



(11) **EP 3 282 454 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
14.02.2018 Bulletin 2018/07

(51) Int Cl.:
H01B 9/00 (2006.01) H01B 7/04 (2006.01)

(21) Application number: **17306058.3**

(22) Date of filing: **08.08.2017**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
MA MD

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(30) Priority: **11.08.2016 KR 20160102373**

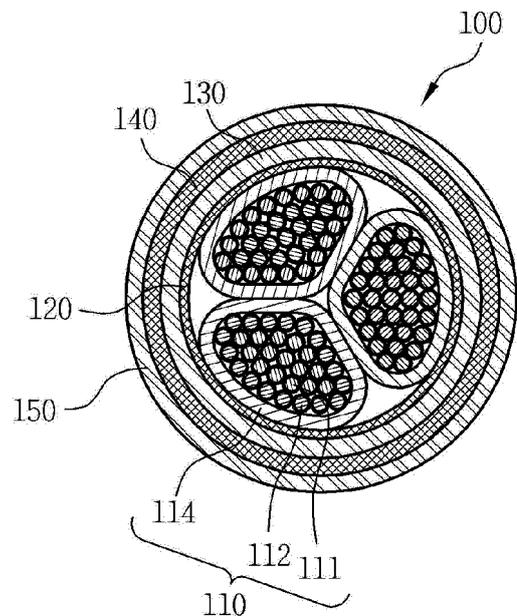
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(54) **POWER CABLE HAVING FLEXIBLE SECTORAL CONDUCTORS**

(57) The present invention relates to a power cable (100) having flexible shaped sectors (110) and is for implementing a shaped sector (110) having flexibility and for securing flexibility while the fan-shaped form of the shaped sector (110) is firmly maintained without being disordered when a power cable (100) using a flexible shaped sector (110) is fabricated. To this end, the present invention is characterized in that in a power cable (100) including one or a plurality of shaped sectors (110), the shaped sector (110) includes inner conductors (111) formed of first type wire cores and outer conductors (112) formed of second type wire cores and the first type wire cores and the second type wire cores are heterogeneous conductors having different materials and/or different wire shape.

[Figure 2]



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Description

[TECHNICAL FIELD]

5 **[0001]** The present invention relates to a power cable having flexible shaped sectors and, more particularly, to a power cable having flexible shaped sectors, wherein it can firmly maintain the shape of sectors, can secure flexibility, and can be fabricated without replacing equipment even in existing equipment in which the processing process and insulation process of a shaped sector have been separated, thereby being capable of improving workability.

10 [BACKGROUND OF THE INVENTION]

[0002] In general, a power cable includes a conductor playing the role of the passage of an electrical flow within the cable and an insulating layer surrounding the conductor. The conductor of such a cable is regulated as a metric size in IEC 60228 and BS 6360, and as an American Wire Gage (AWG) in ASTM as shown in Table 1 below.

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[Table 1]

Classification of conductor	IEC60228	BS6360	ASTM
Solid conductor	class 1	class 1	class A
Stranded conductor	class 2	class 2	class B,C,D
Flexible conductor	class 5	class 5	class I,K
More flexible conductor	class 6	class 6	class M
Classification unit	Metric	Metric	Circular Mil

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[0003] The shape of the conductor may be divided into a round conductor and a sector (fan-shaped) conduct.

[0004] The round conductor may be divided into a common concentric conductor formed by twisting conductors in a spiral form in a conductor stranding process, and a compressed conductor and compacted conductor having a diameter reduced by minimizing the gap of wire rods using a mechanical compression method in a conductor stranding process.

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[0005] The sector conductor is fabricated in a fan shape by compacting concentric conductors in two-core or more multi-wire cables. The gap between wire rods can be reduced in a process of binding the concentric conductors.

[0006] Accordingly, a cable using sector conductors (hereinafter abbreviated as a "sector cable" and refer to FIG. 1(b)) does not require an additional filling for filling the gap and can reduce its diameter compared to a cable using round conductors (hereinafter abbreviated as a "round cable"), such as that illustrated in FIG. 1(a). Accordingly, there are advantages in that the cable using sector conductors can be fabricated with light weight and can reduce costs because weight of a coating matter or metal sheath consumed for an actual sector cable may be smaller than that of the round cable although the coating matter or the metal sheath is coated in the same thickness compared to the round cable in a subsequent insulating process. For example, the diameter reduction and weight reduction effects of each sector cable corresponding to two round cables (3C×70mm²,3C×120mm²) having different sizes are illustrated in Table 2 below.

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[Table 2]

Size	Total diameter (mm)			Weight (kg)		
	Class 2	Sector	%	Class 2	Sector	%
3C×70mm ²	32.2	26.6	-17.3	2.38	2.21	-7.1
3C×120mm ²	40.6	33.0	-18.7	4.03	3.73	-7.4

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[0007] The sector cable is chiefly applied to an onshore cable because the prime cost can be reduced compared to the round cable in terms of cost when the cable is installed due to such diameter reduction and weight reduction effects of the sector cable.

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[0008] However, such a sector cable has a disadvantage in that use of the sector cable in a narrow space, such as a vessel, is very limited due to the lack of flexibility.

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[0009] Table 3 below illustrates the result values of relative comparison tests for each item, which were performed on the assumption of the routing of a cable that passes through several curved points using a round cable and sector cable having the same size.

[Table 3]

Test item	HIS	SECTOR	Ratio (%)
Total diameter	36.8mm	29.8mm	-19.0%
Weight	2880kg/km	2462kg/km	-14.5%
Traction power	61.2kg	79.6kg	30%
Friction resistance	2.12	3.24	52%

[0010] As illustrated in Table 3, it may be seen that in the case of the sector cable, a traction power required to move the cable is about 30% or more compared to the round cable due to the lack of flexibility.

[0011] Meanwhile, the sector conductor can be extruded in a form having a specific thickness only when the head of an extruder from which an insulating matter is output rotates in the same cycle as that of the conductor when a sector cable is fabricated because a fan-shaped conductor is rotated at specific intervals. It is however practically impossible to extrude a compound of a rubber characteristic material in a constant thickness on the fan-shaped conductor that rotates at specific intervals. Accordingly, such a sector cable has many limitations in selecting an insulator, and the insulator of a sector cable now on the market uses, for example, cross-linked polyethylene (XLPE) as a compound having a plastic characteristic.

[0012] However, such cross-linked polyethylene (XLPE), etc. has a disadvantage in that it is not eco-friendly because resins cannot be recycled if the lifespan of the cable expires and thus cross-linked polyethylene are inevitably discarded by incineration.

[0013] Accordingly, Korean Patent Application Publication No. 10-2015-0108962 (October 01, 2015) (hereinafter abbreviated as a "Patent Document 1") discloses a technology regarding a sector cable.

[0014] In accordance with Patent Document 1, light weight can be achieved while reducing the external diameter of the cable, sector insulation can be performed without sector chafing or falling-behind, and manufacturing costs can be reduced while maintaining resistance performance of a conductor, but the flexibility of the sector cable has not been improved as illustrated in Table 3.

[0015] Furthermore, in a cable manufacturing process, the sector cable cannot maintain a fan-shaped form in a subsequent insulating work process because the shape of sector conductors placed under a conveyance drum is disordered in a process of winding and stacking fan-shaped (sector) conductors on the conveyance drum although the shape of the fan-shaped conductors has to be maintained without being disordered up to an insulation process, that is, a next process.

[0016] Due to such a problem, the sector conductor has to be reflected in the layout of a factory so that the processing work and insulating work of the sector conductor can be performed in one process at the same time. Accordingly, there were problems in that existing conductor processing equipment must be changed and insulating equipment must be invested for the purpose of sector conductor processing.

[Prior Art Document]

[Patent Document]

[0017] (Patent Document 1) KR 10-2015-0108962A, published on October 01, 2015.

[CONTENTS OF THE INVENTION]

[PROBLEMS TO BE SOLVED]

[0018] Accordingly, the present invention has been invented to solve the above problems, and an object of the present invention is to provide a power cable having flexible shaped sectors, which can implement a shaped sector having improved flexibility compared to a conventional sector conductor, can firmly maintain the fan-shaped form of shaped sectors and secure flexibility in a process of stacking the shaped sectors below a conveyance drum while being wound on the conveyance drum in order to convey the shaped sectors to an insulating process for the purpose of the insulation of the shaped sectors when fabricating the power cable using the shaped sectors, and can be fabricated without replacing equipment even in existing equipment in which the layouts of the processing process and insulation process of shaped sectors have been separated, thereby being capable of improving workability.

[MEANS FOR SOLVING THE PROBLEMS]

- 5 [0019] One embodiment of the present invention for achieving the object is a power cable characterized in that in a power cable including one or a plurality of shaped sectors, the shaped sector includes inner conductors formed of first type wire cores and outer conductors formed of second type wire cores, and the first type wire cores and the second type wire cores are heterogeneous conductors having different materials and/or different wire shape.
- 10 [0020] More particularly, said shaped sector can comprise inner conductors and outer conductors, said inner conductors comprising wire cores of a first type, and said outer conductors comprising the outmost layer which includes wire cores of a second type, said first type of cores being different from said second type of cores in terms of materials or shapes, or in terms of materials and shapes.
- [0021] The diameter of the first type wire cores can be inferior to the diameter of the second type wire cores.
- [0022] The outer conductors can be pressed to form said sector shape.
- [0023] Said inner conductors can comprise multi-wire cores.
- [0024] Said outer conductors can comprise stranded conductors.
- 15 [0025] Said inner conductors can comprise conductors of class 5 or 6 of IEC 60228 and BS 6360 standard, or class I, K or M of ASTM standard.
- [0026] Said outer conductors can comprise conductors of class 2 of IEC 60228 and BS 6360 standard, or class B of ASTM standard.
- 20 [0027] The power cable having flexible shaped sectors according to one embodiment of the present invention may be configured as another embodiment further including an insulating layer surrounding the outskirt of said shaped sector.
- [0028] Said insulating layer can coat the outside of each of the shaped sectors by surrounding the shaped sector at a specific thickness.
- [0029] Said shaped sector further can comprise a separating layer being positioned between said insulating layer and said outer conductors, and surrounding the outskirt of said outer conductors.
- 25 [0030] The power cable having flexible shaped sectors may be configured as yet another embodiment further including a binding layer combining each shaped sector.
- [0031] Said binding layer can bind the shaped sectors surrounded by the insulating layer, so that the bound shape forms a circular cross section and by compressing and binding neighboring shaped sectors so that the radius portions of the neighboring shaped sectors are subjected to a surface contact up to the central part of the circle.
- 30 [0032] In a preferred embodiment, the power cable can further comprise an internal sheath layer surrounding said binding layer, an external metal cladding layer surrounding said internal sheath layer; and an external sheath layer surrounding said external metal cladding layer. A metal insulating layer can further be positioned between said binding layer and said internal sheath layer.
- [0033] Furthermore, the power cable having flexible shaped sectors may be configured as yet another embodiment further including a metal insulating layer surrounding the outside of the binding layer.
- 35 [0034] The power cable having flexible shaped sectors according to each embodiment of the present invention may be configured to further include an internal sheath layer surrounding the outside of the conductor layer, the insulating layer, the binding layer or the metal insulating layer, an external metal cladding layer surrounding the outside of the internal sheath layer, and an external sheath layer surrounding the outside of the external metal cladding layer.
- 40 [0035] Furthermore, in the power cable having flexible shaped sectors according to each embodiment of the present invention, each of the shaped sectors may be configured to include inner conductors formed by assembling and stranding a plurality of first type wire cores and outer conductors formed of second type wire cores different from the first type wire cores, disposed to surround the outermost side of the inner conductors, and formed to finish the shape of the assembly stranded wires.
- 45 [0036] Furthermore, each of the shaped sectors may be configured to further include a separating layer surrounding the outside of the outer conductor in order to prevent the second type wire cores that form the outer conductors from adhering to an insulator to be coated in a next process.

[EFFECTS OF THE INVENTION]

- 50 [0037] In accordance with the present invention, a shaped sector having improved flexibility can be fabricated using the shaped sector including the inner conductor and outer conductor formed of heterogeneous conductors. Furthermore, work productivity can be improved because a shaped sector can be conveyed to an insulating process after a process of manufacturing the shaped sector when fabricating a power cable using a shaped sector and thus the power cable can be fabricated without replacing equipment or a layout in existing factory equipment in which the layouts of the processing process and insulation process of the shaped sector have been separated.
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[BRIEF DESCRIPTION OF THE DRAWINGS]

[0038]

5 FIGS. 1(a) and 1(b) are cross-sectional views illustrating the insulation binding state of a round conductor and a sector conductor according to a conventional technology.
FIG. 2 is a cross-sectional view of a power cable having flexible shaped sectors according to one embodiment of the present invention.
10 FIG. 3 is a cross-sectional view of a power cable including flexible shaped sectors according to another embodiment of the present invention.
FIGS. 4(a) and 4(b) are extracted cross-sectional views illustrating a round conductor prior to a change of a shape before compression and a shaped sector after a change of a shape by compression in the power cable having flexible shaped sectors according to the present invention.

15 [DETAILED CONTENTS FOR IMPLEMENTING THE INVENTION]

[0039] An overall configuration and operation of a power cable having flexible shaped sectors according to the present invention are described in detail with reference to the accompanying drawings.

20 **[0040]** Terms or words used in this specification and claims should not be construed as having common or dictionary meanings, but should be construed as having meanings and concepts that comply with the technical spirit of the present invention based on the principle that the inventor may appropriately define the terms or words as concepts for describing them in such a way as to best describe his or her invention. Accordingly, the constructions illustrated in the embodiments and drawings written in this specification are only the most preferred embodiments of the present invention. Therefore,
25 it should be understood that a variety of equivalents and modifications capable of substituting the embodiments may be present at the time of filing of this application.

[0041] FIG. 2 is a cross-sectional view of a power cable having flexible shaped sectors according to one embodiment of the present invention. FIG. 3 is a cross-sectional view of a power cable including flexible shaped sectors according to another embodiment of the present invention. FIGS. 4(a) and 4(b) are extracted cross-sectional views illustrating a
30 round conductor prior to a change of a shape before compression and a shaped sector after a change of a shape by compression in the power cable having flexible shaped sectors according to the present invention.

[0042] As illustrated in FIG. 2, the power cable 100 according to one embodiment of the present invention may be configured to include the conductor layer of a cable in which a single or a plurality of shaped sectors 110 including inner
35 conductors 111 and outer conductors 112 formed of heterogeneous conductors, and an insulating layer 114 is disposed in a radial form, a binding layer 120 binding the shaped sectors 110 of the conductor layer, an internal sheath layer 130 surrounding the outside of the binding layer 120, an external metal cladding layer 140 surrounding the outside of the internal sheath layer 130, and an external sheath layer 150 surrounding the outside of the external metal cladding layer 140.

[0043] As illustrated in FIG. 3, the power cable 100 according to another embodiment of the present invention may be configured to include the conductor layer of a cable in which a plurality of shaped sectors 110 including inner conductors
40 111 and outer conductors 112 formed of heterogeneous conductors, separating layers 113, and insulating layers 114, is disposed in a radial form, a binding layer 120 binding the shaped sectors 110 of the conductor layer, a metal insulating layer 121 surrounding the outside of the binding layer 120, an internal sheath layer 130 surrounding the outside of the metal insulating layer 121, an external metal cladding layer 140 surrounding the outside of the internal sheath layer 130, and an external sheath layer 150 surrounding the outside of the external metal cladding layer 140.

45 **[0044]** In each embodiment, the shaped sector 110 includes the inner conductors 111 and the outer conductors 112 bound by twisting the inner conductors 111 and the outer conductors 112 in a spiral form at constant interval and formed of heterogeneous conductors. As illustrated in FIG. 4(a), the shaped sector 110 may be formed into a round conductor by the inner conductors 111 and the outer conductors 112. Thereafter, the round conductor may be processed in a fan-shaped form, such as that illustrated in FIG. 4(b), by changing the shape of the round conductor by compression.

50 **[0045]** As illustrated in FIG. 2, each of the shaped sectors 110 may implement one embodiment through a configuration including the inner conductors 111, the outer conductors 112, and the insulating layer 114 surrounding the outskirts of the outer conductors.

[0046] Furthermore, as illustrated in FIG. 3, each of the shaped sectors 110 may implement another embodiment through a configuration including the inner conductors 111, the outer conductors 112, the separating layer 113 surrounding
55 the outskirts of the outer conductors 112, and the insulating layer 114 coating the outside of the separating layer 113 by surrounding the separating layer 113 at a specific thickness.

[0047] The inner conductors 111 are formed by assembling and stranding a plurality of first type wire cores. In this case, the first type wire cores include stranded wires according to the conductors of class 5 or 6 regulated in IEC 60228

and BS 6360, or the conductors of class I, K or M regulated in ASTM.

[0048] The outer conductors 112 are formed of second type wire cores different from the first type wire cores. The outer conductors 112 are disposed to surround the outmost side of the inner conductors 111 and to finish the shape of the assembly stranded wires forming the inner conductors 111. In this case, the second type wire cores include the conductors of class 2 regulated in IEC 60228 and BS 6360, or stranded wires according to the regulations of class B regulated in ASTM.

[0049] Accordingly, the shaped sector of the present invention includes the inner conductors 111 formed of the first type wire cores and the outer conductors 112 formed of the second type wire cores. The first class and the second class have different materials or wire shapes, or are heterogeneous conductors having different materials and wire shapes. The shaped sector is characterized in that the diameter of the first type wire core is very smaller than that of the second type wire core.

[0050] The separating layer 113 is formed to prevent the second type wire cores that form the outer conductors 112 from adhering to an insulator to be coated in a next process. Such an isolation coating layer 113 is configured to generally surround the outside of the outer conductors 112.

[0051] The insulating layer 114 may be configured by the coating of a single layer including a single material or an insulator of a dual layer form including two different materials. Such an insulating layer 114 may be made of any one or two materials selected from polyvinyl chloride (PVC), polyvinyl chloride/nylon (PVC/polyamide), ethylene propylene rubber (EPR), cross-linked polyethylene (XLPE), low-smoke halogen-free ethylene propylene rubber (LSEPR), low-smoke halogen-free cross-linked polyolefin (LSXLPO), low-smoke halogen-free silicon rubber (LS silicon), silicon rubber (SR), and cross-linked polyolefin (XLPO).

[0052] Furthermore, in the binding layer 120 of the power cable 100 according to each embodiment of the present invention, the shaped sectors 110 surrounded by the insulating layer 114 are disposed and bound in a radial form so that the bound shape forms a circular cross section, and neighboring shaped sectors 110 are compressed and bound so that the radius portions of the neighboring shaped sectors 110 are subjected to a surface contact up to the central part of the circle. Furthermore, the metal insulating layer 121 generally surrounding the circumference of the binding layer 120 may be formed to surround the outside of the binding layer 120.

[0053] Such a combined layer 120 binds the plurality of insulated shaped sectors by twisting the plurality of insulated shaped sectors in a spiral form at specific intervals so that a cross-sectional shape of the shaped sector is a circle, and may be formed of one or two or more tape layers by properly binding tapes after being bound.

[0054] The metal insulating layer 121 may preferably include any one layer selected from one or two or more tape layers, a braid or concentric wire rod layer, and a binding layer of a wire rod and a tape.

[0055] Furthermore, in the power cable 100 according to each embodiment of the present invention, the internal sheath layer 130 is formed to surround the outside of the binding layer 120 or metal insulating layer 121. The external metal cladding layer 140 surrounding the outside of the internal sheath layer 130 and the external sheath layer 150 surrounding the outside of the external metal cladding layer 140 may be sequentially formed on the internal sheath layer 130.

[0056] The internal sheath layer 130 may be formed by coating it on the binding layer 120 or the metal insulating layer 121 by extrusion at a specific thickness or may be formed by binding the internal sheath layer 130 and the binding layer 120 or the metal insulating layer 121 so that they overlap. In this case, the internal sheath layer 130 is preferably made of any one material selected from polyvinyl chloride (PVC), halogen-free thermosetting resins, halogen-free thermoplastic resins, chlorosulphonated polyethylene rubber (CSP), polychloroprene rubber (CR), chlorinated polyethylene rubber (CPE), and silicon rubber (SR).

[0057] The external metal cladding layer 140 may include any one of a circular wire rod or a flat wire rod, a double-sided tape, and a metal-braided layer.

[0058] If the external metal cladding layer 140 includes a circular wire rod or a flat wire rod, it may be made of any one material selected from galvanized metal, copper, tin-coated copper, aluminum, and an aluminum alloy.

[0059] If the external metal cladding layer 140 includes a double-sided tape, it may be made of any one material selected from a steel sheet, a galvanizing steel sheet, aluminum, and an aluminum alloy.

[0060] If the external metal cladding layer 140 includes a metal-braided layer, it may be made of any one material selected from a galvanizing steel-wire braid and a copper braid.

[0061] The external sheath layer 150 is formed by coating it on the external metal cladding layer 140 at a specific thickness by extrusion. In this case, the external sheath layer 150 may be made of any one material selected from polyvinyl chloride (PVC), halogen-free thermosetting resins, halogen-free thermoplastic resins, chlorosulphonated polyethylene rubber (CSP), chloroprene rubber (CR), chlorinated polyethylene rubber (CPE), and silicon rubber (SR).

[0062] The fabrication of the power cable having flexible shaped sectors configured as described above and acting effects thereof according to the present invention are described below.

[0063] First, the inner conductors 111 of the shaped sector 110 are the first type wire cores and are wires according to the regulations of the conductors of class 5 or 6 regulated in IEC 60228 and BS 6360, or the conductors of class I, K or M regulated in ASTM, and they have a multi-wire form. Accordingly, the inner conductor 111 has the flexible conductor

or more flexible conductor form of Table 1, and has a characteristic in that it has better availability than a conventional sector conductor.

[0064] Next, the round conductor, include the inner conductors 111 and the outer conductors 112 which are the second type wire cores different from the first type wire cores and wires according to the regulations of the conductors of class 2 regulated in IEC 60228 and BS 6360, or the regulations of the conductors of class B regulated in ASTM, have the stranded conductor form of Table 1, and are formed of heterogeneous conductors, that is, the first type wire cores formed of the second type wire cores, respectively, by disposing the round conductor to generally surround the outermost side of the inner conductors 111, is formed as illustrated in FIG. 4(a).

[0065] The shape of the round conductor is changed into a sector (fan shape) form as illustrated in FIG. 4(b) by compressing the round conductor formed as described above. The separating layer 113 surrounding the outside of the outer conductors 112 may be further formed on the outer circumference of the outer conductors 112 whose shape has been changed into the sector form in order to prevent the second type wire cores that form the outer conductors 112 from adhering to an insulator to be coated in a next process, if necessary.

[0066] Next, the insulating layer 114 is formed at a specific thickness by coating the insulator having a single layer made of a single material or a dual layer made of two different materials on the outside of the shaped sectors 110.

[0067] When the insulator is coated as described above, the binding layer 120 is formed on the outside of the plurality of shaped sectors 110 twisted in a spiral form at specific intervals by binding and disposing the shaped sectors 110 surrounded by the insulating layer 114 in a radial form so that the bound shape forms a circular cross section and by compressing and binding neighboring shaped sectors 110 so that the radius portions of the neighboring shaped sectors 110 are subjected to a surface contact up to the central part of the circle. Accordingly, the conductor layer forming the cable bounded by the plurality of shaped sectors 110 can be formed.

[0068] Furthermore, the metal insulating layer 121 may be formed on the outside of the binding layer 120, if necessary, using any one of one or two or more tape layers, a braid or concentric wire rod layer, and a binding layer of a wire rod and a tape so that the metal insulating layer 121 surrounds the outside of the binding layer 120.

[0069] When the formation of the conductor layer of the power cable is completed by the plurality of shaped sectors 110 as described above, the inner conductors 111 and the outer conductors 112 within each of the shaped sectors 110 are divided into different types of conductors and primarily formed. Accordingly, in a conductor processing process, the fan-shaped form of the shaped sector can be firmly maintained without being disordered in a process of stacking the shaped sectors 110 below a conveyance drum while being wound on the conveyance drum in order to transfer the shaped sectors 110 to an insulation process, and flexibility can be also be secured.

[0070] Thereafter, the internal sheath layer 130 coated by extrusion or bound in an overlapping manner at a specific thickness, the external metal cladding layer 140 formed of any one of a circular wire rod or flat wire rod, a double-sided tape, and a metal-braided layer, and the external sheath layer 150 coated by extrusion at a specific thickness can be sequentially formed on the outside of the binding layer 120 or the metal insulating layer 121.

[0071] As described above, in accordance with the present invention, the shape of the shaped sectors can be firmly maintained in a process of transferring and stacking the shaped sectors when a power cable is fabricated. Accordingly, the power cable can be fabricated without replacing equipment even in existing equipment in which the layouts of the processing process and insulation process of a conductor have been separated, and a limitation to use of the shaped sectors can be overcome through an increase in the flexibility of the shaped sectors.

[0072] Although the present invention has been described in connection with the limited embodiments and drawings as described above, the present invention is not limited to the above embodiments. Those skilled in the art to which the present invention pertains may modify and change the present invention in various ways from the above description. Accordingly, the spirit of the present invention should be understood by only the following claims, and all of the equal or equivalent modifications of the claims belong to the spirit of the present invention.

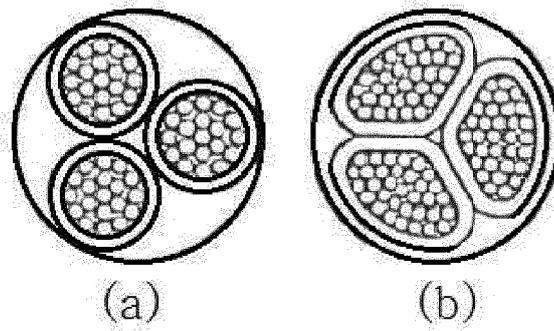
Claims

1. Power cable (100) comprising at least one or several shaped sector(s) (110), **characterized in that** said shaped sector (110) comprises inner conductors (111) and outer conductors (112), said inner conductors comprising wire cores of a first type, and said outer conductors comprising the outmost layer which includes wire cores of a second type, said first type of cores being different from said second type of cores in terms of materials or shapes, or in terms of materials and shapes.
2. Power cable according to claim 1, **characterized in that** the diameter of the first type wire cores is inferior to the diameter of the second type wire cores.
3. Power cable according to claim 1 or 2, **characterized in that** the outer conductors are pressed to form said sector

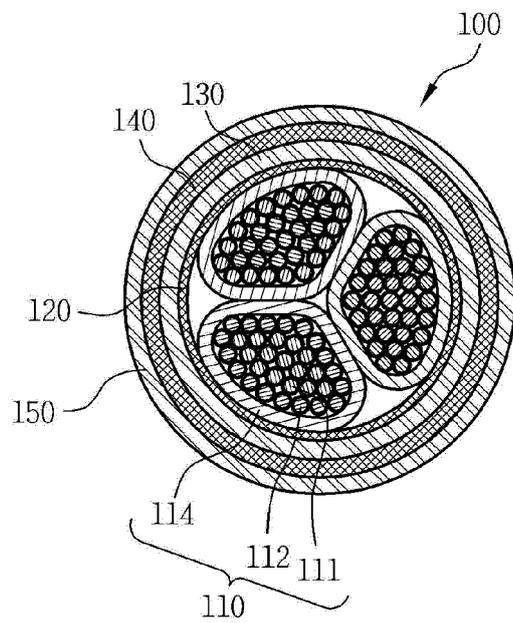
shape.

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4. Power cable according to any one of the preceding claims, **characterized in that** said inner conductors comprise multi-wire cores.
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5. Power cable according to any one of the preceding claims, **characterized in that** said outer conductors comprise stranded conductors.
6. Power cable according to any one of the preceding claims, **characterized in that** said inner conductors comprise conductors of class 5 or 6 of IEC 60228 and BS 6360 standard, or class I, K or M of ASTM standard.
7. Power cable according to any one of the preceding claims, **characterized in that** said outer conductors comprise conductors of class 2 of IEC 60228 and BS 6360 standard, or class B of ASTM standard.
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8. Power cable according to any one of the preceding claims, **characterized in that** said shaped sector further comprises an insulating layer (114) being surrounding the outskirts of said shaped sector.
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9. Power cable according to claim 8, **characterized in that** said shaped sector further comprises a separating layer (113) being positioned between said insulating layer (114) and said outer conductors (112), and surrounding the outskirts of said outer conductors (112).
10. Power cable according to any one of the preceding claims, **characterized in that** said power cable further comprises a binding layer (120) combining each shaped sector.
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11. Power cable according to claim 10, **characterized in that** said power cable further comprising:
- an internal sheath layer (130) surrounding said binding layer (120);
 - an external metal cladding layer (140) surrounding said internal sheath layer (130); and
 - an external sheath layer (150) surrounding said external metal cladding layer (140).
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12. Power cable according to claim 11, **characterized in that** a metal insulating layer (121) is positioned between said binding layer (120) and said internal sheath layer (130).
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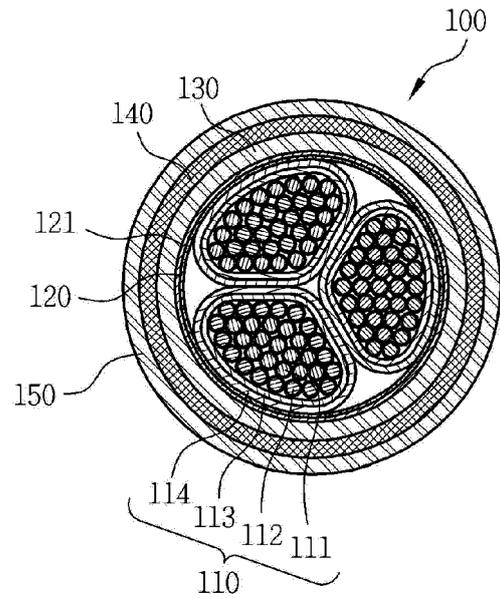
[Figure 1]



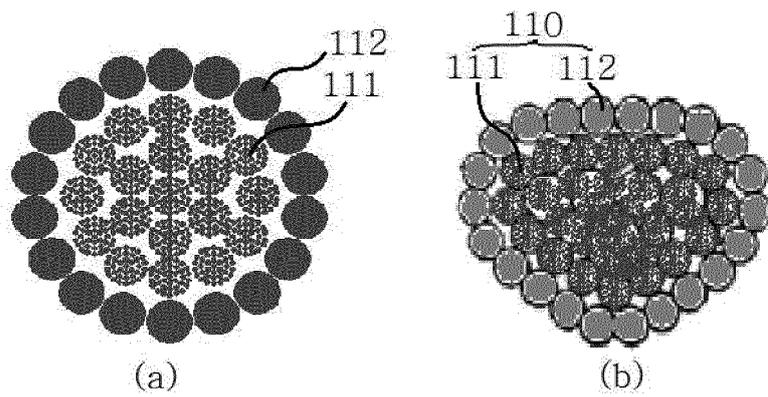
[Figure 2]



[Figure 3]



[Figure 4]





EUROPEAN SEARCH REPORT

Application Number
EP 17 30 6058

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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	DE 905 155 C (AEG) 25 February 1954 (1954-02-25) * page 1, line 1 - line 2 * * page 3, lines 34-39, 50-51, 71-74 * * figures 2, 4a, 4b *	1-12	INV. H01B9/00 ADD. H01B7/04
X	WO 2016/094201 A1 (ABB TECHNOLOGY AG [CH]; SPALDING MATTHEW [US]) 16 June 2016 (2016-06-16) * paragraphs [0022] - [0024] * * figures 4, 5 *	1	
X	DE 718 959 C (AEG) 25 March 1942 (1942-03-25) * page 2, line 34 - line 39 * * figure 2 *	1	
X	JP 2001 076537 A (HITACHI CABLE) 23 March 2001 (2001-03-23) * paragraph [0014]; figure 2 *	1	
A	JP H08 148038 A (FURUKAWA ELECTRIC CO LTD) 7 June 1996 (1996-06-07) * paragraphs [0011] - [0012]; figure 1 *	5	TECHNICAL FIELDS SEARCHED (IPC) H01B
A,D	KR 2015 0108962 A (LS CABLE & SYSTEM LTD [KR]) 1 October 2015 (2015-10-01) * figures 1-3 *	1	
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 20 December 2017	Examiner Hillmayr, Heinrich
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	

1
EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.

EP 17 30 6058

5

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

20-12-2017

10

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 905155 C	25-02-1954	DE 905155 C FR 956294 A	25-02-1954 28-01-1950
-----	-----	-----	-----
WO 2016094201 A1	16-06-2016	EP 3230985 A1 WO 2016094201 A1	18-10-2017 16-06-2016
-----	-----	-----	-----
DE 718959 C	25-03-1942	NONE	
-----	-----	-----	-----
JP 2001076537 A	23-03-2001	NONE	
-----	-----	-----	-----
JP H08148038 A	07-06-1996	NONE	
-----	-----	-----	-----
KR 20150108962 A	01-10-2015	NONE	
-----	-----	-----	-----

15

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25

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35

40

45

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55

EPO FORM P0459

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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Patent documents cited in the description

- KR 1020150108962 [0013]
- KR 1020150108962 A [0017]