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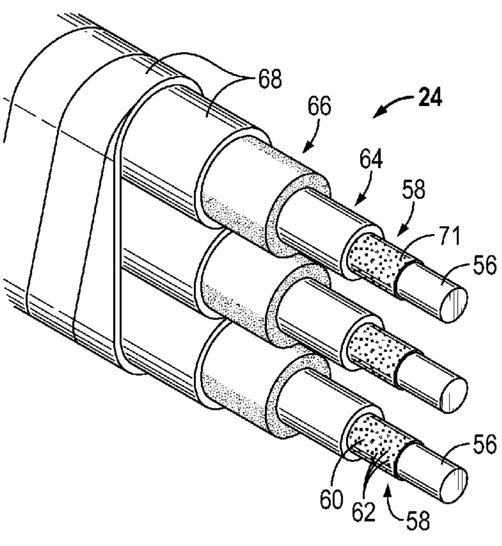
(54) Title: ELECTRICAL DEVICE WITH ELECTRICALLY ENHANCED INSULATION HAVING NANO PARTICULATE FILLER

FIG. 3



(57) Abstract: A technique facilitates transmission of electricity in a variety of environments. An electrical component, e.g. a power cable, is provided with a conductor and often a plurality of conductors for conducting electricity. The conductor(s) is electrically isolated by insulation which comprises a primary insulation material combined with a nano particulate filler. The nano particulate filler facilitates use of the electrical component in harsh environments, such as high heat environments, by providing high dielectric strength and long-term voltage endurance.

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ELECTRICAL DEVICE WITH ELECTRICALLY ENHANCED INSULATION HAVING NANO PARTICULATE FILLER

BACKGROUND

[0001] In many hydrocarbon well applications, power cables are employed to deliver electric power to various devices. For example, power cables are used to deliver electric power to electric submersible pumping systems which may be deployed downhole in a wellbore. The power cables are defined in part by a voltage rating which is established as the highest voltage the power cable can reliably endure without damage or failure while used continuously. The voltage rating of a power cable often depends on the thickness of an insulation layer as well as the material used to construct the insulation layer. However, a variety of traditional insulation layer materials have limited dielectric strength and limited voltage endurance.

SUMMARY

[0002] In general, a methodology and system are provided which facilitate transmission of electricity in a variety of environments. An electrical component, e.g. a power cable, is provided with a conductor and often a plurality of conductors for

conducting electricity. The conductor(s) is electrically isolated by insulation which comprises a primary insulation material combined with a nano particulate filler. The nano particulate filler facilitates use of the electrical component in high voltage applications and/or harsh environments, e.g. high heat environments, by providing high dielectric strength and long-term voltage endurance.

[0003] However, many modifications are possible without materially departing from the teachings of this disclosure. Accordingly, such modifications are intended to be included within the scope of this disclosure as defined in the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] Certain embodiments of the disclosure will hereafter be described with reference to the accompanying drawings, wherein like reference numerals denote like elements. It should be understood, however, that the accompanying figures illustrate the various implementations described herein and are not meant to limit the scope of various technologies described herein, and:

[0005] Figure 1 is a schematic illustration of a well system comprising an example of an electrical power cable coupled with an electric submersible pumping system, according to an embodiment of the disclosure;

[0006] Figure 2 is an orthogonal view of an example of a power cable, according to an embodiment of the disclosure;

[0007] Figure 3 is an orthogonal view of another example of a power cable, according to an embodiment of the disclosure;

[0008] Figure 4 is a schematic illustration of an example of insulation material which comprises a nano particulate filler and is useful in a power cable or other types of electrical devices, according to an embodiment of the disclosure;

[0009] Figure 5 is a cross-sectional view of an example of an electrical connector employing an insulation material with a nano particulate filler, according to an embodiment of the disclosure; and

[0010] Figure 6 is a cross-sectional view of an example of a portion of a stator which may be employed in an electric motor, the stator comprising an insulation material with a nano particulate filler, according to an embodiment of the disclosure.

DETAILED DESCRIPTION

[0011] In the following description, numerous details are set forth to provide an understanding of some embodiments of the present disclosure. However, it will be understood by those of ordinary skill in the art that the system and/or methodology may be practiced without these details and that numerous variations or modifications from the described embodiments may be possible.

[0012] The present disclosure generally relates to a methodology and system which facilitate transmission of electricity in a variety of environments, such as downhole well environments. An electrical component is insulated by a unique insulation material which enables operation of the electrical component in a high voltage/high heat environment. By way of example, the electrical component may comprise a power cable having a plurality of conductors for conducting electricity to a powered component, such as a submersible electric motor of an electric submersible pumping system. The conductors are electrically isolated by the insulation which comprises a primary insulation material combined with a nano particulate filler. The nano particulate filler provides the insulation with high dielectric strength and long-term voltage endurance.

[0013] According to an embodiment, a power cable is constructed to utilize insulation materials having high dielectric strength and long-term voltage endurance. The insulation material comprises nano particulate filler which provides a high surface area that assists in evenly distributing charge buildup and therefore defends against failures resulting from, for example, degradation of the insulation due to heat. By using dielectrically enhancing nano materials, the insulation material and the power cable have a much longer run life and greater reliability. These characteristics enable use of the power cable with higher voltages and/or in higher heat environments, including use of the power cable to power electric submersible pumping systems in downhole environments. Additionally, the insulation materials may be constructed with a high degree of purity to reduce contamination and to thus further guard against localized charges which can lead to failure of the insulation.

[0014] Breakdown strength of electrical insulation materials for power cables determines the ability to insulate the charged conductor from the outside environment. A higher breakdown strength provides a more durable, long-lasting electrical insulation material. Often, breakdown failure in a power cable results from charge concentration which leads to electrical failure in the power cable. Such charge concentrations propagate in the insulation material where voids or material contamination are present. However, incorporation of nano particulate fillers, as described in greater detail herein, improve the electrical properties of the insulation material and guard against such breakdown failures in the insulation material.

[0015] Referring generally to Figure 1, an embodiment of a well system is illustrated as comprising a downhole, electrically powered system, e.g an electric submersible pumping system. Electric power is provided to the electric submersible pumping system or other powered system via a power cable. The power cable, in turn, is coupled with the electrically powered system by an electrical connector, e.g. a pothead assembly. In some applications, the power cable may be part of a motor lead extension. The illustrated electric submersible pumping system or other types of electrically powered systems may comprise many types of components and may be employed in many types of applications and environments, including cased wells and open-hole wells. The well system also may be utilized in vertical wells or deviated wells, e.g. horizontal wells.

[0016] Referring again to Figure 1, a well system 20 is illustrated as comprising an electrically powered system 22 which receives electric power via an electrical power cable 24. By way of example, the electrically powered system 22 may be in the form of an electric submersible pumping system 26, and the power cable 24 may be constructed to withstand high temperature, harsh environments even when used in high voltage applications. Although the electric submersible pumping system 26 may have a wide variety of components, examples of such components comprise a submersible pump 28, a submersible motor 30, and a motor protector 32.

[0017] In the example illustrated, electric submersible pumping system 26 is designed for deployment in a well 34 located within a geological formation 36 containing, for example, petroleum or other desirable production fluids. A wellbore 38 may be drilled and lined with a wellbore casing 40, although the electric submersible pumping system 26 (or other type of electrically powered system 22) may be used in open hole wellbores or in other environments exposed to high temperatures and harsh conditions. In the example illustrated, however, casing 40 may be perforated with a plurality of perforations 42 through which production fluids flow from formation 36 into wellbore 38. The electric submersible pumping system 26 may be deployed into a wellbore 38 via a conveyance or other deployment system 44 which may comprise tubing 46, e.g. coiled tubing or production tubing. By way of example, the conveyance 44 may be coupled with the electrically powered system 22 via an appropriate tubing connector 48.

[0018] In the example illustrated, electric power is provided to submersible motor 30 by electrical power cable 24. The submersible motor 30, in turn, powers submersible pump 28 which draws in fluid, e.g. production fluid, into the pumping system through a pump intake 50. The fluid is produced or moved to the surface or other suitable location via tubing 46. However, the fluid may be pumped to other locations along other flow paths. In some applications, for example, the fluid may be pumped along an annulus surrounding conveyance 44. In other applications, the electric submersible pumping system 26 may be used to inject fluid into the subterranean formation or to move fluids to other subterranean locations.

[0019] As described in greater detail below, the electrical power cable 24 is designed to consistently deliver electric power to the submersible pumping system 26 over long operational periods when subjected to high temperatures due to high voltages and/or high temperature environments. The construction of power cable 24 also facilitates long-term operation in environments having high pressures, deleterious fluids, and/or other harsh conditions. The power cable 24 is connected to the corresponding, electrically powered component, e.g. submersible motor 30, by an electrical connector 52, e.g. a suitable pothead assembly. The electrical connector 52 provides sealed and protected passage of the power cable conductor or conductors through a housing 54 of submersible motor 30.

[0020] Depending on the application, the power cable 24 may comprise an individual electrical conductor protected by an insulation system or a plurality of electrical conductors protected by the insulation system. In various submersible pumping applications, the electrical power cable 24 is in the form of a motor lead extension. In many of these applications, the motor lead extension 24 is designed to carry three-phase current, and submersible motor 30 comprises a three-phase motor powered by the three-phase current delivered through the three electrical conductors of motor lead extension 24.

[0021] Referring generally to Figure 2, an example of electrical power cable 24 is illustrated. In this example, the power cable 24 comprises a plurality of electrical conductors 56 and each conductor 56 is surrounded by a layer of insulation 58. Each layer of insulation 58 comprises an insulation material 60 combined with a nano particulate filler 62 to provide, for example, high dielectric strength and long-term voltage endurance. Additionally, each layer of insulation 58 may be surrounded by at least one barrier layer 64, and the plurality of conductors 56 may be collectively surrounded by a jacket 66. Additionally, an armor layer 68 may be positioned to surround jacket 66 to provide a robust layer which is mechanically strong and corrosion resistant. For example, the armor layer 68 may be formed with lead or a variety of other metals, e.g. steel alloys, or other materials which provide strength and corrosion resistance. In some applications, an additional control line or control lines 70, e.g. hydraulic control lines and/or fiber optic control lines, may be positioned within the power cable 24.

[0022] Depending on the intended applications, the power cable 24 also may comprise an additional filler 71 added to insulation 58 in combination with the nano particulate filler 62. Various additional fillers 71 may be incorporated into insulation material 58 to modify material properties. The additional fillers 71 may be in the form of microscale fillers in some applications but the additional fillers 71 also may be in the form of sub-micron fillers. By way of example, such additional fillers 71 may be useful in a variety of EPDM compounds.

[0023] Examples of additional filler 71 comprise rubber compound fillers, such as kaolin clay which serves to provide mechanical reinforcement and improved extrusion quality. Available rubber compound fillers include treated electrical grade fillers such as Translink™ 37 or 77 available from BASF™. However, additional filler 71 also may comprise many other types of clay or common non-conductive elastomer fillers, such as talc, silica, and calcium carbonate. In some applications, the use of a sufficient amount of thermally conductive fillers 71 improves heat dissipation and lowers power cable temperature. The additional filler 71 also may comprise plasticizer oils to facilitate filler incorporation into the insulation material 60 and/or to improve compound flexibility. In some applications, the additional filler 71 may comprise metal oxides which serve as acid acceptors to improve heat and wet electrical aging. Other examples of additional filler 71 include antioxidants, curatives, and cure accelerators.

[0024] However, the power cable 24 may be constructed with various other features and materials. For example, the electrical power cable 24 may comprise a variety of other and/or additional components depending on the environment in which the power cable 24 is to be employed and on the parameters of a given application. Similarly, the power cable 24 may be constructed in other configurations having an individual electrical conductor 56 or a plurality of electrical conductors 56. For example, a plurality of electrical conductors 56 may be arranged to form a generally flat power cable, as illustrated in Figure 3. In this example, jacket 66 may be disposed individually around each electrical conductor 56 and its associated insulator 58. Similarly, the outer armor layer 68 may be positioned individually around each jacket 66 and/or the armor layer 68 may be positioned collectively around the plurality of electrical conductors 56.

[0025] In the example illustrated in Figure 3, the electrical power cable 24 is illustrated as having three electrical conductors 56. Depending on the application, other numbers of electrical conductors may be employed to deliver power to, for example, the downhole electrically powered system 22. In many applications, the use of three electrical conductors 56 allows delivery of three-phase power to the electrically powered system 22. For example, the power cable 24 may be designed as a three-phase power cable for delivering three-phase power to submersible motor 30 of electric submersible pumping system 26. In such applications, the electric submersible pumping system motor 30 is designed as a three-phase motor.

[0026] Depending on the application, the layers of insulation 58 may comprise a variety of insulating materials 60 combined with various types of nano-particle fillers 62. In some embodiments, the insulator layers 58 may comprise an individual layer, and other embodiments may utilize a plurality of insulation layers. Insulation layers 58 may comprise an extruded insulation layer which is extruded over the tape wrapped insulation layer 66. These and other configurations of insulator 58 may be used to provide the desired insulation between electrical conductors 56 and the surrounding fluid barrier layers 64/jacket 66.

[0027] By way of example, the insulation material 60 of insulator layers 58 may comprise low density polyethylene (LDPE), high density polyethylene (HDPE), polypropylene, ethylene propylene diene monomer (EPDM), or high density cross-linked polyethylene (XLPE). Selection of the insulation material 60 may be guided by a variety of parameters including the desired temperature rating of power cable 24. Similarly, the nano particulate filler may comprise a variety of materials, such as magnesium oxide, boron nitride, hafnium oxide, silicon dioxide, aluminum oxide, nano clay, zinc oxide, and tin oxide. The shape of the particulates also may vary between types of materials and applications.

[0028] By introducing the nano particulate fillers 62 into the insulation layer or layers 58, the dielectric properties of the material can be improved. For example, substantial improvements with respect to breakdown strength and endurance strength are provided. This phenomenon exists due to the boundary layer formed between the nano particles and the bulk insulation material 60 as the nano-particulate filler 62 is dispersed through the insulation material 60. Effectively, the particles of nano-particulate filler 62 create an extremely large amount of surface area and thereby assist in the distribution of charge instead of concentrating electrical charge in the insulation layer 58. This distribution of charge alleviates stress concentrations that would otherwise occur due to charge buildup. As illustrated in Figure 4, for example, each particle of the nano particulate filler 62 creates a boundary layer 72 having a very large surface area between each particle and the corresponding insulation material 60.

[0029] Use of the nano-particulate filler 62 in bulk insulation material 60 also improves electrical insulation properties. By modifying bulk thermoplastic and elastomer insulation materials 60 with various nano particulate filler loadings, the electrical breakdown and voltage endurance of the insulation 58 is substantially improved. In many applications, the nano-particulate filler loadings are on a relatively small scale, e.g. 5% or less, but provide substantially improved material properties with respect to the power cable 24.

[0030] Many types of nano particulate fillers 62 may be combined in various amounts with many types of insulation materials 60. Additionally, various mixtures of nano particulate fillers 62 may be loaded into one or more insulation materials 60. In a specific example, the nano particulate filler 62 is in the form of magnesium oxide and is combined with bulk insulation material 60 in the form of low density polyethylene. In this example, the nano particulate filler 62 comprises approximately a 3% loading and the breakdown strength of the insulation 58 is improved by 50%. In another specific example, the nano particulate filler 62 is in the form of silicon dioxide and is combined with bulk insulation material 60 in the form of high density cross-linked polyethylene. In this example, the nano particulate filler 62 comprises approximately a 5% loading and effectively increases the endurance strength of the insulation 58 by a factor of 100. Functionalizing the particles of the nano particulate filler 62 improves the endurance strength even more. These examples are provided to demonstrate the role of the nano particulate filler 62 in improving electrical insulation material properties and should not be construed as limiting. Many combinations of nano particulate filler 62 and bulk insulation material 60 may be selected according to the parameters of a given application.

[0031] Depending on the parameters of a given application, the other layers of power cable 24 may be formed from a variety of suitable materials. For example, the conductors 56 may be constructed as solid conductors or multi strand conductors formed of copper or another suitable electrically conductive material. The barrier layers 64 may be formed of lead, fluoropolymer, or another suitable material. The jacket 66 may be formed from elastomeric material, such as EPDM, HNBR, NBR, SBR, Silicones, Fluorosilicones, chlorinated polyethylene, chloroprene, butyl, FEPM, or other types of elastomers. Similarly, the armor layer 58 may be formed from a variety of materials, such as galvanized steel, stainless steel, Monel™, or other suitable material. Due to the improved characteristics of insulation layer 58, the materials of the other layers also may be selected to enable construction of power cable 24 with a 5 kV or higher rating.

[0032] The power cable 24 may be constructed in a variety of cable system forms, including motor lead extension systems. In addition to power cables, however, the insulation layer 58 may be constructed for use in a variety of other types of systems. For example, the insulation layer or layers 58 may be utilized in combination with motor magnet wire, brush wires, and/or coil retention systems of electric submersible pumping system motors 30. The insulation 58 also can be used in applications which benefit from materials having high dielectric strength over relatively small distances. Examples of such applications include: insulating the electrical connector 52, e.g. pothead assembly, used to connect the motor 30 with power cable 24; and providing insulation between wires and ground in slot liner films that line stator slots within submersible motor 30. In addition to such electric motor applications, the insulation 58 may be used in high voltage systems commonly found in, for example, wireline tools to improve voltage endurance and to extend the life of the wireline tools.

[0033] Referring generally to Figure 5, an embodiment of electrical connector 52 is illustrated. In this example, electrical conductors 56 comprise or are coupled with internal conductors 74 routed through an external connector housing 76 of pothead assembly 52. The internal conductors 74 are insulated from each other and from external connector housing 76 by insulation 58 which comprises insulation material 60 loaded with a desired percentage of nano-particulate material 62. By way of example, the desired percentage may be 5% or less, e.g. 3-5%.

[0034] Depending on the application, the electrical connector 52 may comprise a variety of other features. In the specific example illustrated, the internal conductors 74 of electrical connector 52 may be coupled with connector ends 78, e.g. terminals, constructed for engagement with corresponding terminals within submersible motor 30 or with another electrically powered device or system. According to some embodiments, a front block component 80 may be positioned around a base of the connector ends 78 and at least one elastomer seal 82 may be positioned between various components within electrical connector 52. Additionally, the electrical connector 52 also may comprise other suitable features, such as shrouds 84 positioned around the extending connector ends 78 as well as a packing gland 86 positioned around the connector ends 78 at a front end of the electrical connector 52.

[0035] However, the insulation 58 may be used in other locations and/or to construct other insulating features. In some applications, for example, the insulation 58 may be formed as layers 88 positioned around internal conductors 74 individually. In these embodiments, the layer or layers of insulation 58 provided around the conductive elements, e.g. internal conductors 74, improves the electrical properties of the insulation material and guards against breakdown failures in the insulation material. For example, the nano particulate filler 62 provides the insulation material 60 with high dielectric strength and long-term voltage endurance. Accordingly, the electrical connector 52 may be used in higher voltage applications and/or higher temperature environments.

[0036] Referring generally to Figure 6, another embodiment utilizing insulation layers 58 is illustrated. In this embodiment, a portion of a stator 90 of submersible motor 30 is illustrated. The stator 90 comprises a plurality of conductive stator elements 92 which form stator slots 94 therebetween. The stator slots 94 are filled with insulation 58 comprising insulation material 60 loaded with nano particulate filler 62 to a desired percentage, e.g 3-5%. Again, the layers of insulation 58 improve the electrical properties of the insulation material and guard against breakdown failures in the insulation 58. For example, the nano particulate filler 62 provides the insulation material 60 with high dielectric strength and long-term voltage endurance.

[0037] The insulation 58 may be formed in layers or a variety of other configurations to provide the desired electrical insulation properties. Additionally, the insulation 58 may be used in combination with a variety of conductors and conductive materials. In downhole applications, the insulation 58 is suitable in many types of power cables used in, for example, high voltage applications. However, the insulation 58 may be used in a variety of other well and non-well related applications that benefit from the improved characteristics of the insulation. Additionally, the type of insulation material and the type of nano-particulate filler may be of different varieties and combined in different percentages according to the parameters of a given application.

[0038] Although a few embodiments of the disclosure have been described in detail above, those of ordinary skill in the art will readily appreciate that many modifications are possible without materially departing from the teachings of this disclosure. Accordingly, such modifications are intended to be included within the scope of this disclosure as defined in the claims.

CLAIMS

What is claimed is:

1. A system for conducting electricity, comprising:

a power cable having a plurality of conductors, each conductor being surrounded by a layer of insulation and each layer of insulation being surrounded by a barrier layer, the power cable further comprising a jacket surrounding the plurality of conductors and an armor layer surrounding the jacket, each layer of insulation comprising a primary insulation material and a nano particulate filler to provide high dielectric strength and long-term voltage endurance.

2. The system as recited in claim 1, wherein the nano particulate filler comprises no more than 5% of the layer of insulation.

3. The system as recited in claim 2, wherein the insulation material comprises a low density polyethylene (LDPE) combined with the nano particulate filler.

4. The system as recited in claim 2, wherein the insulation material comprises a high density crosslinked polyethylene (XLPE) combined with the nano particulate filler.

5. The system as recited in claim 2, wherein the insulation material comprises a high density polyethylene (HDPE) combined with the nano particulate filler.

6. The system as recited in claim 2, wherein the insulation material comprises a polypropylene combined with the nano particulate filler.

7. The system as recited in claim 2, wherein the insulation material comprises an ethylene propylene diene monomer (EPDM) combined with the nano particulate filler.

8. The system as recited in claim 2, wherein the nano particulate filler comprises at least one of: magnesium oxide, boron nitride, hafnium oxide, silicon dioxide, aluminum oxide, nano clay, zinc oxide, tin oxide.

9. The system as recited in claim 2, further comprising an electric submersible pumping system coupled to the power cable.

10. The system as recited in claim 9, wherein the plurality of conductors comprises three conductors which carry three-phase power to the electric submersible pumping system.

11. A method, comprising:

preparing a power cable with a plurality of conductors;

surrounding each conductor of the plurality of conductors with a layer of insulation combining a primary insulation material with a nano particulate filler; and

enclosing the plurality of conductors with a jacket.

12. The method as recited in claim 11, wherein surrounding comprises combining the primary insulation material with an additional filler.

13. The method as recited in claim 11, further comprising protecting each layer of insulation with a barrier layer and surrounding the jacket with an armor layer.

14. The method as recited in claim 13, wherein preparing comprises preparing the power cable with three copper conductors.

15. The method as recited in claim 11, wherein surrounding comprises combining the primary insulation material with the nano particulate filler such that the nano particulate filler comprises no more than 5% of the layer of insulation.

16. The method as recited in claim 15, further comprising selecting the nano particulate filler from at least one of magnesium oxide, boron nitride, hafnium oxide, silicon dioxide, aluminum oxide, nano clay, zinc oxide, tin oxide.

17. A system, comprising:

a downhole electrical component having a plurality of conductors for conducting electricity, the plurality of conductors being separated by an insulation comprising a primary insulation material combined with a nano particulate filler, the nano particulate filler making up no more than 5% of the insulation.

18. The system as recited in claim 17, wherein the downhole electrical component comprises a pothead assembly.

19. The system as recited in claim 17, wherein the downhole electrical component comprises a stator of an electric motor.

20. The system as recited in claim 17, wherein the nano particulate filler comprises at least one of: magnesium oxide, boron nitride, hafnium oxide, silicon dioxide, aluminum oxide, nano clay, zinc oxide, tin oxide.

FIG. 1

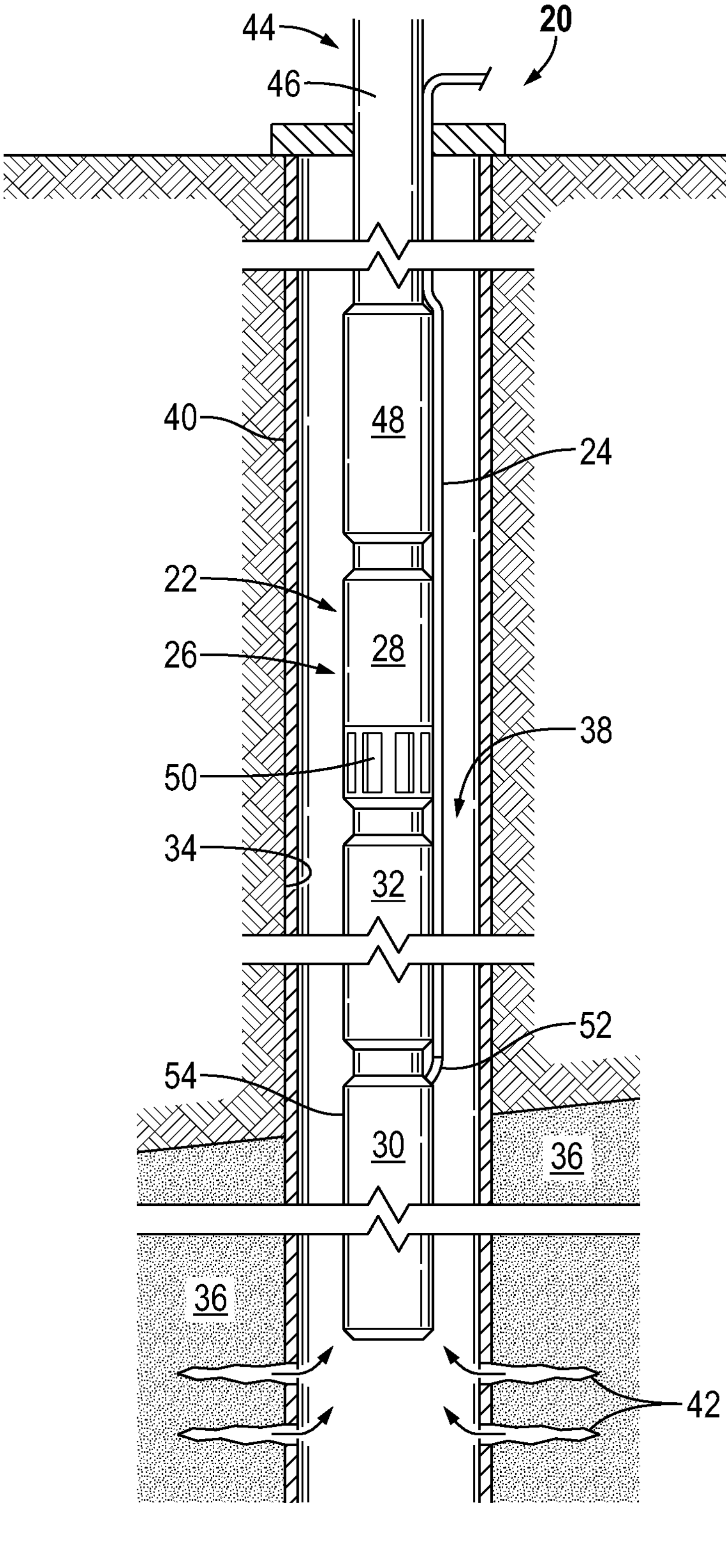

FIG. 2

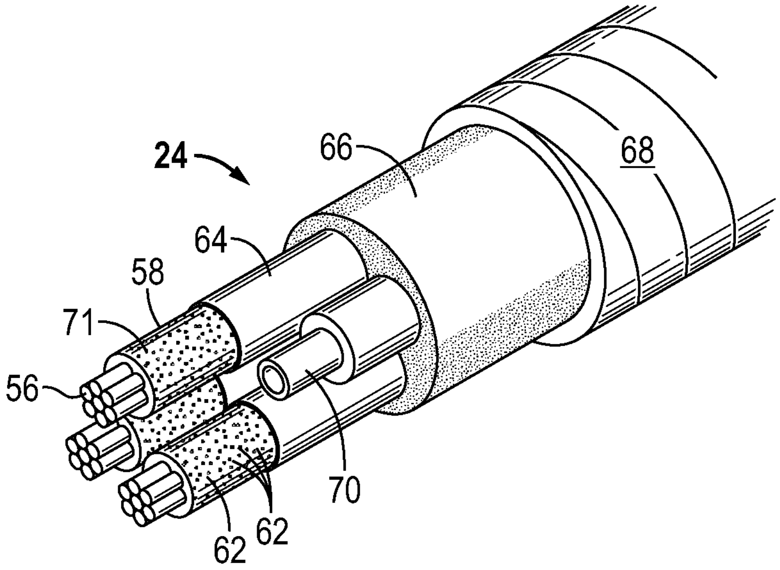

FIG. 4

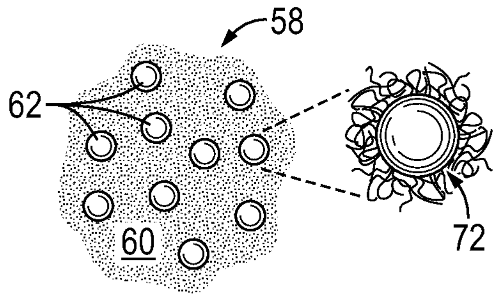

FIG. 3

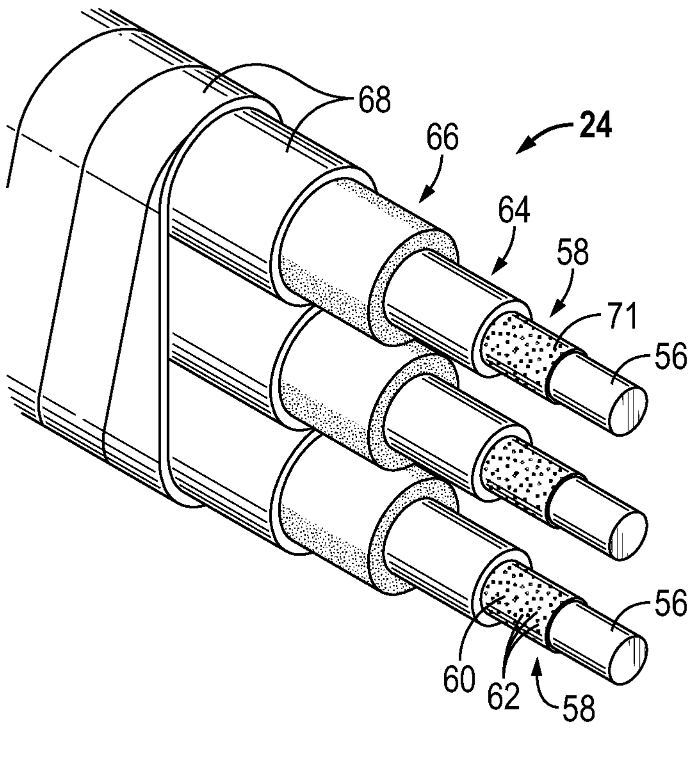

FIG. 5

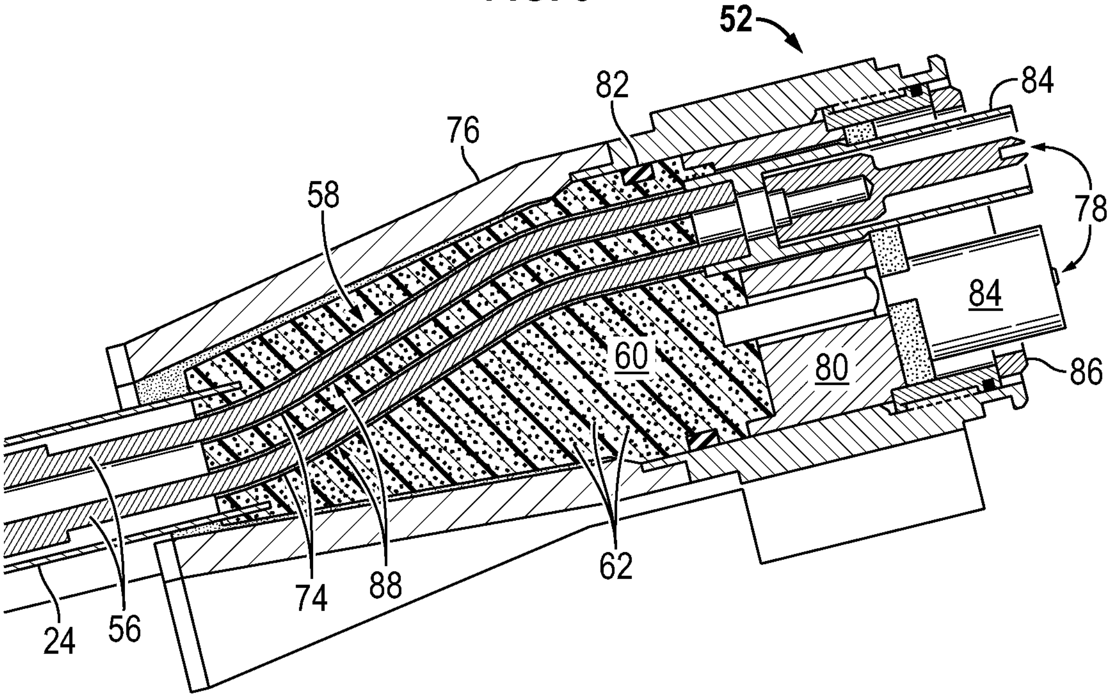
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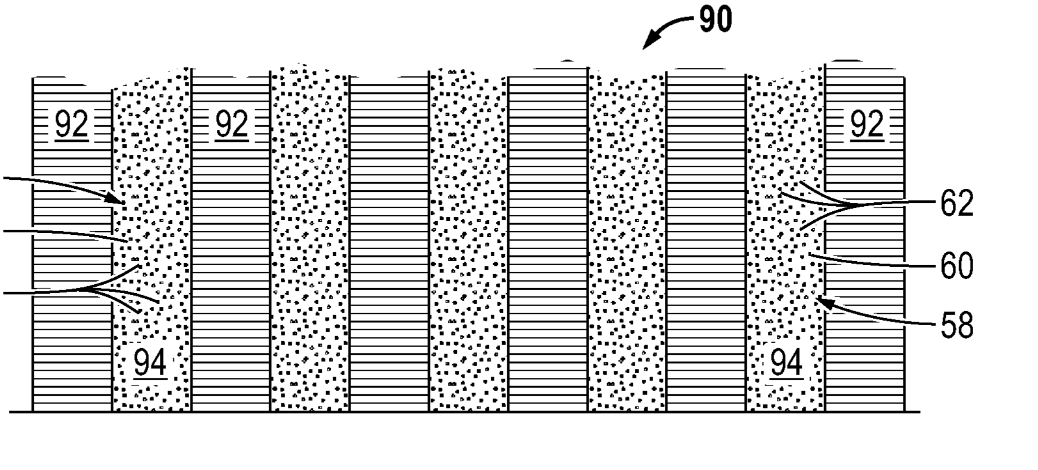
FIG. 6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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2015/027206

A. CLASSIFICATION OF SUBJECT MATTER

H01B 7/02(2006.01)i, H01B 7/282(2006.01)i

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 7/02; H02K 5/02; H01B 3/30; C08K 3/18; H01B 9/02; H01B 3/12; H02K 5/124; H01B 7/282

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & Keywords: cable, insuation, nano particle, LDPE,XLPE,HDPE,PP

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2014-0027152 A1 (JASON HOLZMUELLER et al.) 30 January 2014 See abstract, paragraphs [0019], [0025], claims 1, 3, 5, 7-8, 11, 18-19 and figure 4.	1-20
Y	WO 2011-112704 A2 (GENERAL CABLE TECHNOLOGIES CORPORATION et al.) 15 September 2011 See abstract, paragraphs [0026]-[0027], [0037] and claims 1, 3, 16.	1-20
Y	US 2014-0042835 A1 (SCHLUMBERGER TECHNOLOGY CORPORATION) 13 February 2014 See abstract, paragraphs [0042], [0143] and claims 1, 17.	19
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☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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21 January 2016 (21.01.2016)	**22 January 2016 (22.01.2016)**

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