

United States Patent

Mitacek

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[54] **ELECTRICAL CABLE HAVING
SHEATH LAYERS BONDED WITH
ADHESIVE**

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[58] Field of Search ... 174/102 R, 102 D, 23 R, 23 C,
174/107, 120 R, 104, 113 R, 116, 110 PM,
105 R, 117 A

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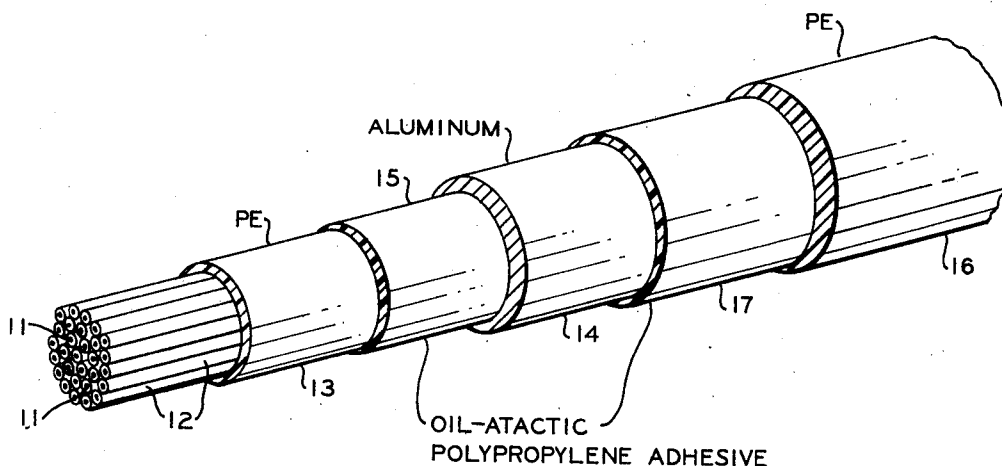
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[57]

ABSTRACT

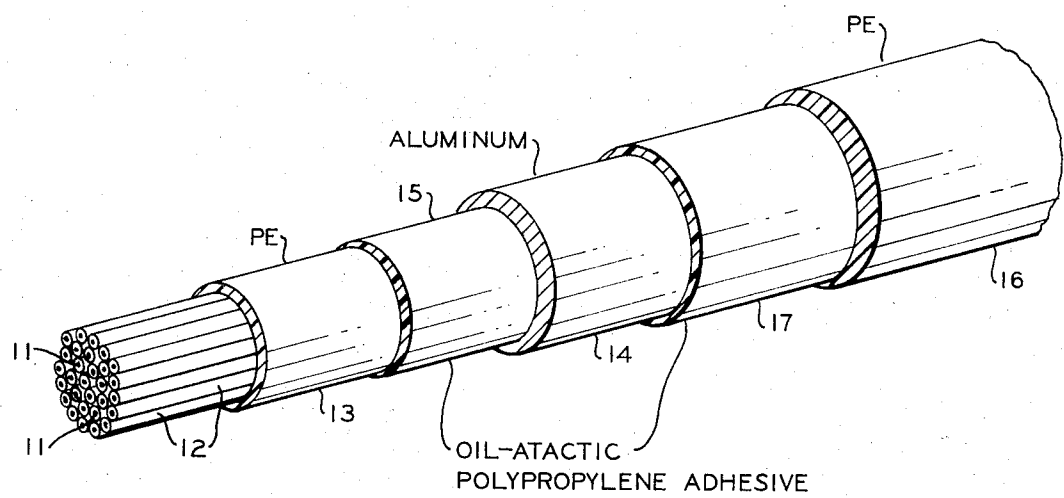
In an electrical cable having at least one polyolefin sheath layer and an aluminum sheath layer, the polyolefin layer is bonded to the aluminum layer with an adhesive material of 50 to 90 weight percent amorphous polypropylene and 50 to 10 weight percent mineral lubricating oil.

7 Claims, 1 Drawing Figure



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ELECTRICAL CABLE HAVING SHEATH LAYERS BONDED WITH ADHESIVE

This invention relates to a sheathed electrical cable. In a specific aspect, the invention relates to a sheathed telephone cable having polyolefin and aluminum layers in the sheath bonded together by an adhesive material.

One of the problems encountered in designing electrical cable such as telephone cable for utilization in underground environment is finding a simple, economical, and yet effective, bonding material by which the sheathing materials such as layers of aluminum and polyolefin can be bonded to each other to form a waterproof exterior sheath. Besides adequately bonding these layers one to another, the bonding material should fill any voids between these layers to prevent the entry and travel of water, and should also allow the polyolefin to be peeled from the aluminum wrapping with moderate effort to expose the aluminum for grounding purposes.

The present bonding composition has been found to be a suitable alternative to other frequently more complex or expensive bonding materials.

Accordingly, it is an object of the present invention to provide a new and improved electrical cable. Another object of the invention is to provide an improved waterproof sheath for an electrical cable. Yet another object of the invention is to provide a material for bonding together the aluminum and polyolefin layers in the sheath of a telephone cable which polyolefin layer and adhesive layer can be peeled from the aluminum when exposure of the aluminum layer is desired.

Other objects, aspects and advantages of the invention will be apparent from a study of the specification, the drawing, and the appended claims to the invention.

In the drawing, the single FIGURE is a perspective view in cross section of a multiconductor electrical cable embodying the present invention. A plurality of electrical conductors 11 are provided with individual insulation coatings 12. The insulated conductors can be stranded or twisted to form the cable core. This core is covered by a circumferentially continuous annular layer 13 of an electrically insulating synthetic thermoplastic organic polymeric material, preferably a polymer of at least one mono-1-olefin having up to eight carbon atoms per molecule. Polyethylene, polypropylene, and copolymers of ethylene or propylene with at least one other mono-1-olefin having up to eight carbon atoms per molecule are particularly suited for use as layer 13. Exemplary copolymers include the copolymers of ethylene and propylene, the copolymers of ethylene and butene, the copolymers of ethylene and hexene, and the copolymers of propylene and butene. Polyethylene, particularly high density polyethylene, is presently preferred for this core wrap material. It can be in the form of a tape or ribbon or it can be an extruded layer.

An annular layer 14 of aluminum is coaxial with and surrounds polymeric layer 13 and is bonded thereto by an adhesive layer 15. The aluminum layer 14 can be in any form known in the art, for example spirally wound aluminum tape, braid, or a longitudinal tape curved to tubular form.

An outer cable coating or protective jacket 16 is coaxial with and surrounds aluminum layer 14, and is bonded thereto by an adhesive layer 17. The cable

coating 16 is an electrically insulating synthetic thermoplastic organic, polymeric material, preferably one of the polymers of at least one mono-1-olefin named hereinabove with regard to layer 13. The cable coating 16 will sometimes contain a material such as carbon black to minimize degradation of the polymer during exposure to sunlight. It can also be in the form of a tape or ribbon but will most often be an extruded layer.

The thickness of these various layers, namely, the core wrap, the aluminum layer, and the outer jacket will depend upon the specific use intended but will generally be sufficient to impart the degree of strength, flexibility, and protection desired.

In accordance with the present invention, each of layers 15 and 17 comprises an adhesive having from about 50 to about 90 weight percent amorphous (atactic) polypropylene, and from about 50 to about 10 weight percent mineral lubricating oil. Other conventional additives such as antioxidants, tackifiers, rodent repellents, pigments, and the like can be present in amounts ranging up to about 10 weight percent based on the adhesive. In a presently preferred embodiment the adhesive comprises from about 60 to about 85 weight percent amorphous polypropylene and about 0.05 to about 2 weight percent of at least one antioxidant with the remainder being the mineral lubricating oil.

In general, the amorphous polypropylene will have a molecular weight in the range of about 700 to about 100,000, as determined by light scattering, and preferably in the range of about 1,000 to about 70,000. The amorphous polypropylene will have a density in the range of about 0.83 to about 0.90 g/cc, as determined by ASTM Test D 1505-60T. The amorphous polypropylene will generally have less than 10, and preferably less than 5, weight percent crystallinity as determined by X-ray diffraction patterns. The amorphous polypropylene can be a homopolymer of propylene or a copolymer of propylene with less than 10 weight percent of at least one other mono-1-olefin, for example, a copolymer of propylene and butene, a copolymer of propylene and ethylene, a copolymer of propylene and hexene, and the like. The presently preferred amorphous polypropylene is a homopolymer and is a material which is well known in the polymer art. It is widely available as a by-product in well known processes for the polymerization of propylene to solid atactic polypropylene, a material already described above as being suitable for conductor insulation, or core wrap, or outer jacket material. Thus, a propylene polymerization process, catalyzed by a catalyst system prepared from a titanium trihalide and an organoaluminum halide, produces a polymer mixture containing solid isotactic polypropylene and 1 to 20 weight percent atactic polypropylene. The atactic portion is extracted with a suitable hydrocarbon solvent and isolated. It will generally be desirable to remove as much of the catalyst residue from the atactic polypropylene as is economically removable to avoid adverse effects upon the electrical properties of the adhesive materials. This can be carried out by any suitable process such as acid washing. Similarly, any additives for the adhesive material should be selected to avoid any significant adverse effects upon the electrical properties of the adhesive material.

The mineral lubricating oil will generally have a viscosity in the range of about 40 to about 150 SUS at 210° F. The lubricating oil can be one obtained by conventional refining or by solvent refining. The polypropylene and the mineral lubricating oil can be blended in any manner known in the art. This is most easily accomplished by simple mixing, preferably at slightly elevated temperatures at which the amorphous polypropylene becomes miscible with the mineral oil.

It will generally be desirable to incorporate a polyolefin decomposition inhibitor, and more particularly at least one antioxidant, into the adhesive material. Suitable inhibitors include 2,2'-methylenebis(4-ethyl-6-tert-butyl-phenol), butylated hydroxytoluene, dilaurylthiodipropionate, 4,4'-thiobis(6-tert-butyl-m-cresol), and the like, and admixtures thereof.

The sheathed cables of the present invention can be assembled by any suitable method in the electrical cable art. As an example, a telephone cable generally contains a number of paired wire conductors, each of which is sealed in an insulating coating such as solid polypropylene. These coated conductor wires are suitably twisted, gathered into a core, and encased in a core wrap such as polyethylene tape. Prior to the wrapping, it is advantageous to pass the core through a bath of viscous waterproofing filler such that the wrapped core has no free or void space between the insulated conductors.

The wrapped core is then covered by a thin layer of aluminum, generally aluminum tape. As part of the aluminum wrapping operation, the adhesive of the invention can be applied to the wrapped core in an amount sufficient to provide a thin yet at least substantially continuous film between the polyethylene wrap and the aluminum wrap.

The final outer jacket of the cable, generally a layer of extruded polyethylene, is then applied together with sufficient adhesive to provide a thin but at least substantially continuous film between the aluminum and the outer jacket.

In a specific illustration of the effectiveness of the present invention, a bonding composition was prepared by mixing, at an elevated temperature, a quantity of amorphous polypropylene and a lubricating oil stock having a viscosity, at 210° F, of about 53-54. The composition contained 75 weight percent amorphous polypropylene. Also included in the composition was 0.2 weight percent of a commercial antioxidant identified as 4,4'-thiobis(6-tert-butyl-m-cresol). A small portion of this bonding material was placed between a sheet of aluminum foil and sheet of high density

polyethylene film. After contact, the two sheets became adequately bonded yet could be separated by peeling without any damage to either of the sheets. The bonded sheets of aluminum and polyethylene were also successfully tested by flexing at -30° F. Flexing at this low temperature did not destroy the bond between the aluminum and the polyethylene.

Reasonable variations and modifications are possible within the scope of the foregoing disclosure, the drawing, and the appended claims to the invention.

What is claimed is:

1. An electrical cable comprising a plurality of electrical conductors, each of said conductors having a coating layer of electrically insulating material, the thus insulated conductors being positioned adjacent one another to form a core, an annular layer of a polymer of at least one mono-1-olefin coaxial to and surrounding said aluminum sheath, said annular layer being bonded to said aluminum sheath by an intervening layer of adhesive material comprising about 50 to about 90 weight percent amorphous polypropylene and from about 50 to about 10 weight percent mineral lubricating oil.

2. An electrical cable in accordance with claim 1 wherein a second annular layer of a polymer of at least one mono-1-olefin is coaxial with said core and positioned between said core and said aluminum sheath and is bonded to said aluminum sheath by a second layer of said adhesive material.

3. An electrical cable in accordance with claim 2 wherein said adhesive material further comprises an antioxidant.

4. An electrical cable in accordance with claim 2 wherein said adhesive material is about 60 to about 80 weight percent amorphous polypropylene and about 0.05 to about 2 weight percent of at least one antioxidant with the remainder being said mineral lubricating oil.

5. An electrical cable in accordance with claim 4 wherein said amorphous polypropylene has a molecular weight in the range of about 700 to about 100,000, as determined by light scattering and a density in the range of about 0.83 to about 0.90 gm/cc at 25° C.

6. An electrical cable in accordance with claim 5 wherein said mineral lubricating oil has a viscosity in the range of about 40 to about 150 SUS at 210° F.

7. An electrical cable in accordance with claim 6 wherein said adhesive material comprises about 75 weight percent amorphous polypropylene, about 25 weight percent mineral lubricating oil, and about 0.2 weight percent of an antioxidant.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,697,670

Dated: October 10, 1972

Bill Mitacek

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 4, line 16, after "core" insert -- an annular aluminum sheath coaxial to and surrounding said core, --.

In the drawings, "atactic" should be "amorphous".

Signed and sealed this 27th day of November 1973.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

RENE D. TEGTMEYER
Acting Commissioner of Patents

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