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Chabot

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[54] **CIRCUIT BREAKER TERMINAL CONNECTOR, AND HEAT DISSIPATOR ASSEMBLY**

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[52] **U.S. Cl.**..... **339/112 R;** 339/147 R; 165/182

[51] **Int. Cl.**..... **H01r 13/66**

[58] **Field of Search** 174/15; 165/182, 185; 339/15, 112, 147

[56] **References Cited**

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[57] **ABSTRACT**

A heat dissipator useful in conjunction with a circuit breaker which has a plurality of terminals, each of which may have an electric cable connected thereto by a connector, includes electrically and thermally conductive structure defining means for effectively connecting the heat dissipator in electrically and terminally conductive relationship between a connector and a terminal and means for effectively dissipating heat. The means for dissipating heat includes two spaced-apart electrically conductive supporting members defining an air space between them and a plurality of spaced-apart thermally conductive dissipator members mounted on and between the supporting members in thermally conductive relationship therewith. The dissipator members conduct heat from the supporting members and dissipate at least a portion of the heat thus conducted into the air space. In a particular embodiment the spaced-apart supporting members are leg portions of a bifurcated metallic member which also includes a bight portion integral with the leg portions and the leg portions are the means for effectively connecting the dissipator to a terminal.

5 Claims, 4 Drawing Figures

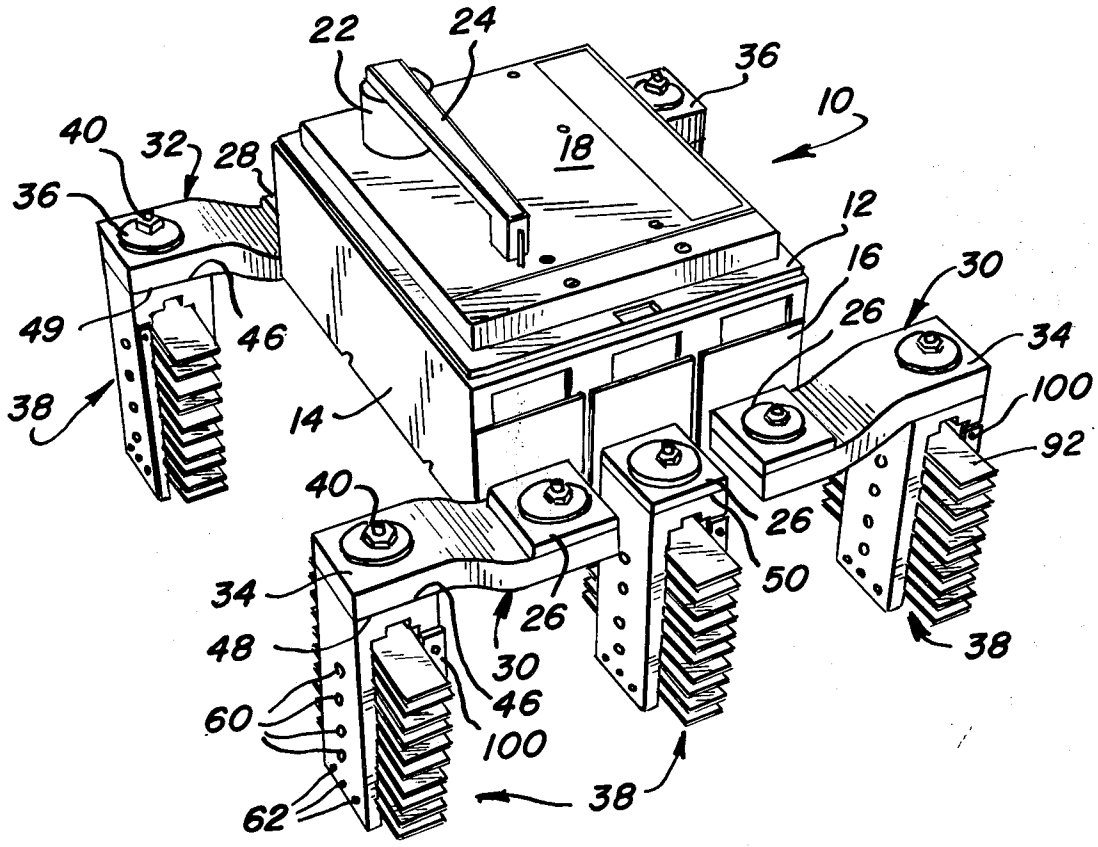


FIG. 1

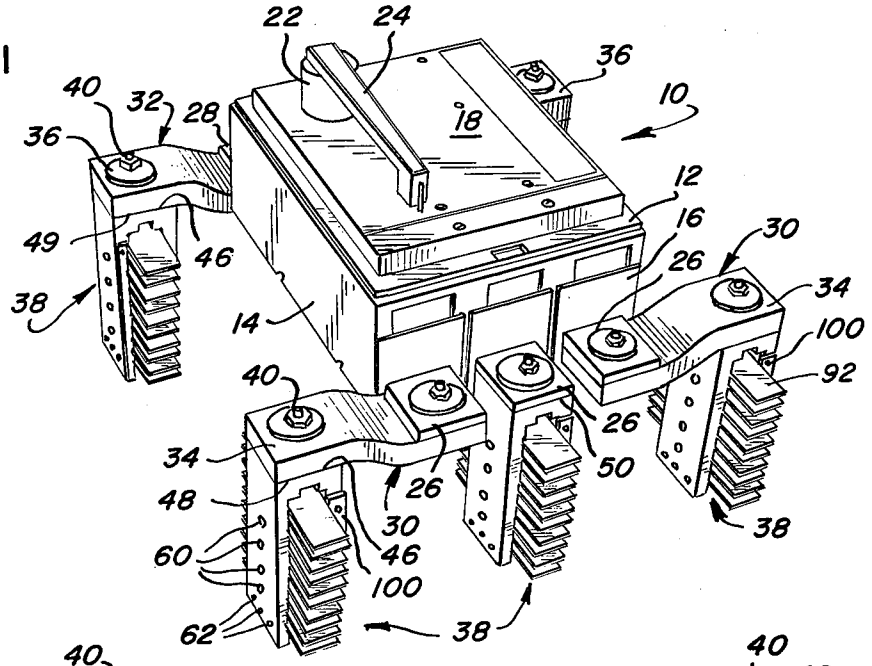


FIG. 2

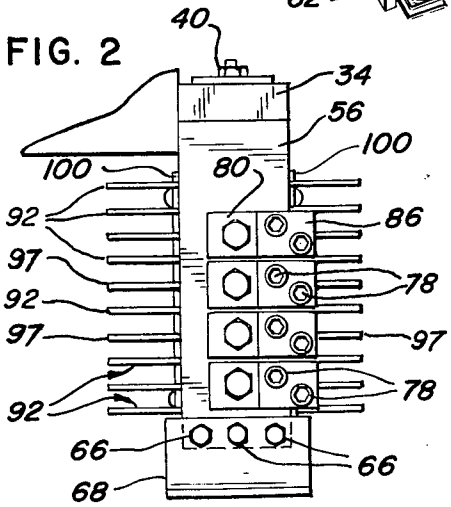


FIG. 3

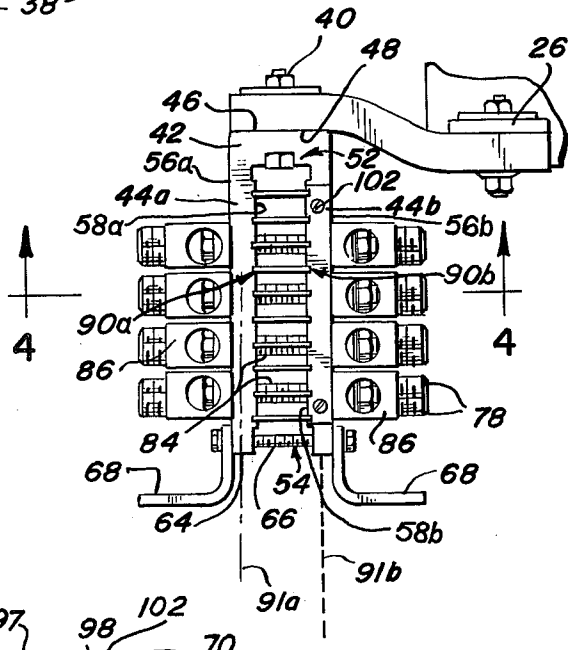
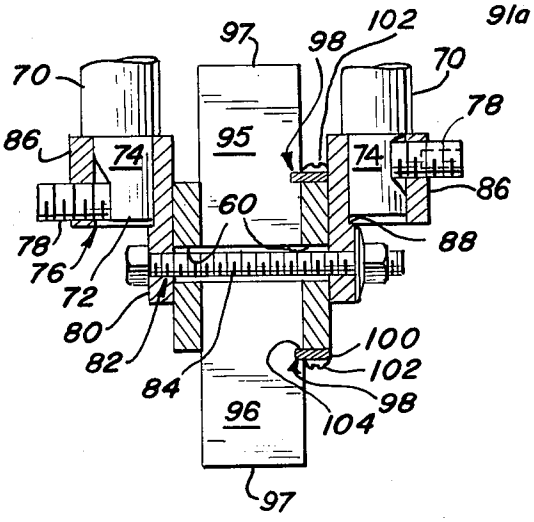


FIG. 4



CIRCUIT BREAKER TERMINAL CONNECTOR, AND HEAT DISSIPATOR ASSEMBLY

This invention relates generally to molded case circuit breakers and more particularly to circuit breaker terminal connectors suitable for use in circuit breakers which are required to pass relatively large values of current during normal operating conditions.

Multipole molded case circuit breakers are conventionally of the multicurrent rating variety and employ a one or more release latches provided to operate a toggle mechanism or mechanism for opening the contacts of the breaker. Each pole has a pair of exposed terminal straps each of which is electrically connected to a contact or contact blade within the circuit breaker housing and to at least one electrical cable of the circuit to be protected. Such a molded case circuit breaker is disclosed in U.S. Pat. No. 3,560,899 which issued to my assignee on Feb. 2, 1971, and the structural details of which are hereby incorporated by reference.

An important physical characteristic of a circuit breaker is the space which the breaker occupies, since the minimum overall size of an installation in which such breakers are employed is — at least to some extent — reflective thereof. At a physical minimum, the breaker case must be large enough to accommodate the internal wiring and parts mounted therein and to permit the requisite movement of those parts. As a practical matter, the volume of such a case must be somewhat greater because of electrical considerations. Molded case circuit breakers have been especially well suited to applications in which the normal operating currents have been relatively small — typically up to 1,600 to 2,000 amperes.

As the current load increases above the 1,600 – 2,000 ampere range, however, the performance of existing molded case circuit breakers has not been satisfactory. Although the current-carrying parts in such a circuit breaker are able to withstand the higher current loads, the breaker terminal straps terminal connector assemblies and cables connected thereto have become overheated, shortening the life of the cable insulation, and, therefore, such circuit breakers have failed to comply with applicable electrical safety standards. Generally a higher-rated breaker having a greater spacing between poles and requiring a greater volume has been substituted for a molded case breaker which was employed for lesser currents. However, in some applications it is undesirable because of space and/or economical limitations to substitute larger breakers for the molded case breakers which exist in an installation or could be used except for the overheating at the terminal straps as mentioned above.

Accordingly, it is an object of the present invention to provide novel and improved terminal connector and heat dissipation assembly which permits the current ratings of existing molded case circuit breakers to be increased, which is simple and inexpensive to construct and install, which may be shipped and handled as a securely assembled unit, which is quiet during operation and which conforms to applicable safety standards.

Other objects, features and advantages of the present invention will become apparent from the following description of a particular embodiment, taken together with the attached drawings thereof, in which:

FIG. 1 is a front perspective view of a molded case circuit breaker having terminal connector assemblies constructed in accordance with the instant invention;

FIG. 2 is a detail view in side elevation of the terminal connector assembly of the instant invention with cable connectors mounted thereon;

FIG. 3 is a detail view in front elevation of the terminal connector assembly shown in FIG. 2; and

FIG. 4 is a view in cross section, taken along line 4—4 of FIG. 3, (with two cables added) of the terminal connector assembly shown in FIGS. 2 and 3.

Referring now to FIG. 1, there is shown a circuit breaker, generally designated 10, enclosed in a molded casing 12 having side walls 14, a bottom wall 16 and top and rear walls (not shown). The casing is closed at the front by a removable cover 18 which is provided with an opening (not shown) surrounded by an upstanding annular boss 22 through which a driving connection is made from the interior mechanism with a common external operating handle 24 which is operable for operating all poles of the circuit breaker. As is well known, the casing is divided into electrically isolated compartments by partition walls (not shown) and suitable insulating barriers are interposed between the internal parts where required.

Each pole on the breaker includes terminal straps 26 and 28 (only one strap 28 is visible in FIG. 1), respectively, which are mounted on the rear wall of the casing 12, and extend out of the bottom and top of the casing, respectively.

Bus bars 30 and 32, which are constructed of aluminum or copper, are suitably secured (for example, by means of the bolts shown) to the straps 26 and 28, respectively, corresponding to the poles for the outer phases of the electrical circuit, extend outwardly from the terminal straps 26 and 28 corresponding to the center phase pole, and terminate in connection pads 34 and 36, respectively, each of which has a suitable aperture (not shown) therein which is sized to accommodate a suitable mounting bolt. Pads 34 and 36 are spaced a sufficient distance from the center phase straps 26 and 28 to permit adequate clearance between electrical phases to satisfy safety requirements for the current and voltage level at which the breaker is expected to operate.

Identical terminal connector assemblies 38 including heat dissipators are secured to center phase straps 26 and 28 and bus pads 34 and 36 by trapped head bolts 40 and extend rearwardly therefrom. Each assembly 38 has an inverted substantially U-shaped bifurcated member (see FIGS. 2–4), preferably constructed of copper or aluminum, including a bight portion 42 having a rectangular cross section and two substantially rectangular leg portions 44a and 44b which are integral with and extend rearwardly parallel to each other from bight portion 42. Bight portion 42 has a substantially planar upper surface 46 which is arranged to be secured firmly against the bottom surfaces 48, 49 and 50, respectively, of bus pad 34, bus pad 36 and straps 26 and 28, respectively, to provide an effective electrical conductive path between each assembly 38 and the bus pad 34 or 36 or straps 26 or 28 upon which the assembly 38 is mounted. A retaining seat 52 (FIG. 3), having a rectangular cross section, is formed in the lower surface of base portion 42 and is arranged to accommodate the trapped head of a bolt.

The leg portions 44*a* and 44*b* define an air space 54 therebetween and each leg portion 44*a* or 44*b* has a planar outer surface 56*a* or 56*b*, respectively, and a planar inner surface 58*a* or 58*b*, respectively. Each leg portion 44*a* or 44*b* also has four connector bolt apertures 60 (FIG. 1) and three mounting plate bolt apertures 62 communicating therethrough.

Each group of four connector bolt apertures 60 is disposed in a vertical configuration along the longitudinal direction of a leg portion 44*a* or 44*b* and each bolt aperture 60 in one leg portion 44*a* of an assembly 38 is aligned with a corresponding bolt aperture 60 in the other leg portion 44*b* of the assembly 38. The three mounting plate bolt apertures 62 through each leg portion 44 are spaced apart adjacent the lower edge 64 of each leg portion 44*a* or 44*b*, are each aligned with a corresponding mounting plate bolt aperture 62 in the other leg portion 44*a* or 44*b* of the assembly 38 and are each arranged to receive a bolt 66 for securing suitable mounting plates (or brackets) 68 for supporting breaker 10 and assembly 38.

As is best shown is FIGS. 2–4, each assembly 38 is arranged to have eight multistrand electrical cables 70 electrically connected to the outer planar surfaces 56*a* and 56*b*, respectively, of its leg portions 44*a* and 44*b*. Each multistrand cable 70 (FIG. 4) has an unsheathed end portion 72 secured in the bore 74 of a connector 76, which is preferably constructed of copper or aluminum, by two binding or clamping screws 78 which are received in threaded openings (not shown) whose axes are longitudinally spaced from each other along bore 74 and are located from each other respectively on opposite sides of the longitudinal axis of the bore 74. Such a connector is disclosed by H.I. Stanback in U.S. Pat. No. 3,609,657 which issued on Sept. 28, 1971, and the structural details of which are included herein for the purposes of illustration. Each connector 76 includes a lug portion 80 provided with a centrally located aperture 82, which is arranged to receive a holding bolt 84, and an enlarged body portion 86 integral with lug portion 80 and including the bore 74, preferably circular, for receiving the unsheathed end portion 72 of the cable. Preferably, the inner face of lug portion 80 is coplanar with the inner face of body portion 86 and the outer face of lug portion 80 is spaced outwardly of the innermost portion of the periphery of bore 74 to define a shoulder 88 which serves as a stop for the cable.

Ten spaced-apart parallel grooves 90*a* or 90*b*, respectively, are formed across the inner surface 58*a* or 58*b*, respectively, of each leg portion 44*a* or 44*b*, and each groove 90*a* is aligned with a corresponding groove 90*b* in the inner surface 58*b* of the other leg portion 44*b* of the respective assembly 38. Each pair of corresponding grooves 90*a* and 90*b* is disposed in a plane which is perpendicular to the longitudinal axes 91*a* and 91*b* of leg portions 44*a* and 44*b*, respectively and the planes in which the pairs of grooves 90*a* and 90*b* are disposed are preferably spaced apart by a distance which is greater than one-half inch. Four pairs of grooves 90*a* and 90*b* are disposed in planes which intersect bolts 84.

Six generally rectangular heat dissipating steel plates 92, each having a shorter dimension which is greater than the separation between the inner surfaces 58*a* and 58*b* of leg portions 44*a* and 44*b*, respectively, in each assembly 38, are provided and each of plates 92 is arranged to be seated in a pair of corresponding grooves 90*a* and 90*b* between leg portions 44*a* and 44*b*. Plates 92 have a longer dimension which is substantially greater than the width of leg portions 44*a* and 44*b* in the direction parallel to grooves 90 to the front and/or rear thereof when the plates 92 or sections 95 and 96 are seated in place and aligned in their respective grooves 90*a* and 90*b*. Relatively rigid metal retaining members 100, which are arranged to be secured to the front and rear of a leg portion 44*a* or 44*b* by screws 102, are provided and each retaining member 100 has a projecting edge portion 104 extending inwardly beyond the inner surface 58*a* or 58*b* of a leg portion 44*a* or 44*b* into the notches 98 in plates 92 and sections 95 and 96, thereby preventing movement of plates 92 and sections 95 and 96 along grooves 90 after the plates 92, sections 95 and 96 and retaining members 100 have been secured in place on heat dissipators 38.

For assembly, the heads of bolts 40 are trapped in seats 52 and their respective nuts secured thereto, plates 92 and sections 95 and 96 are inserted in place in their respective grooves 90*a* and 90*b* in leg portions 44*a* and 44*b*, respectively and retaining members 100 are screwed in place against the front and rear of a leg member 44*a* or 44*b* of each assembly 38 with their projecting edge portions 104 engaged in notches 98. The plates 92 and sections 95 and 96 are thus firmly secured in place and the dissipators may be shipped intact at this stage of assembly to a different assembly site for local installation to a circuit breaker 10. Bus bars 30 and 32 are bolted (or secured by other suitable means) to outer phase straps 26 and 28 of circuit breaker 10 and assemblies 38 are mounted on bus terminal pads 34 and 36 and center phase straps 26 and 28 by bolts 40. Insulated mounting brackets 68 are bolted to assemblies 38 (either before shipment of the dissipators or locally) adjacent the ends 64 of leg portions 44*a* and 44*b*, connectors 76 are secured to the unsheathed cable end portions 72 and the connectors 76 (eight are shown in FIGS. 2 and 3) are secured to the outer surfaces 56 of leg portions 44*a* and 44*b* by bolts 84 and their respective nuts.

In operation, when the electrical circuit has been energized, current flows from cables 70 and their respective connectors 76 through assemblies 38 and into the circuit breaker 10 via straps 26 and 28 (via bus bars 30 and 32, respectively, for the outer phases) and the flow of current generates heat in the unsheathed cable end portions 72, connectors 76 and assemblies 38. Since the current flow in both leg portions 44*a* and 44*b* of each assembly 38 is in the same direction, the resultant current through each plate 92 and section 95 and 96 is negligible. Excess heat is conducted from cable end portions 72 and connectors 76 via leg portions 44*a* and 44*b* to plates 92 and sections 95 and 96 whereupon a significant portion thereof is dissipated by convection into the atmosphere in air space 58 and the region surrounding the plates 92 and sections 95 and 96. The above described dissipation of heat — solely by conduction and convection — prevents the cable from becoming sufficiently overheated to begin to cause a thermal breakdown in the cable insulation and thereby eliminates the need for any forced air cooling of the installation.

In tests employing circuit breakers which had previously been rated for a 2,000 ampere current load, the heat dissipators of the present invention permitted operation under a current load of 2,500 amperes without

appreciably shortening cable insulation life for a spacing between plates which is a minimum of one-half inch. The bolts **84** which secure the connectors **76** to the outer surfaces **56***a* and **56***b*, respectively, of leg portions **44***a* and **44***b* maintained good electrical and thermal contact between connectors **76** and the outer surfaces **58***a* and **58***b*, of leg portions **44***a* and **44***b*, respectively, firmly secured plates **92** and sections **95** and **96** in their respective grooves **90** and maintained effective thermal contact between leg portions **44***a* and **44***b* and the plates **92** and sections **95** and **96** supported thereon without requiring that the plates **92** and sections **95** and **96** be welded to the leg portions **44***a* and **44***b*. Furthermore, projecting edge portions **104** of retaining members **100,** engaged in notches **98,** cooperated with the compressive force imparted by bolts **66** and **84** on plates **92** and sections **92***a* and **92***b* to restrain the plates and sections from movement both parallel and transverse to the longitudinal axes **91***a* and **91***b* of leg portions **44***a* and **44***b*, respectively, and thereby permitted relatively noise-free operation of the breakers under the 2,500 ampere loads.

While the invention has been described with reference to a particular embodiment thereof, it will be understood by those skilled in the art that various modifications in form and detail may be made therein without departing from the spirit and scope of the appended claims.

I claim:

1. A three-pole electrical circuit breaker comprising:

a. a molded casing having a pair of opposite wall portions;

b. three terminal straps, one for a center pole and one for each of two outer poles of the circuit breaker, projecting outwardly of the casing and respectively having outer end portions disposed adjacent one of the opposite wall portions;

c. three terminal straps, one for the center pole and one for each of the two outer poles of the circuit breaker, projecting outwardly of the casing and respectively having outer end portions disposed adjacent an other of the opposite wall portions; and

d. six circuit breaker terminal connector and heat dissipator assemblies electrically and mechanically connected respectively to the outer end portions of the terminal straps, each of said assemblies including an electrically conductive generally U-shaped member having a bight portion connected to its respective terminal strap and a pair of spaced leg portions, a plurality of heat dissipator plates mounted between the leg-portions in spaced relationship to each other and in heat conductive relationship with the leg portions, and electrical cable connecting means secured to the generally U-shaped member on an outer side of one of the leg portions.

2. A circuit breaker as claimed in claim **1** wherein each of the leg portions of the generally U-shaped member has electrical cable connecting means secured to an outer side thereof.

3. A circuit breaker as claimed in claim **1** including four bus bars each connected adjacent one end to a respective terminal strap of one of the outer poles and having a respective one of the terminal connector and heat dissipator assemblies secured thereto adjacent an opposite end, the bus bars spacing the respective terminal connector and heat dissipator assemblies away from the center pole whereby the three terminal connector and heat dissipator assemblies adjacent each of the opposite wall portions of the casing are spaced farther apart than the respective terminal straps.

4. A circuit breaker terminal connector and heat dissipator assembly comprising an electrically conductive generally U-shaped member having a bight portion and a pair of spaced leg portions, a plurality of heat dissipator plates mounted between the leg portions in spaced relationship to each other and in heat conductive relationship with the leg portions, and electrical cable connecting means secured to the generally U-shaped member on an outer side of one of the leg portions.

5. A terminal connector and heat dissipator assembly as claimed in claim **4** wherein each of the leg portions of the generally U-shaped member has electrical cable connecting means secured to an outer side thereof.

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