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(54) Benævnelse: **TRELEDERSTRØMKABLER MED OMGIVENDE UDFYLDNINGSELEMENTER AF PLAST**

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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 1 in addition to an "expanded resistance layer". The "expanded polymeric material" is not, however, a pre-extruded plastic profile.

[0011] While documents US 8 723 030 B2 and WO 2011/059337 A1 disclose power cables according to the preamble of claim 1.

Summary of the invention

[0012] The present invention according to claim 1 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

[0013] 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

[0014] As shown in figures 2 and 3 a three-core power cable 1 is provided. Power cores can have various designs. A power cord according to the invention 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 swellable tape 6 surrounds semi conductor 7. Arranged about swellable tape 6 is a lead sheath 5. On the outside of the power core is a PE sheath.

[0015] 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.

[0016] 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 that the material has properties allowing the serving layer to perform the function of mechanical protection and to provide friction for pulling units etc.

[0017] The extruded filler profiles have a plurality of internal longitudinal walls, forming a honeycombed internal structure comprising a plurality of cells 16.

[0018] 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.

[0019] The filler are designed to withstand impact. The fillers according to one aspect are formed of PE or other suitable plastic material.

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- WO2015040488A **[0010]**
- US8723030B2 **[0011]**
- WO2011059337A1 **[0011]**

Patentkrav

1. Strømkabel (1), der omfatter:
a. en flerhed af ledere (9), der er omgivet af en udvendig beklædning (2), idet området mellem enhver to tilstødende ledere og den umiddelbart modstående indvendige overflade på den udvendige beklædning definerer en interstitiel zone,
b. en flerhed af lange udfyldningselementer af plast (3), idet udfyldningselementerne har en central del, der udfylder mellemrummet (12), som er arrangeret til i det væsentlige at udfylde en interstitiel zone, og to buede armdele, der strækker sig udad, (13),
c. mindst en del af armdelene er placeret mellem lederne og de udvendige beklædning, idet der dannes en barriere mellem lederne og den indvendige overflade af den udvendige beklædning,
kendetegnet ved, at antallet af ledere (9) samt antallet af udfyldningselementer (3) er tre, og hvor armdelene (13) af de tilstødende udfyldningselementer (3) støder op mod hinanden for at danne barrieren mellem lederne (9) og den udvendige beklædning (2).

2. Strømkabel ifølge krav 1, hvor to tilstødende udfyldningselementer støder mod hinanden mellem en leder (9) og den indvendige overflade af den udvendige beklædning (2).

3. Strømkabel ifølge ét af de foregående krav, hvor
a. armdelene og den del, der udfylder mellemrum, har en buet indvendig overflade, og
b. de buede indvendige overflade på armdelene og de dele af tilstødende udfyldningselementer, der udfylder mellemrum, danner for det meste cirkelformede eller halvcirkelformede kanaler, hvor lederne er placeret.

4. Strømkabel ifølge ét af de foregående krav, hvor plastmaterialet af udfyldningselementet er placeret til at modstå og beskytte mod utilsigtede slag mod kablet.

5. Strømkabel ifølge ét af de foregående krav, hvor udfyldningselementerne omfatter en flerhed af interne vægge 15, der definerer en flerhed af lange celler 16.

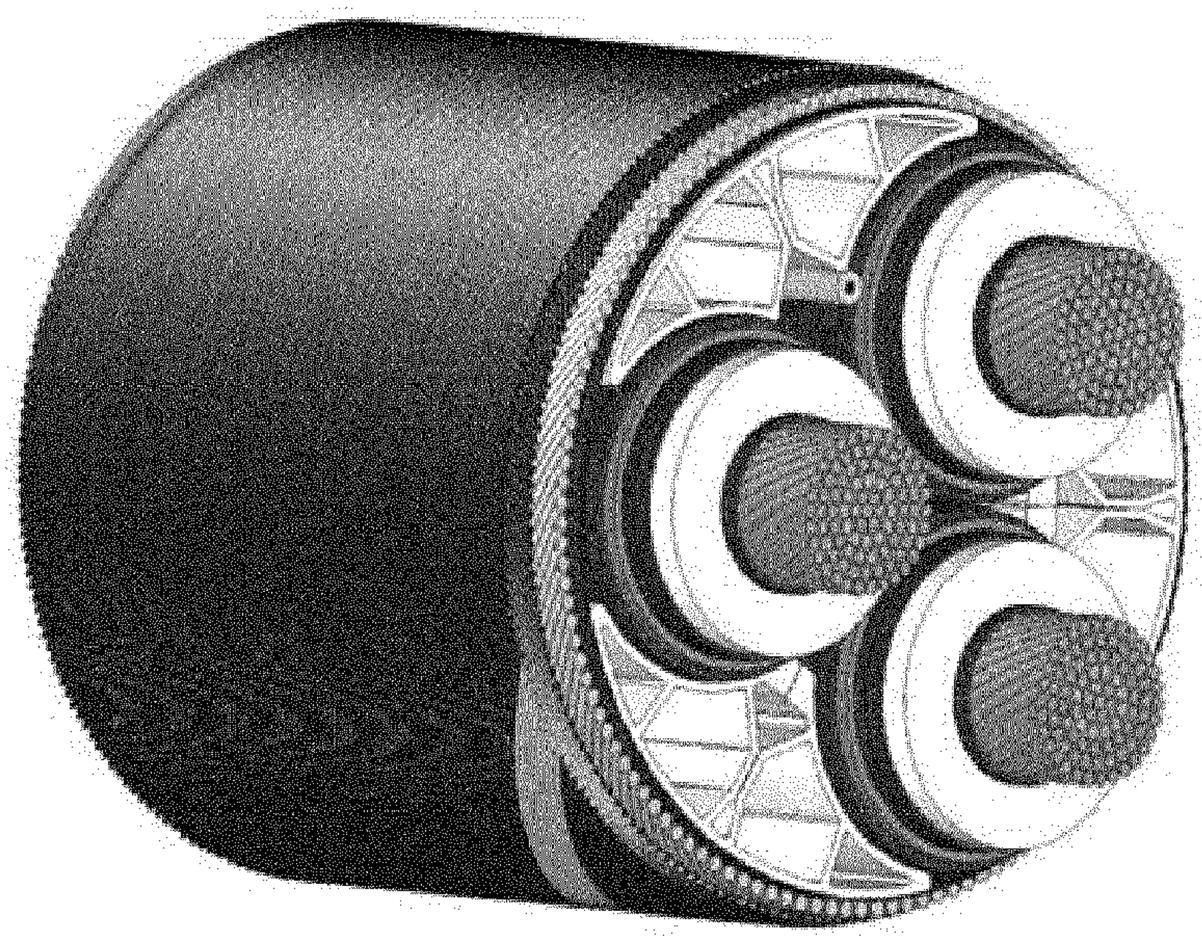
6. Strømkabel ifølge ét af de foregående krav, hvor der er placeret én eller flere hjælpekabler i én eller flere af de lange celler.

7. Strømkabel ifølge ét af de foregående krav, hvor kablet er et højspændingskabel.

8. Strømkabel ifølge ét af de foregående krav, hvor kablet er et mellemspændingskabel.

9. Strømkabel ifølge ét af de foregående krav, hvor kablet er et lavspændingskabel.

DRAWINGS



Prior Art

Figure 1

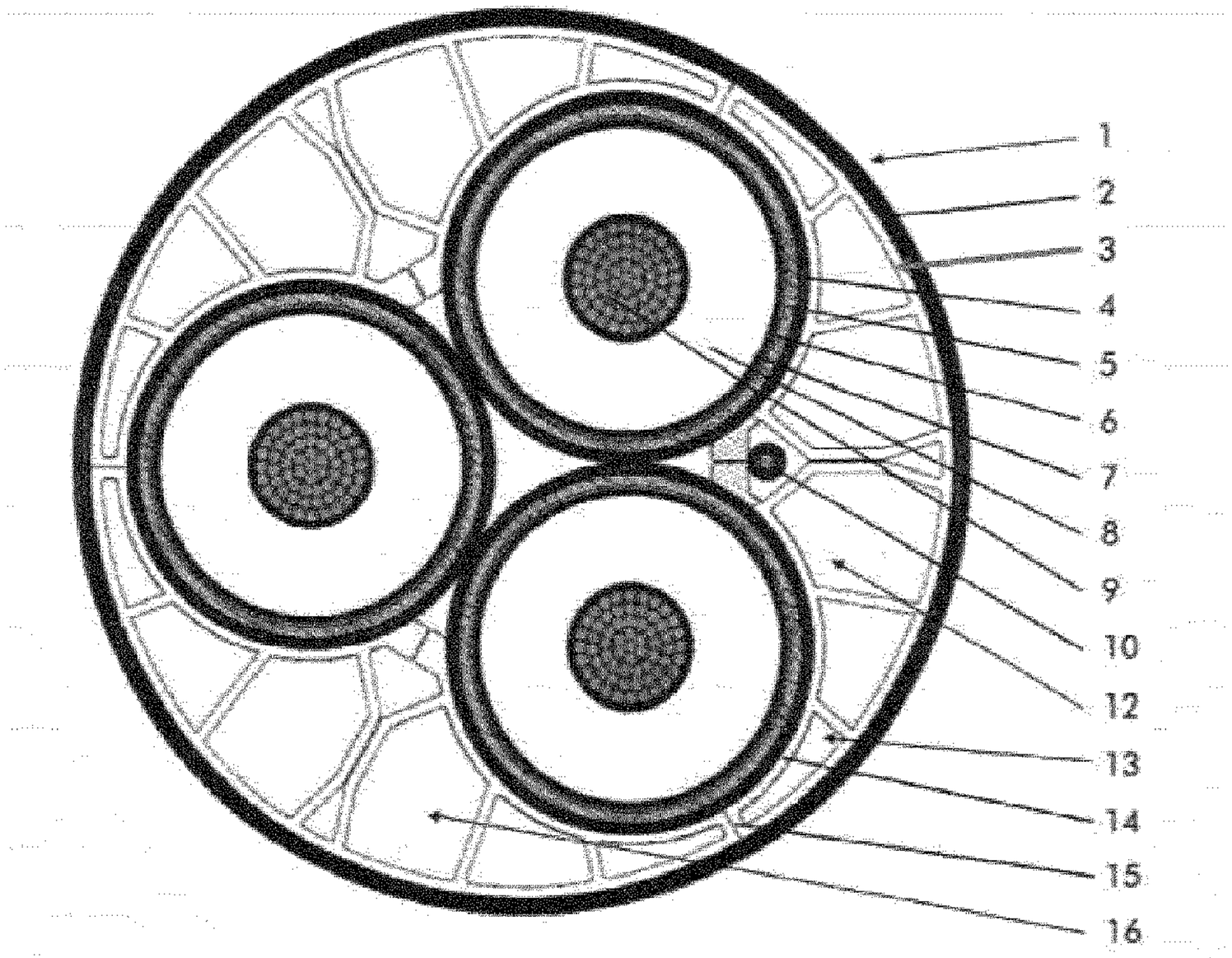


Figure 2

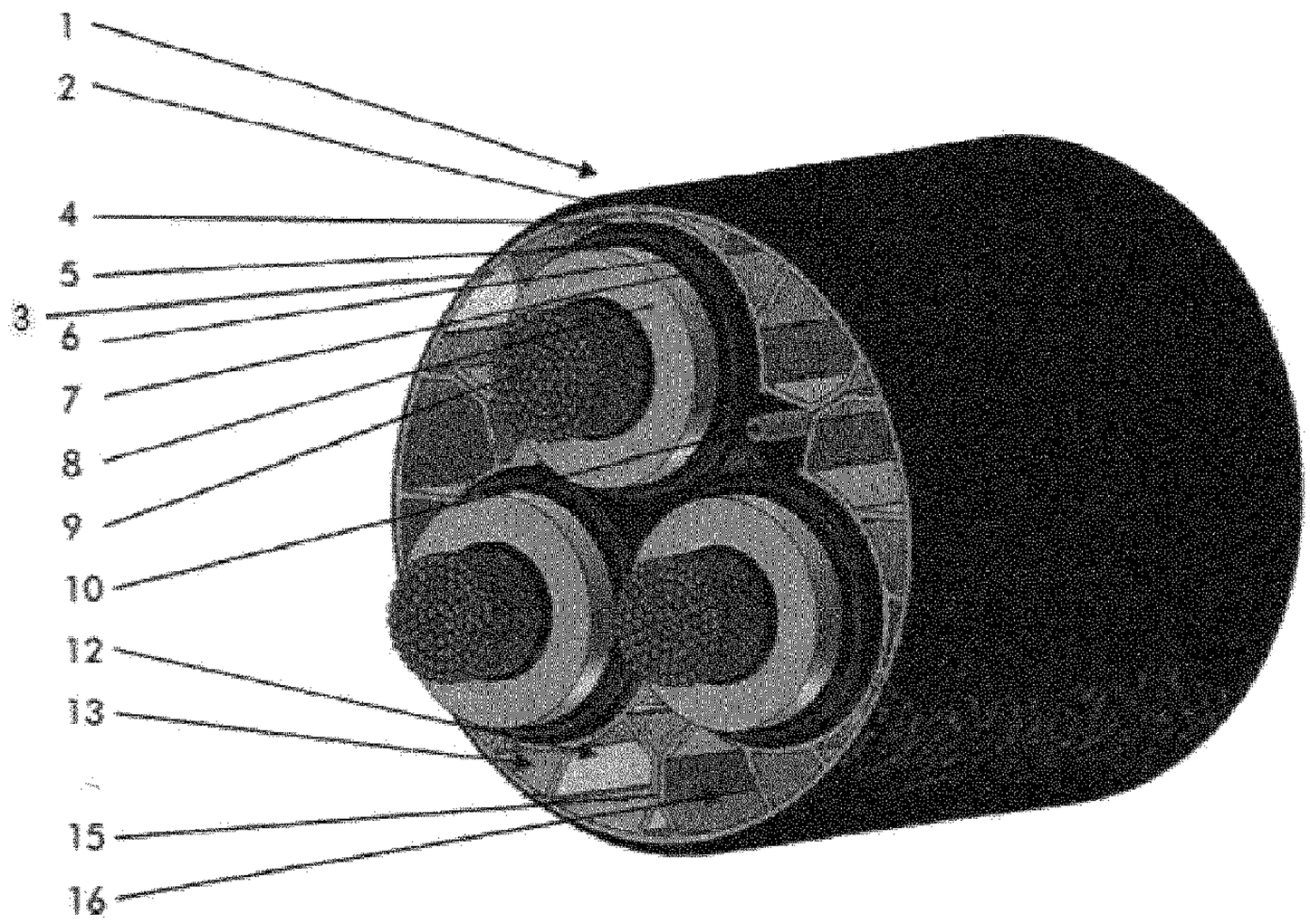


Figure 3