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[54] **TERMINAL STRUCTURE FOR A MULTICONDUCTOR CABLE COOLED BY A CIRCULATING FLUID**
8 Claims, 3 Drawing Figs.

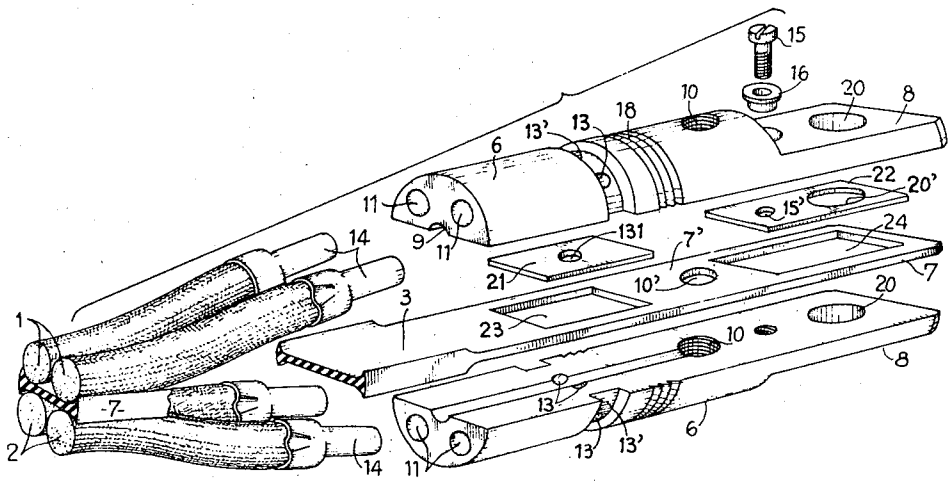
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[50] **Field of Search** ..... 174/15 C, 16, 19, 20

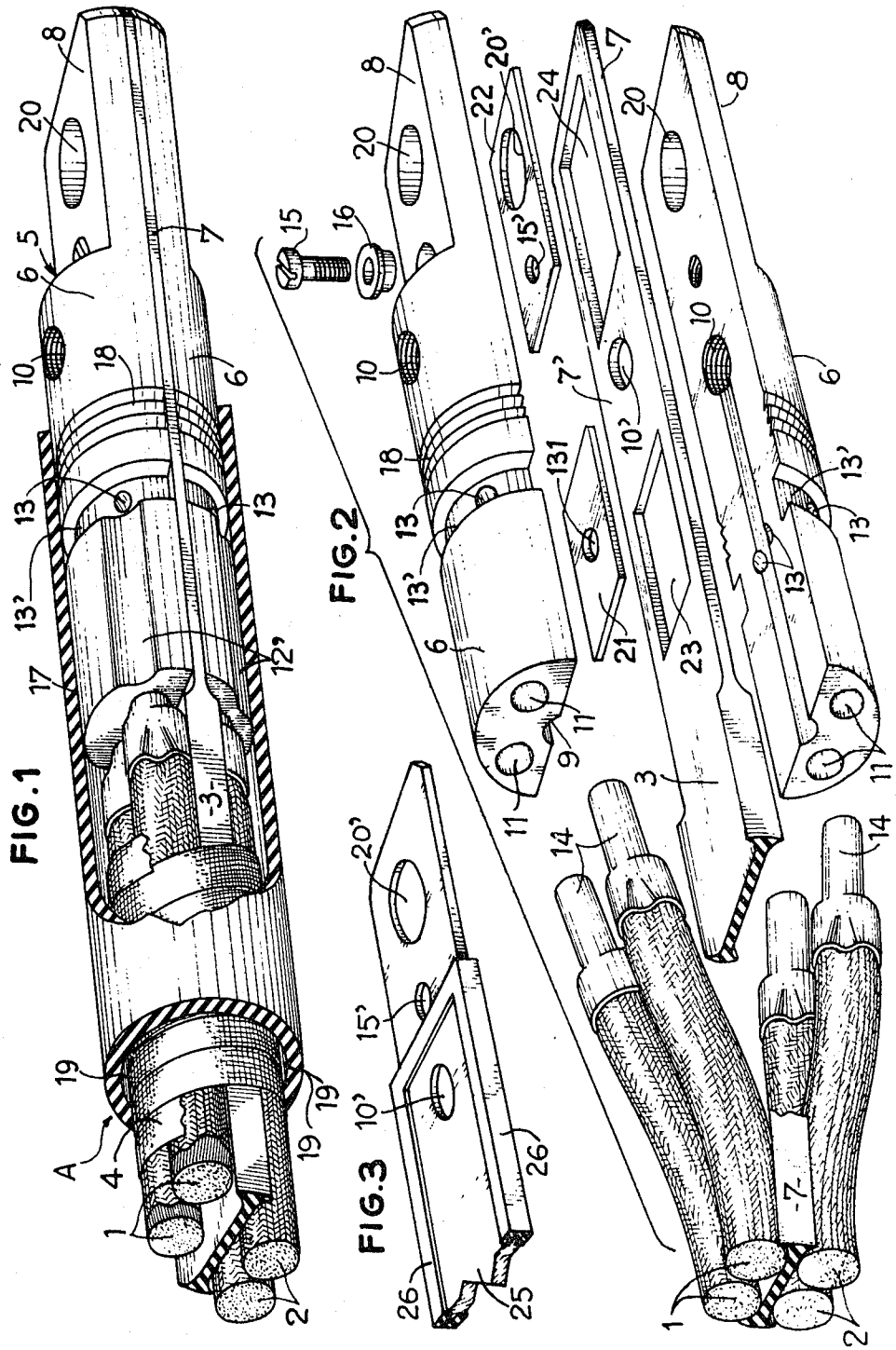
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ABSTRACT: A terminal structure of a multiconductor electric cable wherein the terminal is in two parts and two groups of conductors of different polarities separated by a separating element are cooled by a fluid in a sealing sheath. According to the invention, an elastic sealing element is interposed between plane faces of the two terminal parts in the extension of the separating element. At least one rigid incompressible insulating element, thinner than the sealing element and interposed between said faces, limits the pressure exerted on the sealing element when clamping said parts together.




FIG.1
FIG.2
FIG.3

TERMINAL STRUCTURE FOR A MULTICONDUCTOR CABLE COOLED BY A CIRCULATING FLUID

The present invention relates to electric multiconductor "-kickless" cables for conducting very high intensity currents and cooled by an axially flowing cooling fluid, such as, among others, the cables employed for connecting portable tongs to the resistance-welding stations or the supply cables of electric arc furnaces, or the like.

It is known that these cables may carry, as the case may be, currents whose intensity can be of the order of 10,000–50,000 a. per phase.

These cables must be very strong so as to be able to withstand the various mechanical stresses inherent in their use and in electromagnetic phenomena. Further, their cooling by a circulation of a fluid agent creates numerous problems, particularly as concerns the terminals, from the sealing point of view.

It is indeed known that these cables have a plurality of conductors each of which consists of numerous threads of wire of small diameter twisted together in accordance with a special arrangement intended to reduce friction between the threads.

The problems created by the sealing are particularly difficult to solve in respect of the terminals of multiconductor cables in which the two polarities of the conductors are grouped under the same outer sheath, but separated from each other by a separating element, the conductors of the two polarities being either opposed or alternating. Indeed, these terminals are made in two semicylindrical parts insulated from each other but interconnected in a sealed manner.

It is known that each of the two parts of the terminal comprises an inner semicylindrical axial passage communicating with the inner end face of the terminal and opening at its other end in a tapped aperture for the inlet of the cooling fluid, this axial passage serving to being the fluid on the axis of the cable and also being capable of serving as a departure point of radial branch passages for the fluid which enables the periphery of the bundle of conductors to be irrigated.

As the two parts of the terminal must be electrically insulated from each other, there is usually placed therebetween a plate of rigid insulating material. However, this material does not afford a satisfactory seal.

Consequently, it is necessary to dispose a sealing element between each half of the terminal and said insulating plate, around the axial passage and the cooling fluid inlet aperture.

These sealing elements are generally disposed in a recess provided for this purpose in each part of the terminal, but this arrangement is only effective if there is a precise positioning of the various clamping planes, which precision is liable to be easily destroyed, in operation, under the action of the various electromechanical forces to which the cable is subjected.

The object of the invention is to provide a terminal structure having a sealing device which is easy to make and efficient and reliable in service.

The terminal structure according to the invention comprises two terminal parts having plane faces, an elastically yieldable insulating element which is interposed between said faces and constitutes a sealing element in the extension of an element separating the conductors of the phases, means clamping said terminal parts to form an assembly by compression of said elastically yieldable element, and at least one rigid incompressible insulating element having a thickness less than the thickness of the elastically yieldable element in the free uncompressed state and constituting an abutment limiting the pressure exerted on said elastically yieldable element when clamping said two parts together.

According to one of the invention said sealing element has a plurality of openings in each of which is disposed a rigid incompressible insulating element having a thickness less than that of said sealing element in the free uncompressed state.

Further features and advantages of the invention will be apparent from the ensuing description with reference to the accompanying drawing.

In the drawing:

FIG. 1 is a perspective view, with a part cut away, of an end terminal for a multiconductor cable having opposed polarities including a sealing element according to the invention;

FIG. 2 is an exploded perspective view showing the arrangement of the various parts, and

FIG. 3 is a view of a modification of the sealing device disposed between the two halves of the terminal.

With reference to the drawing, the invention is shown applied to a cable A having a terminal **5** such as the type described in applicant's French Pat. No. 1,589,129.

This cable is of the type having opposed polarities comprising a plurality of conductors **1** and **2** of respectively positive and negative polarity, in operation, the conductors of opposed polarities being separated by an insulating separating element **3** which axially extends in the cable, the threads of each conductor being themselves maintained by a permeable textile sheath or the like in the known manner.

Each group of conductors **1**, **2** is connected to a terminal **5** in the manner described in said French patent application. The terminals **5** of each end of the cable are similar and consequently only one thereof will be described.

The terminal **5** has two parts **6** of copper which have a generally semicylindrical shape and are symmetrical relative to an end portion **7** of the separating element **3** which is plane that is, has a rectangular cross section in this region and separates these parts and insulates them from each other.

Each half **6** of the terminal has at its outer end a flat portion **8**, in the known manner, adapted to be connected to the apparatus with which the cable is combined.

Each terminal half also has, on its inner plane face, an axial passage **9** which extends from a radial tapped aperture **10** to its inner end, the radial aperture **10** being adapted to receive a cooling fluid supply nozzle in accordance with a known arrangement.

Longitudinal apertures **11** are also provided which open out on the inner end face of each terminal half **6**, these longitudinal apertures being adapted to receive the ends of conductors **1**, **2**.

Further, at least one radial aperture **13** is provided in the vicinity of the end of each of the longitudinal apertures **12** and connects the end of a groove **13'**, provided in the outer face of each half-terminal, with the axial passage **9**.

The end of each conductor **1**, **2** is fitted in a plug **14** constituted by a copper sleeve and each plug **14** is then inserted in a longitudinal aperture **11** in which it is held by a press operation.

The two half-terminals **6** are maintained assembled by a screw **15** screwed in one of the half-terminals whose head and shank are insulated from the other half-terminal by an insulating sleeve **16**, and by an outer insulating sheath which is a force fit on the assembled terminal **5**. Preferably this sheath **17** is held tight by a clamping collar of known type (not shown) and grooves **18** are provided on the outer face of the terminal **5** between the recess **13'** and the aperture **10** so as to ensure that the sheath **17** is well held in position.

The sheath **17** has an inside diameter equal to the diameter of the terminal **5** and greater than the outside diameter of the conductors **1**, **2** surrounded by the tape **4** so as to leave a gap **19** between the sheath and the conductors (FIG. 1) all around the latter.

Owing to this arrangement, the cooling fluid which enters the terminal **5** by way of the apertures **10** flows along the axial passage **9** and thereafter flows axially in the center of the cable between the conductors **1**, **2** and by way of radial apertures **13**, recesses **12'** in the outer face of the terminal formed by the press operation for gripping the plugs **14**, and in the gap **19** between the conductors and the outer sheath **17** and thus affords an extremely efficient cooling of all the conductors.

If desired, there can be provided between the conductors a spring or other flexible and permeable element affording axially a passage of minimum section for the cooling fluid.

To ensure a complete seal between the two halves **6** of the terminal **5**, the separating element **3**, which can be for exam-

ple of rubber, has a rectangular-sectioned portion 7 which extends between the half-terminals 6 and is clamped therebetween.

However, the rectangular-sectioned portion 7 of the separating element 3 must have a number of openings in the region of the apertures 10 for the passage of the cooling fluid, in the region of the clamping screw 15 and at the end of the terminal in the region of an aperture 20 provided in the flat portion 8 and adapted to ensure the connection with the electric apparatus in a continuous manner.

To preclude any flow or creep of the edges of the portion 7, there are provided spacer members 21, 22 adapted to withstand the force clamping together the two halves of the terminal and limit the pressure exerted on the portion 7 of the separating element 3 which affords the seal. For this purpose, the thickness of these spacer members 21, 22 is a little less than that of the portion 7.

These spacer members are advantageously of the material known under the Trademark "Celoron" (Trademark for macerated canvas or paper-based industrial laminated or molded plastics having high-impact strength) and are disposed in openings 23, 24 formed in the portion 7.

The spacer member 21 (FIG. 2) is constituted by a plate of "Celoron" disposed in the opening 23 and having an aperture 31 in the region of the radial apertures 13.

It sill be observed that there is a solid part 7' in the portion 7 of the separating element 3 between the openings 23 and 24 so that the length of the longitudinal narrow marginal portions laterally defining the openings 23 and 24 is restricted solely to these openings, which thus reduces any tendency on the part of these sides to deform outwardly of the terminal.

Owing to this arrangement, there is achieved a durable sealing of the terminal 5 by means of a simple device which is very easily assembled, while the two halves of the terminal are maintained at the same distance apart throughout their length.

According to a modification of the sealing device for the terminal 5 shown in FIG. 3, there can be provided a plate 25 of "Celoron" having a generally rectangular shape and including the necessary apertures 10', 15', 20' onto which is moulded a sealing element 26 of rubber which surrounds the aperture 10' by way of which the cooling fluid is supplied.

In this case, the parts of the "Celoron" plate onto which the sealing element of rubber is moulded have a thickness which is locally reduced to permit the clamping of the sealing element in a manner limited by the rest of the plate which thus performs its function of spacer member, said reduced-thickness parts serving solely as a support for the sealing element 26.

In the embodiment of the sealing device shown in FIG. 2, the elastically yieldable sealing element 7 is constituted by a rectangular-sectioned portion of the separating element 3, that is, it is in one piece with the latter, This sealing element may of course be a separate member, as in the embodiment shown in FIG. 3, and connected to the phase-separating element 3 in any suitable manner, for example by an adhesive.

Although specific embodiments of the invention have been described, many modifications and changes may be made therein without departing from the scope of the invention as defined in the appended claims.

Having now described my invention what I claim as new and desire to secure by Letters Patent is;

1. A terminal structure adapted to receive a multiconductor electric cable of the type comprising two groups of conductors of different polarities separated by an insulating separating element and disposed within a sealing sheath and cooled by a fluid circulating within the sheath, said terminal structure comprising two half-terminals each having a generally semicylindrical shape, an axial cooling fluid passage defined by said half-terminals, aligned radial cooling fluid inlet apertures in said half-terminals and communicating with said axial cooling fluid passage, and aligned radial second apertures in said half-terminals for means fixing the terminal structure to a terminal-receiving part, opposed inner plane faces on said two half-terminals, an elastically yieldable insulating and sealing element adapted to be in the extension of said separating element and interposed between and sealingly engaging said opposed plane faces and in a compressed condition radially of said half-terminals for sealing the cooling fluid in said inlet apertures and said axial fluid passage from the exterior, screw means radially extending through said half-terminals for assembling said half-terminals, and at least one rigid incompressible insulating element having a thickness less than the overall thickness of said sealing element in a free uncompressed condition of said sealing element, said incompressible element engaging said plane faces and constituting an abutment limiting the pressure exerted on said sealing element when radially clamping said two half-terminals against said sealing element and incompressible element by said screw means.

2. A terminal structure adapted to receive a multiconductor electric cable of the type comprising two groups of conductors of different polarities separated by an insulating separating element and disposed within a sealing sheath and cooled by a fluid circulating within the sheath, said terminal structure comprising two half-terminals each having a generally semicylindrical shape, an axial cooling fluid passage defined by said half-terminals, aligned radial cooling fluid inlet apertures in said half-terminals and communicating with said axial cooling fluid passage, and aligned radial second apertures in said half-terminals for means fixing the terminal structure to a terminal-receiving part, opposed inner plane faces on said two half-terminals, an elastically yieldable insulating and sealing element adapted to be in the extension of said separating element and interposed between and sealingly engaging said opposed plane faces and in a compressed condition radially of said half-terminals for sealing the cooling fluid in said inlet apertures and said axial fluid passage from the exterior, screw means radially extending through said half-terminals for assembling said half-terminals, said sealing element comprising openings and spacer members of a hard insulating material disposed in said openings, the thickness of said spacer members being less than the thickness of said sealing element in a free uncompressed condition of said sealing element, said spacer members engaging said plane faces and constituting abutments limiting the compression of said sealing element when radially clamping said half-terminals against said sealing element and spacer members.

3. A terminal structure as claimed in claim 2, further comprising radial cooling fluid outlet apertures in said half-terminals and communicating with said axial passage and with an outer groove in said half-terminals, one of said openings completely surrounding said outlet apertures in planes containing said plane faces for the passage of the cooling fluid and another of said openings being in radial alignment with said second apertures and said screw means to allow passage of said fixing means and screw means, a further opening being provided in said sealing element in radial alignment with said inlet apertures.

4. A terminal structure as claimed in claim 1, wherein said incompressible element comprises a plate which has an aperture coincident with the fluid inlet apertures in the half-terminals and extends at least along the entire length of said axial cooling fluid passage.

5. A terminal structure adapted to receive a multiconductor electric cable of the type comprising two groups of conductors of different polarities separated within a sealing sheath and cooled by a fluid circulating within the sheath, said terminal structure comprising two half-terminals each having a generally semicylindrical shape, an axial cooling fluid passage defined by said half-terminals, aligned radial cooling fluid inlet apertures in said half-terminals and communicating with said axial cooling fluid passage, and aligned radial second apertures in said half-terminals for means fixing the terminal structure to a terminal-receiving part, opposed inner plane faces on said two half-terminals, an elastically yieldable insulating and sealing element adapted to be in the extension of said separating element and interposed between and sealingly engaging

said opposed plane faces and in a compressed condition radially of said half-terminals for sealing the cooling fluid in said inlet apertures and said axial fluid passage from the exterior, screw means radially extending through said half-terminals for assembling said half-terminals, a rigid incompressible insulating element interposed between and engaging said plane faces and comprising an aperture in alignment with said cooling fluid inlet apertures, said sealing element extending round said aperture in said incompressible element and extending on each side of said axial cooling, fluid passage and adapted to extend into said sheath, and recessed portions in said incompressible element in which said sealing element is fixed by being moulded to said recessed portions, said recessed portions having a depth which is less than the thickness of said sealing element disposed in said recessed portions, when in a free uncompressed condition, whereby said incompressible element constitutes an abutment limiting the pressure exerted on said sealing element when radially clamping said half-terminals against said sealing element and incompressible element by said screw means.

6. A terminal structure as claimed in claim **5**, wherein said sealing element forms one single piece with said element separating the conductors of opposed polarities.

7. A terminal structure as claimed in claim **1**, wherein said sealing element is separate from said separating element and secured thereto.

8. A terminal structure as claimed in claim **7**, wherein said sealing element is adhered to said separating element.