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(54) **Electric cables.**

(57) Performance under fire conditions of an electric cable having armour wires located between an inner polymeric sheath and an outer sheath of halogen-free low-smoke-and-fume polymer-based composition is enhanced by coating the metal wires with a heat-resistant adhesive, such as an epoxy resin. This promotes bonding of the outer sheath to the wires, and is thought to function by extending the time for which the wires act as an effective heat sink.

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ELECTRIC CABLES

This invention relates to electric cables for service in conditions where precautions need to be taken in respect of the possibility of fire occuring.

Public safety demands cables that will not contribute substantially to toxic hazard or smoke obscuration in case of fire and will continue to function under fire conditions for long enough to serve evacuation procedures. These characteristics need to be achieved without compromising the service life of the cable, which purchasers expect to be in excess of thirty years.

It is an object of the present invention to provide an electric cable which satisfies the above conditions.

Accordingly there is provided an electric cable comprising; a core comprising at least one insulated metallic conductor; an inner sheathing layer; an armour layer comprising a plurality of metallic armour wires, some or all of the wires being coated with a heat resistant adhesive; and an outer sheathing layer of a halogen-free low-smoke-and-fume polymer based composition.

The heat resistant adhesive is preferably a thermosetting adhesive, conveniently a two part epoxy resin adhesive. Typically the coating of heat resistant adhesive is at least 0.1mm in thickness.

The fire performance of the cable is enhanced by the addition of the heat resistant adhesive coating to the armour layer. It is believed that the adhesive inhibits "slumping" of the outer sheathing of the cable under fire conditions; the separation of the outer sheathing layer from the armour layer. With better and/or longer contact between the armour layer and the outer sheathing layer, the armour layer can act as a heat sink conducting away heat from the outer sheathing layer and lowering the temperature thereof.

The conductor is preferably of stranded or solid copper, but could be of aluminium or other suitable metal. Its insulation will normally be of polymer-based material and is preferably halogen-free, though this is not essential. Crosslinked polyethylene is prefered, but alternatives such as ethylene-propylene co- and terpolymers, ethylene/vinyl acetate copolymers and silicone rubbers could be used. The core may also comprise a conductor screen and/or a dielectric screen of "semiconducting" material as appropriate to the service voltage of the cable.

Preferably the inner sheathing layer is polymer-based and is halogen-free. The inner sheathing layer is conveniently a conventional cable-sheathing polyethylene composition, or may even be a low-smoke-and-fume polymer-based composition. The outer sheathing layer may be of any suitable halogen-free low-smoke-and-fume sheathing composition, either thermoplastic or crosslinked.

Example 1

A three-core power cable rated at 11KV has 2.10mm stranded copper conductors nominally 13mm in diameter, to each of which is applied a conventional conductor screen 0.8mm thick, conventional crosslinked polyethylene insulation with a radial thickness of 3.4mm, and a conventional dielectric screen with a nominal thickness of 0.8mm. Each core is then wound with a 25.5mm copper tape, applied with a right hand lay with a 4mm overlap, to give three cores each with a nominal diameter of 23.71mm. The three cores are laid up with a right hand lay, with a conventional filler composition therebetween, and bound with a 51mm nylon tape with an 8mm overlap to form a single core with a nominal diameter of 51.61mm. Over this core there is applied an inner sheathing layer of medium density polyethylene with a radial thickness of 1.6mm. An armour layer is then applied, consisting of 65 galvanised steel wires 2.5mm in diameter and applied with a left-hand lay. The wires are pre-coated with a heat resistant adhesive such as that sold by Permabond Adhesives Limited under Product No. E37. E37 is a two part epoxy resin adhesive comprising a resin component and a hardener component, mixed in a ratio of approximately 5 to 1 (by weight or volume). The resin component has viscosity of 15000cP and a specific gravity of 1.16, whilst the hardener component has a viscosity of 700cP and specific gravity of 1.08. The outer sheathing layer is 3mm in radial thickness and is made of a low-smoke-and-fume composition comprising, in parts by weight:

ingredient	parts
alumina trihydrate (specific area $7m^2/g$))	200
low density polyethylene (MFI 2)	40
ethylene-propylene terpolymer (Mooney Viscosity ML 1 + 4 = 54±5) (Exxon Vistalon 3708)	30
ethylene-propylene terpolymer (Mooney Viscosity ML 1 + 4 = 26±5) (Exxon Vistalon 2504)	30
aliphatic crystalline resin processing aid (Exxon Escorex 1202B)	20
antioxidant (Flectol H)	2

This example cable gave an A_o value of 0.75 in a 3m cube fire test following the proceedure of appendix F of BS6724:1986. A similar cable without the two part epoxy-resin adhesive gave an A_o value of 1.45.

Example 2

This is similar to Example 1 except that the coating on the armour wires, instead of being formed from the proprietory E37 adhesive, is formed from a mixture of 100 parts (by weight) of a glycidyl ether resin with a molecular weight range of 450-1400 and 7 parts of a hardener consisting essentially of diethylamino propylamine, applied by brushing to a nominal thickness of 0.5mm.

Claims

1. An electric cable comprising: a core comprising at least one insulated metallic conductor; an inner sheathing layer; an armour layer comprising a plurality of metallic armour wires, some or all of the wires being coated with a heat resistant adhesive; and an outer sheathing layer of a halogen-free low-smoke-and-fume polymer-based composition.

2. An electric cable according to claim 1 wherein the heat resistant adhesive is a thermosetting adhesive.

3. An electric cable according to claim 2 wherein the heat resistant adhesive is a two part epoxy resin adhesive.

4. An electric cable according to any of claims 1 to 3 wherein the coating of heat resistant adhesive is at least 0.1mm in thickness.

5. An electric cable according to any preceding claim wherein the conductor insulation is polymer-based and is halogen-free.

6. An electric cable according to claim 5 wherein the conductor insulation is of crosslinked polyethylene.

7. An electric cable according to any of claims 1 to 6 wherein the inner sheathing layer is polymer-based and is halogen-free.

8. An electric cable according to claim 7 wherein the inner sheathing layer is a low-smoke-and-fume polymer based composition.

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EUROPEAN SEARCH REPORT

Application number

DOCUMENTS CONSIDERED TO BE RELEVANT

EP 90301360.5

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
Y	EP - A2 - 0 100 829 (AEG-TELEFUNKEN) * Page 3, lines 24-31; page 4, line 20 - page 5, line 3; claims * --	1,2,5-8	H 01 B 7/18 H 01 B 3/18
Y	DE - A1 - 2 925 387 (SIEMENS) * Page 2, lines 17-24; page 4, line 30 - page 5, line 18; fig. * --	1,2,5-8	
A	FR - A1 - 2 576 709 (CABLES ELECTRIQUES) * Abstract; page 6, lines 17-33; fig. 1-4 * ----	1	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

H 01 B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
VIENNA	24-04-1990	KUTZELNIGG

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
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