United States Patent

Lemieux

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[54] **FILLED CABLE CORE WITH FORAMINOUS CORE WRAP**

[72] Inventor: **Roger Joseph Lemieux,** Dollard Des Ormeaux, Quebec, Canada

[73] Assignee: **Northern Electric Company Limited,** Montreal, Quebec, Canada

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[52] **U.S. Cl.** .....**174/23 R,** 174/102 R, 174/107, 174/110 SY, 174/110 F

[51] **Int. Cl.** **H01b 7/18,** H02g 15/00

[58] **Field of Search**...174/23 R, 23 C, 20, 22 R, 107, 174/124 R, 102, 110 F, 110 SY

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Primary Examiner—E. A. Goldberg

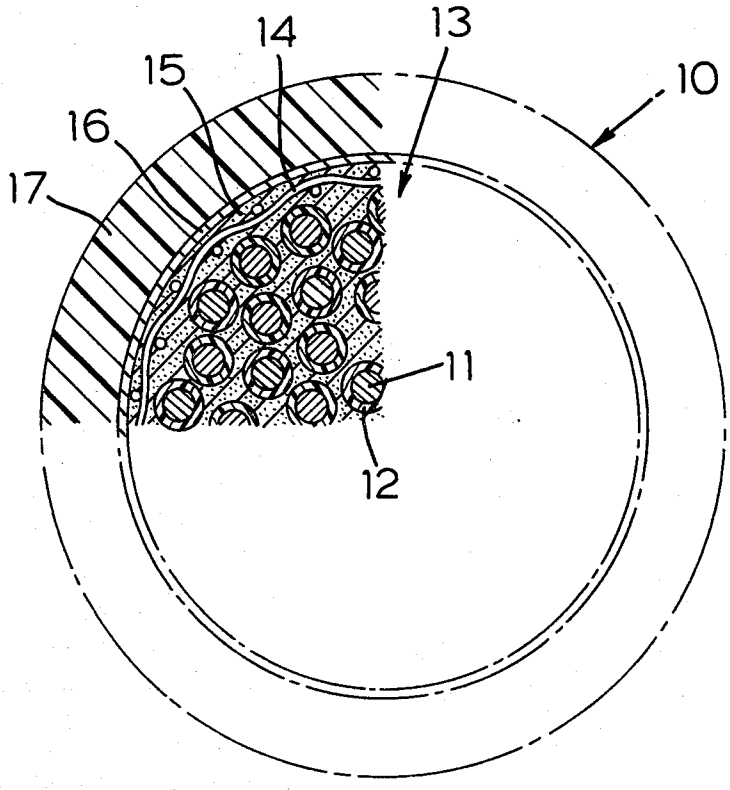
Assistant Examiner—A. T. Grimley

Attorney—Westell & Hanley

[57] **ABSTRACT**

A multi-conductor sheathed electric cable having a core filled with foamed plastic material, in which a foraminous wrap circumscribes the insulated conductors of the core, the conductors and wrap being embedded in the foamed plastic material, and the filler material completely filling all voids within the sheath.

8 Claims, 2 Drawing Figures



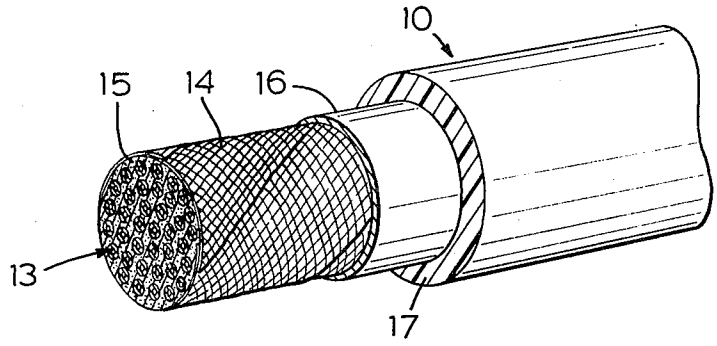


FIG. 1

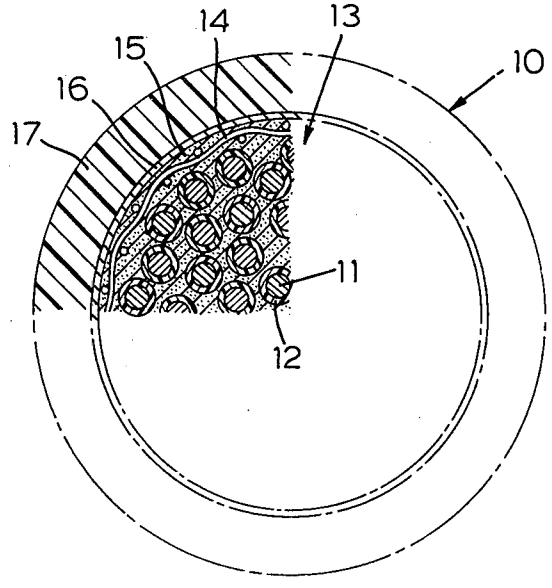


FIG. 2

INVENTOR.
ROGER J. LEMIEUX
BY Westell & Hanley

FILLED CABLE CORE WITH FORAMINOUS CORE WRAP

The present invention relates to an electric cable and more particularly to a multi-conductor cable having a filled core.

Multi-conductor electric cables consist of a number of individually insulated conductors forming a core encased in a sheath which may comprise a jacket, usually of polymeric material such as polyethylene, overlying a metal shield. The core is normally covered with a polyester tape such as Mylar (trade mark) applied helically or longitudinally. The core wrap separates the core from the metal shield to provide additional dielectric protection between the insulated conductors and the metal shield, and to protect the core from the heat of the jacket material when the jacket is extruded over the metal shield.

The interstices between the insulated conductors, and other voids under the metal layer amount to about 15 to 20 percent of the volume within the sheath. Water entering through perforations in the sheath can fill these spaces and migrate along the cable for long distances. The presence of this water increases the mutual capacitance level in the cable and can cause short circuits between conductors which may have pinholes or other defects in their individual insulating coverings. In addition, the water also acts as an electrolyte causing corrosion of any exposed metal surface of the conductors or the metal shield.

Recent developments have led to the filling of the interstices in the core with water-impermeable materials such as petroleum jelly and the like or foamable plastics such as polyurethane. While these fillings have proven to be most effective in preventing moisture from penetrating the core of the cable, they have been confined to the volume within the core wrap and therefore have not provided a filling for the random voids which may, and usually do, exist between the core wrap and the metal shield.

It is an object of the present invention to provide an improved multi-conductor sheathed electric cable having a core filled with foamed plastic material, by using a foraminous wrap about the core.

An example embodiment of the invention is shown in the accompanying drawings in which:

FIG. 1 is a cross-sectional perspective view of a multi-conductor electric cable; and

FIG. 2 is an enlarged cross-sectional view of the cable shown in FIG. 1.

The example embodiment of the invention shown in the drawings consists of a cable **10** having a plurality of conductors **11**, each having an insulating coating **12**, which form a central core **13** of the cable. A foraminous web or mesh circumscribes core **13** as a core wrap **14** and is preferably spirally wound on the core. Both core **13** and core wrap **14** are embedded in a filler **15** of a closed-cell expanded plastic foam material such as polyurethane. Core **13**, core wrap **14**, and filler **15** are encased in a metallic shield **16**, such as aluminum, which is in turn overlain with an outer jacket or sheath **17** of polymeric material such as polyethylene.

Core wrap **14** is perforated and is preferably formed of loosely woven strand material which does not melt at the extrusion temperature of outer jacket **17**. A polyester or a polyolefin plastic is suitable for the purpose.

In fabricating the cable of the invention, individual insulated conductors **11** are stranded together to form core **13** which is then impregnated with expandable foam plastic material, such as polyurethane which would be mixed with a catalyst and a blowing agent to initiate an exothermic reaction. Immediately thereafter core wrap **14** is applied to the core such as by applying it in the form of a tape about the core, either spirally or longitudinally in known manner. Shield **16** is then formed about core wrap **14**, and polyethylene jacket **17** is extruded over shield **16**, before the expansion of the polyurethane has materially advanced. It will be appreciated that these steps in forming the cable, except for stranding the core, are carried out continuously and in sequence, the polyurethane and catalyst being metered out as core **13** advances. If preferred, the polyurethane and catalyst may be applied after core wrap **14** has been placed on core **13**. The foraminous nature of core wrap **14** allows the expanding foam plastic material to pass through it and fill any space surrounding core **13** within the metal shield **16** as well as all the interstices within the body of the core. An expansion ratio of 10 to 30 times the initial volume of polyurethane maintains a sufficiently low specific inductive capacitance, in the order of approximately 1.1 to 1.2.

While the material of the core wrap **14** will normally be non-hygroscopic such as the polyester or polyolefin plastics mentioned above, the material need not be so limited since any tendency of the core wrap to absorb and transmit moisture will be of little consequence because the core wrap is embedded in the expanded foam plastic filler. Thus the core wrap material may be, for example, paper, asbestos, jute or the like.

Preferably shield **16** is coated on both surfaces with an acrylic acid copolymer which acts to bond polyethylene jacket **17** to its outside surface and expanded foam plastic filler **15** to its inside surface, thus preventing the migration of water at these interfaces.

Moreover, the pressure of the expanding filler material against the underside of coated metal shield **16** combines with the restraining effect of extruded jacket **17** to enhance the bonding of the metal shield at the interfaces with the jacket and the filler material, and between the overlapping edges of the shield.

Where shield **16** is not coated for bonding purposes, the expanding foam plastic material creates pressure at the interface of filler **15** with shield **16** and also at the interface of shield **16** with jacket **17**, and this pressure acts to prevent the passage of water at the four interfaces. To lower the coefficient of friction between conductors **12** and filler **15** the conductors may be coated with a thin film of petroleum jelly; this increases the flexibility of cable **10**.

It will be appreciated that an expandable foam plastic material such as polystyrene could be used to form filler **15** with the extrusion temperature of polyethylene jacket **17** onto metal shield **16**, normally between **400°** and **500°** F., acting to initiate an endothermic reaction to expand the polystyrene. Where an expandable foam plastic is used having an exothermic reaction, such as polyurethane, the extrusion heat of outer jacket **17** would serve to speed up that reaction.

I claim:

1. A multi-conductor electric cable comprising:
a tubular sheath;

a plurality of insulated conductors forming a core located axially within the sheath;

a foraminous wrap circumscribing the core; and

a foamed plastic material filling all of the voids within the sheath, the core and wrap being embedded in the foamed plastic material, said foraminous wrap having apertures therein of a size to permit the passage of the foamed plastic material therethrough sufficiently to fill all of the voids within the sheath.

2. A cable as claimed in claim 1 in which the wrap comprises a loosely woven mesh.

3. A cable as claimed in claim 1 in which the wrap is spirally wound on the core.

4. A cable as claimed in claim 1 in which the wrap is formed of material selected from the class consisting of a polyester and a polyolefin.

5. A cable as claimed in claim 4 in which the foamed plastic material is polyurethane.

6. A cable as claimed in claim 4 in which the foamed plastic is polystyrene.

7. A multi-conductor electric cable comprising:

a tubular sheath having an inner annular metallic shield and an outer polyethylene jacket;

a plurality of insulated conductor strands forming a core located axially within the sheath;

an annular foraminous wrap containing the core and spacing the core from the metallic shield; and

a foamed plastic material permeating the entire volume within the metallic shield to fill all of the voids therein, the core and wrap being embedded in the foamed plastic material, and said foraminous wrap having apertures therein of a size to permit the passage of the foamed plastic material therethrough sufficiently to fill all of the voids within the sheath.

8. A cable as claimed in claim 7 in which the wrap comprises a mesh of loosely woven strands of polyethylene and the foamed plastic material is polyurethane.

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