TERMINAL WITH GREASE RETAINING MEMBERS

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ABSTRACT

A terminal for high voltage electrical cable formed with a chamber extending through the terminal from an inlet end for engagement over the cable to an outlet end, and having a viscous insulating grease filling a portion of the chamber from the inlet end. The terminal includes means operable upon insertion of the cable into the inlet end of the chamber for retaining the grease in the chamber about the cable for a predetermined distance from the inlet end.

8 Claims, 4 Drawing Figures
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TERMINAL WITH GREASE RETAINING MEMBERS

BACKGROUND OF THE INVENTION

This invention relates to terminals for high voltage cables having a semi-conductive sheath.

Terminals of the type described in U.S. Letters Patent No. 3,542,942 are formed with a chamber having an inlet end for insertion of the cable end to be terminated, and an outlet end for a connector element attached to the cable conductor. The chamber is partially filled with a thixotropic insulating grease of a quantity to completely fill the voids in the chamber after the cable end has been inserted. A complete grease fill (no air pockets) is particularly important adjacent the inlet end of the chamber which is attached to the semi-conductive sleeve of the cable as this area experiences the greatest electrical stress.

Assembly of the shielded conductor with the terminal typically comprises threading the end of the cable through the partially grease-filled chamber. The insulating grease in the chamber tends to move through the chamber with the cable leaving air pockets, particularly adjacent the inlet end of the chamber. Air within these tiny pockets is ionized by the high electrical stress, producing a chemical and mechanical breakdown in the surrounding insulating grease or cable insulation. This breakdown will progress until the insulating property of the cable insulation and insulating grease is destroyed and the high voltage carried by the conductor arcs to an available ground.

A terminal according to the present invention provides means for insuring essentially air-pocket-free insulating grease in the chamber about the cable for a predetermined distance from the inlet end of the chamber. According to the present invention there is provided a terminal for a high voltage electrical cable. The terminal is formed with a chamber having an outlet end and an inlet end adaptable for engagement over the cable. A viscous electrically non-conductive grease fills a portion of the chamber from the inlet end, and retaining means is mounted in the chamber for retaining the grease in the chamber about the cable between the retaining means and the inlet end upon threading of the cable into the chamber from the inlet end.

The invention will be further described with reference to the accompanying drawing wherein like numbers refer to like parts in the several views, and wherein

FIG. 1 is a vertical sectional view of a terminal constructed according to the present invention connected to an electrical cable;

FIG. 2 is a fragmentary vertical sectional view of a terminal as shown in FIG. 1 prior to assembly with the electrical cable;

FIG. 3 is a perspective view of a first retaining member used in the terminal shown in FIGS. 1 and 2; and

FIG. 4 is a perspective view of a second retaining member used in the terminal shown in FIGS. 1 and 2.

Referring now to FIG. 1, there is shown a terminal according to the present invention, generally designated 10, for terminating a high voltage electric power cable 12. The electrical cable 12 is of the type having a central conductor 14, and an insulating sleeve 16 between the conductor 14 and a cylindrical semi-conductive shield 18. The device 10 is useful for terminating the semi-conductive shield 18 where a continuing length 20 of the insulated conductor 14 is to be connected to a second conductor member (not shown) at a connector element 21 attached to the conductor 14. The insulating sleeve 16 is typically formed of a polyethylene or cross-linked polypropylene material; and the semi-conductive shield 18 is typically comprised of a semi-conductive ethylene propylene material. As illustrated, the cable 12 may have a multiplicity of ground wires 22 wrapped around the semi-conductive shield 18 to afford an efficient path to ground from the shield 18 and to provide mechanical strength for the cable 12.

The terminal 10 includes wall means for defining a chamber 24 within the terminal 10 and having an inlet end 26 adapted for engagement with the cable 12.

The wall means includes a boot or semi-conductive stress relief cone member 28 for shaping the electrical stress lines, having an internal wall 30 defining a funnel-shaped bore 32. The wall 30 adjacent the small end of the bore 32 defines the inlet end 26 adapted for engagement with the end 33 of the semi-conductive shield 18 to position the continuing length 20 of the insulated conductor 14 centrally projecting from the large end 34 of the bore 32.

The semi-conductive member 28 is formed of a flexible, resilient elastomeric material having less than 1 megohm per square centimeter resistance (such as "Nordel" conductive ethylene-propylene terpolymer) to continue the semi-conductive electrical path of the shield 18 onto the device 10. The wall 30 adjacent the inlet end 26 is formed with annular sealing grooves 38 for an air tight seal about the shield 18, and conforms to engage the end of the semi-conductive shield 18. The wall 30 adjacent the large end of the bore 32 is formed with inwardly extending parallel spaced ridges 40 engageable with mating grooves formed about a hub on one end of a porcelain insulator 42. The surface of the insulator 42 contacted by the semi-conductive member 28 is coated with a conductive material to prevent ionization of air in any voids left therebetween. A grounding insulator support clamp 43 attached to the ground wires 22 may be engaged about the end of the semi-conductive member 28.

The insulator 42 is formed with a cylindrical bore 44 of larger diameter than the insulating sleeve 16 and is attached to the semi-conductive member 28 with the bores 44 and 32 axially aligned to concentrically position the continuing length 20 of the insulated conductor 14 within the cylindrical bore 44. The outer surface of the insulator 42 is formed along its length with a series of rings 46 to provide a long surface path between the conductor element 21 and the grounding clamp 43 to restrict arcing therebetween.

The bores 32 and 44 form the chamber 24 within the terminal 10. The outlet end of the chamber 24 opposite the semi-conductive member 28 is defined by a central opening through a resilient sealing cup 48 engaging the end of the insulator 42 and an outer stainless steel cap 49. The connector element 21 projects through the central opening in the cup 48 and cap 49 and is held in that position by a snap ring 50.
A viscous, thixotropic electrically insulating grease 52 having a high dielectric strength is provided only in sufficient volume to fill the voids remaining in the chamber 24 for a predetermined distance from its inlet end 26, which distance is less than the length of the chamber 24, after the cable has been inserted (FIG. 1). Prior to engagement with a power cable 12 the grease fills a portion of the chamber 24 extending from the inlet end 26 of the chamber 24 (FIG. 2). A removable plug 54 engageable with the inlet end 26 is provided to protect the grease 52 prior to use of the terminal 10.

Retaining means or retaining members 56 and 58 are mounted in the chamber 24 for retaining the grease 52 in the chamber 24 about the continuing length 20 of cable 12 between the retaining member 56 or 58 and the inlet end 26 upon threading of the cable 12 through the chamber 24 from the inlet end 26.

The retaining member 56 as best seen in FIG. 3 has wall means forming a hollow truncated conical wall 60 defining an orifice 62 at its small end and an annular lipped flange 64 formed about the large end thereof for engagement with the end of the hub on the insulator 42 and the wall 30 for retaining the grease 52 between the retaining member 56 and the inlet end 26 of the semi-conductive member 28. Suitable materials for forming the retaining member 56 include polyethylene or polypropylene. The truncated conical wall 60 is pointed toward the outlet end of the chamber 24 and guides the end of a cable 12 being threaded into the chamber 24 through the orifice 62. The orifice 62 is generally of smaller diameter than the insulating sleeve 16. The truncated conical wall 60 is of decreasing thickness toward the orifice 62 and will stretch adjacent the orifice 62 to closely surround the conductor element 21 and insulating sleeve 16 to provide a wiping action for restricting the grease 52 from moving with the cable 12 being threaded through the chamber 24. Thus grease 52 is retained within the chamber portion defined by the conducting member 28 and retaining member 56 to prevent air from entering the chamber 24 with the cable 12 and air pockets from developing upon movement of the grease.

The retaining member 58, best seen in FIG. 4, has wall means comprising a hollow cylindrical wall 66 formed with axially extending grooves 68 on the outer periphery thereof, and a concentric hollow truncated conical wall 70 inwardly extending from an end 71 of the cylindrical wall 66 to an orifice 72 defined at the small end thereof. The retaining member 58 is attached as by an adhesive to the insulator wall defining the cylindrical bore 44 within the predetermined distance from the inlet end 26 of the chamber 24. Preferably the retaining member is attached at a point in the bore 44 at which the electrical stress is sufficiently small that air present in the chamber will not be sufficiently ionized to alter the insulating materials. Preferred materials for the restraining member 58 are elastomers such as ethylene-propylene terpolymers. The truncated conical wall 70 is pointed toward the outlet end of the chamber 24 and guides the end of the cable 12 through the orifice 72. The orifice 72 is smaller in diameter than the insulating sleeve 16. The distal end of the truncated conical wall 70 will stretch to conform to the periphery of the continuing length 20 of insulated conductor 14 and provide a wiping action for restricting grease from moving with the cable 12 through the chamber 24. The grooves 68 provide a path for escape of grease 52 after engagement of the cable sleeve 16 with the orifice 14. Further engagement of the cable 12 is displaced as by increased volume of the entry section of cable 12. A cable 12 to be connected to the terminal 10 is prepared by attaching a connector element 21 to the conductor 14 and stripping the semi-conductive shield 18 from the end for a distance to expose an appropriate continuing length 20 of insulated conductor 14. The plug 54 is removed from the terminal 10, and the cable 12 is threaded into the chamber 24 through the inlet end 26. Initial insertion of the cable 12 will displace the insulating grease 52 through the orifice 62 until the end of the cable 12 engages the orifice 62 to deform the adjacent end of the wall 60 around insulating sleeve 16 to retain the grease 52 within the portion of the chamber 24 defined by the wall 30 and the retaining member 56.

Further insertion of the cable 12 will displace the grease 52 to completely fill the chamber 24 between the retaining members 56 and 58 and may displace grease 52 through the orifice 72 prior to engagement by the distal end of the cable 12. Subsequent needed displacement of grease from the chamber portion between the retaining members 56 and 58 is afforded by the axial grooves 68 on the retaining member 58.

Having thus described the present invention, what is claimed is:

1. A terminal adapted for engagement with an end of a semi-conductive shield for a high voltage electrical power cable having a central conductor, and an insulating sleeve between the conductor and the semi-conductive shield, to afford connection of a continuing length of the insulated conductor to a second conductive member, said terminal comprising:
   a boot having wall means for defining a bore with an inlet end and an opposite larger end, and having means adjacent the inlet end of said boot adapted for engagement with the end of the semi-conductive shield to position the continuing length of the insulated conductor centrally projecting through the larger end of said bore;
   an insulator having wall means for defining a cylindrical bore of larger diameter than said insulating sleeve and attached to the wall means of said boot adjacent said larger end with said bores aligned to centrally position a said continuing length of the insulated conductor within said cylindrical bore, said bores comprising a chamber within said terminal;
   a viscous electrically insulating grease filling a portion of said chamber extending from said inlet end; and
   at least one retaining member having a hollow truncated conical wall mounted in said cylindrical bore within a predetermined distance from said inlet end with a large end thereof engaging the wall means of the chamber and a small end thereof directed away from said inlet end and adapted for engagement around the continuing length of the insulated conductor to retain said grease in said chamber about said continuing length of insulated conductor between said inlet end and said retaining member upon threading of the continuing length of insulated conductor through said chamber from said inlet end.
2. The terminal of claim 1 wherein said hollow truncated conical wall is of decreasing thickness toward said small end and is deformable to closely conform to the periphery of the continuing length of the insulated conductor.

3. The terminal of claim 1 wherein said retaining member is formed of a resilient elastomeric material, and said hollow truncated conical wall is elastic to conform to the periphery of the continuing length of the insulated conductor.

4. The terminal of claim 1 wherein said boot is a stress relief cone having a funnel-shaped bore, and said terminal comprises first and second retaining members, the large end of said first retaining member being mounted at the juncture between said stress cone and said insulator, and said second retaining member being spaced from said first retaining member along said cylindrical bore.

5. A terminal adapted for engagement with an end of a semiconductive shield for a high voltage electrical power cable having a central conductor, and an insulating sleeve between the conductor and the semiconductive shield, to afford connection of a continuing length of the insulated conductor to a second conductive member, said terminal comprising:

a stress relief member having wall means for defining a first bore with an inlet end and an opposite end, and having means adjacent the inlet end of said bore adapted for engagement with the end of the semiconductive shield to position the continuing length of the insulated conductor centrally projecting through said opposite end of said first bore; an insulator having wall means for defining a cylindrical bore of larger diameter than said insulating sleeve and attached to the wall means of said stress relief member adjacent said opposite end with said bores aligned to centrally position a said continuing length of the insulated conductor within said cylindrical bore, said bores comprising a chamber within said terminal having an outlet opening spaced a first distance from said inlet opening; a viscous electrically insulating grease filling a portion of said chamber extending from said inlet end, the volume of said insulating grease being only sufficient to fill the space within said chamber around the continuing length of the insulated conductor for a predetermined distance from said inlet end, said predetermined distance being less than said first distance; and at least one retaining member having a hollow truncated conical wall mounted in said cylindrical bore within said predetermined distance from said inlet end with a large end thereof engaging the wall means of the chamber and a small end thereof directed away from said inlet end and adapted for engagement around the continuing length of the insulated conductor to retain said grease in said chamber about the continuing length of insulated conductor between said inlet end and said retaining member upon threading of the continuing length of insulated conductor through said chamber from said inlet end.

6. The terminal of claim 5 wherein said hollow truncated conical wall is of decreasing thickness toward said small end and is deformable to closely conform to the periphery of the continuing length of the insulated conductor.

7. The terminal of claim 5 wherein said retaining member is formed of a resilient elastomeric material, and said hollow truncated conical wall is elastic to conform to the periphery of the continuing length of the insulated conductor.

8. The terminal of claim 5 wherein said terminal comprises first and second retaining members, the large end of said first retaining member being mounted at the juncture between said stress relief member and said insulator, and said second retaining member being spaced from said first retaining member along said cylindrical bore.

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