

BUNDLED SUBMARINE CABLE AND MANUFACTURING METHOD THEREOF

TECHNICAL FIELD

[0001] The present invention relates to the field of submarine cable, and in
5 particular, to a bundled submarine cable and a manufacturing method thereof.

BACKGROUND

[0002] The bundled submarine cable transmission technology integrates multiple
three-core return circuits into one cable, and transmits electric energy with different
voltage levels and different frequencies at the same time.

10 [0003] The existing bundled submarine cable has the following technical defects:
restricted by equipment manufacturing capability, the currently common bundled
submarine cable has a three-core structure, whose utilization rate is limited in the
development of marginal oil fields. Especially in the design of dynamic submarine
cables, a plurality of small-sized bundled cables are often suspended on a floating
15 foundation, which is prone to collision and interference during operation; when
multi-core bundled cables transmit high-power electrical energy, heat in a J-tube, a
position of sea-bottom embedment and a bending reinforcement member is easy to
concentrate, resulting in excessive temperature, thereby reducing the transmission
capacity. In order to achieve required transmission capacity, a larger conductor cross
20 section is usually selected, which increases manufacturing cost; different return
circuits are twisted and integrated together, and due to the same intercept, it will cause
serious crosstalk problems, that is, one group of wire cores will cause instantaneous
charge accumulation to other groups of return circuits under different transmission
frequencies and different voltages, affecting normal operation of the terminal device.

SUMMARY

[0004] In view of the above, it is necessary to provide a bundled submarine cable.

[0005] The technical solution provided by the present invention is:

a bundled submarine cable includes a protective layer and at least three
5 groups of three-core return circuits disposed in the protective layer, each group of the three-core return circuits uses different twisting intercepts respectively.

[0006] Preferably, the three-core return circuit includes three wire core units and a reinforcement tape located on an outer periphery of the three wire core units, each of the wire core units includes a plurality of conductors located in a center and an
10 insulation layer, a metal shield layer and a phase-separating protective sheath which are sequentially cladded on the conductors.

[0007] Preferably, the reinforcement tape and the protective layer are further filled with a plurality of filling units.

[0008] Preferably, the protective layer includes an inner protective layer, an armor
15 layer and an outer sheath layer which are sequentially disposed from inside to outside, the armor layer is a single-layer or multi-layer armor structure, the outer sheath layer is disposed on the outer periphery of the armor layer, and a plurality of drilling holes are opened on the inner protective layer.

[0009] Preferably, an interval between two adjacent drilling holes on the inner
20 protective layer is 5-10m.

[0010] Preferably, a plurality of optical units are further disposed in the protective layer, the optical units are distributed on an inner side of the protective layer along a circumferential array.

[0011] Preferably, a number of the three-core return circuits is greater than or
25 equal to 3 and less than or equal to 13.

[0012] Preferably, the twisting intercepts of the three-core return circuits are set incrementally clockwise.

[0013] Another object of the present invention is to provide a manufacturing method of bundled submarine cable for manufacturing the above-mentioned bundled

submarine cable, including the following steps:

5 cabling three-core return circuits individually, then placing the cabled three-core return circuits on a cabling wire setting-out holder as independent units and cabling according to a designed cross-section at a twisting point, and cladding a outer periphery with a protective layer.

[0014] Preferably, during a process of cabling the three-core return circuits individually, a cabling gap is filled with a filling unit and cladded with a reinforcement tape.

10 [0015] The multiple three-core return circuits of the above-mentioned bundled submarine cable are integrated into one submarine cable, which meets the requirements for power transmission at different frequencies and different powers of multiple electric submersible pumps for an underwater production system or multiple generator sets for offshore new energy development, and a whole cable is formed by using different twisting intercepts among the three-core return circuits, so that
15 crosstalk among wire cores is greatly reduced, and the operation safety of a terminal device is improved.

BRIEF DESCRIPTION OF DRAWINGS

[0016] The present invention will be described in further detail below in conjunction with accompanying drawings and specific embodiments.

20 [0017] FIG. 1 is an entire schematic diagram of a bundled submarine cable in an embodiment of the present invention.

[0018] FIG. 2 is an entire schematic diagram of three groups of three-core return circuits in the present invention.

25 [0019] FIG. 3 is an entire schematic diagram of four groups of three-core return circuits in the present invention.

[0020] FIG. 4 is an entire schematic diagram of five groups of three-core return circuits in the present invention.

[0021] FIG. 5 is an entire schematic diagram of seven groups of three-core return circuits in the present invention.

[0022] FIG. 6 is an entire schematic diagram of nine groups of three-core return circuits in the present invention.

5 **[0023]** FIG. 7 is an entire schematic diagram of a three-core return circuit in an embodiment of the present invention.

[0024] Description of main reference signs

Bundled submarine cable	100
Protective layer	10
Inner protective layer	11
Drilling hole	111
Aarmor layer	13
Outer sheath layer	15
Three-core return circuit	30
Wire core unit	31
Conductor	311
Conductor shield layer	312
Insulation layer	313
Insulation shield layer	314
Metal shield layer	315
Phase-separating protective sheath	317
Reinforcement tape	33
Filling unit	50
Optical unit	70

[0025] The following specific embodiments will further illustrate the present invention in conjunction with the above accompanying drawings.

DESCRIPTION OF EMBODIMENTS

[0026] In order to understand the above objects, features and advantages of the embodiments of the present invention more clearly, the present invention will be described in detail below with reference to the accompanying drawings and specific
5 embodiments. It should be noted that the features in the embodiments of the present application may be combined with each other without conflict.

[0027] Many specific details are set forth in the following description to facilitate a full understanding of the embodiments of the present invention, and the described embodiments are a part of, but not all, embodiments of the present invention. Based
10 on the embodiments in the present invention, all other embodiments obtained by those of ordinary skill in the art without creative work fall within the protection scope of the embodiments of the present invention.

[0028] Unless otherwise defined, all technical and scientific terms used herein have the same meaning as commonly understood by those of ordinary skill in the art
15 to which the embodiments of the present invention belong. The terms used in the specification of the present invention are only for the purpose of describing specific embodiments, and are not intended to limit the embodiments of the present invention.

[0029] Please refer to FIG. 1, a bundled submarine cable 100 includes a protective layer 10, at least three groups of three-core return circuits 30, a filling unit 50 and a
20 plurality of optical units 70, the protective layer 10 is cladded on the outer periphery of the three-core return circuit 30, so as to provide outer layer protection for the bundled submarine cable 100, the filling unit 50 and the optical unit 70 are filled the gaps between the three-core return circuits 30, and the twisting intercepts of each of the three-core return circuits 30 are different.

[0030] Please refer to FIG. 1, the protective layer 10 includes an inner protective layer 11, an armor layer 13 and an outer sheath layer 15 which are sequentially disposed from inside to outside. In an implementation, the inner protective layer 11 is a polyethylene sheath, to improve the structural roundness and lateral pressure resistance. The inner protective layer 11 is also provided with a drilling hole 111, and
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the drilling hole 111 is used to facilitate the injection of seawater into the gap between the three-core return circuits 30, so that the seawater can quickly take away the heat collection in the three-core return circuits 30, and at the same time raise the current carrying capacity of the bundled submarine cable 100. In an implementation, the distance between two adjacent drilling holes 111 is 5-10m. The armor layer 13 is used to improve the circumferential tensile strength and lateral compression strength, in an implementation, the armor layer 13 is a single-layer armor steel wire layer, in other implementations, the armor layer 13 can also be provided as a multi-layer armor structure. The outer sheath layer 15 is cladded on the outer periphery of the armor layer 13, and the outer sheath layer 15 is used to fasten the armor layer 13. In an implementation, the outer sheath layer 15 is a polypropylene rope, the polypropylene rope is cladded on the outer periphery of the armor layer 13.

[0031] Please refer to FIG. 1, in an embodiment, the three-core return circuits 30 are disposed in thirteen groups, and nine of the thirteen groups of the three-core return circuits 30 are disposed on an inner side of the protective layer 10 along a circumferential array, the other four groups of the three-core return circuits 30 are disposed in the center of the nine groups of three-core return circuits 30 disposed along a circumferential array. Please refer to FIGS. 2 to 6, in other implementations, the number of groups of the three-core return circuits 30 can also be set to any one of 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, and 13. The three-core return circuits 30 are filled in the inner side of the protective layer 10 in an orderly manner, and the three-core return circuits 30 are symmetrically disposed on the inner side of the protective layer 10. For example, in an implementation, the twisting intercepts of the three-core return circuits 30 may be set to be incrementally in a clockwise direction.

[0032] Please refer to FIG. 7, the three-core return circuit 30 includes three wire core units 31 and a reinforcement tape 33 located on the outer periphery of the wire core units 31, and each of the wire core units 31 includes a conductor 311 located in the center and a conductor shield layer, an insulation layer 313, an insulation shield layer 314, a metal shield layer 315 and a phase-separating protective sheath 317, which are sequentially cladded on the outer periphery of the conductor 311 from

inside to outside respectively. The conductor 311 is used to transmit electrical energy, in an implementation, the conductor 311 is a copper conductor, and in other implementations, the conductor 311 may also be an aluminum conductor. The metal shield layer 315 is used to reduce the outer diameter of the wire core unit 31, which
5 reduces the minimum bending radius of the submarine cable, and plays a radial water blocking role on the wire core unit 31. In an implementation, the metal shield layer 315 is a copper-plastic composite tape.

[0033] Please refer to FIG. 1 and FIG. 2, the filling unit 50 and the optical unit 70 are both disposed on the inner side of the protective layer 10, and the filling unit 50 is
10 used to fill the cabling gap to ensure the same outer diameter after cabling. In an implementation, the filling unit includes a polyethylene rod and a special-shaped filling strip.

[0034] Manufacturing method:

[0035] The three wire core units 31 are wound as basic units of the three-core return circuit 30, and the copper-plastic composite tape is cladded under the
15 phase-separating protective sheath 317 of each wire core unit 31, and the copper-plastic composite tape is used as a metal shield layer 315 to clad the outer periphery of the wire core unit 31. In an implementation, the copper-plastic composite tape is a double-sided plastic layer. During the process of extrusion molding of the
20 phase-separating protective sheath 317, the plastic layer of the copper-plastic composite tape is bonded and fused to improve the radial water blocking capability; during the cabling process of the three-core return circuit 30, the cabling gap is filled with the filling unit 50 to ensure the same outer diameter after cabling. The cabled three-core return circuit 30 is cladded with a reinforcement tape 33 to prevent being
25 worn out in the next process.

[0036] The cabled three-core return circuit 30 is placed on each cabling wire setting-out holder as an independent unit, and cabled according to the designed cross section at a twisting point. During the cabling process, the optical unit 70 and the filling unit 50 are twisted with the three-core return circuit 30 at the same time and
30 filled the gap between the three-core return circuits 30.

[0037] The cabled bundled submarine cable 100 is cladded with the reinforcement tape 33, and a polyethylene sheath is extruded on the outer periphery of the reinforcement tape 33 to form an inner protective layer 11 for total cladding protection;

5 **[0038]** The inner protective layer 11 is drilled every 5-10m to form drilling holes 111, so that during construction, the seawater can penetrate into the inner protective layer 11 to satisfy the internal and external pressure balance, and increase the weight of the bundled submarine cable 100 in water and improve stable performance in seawater at the same time.

10 **[0039]** A single-layer or multi-layer armor structure is used on the outer periphery of the bundled submarine cable 100, finally, the outer sheath layer 15 is manufactured by using polypropylene ropes to clad and bind, so as to implement the manufacturing of the bundled submarine cable 100.

[0040] The above-mentioned bundled submarine cable 100 uses different twisting
15 intercepts for each group of three-core return circuits 30, so that when the bundled submarine cable 100 forms a whole cable, the crosstalk among the wire core units 31 will be greatly reduced, and the operation safety of the terminal device will be improved.

[0041] The above implementations are only used to illustrate the technical
20 solutions of the embodiments of the present invention, but not to limit them. Although the embodiments of the present invention have been described in detail with reference to the above preferred implementations, those of ordinary skill in the art should understand that modifications or equivalent replacements of the technical solutions of the embodiments of the present invention should not depart from the spirit and scope
25 of the technical solutions of the embodiments of the present invention.

CLAIMS

1. A bundled submarine cable, comprising a protective layer and at least three groups of three-core return circuits disposed in the protective layer, wherein each group of the three-core return circuits uses different twisting intercepts respectively.

5 2. The bundled submarine cable according to claim 1, wherein the three-core return circuit comprises three wire core units and a reinforcement tape located on an outer periphery of the three wire core units, each of the wire core units comprises a plurality of conductors located in a center and an insulation layer, a metal shield layer and a phase-separating protective sheath which are sequentially cladded on the
10 conductors.

3. The bundled submarine cable according to claim 2, wherein the reinforcement tape and the protective layer are further filled with a plurality of filling units.

4. The bundled submarine cable according to claim 1, wherein the protective layer comprises an inner protective layer, an armor layer and an outer sheath layer
15 which are sequentially disposed from inside to outside, the armor layer is a single-layer or multi-layer armor structure, the outer sheath layer is disposed on the outer periphery of the armor layer, and a plurality of drilling holes are opened on the inner protective layer.

5. The bundled submarine cable according to claim 4, wherein an interval
20 between two adjacent drilling holes on the inner protective layer is 5-10m.

6. The bundled submarine cable according to claim 1, wherein a plurality of optical units are disposed in the protective layer, the optical units are distributed on an inner side of the protective layer along a circumferential array.

7. The bundled submarine cable according to claim 1, wherein a number of the
25 three-core return circuits is greater than or equal to 3 and less than or equal to 13.

8. The bundled submarine cable according to claim 1, wherein the twisting intercepts of the three-core return circuits are set incrementally clockwise.

9. A manufacturing method of bundled submarine cable for manufacturing the bundled submarine cable according to any of claims 1 to 8, comprises the following steps:

5 cabling three-core return circuits individually, then placing the cabled three-core return circuits on a cabling wire setting-out holder as independent units and cabling according to a designed cross-section at a twisting point, and cladding a outer periphery with a protective layer.

10. The manufacturing method of bundled submarine cable according to claim 9, wherein during a process of cabling the three-core return circuits individually, a cabling gap is filled with a filling unit and cladded with a reinforcement tape.