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(54) **THREE CORE POWER CABLES WITH SURROUNDING PLASTIC FILLER**

(57) A power cable having the components of a traditional three-core, steel wire armored power cable, but eliminating the metallic armoring wires. Impact resistance is provided by extruded plastic fillers (3) that are arranged to fill the interstices between conductors, and surround the conductors. The plastic fillers comprise an interstices-filling central portion (12) and two outwardly extending curved wing portions (13). The wing portions

have a length and shape such that ends of adjacent wing portions abut one another and form a barrier between the intermediate core and the outer covering. The curved inner surface of the wing portions, together with curved inner surfaces of the interstices-filling central portion form semi-circular or mostly circular channels with which are positioned the cores.

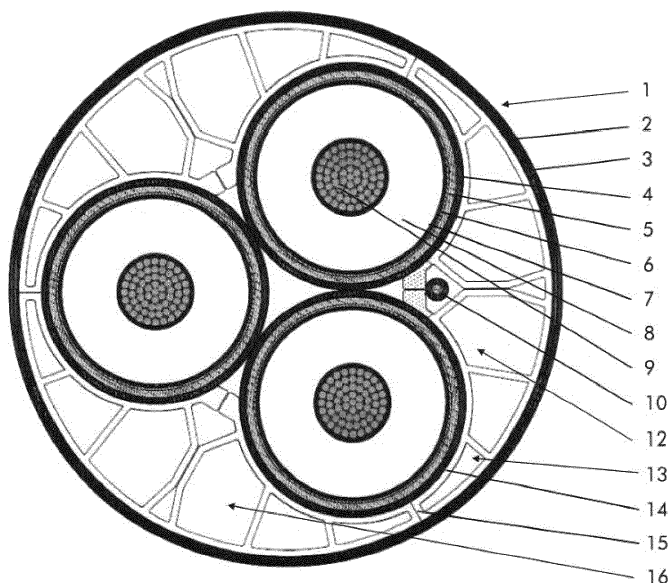


Figure 2

Description

Filed of the invention

[0001] The invention relates to impact resistant power cables, in particular to multipolar power cables, more particularly to three-core power cables.

Background

[0002] Impact resistant multipolar cables are employed in a number of industries. Such cables provide protection against accidental impact to the cable. The cables can provide distribution of low, medium or high voltage electrical power.

[0003] As used herein, "low voltage" means voltage less than about 1 kV.

[0004] As used herein, "medium voltage" means voltage between about 1kV - 36 kV..

[0005] As used herein, "high voltage" means voltage greater than about 36 kV.

[0006] A particular type of cable, known as a "steel wire armored cable" commonly abbreviated "SWA", is a hard wearing power cable designed for the supply of mains electricity. It is one type of a number of armored electrical cables, and is used in underground systems, power networks and subsea applications. A particular type of SWA is an armored three-core power cable, known to one skilled in the art of power cables.

[0007] Traditional three-core power cables comprise three insulated conductors grouped together in the center of the cable, and surrounded by an outer covering or roving. The cable has so-called interstitial zones between any two adjacent cores and the outer covering. As used herein, the term "interstitial zone" refers to the generally triangular shaped area defined by the space between two adjacent cores and the immediately opposing inner surface of the outer layer. By "immediately opposing" is meant the general area of the portion of the outer covering at a point that intersects the shortest segment of a line that is perpendicular to a line bisecting the two cores. The term "triangular" is only meant in a general sense, as the opposing segment of the outer cover is obviously curved, as are the cores themselves.

[0008] An extruded plastic profile known as a "filler" is arranged to fill the interstitial zones and hold the three conductors in a relative position so as to maintain the cable's circular cross section. A binder layer is often arranged about the filler, and a layer of wound metallic armoring wires is arranged between the binder and the outer covering. An illustration of known prior art SWA cables is illustrated in Figure 1. The purpose of the metallic armoring wires is to provide tensile strength and impact resistance for the power cable. As shown in Figure 1, in traditional power cables the plastic fillers do not completely surround the conductors. This is not necessary, as in the prior art it is the steel wires, not the fillers, that provide impact protection for the cores.

[0009] While the metallic armoring provides a benefit in terms of impact protection, the armoring has drawbacks. The metallic armoring adds weight to the cable, as well as cost. In addition, the metallic armoring causes a condition known as "armor loss", that can decrease the current rating of the cable. Armor loss occurs due to circulating currents in the armoring due to fluctuating electrical fields and due to charging current. The current rating and current loss of three-core power cables is calculated using the IEC 60287 standard.

[0010] WO2015040488 describes disadvantages of metal armor wires in a power cable, and suggests eliminating them, and instead using a solid "expandable polymeric material" that surrounds the cores in addition to an "expanded resistance layer". The "expanded polymeric material" is not, however, a pre-extruded plastic profile.

Summary of the invention

[0011] The present invention has as its object to overcome the deficiencies of the prior art, in particular the disadvantages caused by metallic armoring wires, while providing a simple and cost effective arrangement for filling the interstitial zones of the cable. The power cable of the invention comprises the components of a traditional three-core power cable, but eliminates the metallic armoring wires. Impact resistance is provided instead by extruded plastic fillers that surround the cores. The fillers are arranged to fill the interstices between conductors, and surround the conductors. The plastic fillers comprise an interstices-filling central portion and two outwardly extending curved arm portions. The arm portions have a length and shape such that ends of adjacent arm portions abut one another and form a barrier between the intermediate core and the outer covering. The curved inner surface of the arm portions, together with curved inner surfaces of the interstices-filling central portion form semi-circular or mostly circular channels with which are positioned the cores.

Brief description of the drawings

[0012] The invention will be described in detail with reference to the following figures, wherein:

Figure 1 is an illustration of the prior art

Figure 2 is a cross sectional view of an embodiment of the cable according to the invention

Figure 3 is a perspective view of an embodiment of the cable according to the invention

Detailed description

[0013] As shown in figures 2 and 3 a three-core power cable 1 is provided. According to one possible embodiment, the cable comprises three power cores. Power

cores can have various designs. A non-limiting example of power cores is illustrated in figure 2 and 3, where the power cores comprise a conductor 9, typically made of copper or aluminum in the form of twisted wires or a rod, surrounded by an insulation layer 8. Surrounding insulation layer 8 is an outer semi conductor 7. A water swella-
 5 ble tape 6 surrounds semi conductor 7. Arranged about swella-
 10 ble tape 6 is a lead sheath 5. On the outside of the power core is a PE sheath 4. It should be understood that the power core described above is only illustrative of the various configurations possible for the power cores.

[0014] Arranged between the power cores and filling the interstitial zones are three extruded plastic profiles or "fillers" 3. The fillers, when viewed in cross section, have a central, interstices-filling portion 12 as well as two curved "arm" portions 13. The fillers have curved outer surfaces, whereby, when positioned within the cable, the arm portions of adjacent fillers abut to form a continuous circumference radially surrounding the power cores. According to one alternate aspect, the ends of the curved arm portions of the profile, again when viewed in cross section, may be equipped with a "male" protrusion and a "female" indentation, such that adjacent filler profiles interlock. As can be seen in figure 2, the point of abutment of two adjacent arms is immediately between a core and the inner surface of the outer covering.

[0015] The fillers 3 have a longitudinal, semi-circular curved face 14 along the inner surfaces of the arm and interstices-filling portions of the filler profiles. When adjacent fillers abut one another, the adjacent curved faces 14 create a mostly circular or semi-circular longitudinal channel in which a power core is arranged. An outer covering or server layer 2, made of for example of polypropylene (PP) yarn, polyethylene (PE) sheath or other suitable material surrounds the fillers. The term "suitable" in this connection means that the material has properties allowing the serving layer to perform the function of mechanical protection and to provide friction for pulling units etc.

[0016] The extruded filler profiles have a plurality of internal longitudinal walls, forming a honeycombed internal structure comprising a plurality of cells 16.

[0017] The fillers may optionally comprise one or more spaces formed by adjacent profiles for arranging one or more auxiliary cables such as a fiber optical cable 10.

[0018] The filler are designed to withstand impact. The fillers according to one aspect are formed of PE or other suitable plastic material.

Claims

1. A power cable (1) comprising:

a. a plurality of cores (9), surrounded by an outer covering (2), the area between any two adjacent cores and the immediately opposing inner sur-

face of the outer covering defining an interstitial zone,

b. a plurality of elongated plastic fillers (3), said fillers having a central, interstices-filling portion (12) arranged to essentially fill an interstitial zone, and two curved, outwardly extending arm portions (13),

c. wherein at least a part of the arm portions are arranged intermediate the cores and the outer covering, forming a barrier between the cores and the inner surface of the outer covering.

2. A power cable according to claim 1, wherein arm portions of adjacent fillers abut to form the barrier between the cores and the outer covering.

3. A power cable according to one of the preceding claims, wherein

a. the arm portions and the interstices-filling portion have a curved inner surface, and

b. the curved inner surfaces of the arm portions and interstices-filling portions of adjacent fillers form mostly circular or semi-circular channels, in which channels are arranged the cores.

4. A power cable according to one of the preceding claims wherein the plastic material of the filler is arranged to withstand and protect against accidental impact against the cable.

5. A power cable according to one of the preceding claims wherein the fillers comprise a plurality of internal walls 15 defining a plurality of elongated cells 16.

6. A power cable according to one of the preceding claims, wherein one or more auxiliary cables is arranged in one or more of the elongated cells.

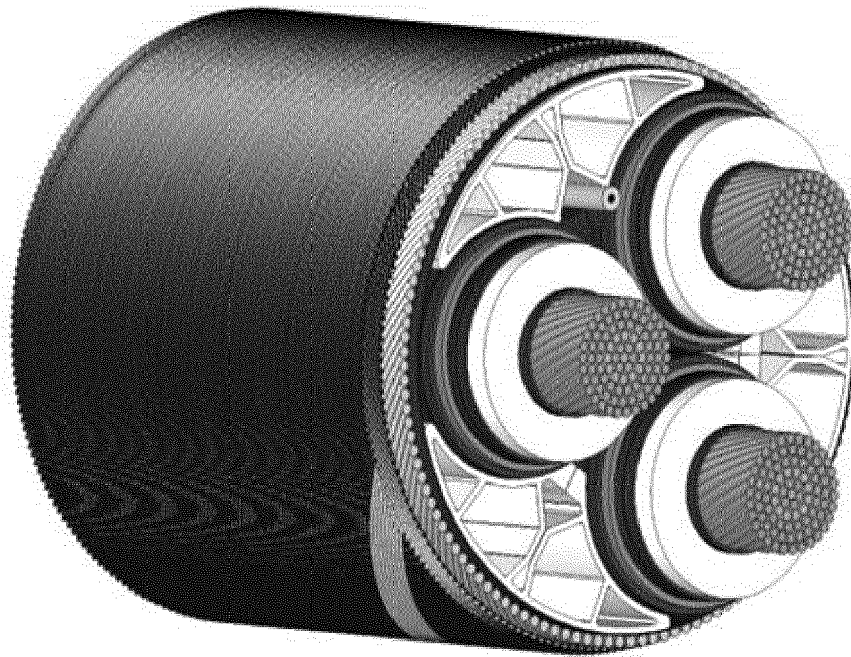
7. A power cable according to one of the preceding claims, wherein the number of cores is three.

8. A power cable according to one of the preceding claims wherein the cable is a high voltage cable.

9. A power cable according to one of the preceding claims wherein the cable is a medium voltage cable.

10. A power cable according to one of the preceding claims wherein the cable is a low voltage cable.

11. A power cable according to one of the preceding claims wherein the number of filler is equal to the number of cores.



Prior Art

Figure 1

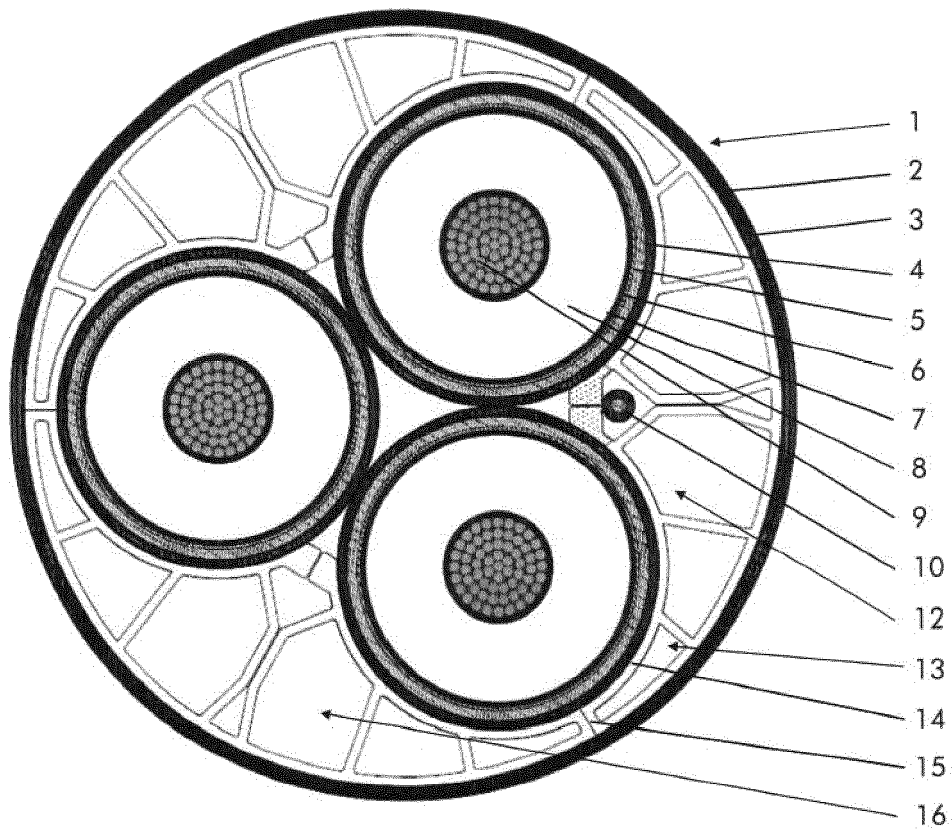


Figure 2

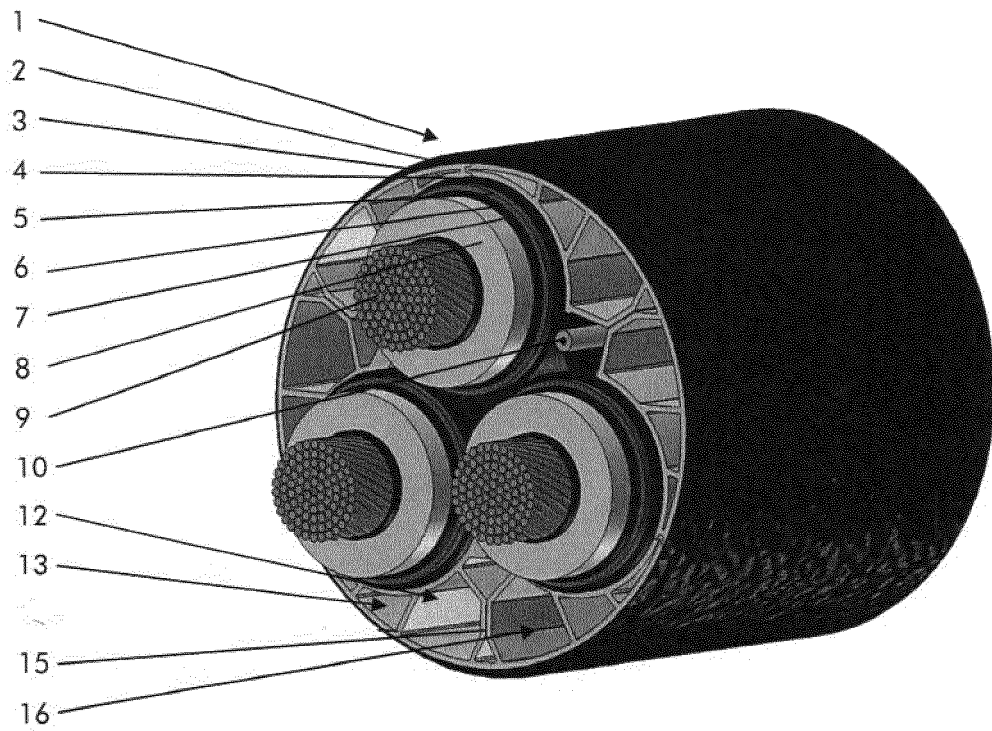


Figure 3



EUROPEAN SEARCH REPORT

Application Number
EP 16 30 5537

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	WO 2014/202141 A1 (ABB TECHNOLOGY LTD [CH]) 24 December 2014 (2014-12-24) * figures 1,2 * -----	1	INV. H01B7/18
			TECHNICAL FIELDS SEARCHED (IPC)
			H01B G02B
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 17 October 2016	Examiner Salm, Robert
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 L : document cited for other reasons & : member of the same patent family, corresponding document	

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EPO FORM 1503 03.02 (P04C01)

17-10-2016

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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