating bimetal **102**. Ambient compensating bimetal **102** is chosen to be extremely sensitive to changes in ambient temperature while overcurrent bimetal **101** is effected to a lesser degree in changes in ambient temperature. Thus, the deflection of bimetal portion **102** will be due primarily to changes in ambient temperature while the deflection of bimetal portion **101** will be due primarily to heating thereof caused by circuit current passing therethrough.

If adjusting screw **103** is set in position while circuit breaker **20** is subjected to a calibrating ambient temperature to establish a gap distance S between screw tip **105** and tripper bar extension **53**, a rise in ambient temperature while causing the upper end of overcurrent bimetal **101** to deflect to the left will at the same time cause the free end of ambient compensating bimetal **102** to deflect to the right thereby maintaining the gap distance S substantially constant.

Circuit current flowing through overcurrent bimetal **101** will cause heating and accompanying deflection thereof which will move screw tip **105** to the left. Under current overload conditions this leftward deflection will cause screw tip **105** to engage tripper bar **46** counterclockwise with respect to FIGURE 3. Thus, latch member **44** is freed of tripper bar **46** and latch tip **43** is in turn freed of latch member **44** which causes automatic tripping of circuit breaker **20**.

With ambient compensating bimetal **102** brazed to overcurrent bimetal **101** heating of the latter by circuit current will be conducted to the former to cause a deflection thereof. This may be compensated for in the calibration setting of adjusting screw **103** together with a suitable choice of bimetals which possess the required characteristics which enables the deflection of portion **101** to complement the deflection of portion **102**. Heat conduction between compounded bimetal portions **101** and **102** may be substantially eliminated by interposing a suitable heat insulator therebetween.

It is also to be noted that ambient temperature compensating bimetal **101** is made to be much lighter in construction than overcurrent bimetal **101** since the former is not required to carry circuit current.

Thus, I have provided novel ambient temperature compensation means, for a circuit breaker, comprising a compounded bimetal whereby the time delay trip unit of a circuit breaker will cause tripping thereof after a predetermined time delay regardless of the ambient temperature of the environment in which the circuit breaker is operating.

Although I have here described preferred embodiment of my novel invention, many variations and modifications will now be apparent to those skilled in the art, and I therefore prefer to be limited, not by the specific disclosure herein, but only by the appending claims.

I claim:

1. A time delay trip device for a circuit breaker comprising an elongated compounded bimetal including aligned first and second portions connected at one of the ends thereof; circuit connections at opposite ends of said first portion whereby circuit current passes through said first portion, said second portion adapted to be non-current carrying; the other end of said first portion being fixedly mounted; the other end of said second portion being freely movable; means carried by said bimetal at the other end of said second portion positioned for engagement with and operation of a circuit breaker latch release mechanism upon predetermined circuit conditions; said compounded bimetal being adjusted at an ambient calibration temperature whereby said means is positioned a predetermined distance from a latch release mechanism; the second end of said second portion being deflectable in a first direction to effect tripping of said circuit breaker under predetermined current overload conditions when said circuit breaker is subjected to said ambient calibration temperature; said second portion being arranged, upon a rise in temperature thereof above said ambient

calibrating temperature, to move said means in a second direction opposite to said first direction; said first portion being deflected primarily as a result of heat generated by current passing therethrough; said second portion being deflected primarily as a result of ambient temperature; said first and second portions being constructed to complement one another whereby said time delay trip device will trip said circuit breaker at substantially said predetermined current overload conditions regardless of the ambient temperature to which said circuit breaker is subjected, said latch release mechanism including a tripper bar operable to trip said circuit breaker under control of said time delay trip device, said tripper bar being positioned a predetermined distance from said time delay trip device during normal operation, the deflection of said first bimetal portion due to overload current being adapted

to urge said bimetal towards engagement with said tripper bar.

2. The device as set forth in claim 1 in which the means comprises an adjusting screw for varying the predetermined distance between the means and a latch release mechanism.

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