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CIRCUIT BREAKER WITH NOVEL TERMINAL STRAP

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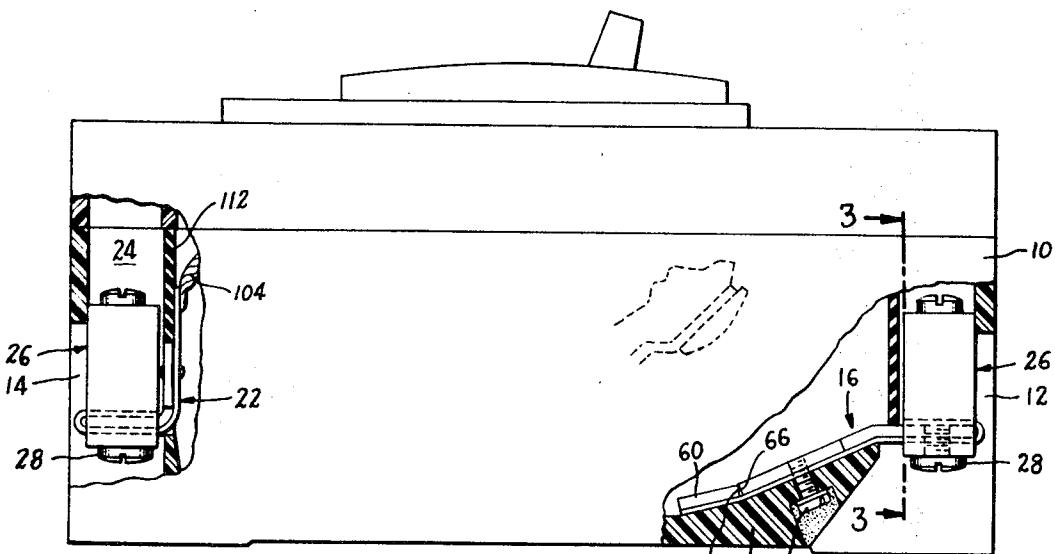


FIG. 1

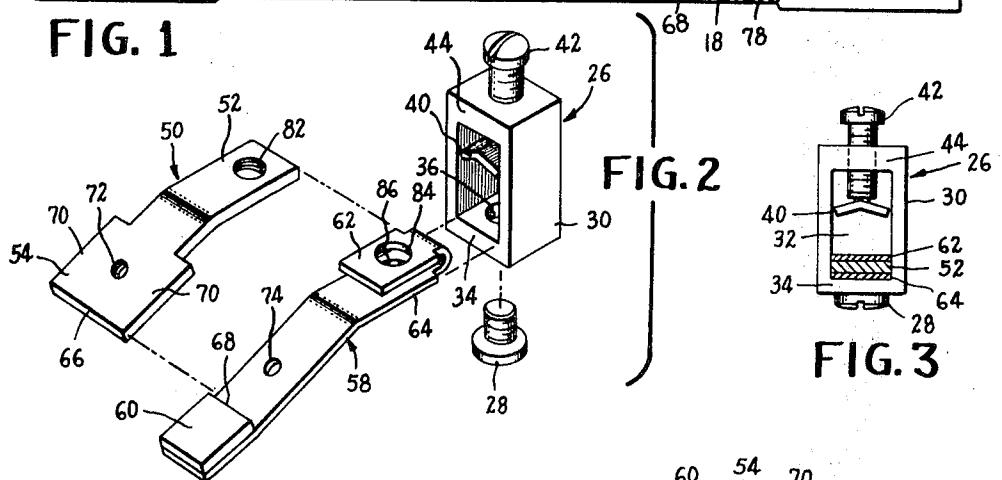


FIG. 2

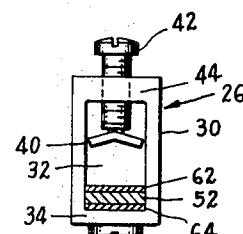


FIG. 3

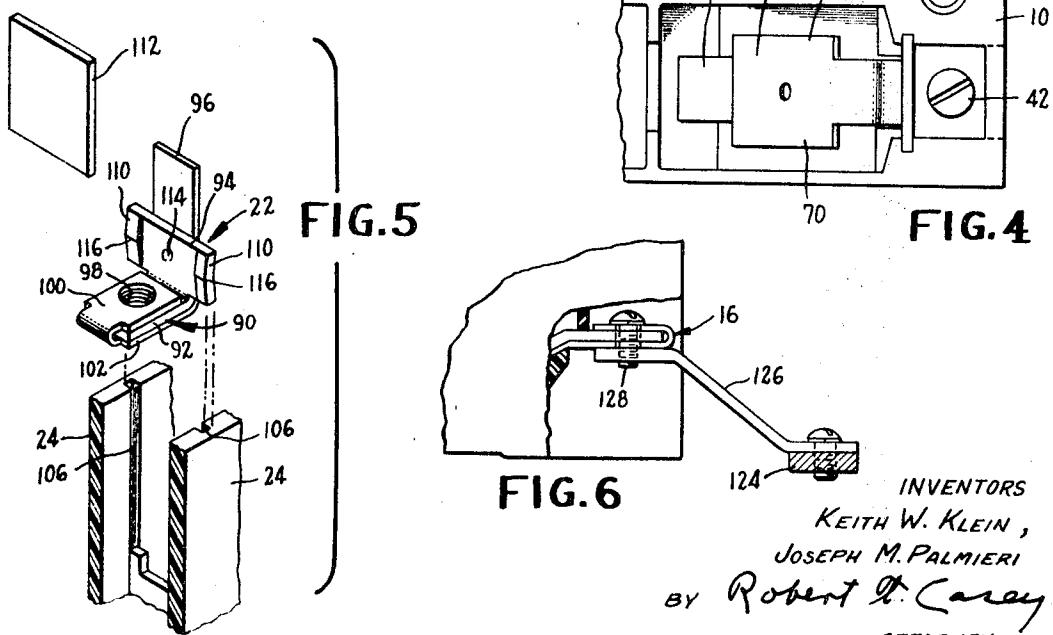


FIG. 5

FIG. 4

FIG. 6

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CIRCUIT BREAKER WITH NOVEL TERMINAL STRAP

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10 Claims

ABSTRACT OF THE DISCLOSURE

A composite metal terminal strap for circuit breakers and the like is comprised of a rigid steel support plate and a substantially thinner copper strip in intimate surface confronting relationship with the support plate throughout its length. The support plate includes a mounting portion and a terminal end portion adapted to support a terminal connecting lug. The copper strip is reversely bent around the terminal end of the plate to laminably enclose it and provide top and bottom conductive surfaces. The copper strip may advantageously mount a contact on its free end while the support plate is capable of acting as an arc runner.

BACKGROUND AND SUMMARY OF THE INVENTION

The present invention generally relates to electrical connectors for switches, circuit breakers and the like and is particularly directed to a new and improved electric terminal strap construction of the type finding particular application in making connections to circuit breakers and the like.

Heretofore electric terminal straps have typically been constructed of solid, heavy gauge, copper strip materials which provide good current conducting properties coupled with the requisite structural characteristics necessary for reliable operation over a prolonged period of time. However, the thickness of the copper stock material required to provide the desired structural characteristics far exceeds that necessary for the electrical requirements of electric terminal straps. Although it is possible to retain high electrical performance with terminal strap material of substantially smaller gauge, this results in an appreciable loss of structural characteristics, particularly the strength and rigidity characteristics required of terminal straps used in circuit breakers and the like.

Accordingly, it is an object of the present invention to provide a composite electric terminal strap which maintains high current conducting paths and electrical connecting surfaces at the terminal with a substantially decreased volume of copper while at the same time providing the rigidity and strength heretofore associated with substantially heavier gauge, copper stock material.

Another object of the present invention is to provide a new and improved terminal strap of composite metal construction which permits the use of flexible current conducting members without loss in the sturdiness and rigidity of the terminal portions thereof and without requiring the current conducting members to provide a mounting or supporting function for the terminal portions.

A further object of the invention is to provide a terminal strap of the type described which effects substantial economies in construction and increased ease of assembly. Included in this object is the provision for a contact support strap adapted to prolong the useful life of the contact while providing a highly efficient and durable arc runner independent of the contact.

Other objects will be in part obvious and in part pointed out more in detail hereinafter.

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These and related objects are accomplished in accordance with the present invention by providing a composite metal terminal strap which utilizes the rigidity and strength of a steel mounting and supporting plate and the current conducting capability of a substantially thinner copper strip positioned in surface confronting relationship with the plate and having an end portion thereof reversely bent so as to sandwich the steel plate between layers of the copper strip at the terminal connecting portion thereof. The thin copper strip may mount a contact of the circuit breaker on one end thereof while the steel supporting plate serves as an arc runner. The plate additionally provides for securely mounting the terminal strap within the circuit breaker and can support a connecting lug within the terminal recess of the breaker.

The invention accordingly consists in the features of construction, combination of elements and arrangement of parts which will be exemplified in the construction hereafter set forth.

BRIEF DESCRIPTION OF THE DRAWING

In the drawing:

FIG. 1 is an elevation view of a circuit breaker, partially broken away and partially in section, illustrating both line and load terminal straps constructed in accordance with the present invention;

FIG. 2 is an exploded isometric view of the line terminal strap and terminal clamping lug depicted in FIG. 1;

FIG. 3 is a sectional view of the strap and lug of FIG. 2 taken along the line 3—3 of FIG. 1;

FIG. 4 is a fragmentary plan view illustrating the line terminal of FIG. 2 as mounted in the circuit breaker of FIG. 1;

FIG. 5 is an exploded isometric view illustrating the construction at the load terminal of the circuit breaker of FIG. 1; and

FIG. 6 is a fragmented view, partially broken away and partially in section, illustrating another type of connection between a terminal strap of the present invention and a current conductor.

DESCRIPTION OF PREFERRED EMBODIMENTS

Referring now to the drawing in greater detail, wherein like reference numerals indicate like parts throughout the several figures, the invention is illustrated in the environment of a circuit breaker which includes an insulating casing 10 having a plurality of recesses 12, 14 on opposite ends thereof for housing the line and load terminals respectively. A contact carrying line terminal strap 16 is securely fastened to the base 18 of the casing 10 and projects into the end recess 12 while the load terminal strap 22 is shown securely mounted between the walls 24 of the load terminal recess 14. As illustrated in FIG. 1 both terminals are provided with lead connecting lugs 26 securely fastened to the terminal straps 16, 22 by means of mounting screws 28. Each connecting lug 26 includes a generally rectangular frame member 30 defining an enlarged central passage 32 extending through the lug and adapted to receive a terminal end of the strap. The frame 30 includes a substantially flat base portion 34 having a central aperture 36 through which extends the mounting screw 28 for fastening the lug 26 to the terminal strap. A clamping plate 40 is mounted within the passage 32 by means of a threaded plate operator 42 carried by the top 44 of frame member 30. As can be appreciated, the clamping plate 40 can be moved reciprocally toward and away from the flat base portion 34 by means of the operator 42 to compressively clamp and hold an electrical lead in firm contact with the terminal end of the strap.

The terminal strap of the present invention is a composite metal member and generally includes a strong durable support plate preferably having terminal and mount-

ing portions and a substantially thinner current conducting strip disposed in surface confronting relationship with the support plate. The conducting strip is reversely bent at one end to laminably enclose the terminal portion of the support strip. Referring more specifically to FIGS. 1-4, the line terminal strap 16 is shown as a composite metal member comprised of an elongated support plate 50 having a flat, generally rectangular, terminal portion 52 at one end thereof and an integral angularly disposed mounting portion 54 at its opposite end. The support plate 50 is preferably a rigid metal member constructed of high strength material, such as steel, and imparts to the composite strap a major portion of its structural rigidity, particularly at the terminal portion 52 which is suspended within the recess 12 of the circuit breaker.

As mentioned hereinbefore the terminal strap additionally comprises a current conducting strip in intimate surface contact with the support plate. In line terminal strap 16 the current conducting strip is a thin generally rectangular copper strip 58 which underlies the plate 50 in face to face relationship along its entire length and extends beyond both ends thereof. One end of strip 58 mounts a stationary contact 60 of the circuit breaker while the opposite end thereof is reversely bent around the terminal portion 52 of the support plate to provide top and bottom conducting layer portions 62, 64, respectively, in contact with opposite flat surfaces of the terminal portion. Accordingly, it is preferred that the current conducting strip not only have good electrical properties such as those possessed by copper strips or bars but also be formed of thin, somewhat flexible material which can be easily formed into the desired shape to provide the terminal strap with conductive top and bottom surfaces at the terminal end thereof. Additionally, as shown, the contact 60 and support plate 50 are of appropriate size so that the free end 66 of the plate's mounting portion 54 substantially abuts the rear edge 68 of the contact carried by the current conducting strip 58. In this manner the plate 50 is able to advantageously serve as an arc runner for the terminal strap 16 of the circuit breaker. In fact, as best shown in FIGS. 2 and 4, mounting portion 54 of the support plate is provided with a pair of side planar extensions 70 projecting outwardly from opposite sides thereof to provide an increased arc runner area.

As can be appreciated the support plate 50 can be easily assembled on the current conducting strip 58 by sliding the terminal portion 52 between overlying and underlying strip portions 62, 64 until end 66 is properly positioned adjacent the rear edge 68 of contact 60. This in turn brings the central threaded aperture 72 within mounting portion 54 into registry with the aperture 74 in strip 58 for threadably receiving the fastener 78 extending through the base 18 of the casing. In this manner the terminal strap 16 is securely attached to the base of the casing while firmly holding the flexible current conducting strip 58 in a firm secure position between the plate and the base 18.

Additionally, the terminal portion 52 of the support plate is provided with an enlarged threaded aperture 82 for threadably receiving the mounting screw 28 of connecting lug 26, strip portions 62, 64 having apertures 84, 86, respectively, disposed in alignment with aperture 82 to permit the free passage of screw 28 therethrough. In this manner the present invention additionally relieves the current conducting copper strip of any mounting or supporting function at the terminal end of the strap thereby facilitating the use of thinner copper stock material.

As mentioned hereinbefore a similar arrangement is provided in the load terminal strap 22 wherein the support plate 90 includes a substantially flat terminal portion 92 at one end thereof and an integral mounting portion 94 of greater transverse dimension than the terminal portion. As shown, the mounting portion 94 of plate 90 also is angularly disposed relative to the terminal portion. However, in strap 22 the mounting portion of the

plate is at substantially a right angle to its integral terminal portion whereas in strap 16 the mounting portion 54 was disposed at an angle of about 30° to the plane of terminal portion 52.

The current conducting strip 96 employed in the load terminal strap also is an elongated generally rectangular strip of copper or the like which is similarly bent around the terminal end portion 92 of the support plate to provide a substantially identical laminar structure at the load terminal having highly conductive top and bottom conductive layer portions 100, 102 respectively. The conductive layers are apertured at the terminal end of the strap 22 in much the same manner as strap 16 to provide access to the threaded aperture 98 within the support plate's terminal portion 92. Additionally the copper strip 96 extends beyond the mounting portion 94 of the support blade so that a suitable conducting braid 104 or the like may be affixed thereto.

As illustrated in FIG. 5 the walls 24 of the load terminal recess 14 are provided with a pair of aligned grooves or channels 106 providing a mounting slide adapted to receive the transversely extending side portions 110 projecting outwardly beyond the side edges of terminal portion 92. A fiber board separator 112 substantially equal in width to the mounting portion 94 readily slides along the channels 106 after mounting of the strap 22 in the recess 14. The separator 112 is effective in masking the end portion of the copper conducting strip 96 having the conducting braid 104 affixed thereto from the recess 14 and particularly the lug 26 mounted therein. If desired, the support plate 90 may be securely attached to the current conducting strip 96 by means of a fastener 114 and the side portions 110 received by channels 106 may be provided with a slight transversely extending bend as at 116 in order to assure a tight fit within the channels of the recess 14.

The terminal straps of the present invention provide an electrical terminal which includes an exposed copper surface on both the top and bottom thereof. Advantageously this construction permits the attachment of current conductors thereto through means other than the connecting lug 26 described hereinbefore. For example, as shown in FIG. 6 a bus bar 124 may be suitably connected to the line terminal strap 16 through a copper strip 126 secured to the terminal end of the strap by means of the threaded connector 128.

It will be appreciated from the foregoing detailed description that the present invention provides a simple yet highly desirable composite terminal strap construction which provides substantial economies in the manufacture and assembly thereof without interfering with the structural or electrical properties. Additionally, the structure of the present invention provides great versatility of application facilitating its use in a wide number of applications.

As will be apparent to persons skilled in the art, various modifications and adaptations of the structure above-described will become readily apparent without departure from the spirit and scope of the invention.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A composite electrical terminal strap comprising an elongated rigid support plate including a substantially planar terminal portion at one end thereof and a current conducting strip in intimate surface contact with said support plate along a substantial portion of its length including the terminal portion, the current conducting strip including overlying and underlying current conducting portions laminably confining the terminal portion of said support plate.

2. The terminal strap of claim 1 for use in circuit breakers and the like wherein the support plate includes a mounting portion integral with the terminal portion, said mounting portion including means for firmly affixing

the strap in a stabilized position within the circuit breaker, the current conducting strip extending substantially the full length of said support plate and smoothly bent around the terminal portion thereof to provide an interconnection between the overlying and underlying portions of the current conducting strip and assure positive current conductivity between exposed opposite surfaces of the strap at the terminal portion.

3. The terminal strap of claim 1 wherein the support plate is a substantially rigid metal member including a mounting portion of enlarged transverse dimension for securely mounting the strap and providing a rigid support for the terminal portion thereof, the current conducting strip being substantially thinner and more flexible than the support plate and having one end bent around the terminal portion of the support plate to provide a laminar structure with the overlying and underlying portions comprising exposed top and bottom surfaces for the strap at its terminal portion.

4. The terminal strap of claim 1 for use in circuit breakers and the like wherein the current conducting strip mounts a contact on one end thereof, said support plate being positioned adjacent the contact to provide an arc runner for the strap.

5. The terminal strap of claim 1 for use in circuit breakers and the like wherein the terminal portion of the support plate is a substantially flat generally rectangular portion and the support plate includes an angularly disposed integral mounting portion providing a rigid support for the terminal portion and having means for securely mounting the strap in the circuit breaker, the current conducting strip being of greater longitudinal dimension than the support plate and disposed in abutting face to face relationship therewith, said current conducting strip having an end portion bent around the terminal portion of the support plate to provide a laminar structure suitable for current conduction on external opposed surfaces thereof.

6. The terminal strap of claim 1 for use in circuit breakers and the like wherein the terminal portion of the support plate includes means for mounting a conductive connector thereon in intimate contact with one of said overlying and underlying current conducting portions.

7. An electrical apparatus assembly comprising a supporting base of insulating material and a composite electrical terminal strap assembly supported on said insulating base, said terminal strap assembly comprising a support plate of relatively low conductivity, relatively high strength metal, means fixedly mounting said support plate on said base of insulating material, and an elongated strip

of relatively high conductivity, relatively low strength metal in intimate surface contact with said support plate along a substantial portion of its length, said elongated strip including a portion bent around an edge portion of said support plate to provide interconnected portions of the elongated strip overlying and underlying said support plate, electrical connecting means supported on said insulating base for connecting an external conductor to said terminal strap assembly, said electrical connecting means including a portion in engagement with one of said overlying and underlying portions of said elongated strip.

8. An electrical apparatus assembly as set forth in claim 7 wherein said electrical connecting means comprises a generally rectangular frame member defining an enlarged central passage extending therethrough and receiving an end portion of said terminal strap assembly, said frame member including a substantially flat base portion having an aperture, mounting means extending through said aperture and connecting said frame member to said underlying portion of said elongated strip at one end of said terminal strap assembly, said electrical connecting means including clamping means for clamping an external conductor to said overlying portion of said elongated strip at said end portion of said terminal strap assembly.

9. An electrical apparatus assembly as set forth in claim 8, wherein said elongated strip includes an end portion opposite said terminal end portion extending beyond said support plate, and an electrical contact member supported on said extended end portion of said elongated strip in closely juxtaposed relation to an edge portion of said support plate.

10. Electrical apparatus assembly as set forth in claim 9, wherein said assembly also includes means rigidly anchoring said support plate to said insulating base with said elongated strip trapped between said support plate and said insulating base, said anchoring means including means extending through an aperture in said insulating mounting base and clampingly engaging said support plate.

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