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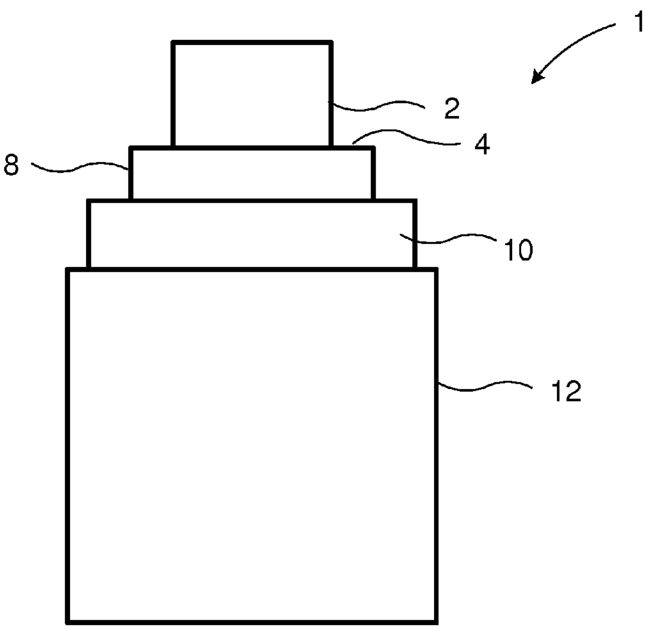

Fig. 1

(57) Abstract: The present invention relates to an electric power cable (1, 3) comprising a metal conductor (2) and an electric insulation layer (4) extruded to coaxially and radially surround the conductor (2), wherein the insulation layer (4) comprises a polymeric surface (6) facing away from the conductor (2). A metallic coating (8) is adsorbed on the polymeric surface (6) and the adsorbed coating (8) provides a water barrier for the electric power cable. The invention also relates to a process for the production of such electric cable.

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ELECTRIC POWER CABLE AND PROCESS FOR THE PRODUCTION OF ELECTRIC POWER CABLE

TECHNICAL FIELD

The present invention relates to an electric power cable and to a process for the production of an electric power cable as defined in the appended claims.

BACKGROUND ART

High voltage electric power cables are used to transmit electric power of medium or high voltage. The cables normally comprise a conductor and radially surrounding polymer insulation. Such electric cables may be buried into the ground, so called land cables or the electric power cables may be buried into a sea bed or they may freely extend between two fixing points in sea water. Cables used in sea applications are called submarine, sea water or underwater power cables. Underwater power cables are used today in an increasing amount due to the increased need of power transfer from for example offshore energy sources, including offshore renewable energy plants, such as wind power plants. Also the length for power transfer cables is increasing since there is a need to interconnect different regional electrical transmission networks to allow global trading of energy. Areas, where energy is on the other hand needed and on the other hand produced, may also be remote from each other which further increases a need for safe power transfer.

To protect the conductor and the insulation in the high voltage cables, aluminium or copper laminate or an extruded lead sheath is often provided around the insulation layer or an additional layer as a water barrier. A polymer jacket may then be applied on top of the laminate or sheath. One reason to apply the polymer jacket on the laminate is to allow bending of the cable without the laminate opening up. Today the process of applying the laminate and the polymer jacket is done in one continuous process. There are challenges with the laminate application leading to quality problems and increased costs during the manufacture. High voltage cables are often also provided with a swelling tape that surrounds an insulation and/or insulation screen of the cable.

WO2008/071754 discloses an electric power cable comprising at least one electric conductor, an electric insulation surrounding the conductor and comprising a polymer and a tubular protective sheath surrounding the electric insulation to provide a water barrier. According to this document, the sheath is a tubular element enclosing the electric insulation. Thus, there is a risk for leakage problems with this solution.

Another example of this kind of corrosion-protecting laminate is known for example from document US 6,596,393 B1 which discloses a coaxial cable comprising an elongate center conductor, a dielectric layer surrounding the center conductor and an outer conductor comprising an aluminium-polymer-aluminium tape extending longitudinally of the cable and having overlapping longitudinal edges. Problems may arise with the overlap, thus leading to an increased risk for leakage.

SUMMARY OF THE INVENTION

In view of the prior art, there is a need for an electric cable that comprises an improved water barrier. There is also need for a cable that can be manufactured without quality problems arising from the application of a laminate to the surface of the cable. There is also a need for a water barrier which has a low risk for loosening from the insulation layer. Further, there is need for a cable that can be bent without the risk for formation of creases or deformations in the water barrier layer.

The object of the present invention is therefore to provide a cable with a water barrier that eliminates the problems associated with the prior art solutions, e.g. the laminate application. A further object is to provide a water barrier that is strongly adhered to the insulation layer of an electric cable thus providing an improved water tightness of the water barrier and avoiding problems associated with leaking overlaps of laminate tapes.

It is a further object to provide a cable with a water barrier which completely seals the surface of the insulation layer of the cable.

It is also an object of the present invention to provide a process for the production of an electric power cable with an improved water barrier.

The objects above are achieved by an electric power cable comprising a metal conductor and an electric insulation layer extruded to coaxially and radially surround the conductor, wherein the insulation layer comprises a polymeric surface facing away from the conductor and wherein a metallic coating is adsorbed on the polymeric surface. Such metallic coating can provide in itself a water barrier to the insulation layer with the advantages mentioned above, or such metallic layer can provide a foundation for a water barrier having the advantages above.

Preferably, the polymeric surface of the insulation layer is chemically modified and the adsorption of the metallic coating is achieved by means of chemisorption, whereby the metallic coating is chemically bound to the polymeric surface. Thus, a very strong adhesion of the metallic coating to the polymeric surface can be provided.

The metallic coating is preferably continuous over the polymeric surface radially surrounding the conductor and the metallic coating covers the polymeric surface of the insulation layer completely. Thus, a water barrier that protects the insulation layer completely can be provided.

According to one aspect, the metallic coating further comprises a plated metal coating. In this way, a metallic coating of desired thickness can be easily provided on the insulation layer of the electric power cable.

The thickness of the metallic coating is preferably 0.05-3 mm. Thus, a good water barrier property can be obtained by the coating, while the electric cable is still easy to handle, e.g. to bend.

Preferably, the metallic coating comprises copper. Copper has very good water barrier properties and can be adhered to the surface of the insulation layer.

The electric power cable can be a high voltage direct current cable or the cable can be a high voltage alternating current cable. Both cables can be used to transmit electric power of medium or high voltage.

The high voltage alternating current cable may comprise three conductors, wherein each of the conductors is radially surrounded by a respective insulation layer having a polymeric surface on which a metallic coating is adsorbed. In this way an effective water barrier can be provided for each insulation layer.

The insulation layer comprises preferably cross-linked polyethylene or ethylene-propylene rubber. These polymers provide excellent insulation properties and can be chemically modified.

Preferably, the electric power cable is a submarine cable. The electric power cable may also be a land cable.

Thus, the metallic coating as described above forms a water barrier for the electric power cable.

The present invention also relates to a process for the production of an electric power cable comprising the steps of:

a. providing a conductor and attaching by means of extrusion an insulation layer to coaxially and radially surround the conductor, wherein the insulation layer comprises at least a polymeric surface facing away from the conductor; and
b. providing a metallic coating on the polymeric surface by means of adsorption.

The process may further comprise:

c. after the step (a) and before the step (b), chemically modifying the polymeric surface to obtain reactive radicals such that the metallic coating can be adsorbed to the polymeric surface by means of chemisorption, whereby the metallic coating is chemically bound to the polymeric surface.

Further, the process may comprise after the steps a, b and optionally c:

d. performing plating, such as electro plating or electroless plating to the electric power cable to obtain a metal coating of a desired thickness.

Further features and advantages of the present invention are described more in detail in the following detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

Examples of the present invention will be described below with reference to the accompanied drawings in which:

Fig. 1 is a side view of a single phase electric power cable according to the present invention;

Fig. 2 is a cross-section of a single phase electric power cable according to the present invention;

Fig. 3 is a cross section of a three phase electric power cable according to the present invention.

Fig. 4 is a flow chart showing the steps of a process for the production of the electric power cable according to the present invention

DETAILED DESCRIPTION

Definitions

By adsorption is meant adhesion of a substance, which can be atoms, ions or molecules, such as monomers or polymers, from a gas, liquid or dissolved solid, on the surface of a solid, e.g. polymeric surface, whereby a thin coating or film, which can be as thin as only one molecule thick, is formed. Adsorption may be chemisorption which involves a chemical reaction between the surface and the adsorbate or physisorption in which the interacting forces between the surface and the substance are rather weak and can be caused for example by van der Waals forces.

By chemical modification of a surface is meant that the chemical properties of the surface are modified to enable chemisorption, i.e. for example by forming free radicals on the surface of the polymeric surface layer of the insulation layer.

By polymeric surface is meant that the surface comprises at least one polymer.

Cables

Electric power cables comprising an insulation layer coaxially and radially surrounding the conductor and comprising a polymeric surface facing away from the conductor, wherein the polymeric surface comprises a metallic coating that is adsorbed to the polymeric surface according to the present invention can be of various kinds, for example of a type single phase electric power cable or three phase electric power cable. For example, the cables may be high voltage direct current (HVDC) cables, high voltage alternating current (HVAC) cables, extra high voltage cables (EHV), medium-voltage cables and low-voltage cables.

Single phase electric power cables comprise a conductor, which is usually mainly constituted by a metal such as copper. The conductor is surrounded by an electric insulation layer which can be mainly constituted of a polymer and the electric insulation layer has at least a surface of polymeric material. The conductor may be directly or undirectly surrounded by the polymeric insulation layer, i.e. the electric power cable may comprise at least one material layer between the conductor and the insulation layer. Preferably, the insulation layer comprises cross-linked polyethylene or ethylene-propylene rubber. These materials render the insulation layer relatively thermally stable while an effective insulation property is obtained. The polymeric surface faces away from the conductor thus providing effective insulation.

The electric insulation layer has been traditionally enclosed by a protective layer, i.e. a surrounding barrier to provide a water barrier for the electric power cable. Such surrounding barriers have been for example sheath-like barriers. The purpose with such barriers has been to act as a water barrier to prevent intrusion of water into the electric insulation. Water barriers are required since the inherent properties of the electric insulation are such that the insulation may deteriorate and loose its insulation effect if the insulation is subjected to water for a longer period. According to the present invention, the surface of the polymeric material comprises a metallic coating that is adsorbed to the polymeric surface which provides a water-barrier for the insulation layer and the conductor instead of a traditional sheath-like barrier.

Normally, the conductor has a generally circular cross section, even though alternative shapes might be conceived. The surrounding electric insulation layer may have a cross-section with an outer peripheral shape corresponding to the outer peripheral shape of the conductor, normally a generally circular outer periphery.

The insulation layer can be directly attached to and in immediate contact with the conductor. However, cables in the present invention are not limited to such designs, and there may be further intermediate components provided in between the conductor and the electric insulation layer. It is also possible that the insulation layer comprises elements of another material embedded in the polymeric material. It should be further understood that the conductor and the insulation layer can be surrounded by further material or layers of material. For example, the electric cable may comprise an insulation system comprising an inner conducting screen facing the conductor, the insulation layer and an outer semiconducting screen. The semi-conducting inner and outer screen may contain carbon black as active conducting filler. Further materials and layers may have different tasks such as that of holding the different cable parts together, giving the cable mechanical strength and protecting the cable against physical as well as chemical attacks, e.g. corrosion. Such materials and layers are commonly known to the person skilled in the art. For example, such further materials may include armouring, for example steel wires.

As mentioned above, the electric power cables according to the present invention can also be for example of a type three-phase electric power cable. Such cables comprise three conductors, each of which is surrounded by a separate electric insulation layer. Each electric insulation layer is in turn radially surrounded by a respective insulation layer having a polymeric surface on which a metallic coating is adsorbed. The three phase electric power cable may also comprise further material and layers arranged around and enclosing the rest of the cable as described above. Such further material and layers may have different tasks such as that of holding the different cable parts, as described above, together, and giving the cable mechanical strength and protection, against physical as well as chemical attack, e.g. corrosion, and are commonly known to the person skilled in the art. Also, in connection with three-phase electric power cables, the metallic coating adsorbed to the polymeric surface of the insulation layer provides a water-barrier for the insulation layer.

The cables may be underwater power cables or the cables may be land cables, which both require a water barrier.

Metallic coating

Basically, the polymeric surface of the insulation layer that has a metallic coating adsorbed on the polymeric surface can be obtained by physically or chemically adhering the metallic coating to the surface, i.e. by means of adsorption. To enable chemisorption, the surface of the polymeric insulation layer can be modified by the use of several known technologies. As mentioned above by modification is meant that, for example, free radicals are formed on the surface of the polymeric surface. After modification a chemical reaction that bonds e.g. a polymer containing a metal group on the surface is possible. Technologies for chemisorption are known in the prior art and examples of suitable technologies are discussed below. Physisorption of the metallic coating on the surface of the polymeric surface can also be obtained by the use of known technologies. The adsorbed metallic coating is essential if the thickness of the metallic coating is to be increased by traditional methods, such as plating. Metal plating requires an electrically conducting surface, which is provided by the adsorbed metallic coating. By means of plating, such as electro plating or electroless plating, it is possible to obtain a metallic coating having a desired thickness.

One possible method to provide a metallic coating that is adsorbed by means of physisorption on the surface of the polymeric insulation layer is to use Physical Vapour Deposition method, hereinafter caller PVD. PVD can be performed in many different ways, such as sputter deposition, also called sputtering. In sputtering a glow plasma discharge is used to bombard the polymeric surface of the insulation layer, thus sputtering some material away as a vapor for subsequent deposition. Different metals can be provided on the surface by means of PVD and/or sputter deposition, and thus a thin metallic coating adhered to the polymeric surface of the insulation layer can be provided.

As mentioned above, the polymeric surface can be chemically modified to enable chemical bonding, i.e. chemisorption, of a metallic coating on or to the surface and thereby obtain a polymeric surface that comprises a metallic coating. Thus, in chemisorption, the surface of the polymeric insulation layer is chemically modified, whereby the metallic coating can be adsorbed to the polymeric surface, and a metallic coating can be chemically bound to the polymeric surface. In such a way, a strong adhesion to the polymeric surface can be provided.

Preferably, the metallic coating is covalently bound to the surface. The covalent bond may be achieved by means of first modifying the polymeric surface to provide reactive radicals so that a monomer, polymer or molecule can react with the reactive radicals in the polymeric surface of the insulation layer. The monomer, polymer or molecule comprises a metal group or is able to be substituted by a metal group and reacts with the reactive radicals on the surface and is then thus covalently bound to the surface. The chemical bond is strong to sufficiently bond the coating to the surface.

Adsorption by means of chemisorption can be provided by using several technologies. For example, a metallic coating can be adsorbed on or to the the polymeric surface by the use of Chemical Vapour Deposition, hereinafter called CVD. In CVD, a substrate is exposed to one or more volatile precursors, which react and/or decompose on the substrate surface to produce the desired deposit. For example, the surface may be modified by subjecting the surface to plasma excitation that creates active species, e.g. reactive radicals on the surface that initiate polymerization. In CVD polymerization, vapour-phase monomers react to form solid films directly on the surface of a substrate and thus provide a coating on the surface. Polymerization and coating of the surface may occur in a single processing step. This enables the formation of cross-linked coatings as well as copolymers of incompatible monomers, such as conducting polymers together with inert polymers of the polymeric insulation layer.

Accordingly, in chemical modification of the surface, reactive radicals are formed on the surface. Reactive radicals can be formed by radiating the surface e.g. with plasma corona radiation or other ionizing radiation. Thus, hydrogen atoms are removed from the polymeric surface to form reactive radicals. Molecules or polymer chains that comprise a metal ion or a metal group or a group being able to be substituted by a metal group or a metal ion can then be covalently bound to the polymeric surface comprising the reactive radicals.

A method based on this technology is disclosed e.g. by WO9834446, and as disclosed by it, the chemical modification of the polymeric surface of the insulation layer can be initiated by activating groups in and/or on the polymeric surface of the insulation layer to enable adsorption of a metallic coating. During the activation, reactive radicals are obtained on the polymeric surface. After activation, the activated groups in the surface can react with polymers containing a metal group or metal ion or being able to incorporate a metal group or metal ion. The metal in the metal group or metal ion can be for example, but not limited to copper, nickel, palladium, gold and silver. By the reaction, the molecules are chemically bound to the surface. The bond is covalent which strongly bonds the metallic coating to the surface. The metallic coating achieved by this method is thin and the thickness of the coating can be increased by plating. The plated metal coating further improves the water barrier property of the metallic coating, and it is easy to adjust the desired thickness of the metallic coating. For example, it will be possible to bend the cable without the risk for breakage of the coating, and thus it will be possible to effectively prevent water from reaching the insulation material.

According to WO9834446, the activation may be performed by adding a chemical initiator to the surface that is able to remove hydrogen atoms from the underlying surface of organic material. As explained in WO9834446, the initiator can initiate a chemical reaction on the surface and may be a compound with the ability to form radicals and can be for example a photo initiator, such as a compound comprising carbonyl groups, e.g. aromatic carbonyl groups. The initiator can be applied to the surface for example by immersing the electric power cable in a solution containing the photo initiator or alternatively the photo initiator may be spread to the surface for example by means of spraying. The photoinitiator is then subjected to UV-radiation to initiate the activation of groups in the surface layer. Monomers containing groups that are able to bond covalently to the surface of the insulation layer can be added simultaneously with the photo initiator, e.g. in a mixture. Examples of such monomers are organic molecules having a double bond between two carbon atoms, and these monomers may include metal groups or can easily be modified to include metal groups. Suitable monomers are monomers able to bond covalently to the substrate surface layer. The monomers suitable for use can be for example but not limited to acrylic acid, methacrylic acid, butyl acrylate, glycidyle acrylate, glycidyl methacrylate, methyl-meth-acrylate, vinylpyrdine isomers, acrylonitrile, vinyl acetate, N-vinyl-2-pyrrolidone, 4-vinylpyrridine, 1 ,4-butanedioldimeth-acrylate, styrene and mixtures thereof. Alternatively, the surface may be first activated with the photo initiator and after activation with a following UV-radiation the surface may be treated with a solution of suitable metal ion such as Pd(II), Pt(II), Cu(II), Ni(II) or Ag(I). Then the metal ions are reduced to an atomic state by means of a chemical reaction or by means of a photochemical reaction. Thus, after activation of groups on the surface, the monomers, polymers or molecules containing a metal group or being able to contain a metal group are covalently bound to the activated groups on the surface of the insulation layer, and thus, a polymeric surface on which a metallic coating is adsorbed, is obtained, and thus the polymeric surface comprises the metallic coating adsorbed on the polymeric surface

The polymeric surface of the insulation layer may also be modified by other means, such as by using a method described in WO2012066018 for applying a first metal on a substrate. The method basically comprises: a) applying a coating, i. e a thin coating layer of plasma polymers, by treatment of the surface in a plasma, said plasma comprising a compound selected from alkanes up to 10 carbon atoms, and unsaturated monomers. In this way the surface is modified. Thereafter one of steps bI or b2 is performed, i.e. bl) producing polymers on the surface of said substrate, said polymers comprising carboxylic groups and adsorbed ions of a second metal, reducing said ions to the second metal, or alternatively b2) producing polymers comprising carboxylic groups on the surface bringing the surface of said substrate in contact with a dispersion of colloidal metal particles of at least one second metal. In this way a polymer containing a metal group of a second metal can be adsorbed on the surface. Thereafter it is possible to deposite the first metal, e.g. copper on said second metal, which second metal is adsorbed on the surface. Thus, a polymeric surface on which a metallic coating is adsorbed, is obtained.

As mentioned above, the polymeric surface of the insulation layer on which a metallic coating is adsorbed may be further treated so as to deposit a thicker coating on the surface. Varieties of methods to deposit metals on this polymeric surface can be used. Examples of methods that can be used are metal plating methods, such as electro plating, electroless plating etc., i.e. the application of a thicker layer can be performed by using conventional autocatalytic baths for metal plating or by means of other suitable methods such as atomization in an inert atmosphere. These methods are well known in the art and will not be described more in detail.

Since the coating is adsorbed on the surface of the insulation layer, it will be able to handle thermal expansion of the underlying cable insulation as well as bending of the cable without breaking or formation of creases or folds that could deteriorate the water barrier property.

Examples of electric power cables are shown in the appended Figures that will be explained in more detail below.

Fig. 1 shows a side view of a single phase electric power cable 1 according to the present invention. The electric power cable 1 comprises a conductor 2, which can be constituted by a metal such as copper. The conductor is surrounded by an insulation layer 4 which comprises a polymeric surface (6, see Fig. 2) and which insulation layer 4 is preferably constituted by a polymer. The polymeric surface 6 faces away from the conductor 2 and a metallic coating 8 is adsorbed on the polymeric surface 6. The metallic coating may be provided to the desired thickness by means of metal plating. The metallic coating provides a water barrier for the electric cable 1 and prevents the intrusion of water into the insulation layer 4.

In Fig. 2 a cross section of the single phase electric power cable 1 of Fig. 1 is shown. As can be seen, the insulation layer 4 is directly attached to and in immediate contact with the conductor 2. The coating 8 is adsorbed to the polymeric insulation layer 4, and the desired thickness is provided by means of metal plating. However, it should be understood that the structure of the electric power cable is not limited to such designs and there may be intermediate components provided between the conductor and the insulation layer.

The conductor 2 and the insulation layer 4 with the coating 8 are normally surrounded by further material or layers of material as indicated by numeral 10 in the figures. Such further layers of material 10 may have different tasks such as that of holding the different cable parts, as described above, together, and giving the cable mechanical strength and protection against physical as well as chemical attacks, e.g. corrosion, and are commonly known to the person skilled in the art. The electric power cable 1 in Fig. 1 and 2 is surrounded by an outer sheath 12.

Fig. 3 shows an example of a three-phase cable 3 according to the invention. The cable 3 comprises three conductors 2, wherein each of the conductors 2 is radially surrounded by a respective insulation layer 4 provided with a metallic coating 8 that is adsorbed to the polymeric surface 6. Each of the conductors may comprise several layers of material 10 and/ or the cable 3 as a whole may comprise several material layers 10. The electric power cable 3 in Fig. 3 is surrounded by an outer sheath 12.

To provide an efficient water barrier, the metallic coating 8 is continuous over the whole polymeric surface 6 of the insulation layer 4 and the coating seals the surface 6 of the insulation layer 4 completely. The electric power cable is preferably a submarine cable, in which a water barrier is essential to protect the insulation layer.

In Fig. 4 a flow chart showing the steps in a process for the production of an electric power cable is illustrated. The process comprises the steps of:

a. providing a conductor 2 and attaching by means of extrusion an insulation layer 4 to coaxially and radially surround the conductor 2, wherein the insulation layer 4 comprises at least a polymeric surface 6 facing away from the conductor 2; and
b. providing a metallic coating 8 on the polymeric surface 6 by means of adsorption.

The process may further comprise:

c. after the step a) and before the step b), chemically modifying the polymeric surface 6 to obtain reactive radicals such that the metallic coating 8 can be adsorbed to the polymeric surface 6 by means of chemisorption, whereby the metallic coating 8 is chemically bound to the polymeric surface 6.

Further, the process may comprise after the steps a, b and optionally c:

d. performing plating, such as electro plating or electroless plating to the electric power cable 1, 3 to obtain a metallic coating of a desired thickness.

The adsorption of the metallic coating, the chemical modification of the polymeric surface and the plating can be performed as described above in the detailed description.

It should be understood that the above description of preferred embodiments has been made in order to exemplify the invention, and that alternative solutions will be obvious for a person skilled in the art, however without departing from the scope of the invention as defined in the appended claims supported by the description and the drawings.

CLAIMS

1. Electric power cable (1, 3) comprising a metal conductor (2) and an electric insulation layer (4) extruded to coaxially and radially surround the conductor (2), wherein the insulation layer (4) comprises a polymeric surface (6) facing away from the conductor (2), **characterized in that** a metallic coating (8) is adsorbed on the polymeric surface (6).

2. Electric power cable according to claim 1, characterized in that the polymeric surface (6) of the insulation layer (4) is chemically modified and the adsorption of the metallic coating is achieved by means of chemisorption, whereby the metallic coating is chemically bound to the polymeric surface.

3. Electric power cable according to any one of the claims 1 or 2, characterized in that the metallic coating (8) is continuous over the polymeric surface (6) radially surrounding the conductor (2) and the metallic coating (8) covers the polymeric surface (6) of the insulation layer (4) completely.

4. Electric power cable according to any one of the preceding claims, characterized in that the metallic coating (8) further comprises a plated metal coating.

5. Electric power cable according to claim 4, characterized in that the total thickness of the metallic coating (8) is 0,05-3 mm.

6. Electric power cable according to any one of the preceding claims, characterized in that the metallic coating (8) comprises copper.

7. Electric power cable according to any one of the preceding claims, characterized in that the cable is a high voltage direct current cable (1).

8. Electric power cable according to any one of claims 1-6, characterized in that the cable is a high voltage alternating current cable (3).

9. Electric power cable according to claim 8, characterized in that the high voltage alternating current cable (3) comprises three conductors (2), wherein each of the conductors is radially surrounded by a respective insulation layer (4) having a polymeric surface (6) on which a metallic coating (8) is adsorbed.

10. Electric power cable according to any one of the preceding claims, characterized in that the insulation layer (4) and/or the polymeric surface (6) of the insulation layer (4) comprises cross-linked polyethylene or ethylene-propylene rubber.

11. Electric power cable according to any one of the preceding claims, characterized in that the electric power cable (1, 3) is a submarine cable.

12. Electric power cable according to any one of the preceding claims, characterized in that the metallic coating forms a water barrier for the electric power cable.

13. Process for the production of an electric power cable (1, 3) comprising the steps of:
    a. providing a conductor (2) and attaching by means of extrusion an insulation layer (4) to coaxially and radially surround the conductor (2), wherein the insulation layer (4) comprises at least a polymeric surface (6) facing away from the conductor (2);
    b. providing a metallic coating (8) on the polymeric surface (6) by means of adsorption.

14. Process according to claim 13, further comprising:
    c. after the step (a) and before the step (b), chemically modifying the polymeric surface (6) to obtain reactive radicals such that the metallic coating (8) can be adsorbed to the polymeric surface (6) by means of chemisorption, whereby the metallic coating (8) is chemically bound to the polymeric surface (6).

15. Process according to claim 13 or 14, further comprising after the steps a, b and optionally c:
    d. performing plating, such as electro plating or electroless plating to the electric power cable (1, 3) to obtain a metallic coating (8) of a desired thickness, wherein the metallic coating provides a water barrier for the electric power cable.

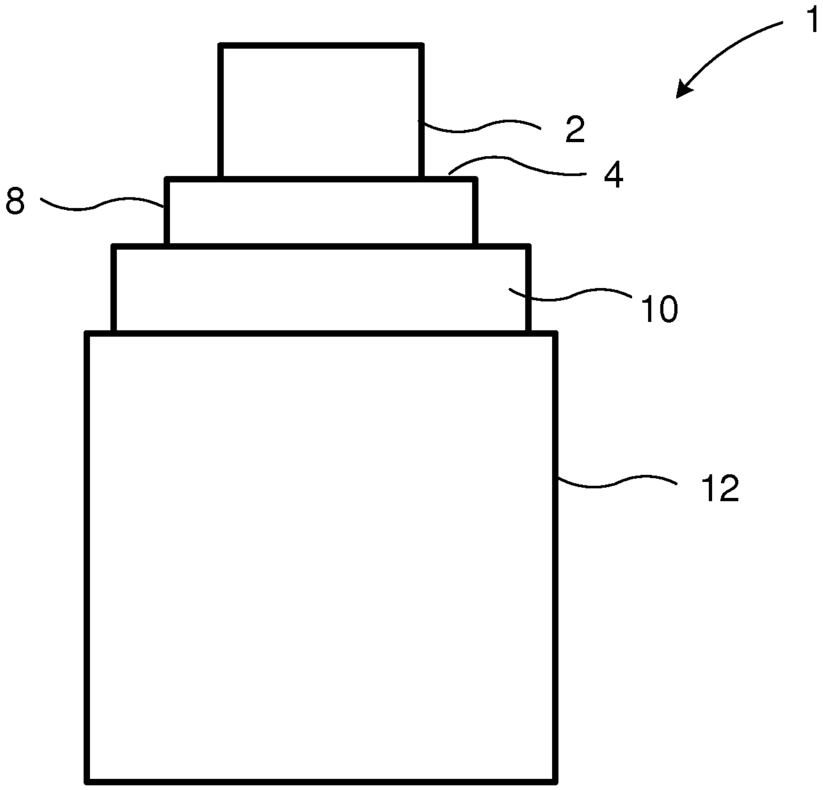

Fig. 1

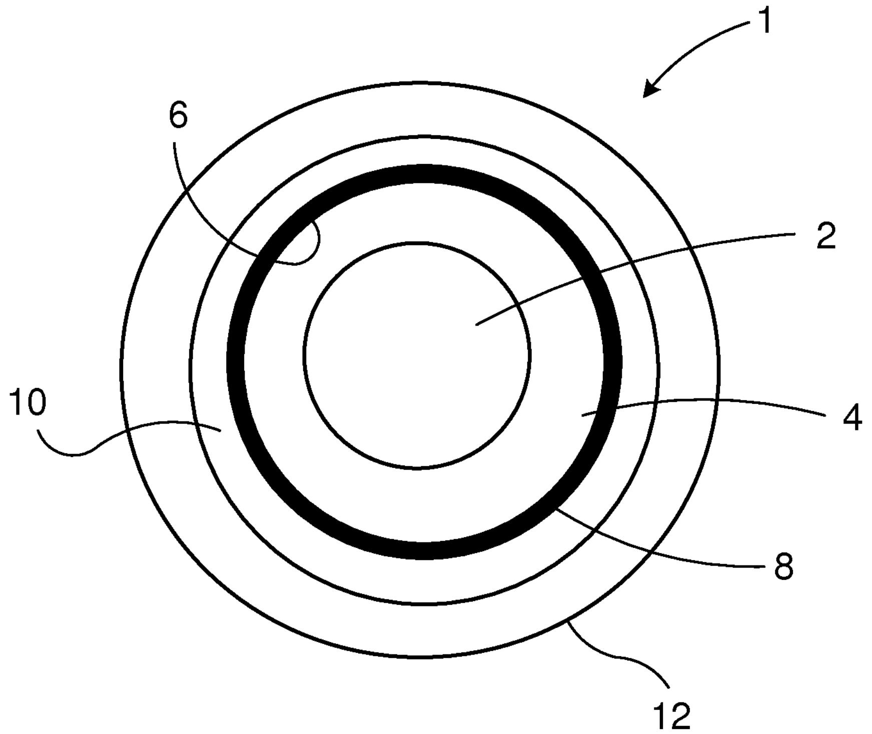

Fig. 2

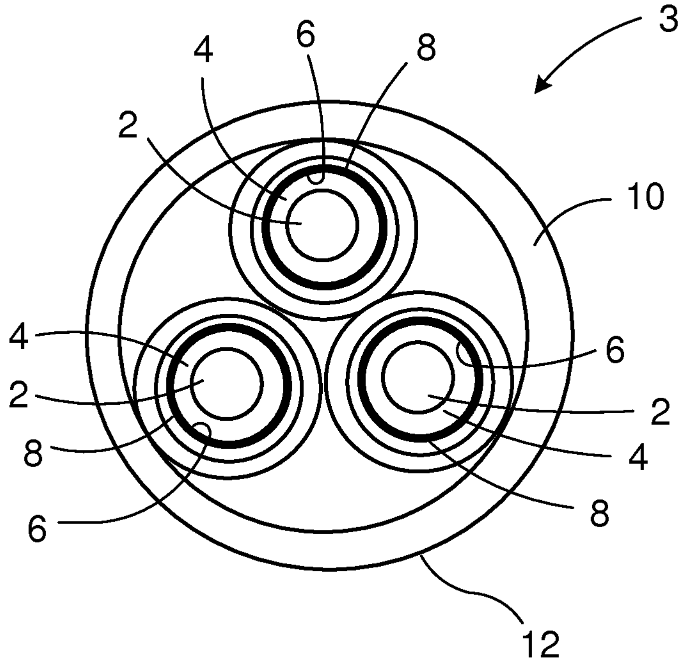

Fig. 3

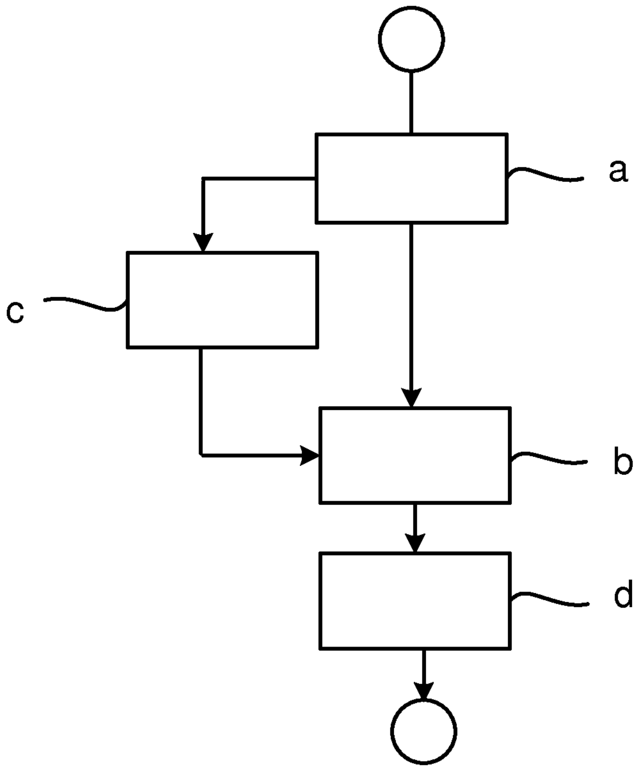

Fig. 4

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2014/056395

A. CLASSIFICATION OF SUBJECT MATTER
INV. H01B7/282 H01B9/00 C23C14/00 C23C16/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H01B C23C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, COMPENDEX, INSPEC, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3 340 353 A (MILDNER RAYMOND C) 5 September 1967 (1967-09-05) column 1, line 55 - column 2, line 53; claims 1-5; figures 1-2; examples 1-2 -----	1-15
X	US 3 485 938 A (KINGSLEY KENYON W) 23 December 1969 (1969-12-23) column 3, line 25 - column 4, line 34; claims 1-6; figure 2 -----	1-15
X	US 2014/060884 A1 (PATEL DARREN LINDSAY [GB]) 6 March 2014 (2014-03-06) paragraph [0060] - paragraph [0064]; examples 1-2 -----	1-15

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
12 November 2014	21/11/2014

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Mehdaoui, Imed

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2014/056395

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 3340353 A	05-09-1967	BE 693288 A	27-07-1967
		DE 1615949 A1	10-09-1970
		FR 1507698 A	29-12-1967
		GB 1112816 A	08-05-1968
		NL 6700700 A	31-07-1967
		US 3340353 A	05-09-1967
US 3485938 A	23-12-1969	NONE	
US 2014060884 A1	06-03-2014	EP 2706539 A1	12-03-2014
		GB 2505660 A	12-03-2014
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