SUBMARINE PHOTOELECTRIC COMPOSITE CABLE

TECHNICAL FIELD

[0001] The present invention relates to the field of cable manufacturing, and in particular, to a submarine photoelectric composite cable.

BACKGROUND

[0002] In a submarine observation network system, a submarine photoelectric composite cable is generally used to implement electric energy and information loop transmissions between underwater main node and branch node devices. The existing submarine photoelectric composite cable implements the information loop transmission through an optical fiber, and implements the electric energy loop transmission through a conductor component. Most of the submarine photoelectric composite cables are equipped with a backup wirecore for fault backup. However, when an insulation breakdown occurs in the submarine photoelectric composite cable, the existing submarine photoelectric composite cable cannot effectively lead out a short-circuit current, which may cause simultaneous breakdown or excessive current of a plurality of conductor components, thus damaging the backup wirecore in the submarine photoelectric composite cable and a underwater equipment connected to the submarine photoelectric composite cable. In addition, when the existing photoelectric composite cable works for a long time, temperature rises due to heat emitted by a line loss under a power supply condition. In a long-term high temperature environment, service life of the optical fiber will be reduced and the loss of the optical fiber will increase, thus affecting the service life of the cable and signal transmission quality.

SUMMARY

[0003] In view of this, it is necessary to provide a submarine photoelectric composite cable that can effectively lead out a short-circuit current and prevent the optical fiber from being in a high temperature environment.

[0004] In an embodiment of the present invention, there is provided a submarine photoelectric composite cable, which includes an optical fiber component, a conductor layer, a shield layer, a protective layer, an armor layer and an outer sheath layer sequentially cladded from inside to outside, where the conductor layer includes conductor components, the conductor components are twisted outside the optical fiber component, the submarine photoelectric composite cable further includes ground wire components, the ground wire components are filled in gaps between the conductor layer and the shield layer and/or between the conductor layer and the optical fiber component, the conductor components include conductors, a cross section of each conductor along a radial direction of the conductor components is a first cross section, the ground wire components include second conductors, cross sections of the second conductors along a radial direction of the ground wire components are second cross sections, an area of any one of the first cross sections is smaller than a total area of the second cross sections, the optical fiber component includes an optical fiber unit and a thermal insulation layer, the thermal insulation layer is cladded outside the optical fiber unit.

[0005] Further, the submarine photoelectric composite cable further includes a waterproof material, and the waterproof material is filled in twisted gaps between the optical fiber component, the conductor components and the ground wire components.

[0006] Further, the ground wire components further include semi-conductive protective layers, and the semi-conductive protective layers are cladded outside the second conductors.

[0007] Further, the optical fiber unit is distributed at an axis position of the submarine photoelectric composite cable.

[0008] Further, the optical fiber unit includes an optical fiber tube and a first

protective layer, and the first protective layer is cladded outside the optical fiber tube, the thermal insulation layer is cladded outside the first protective layer.

[0009] Further, the optical fiber tube includes an optical fiber, a waterproof ointment and a stainless steel tube, where the optical fiber is installed in the stainless steel tube, and the waterproof ointment is filled in the stainless steel tube.

[0010] Further, the conductor components further include insulation layers, and the insulation layers are cladded outside the conductors.

[0011] Further, the armoring layer includes a reinforcement member, and the reinforcement member is twisted outside the protective layer to form an armor structure.

[0012] Further, the number of layers of the armor structure is 1 to 6.

[0013] Further, the gap between the armor structures is filled with waterproof asphalt.

[0014] In the above-mentioned submarine photoelectric composite cable, the ground wire components are filled in gaps between the conductor layer and the shield layer and/or the conductor layer and the optical fiber component, any one of the first cross sections has an area smaller than a total area of the second cross sections, which makes magnitude of current that the ground wire components withstand is greater than or equal to magnitude of current passed any one of the conductor components, so as to effectively lead out a short-circuit current when insulation breakdown occurs, thereby protecting the backup wirecore and underwater device. The thermal insulation layer is cladded outside the optical fiber unit to effectively block the heat emitted by the conductor layer during operation, so that the temperature of the optical fiber is in a lower range.

BRIEF DESCRIPTION OF DRAWINGS

[0015] FIG. 1 is a structural diagram of a submarine photoelectric composite cable in an embodiment of the present invention.

[0016] FIG. 2 is a structural diagram of an optical fiber unit in an embodiment of

the present invention.

[0017] Description of main element symbols

Submarine photoelectric composite cable	100
Optical fiber component	10
Optical fiber unit	11
Optical fiber tube	111
Optical fiber	1111
Waterproof ointment	1112
Stainless steel tube	1113
First protective layer	112
Thermal insulation layer	12
Conductor layer	20
Conductor component	21
Conductor	211
Insulation layer	212
Shield layer	30
Ground wire component	40
Second conductor	41
Semi-conductive protective layer	42
Protective layer	50
Armor layer	60
Reinforcement member	61
Outer sheath layer	70

[0018] The following specific embodiments will further illustrate the present invention in conjunction with the above accompanying drawings.

DESCRIPTION OF EMBODIMENTS

[0019] 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 embodiments. It should be noted that the features in the embodiments of the present application may be combined with each other without conflict.

[0020] 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 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.

[0021] 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 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.

[0022] Please refer to FIG. 1, a submarine photoelectric composite cable 100 includes an optical fiber component 10, a conductor layer 20, a shield layer 30, a protective layer 50, an armor layer 60 and an outer sheath layer 70 which are sequentially cladded from inside to outside. The submarine photoelectric composite cable 100 further includes a plurality of ground wire components 40, and the ground wire components 40 are filled in the gaps between the conductor layer 20 and the shield layer 30 and/or between the conductor layer 20 and the optical fiber component 10 to effectively lead out a short-circuit current when an insulation breakdown occurs, and protect a backup wirecore and an underwater device.

[0023] Please refer to FIG. 1 and FIG. 2 together. The optical fiber component 10 includes an optical fiber unit 11 and a thermal insulation layer 12, and the thermal insulation layer 12 is cladded outside each optical fiber unit 11. The optical fiber unit

11 is generally distributed at an axis position of the submarine photoelectric composite cable 100. The optical fiber unit 11 includes an optical fiber tube 111 and a first protective layer 112 sequentially cladded from inside to outside. Specifically, the optical fiber tube 111 includes an optical fiber 1111, a waterproof ointment 1112 and a stainless steel tube 1113. The optical fiber 1111 is installed in the stainless steel tube 1113, and the number of cores of the optical fiber 1111 ranges from 1 to 192. The waterproof ointment 1112 is filled in the stainless steel tube 1113 to improve the waterproof performance of the optical fiber tube 111. The first protective layer 112 is configured to protect the optical fiber tube 111. In an embodiment, the optical fiber component 10 includes one optical fiber unit 11. It can be understood that the number of the optical fiber unit 11 is not limited to one in this embodiment, and can be adjusted according to specific requirements. The first protective layer 112 is made of one or more of polyethylene, polypropylene, polyvinyl chloride and other equivalent materials. The stainless steel tube 1113 is seamlessly welded by stainless steel strips.

[0024] The thermal insulation layer 12 is cladded outside the first protective layer 112 to effectively block the heat emitted by the conductor layer 20 during operation, so that the temperature of the optical fiber 1111 is in a lower range, thus preventing reduced service life and increased loss of the optical fiber due to high temperature, thereby preventing the transmission performance of the optical fiber 1111 from being reduced. In an implementation, the thermal insulation layer 12 is made of one or more of mica, asbestos, and other equivalent materials.

[0025] The conductor layer 20 includes a plurality of conductor components 21. The conductor components 21 are twisted outside the optical fiber component 10, and the periphery of each conductor component 21 is tangent to the periphery of the optical fiber component 10. The conductor component 21 includes a plurality of conductors 211 and an insulation layer 212 sequentially from inside to outside. In an implementation, the conductor layer 20 includes six conductor components 21, and the conductor components 21 are evenly arranged on the periphery of the optical fiber component 10. The conductors 211 are made of one or more of copper, aluminum, and other equivalent materials. The insulation layers 212 are made of one or more of

polyethylene, polypropylene, polyvinyl chloride and other equivalent materials.

[0026] The shield layer 30 is cladded outside the conductor layer 20. Specifically, the inner wall of the shield layer 30 is tangent to each of the conductor components 21. The ground wire components 40 are filled in gaps between the conductor components 21 and the shield layer 30 and/or between the conductor components 21 and the optical fiber component 10. The submarine photoelectric composite cable 100 further includes a waterproof material (not shown), and the waterproof material is filled in the twisted gaps among the optical fiber component 10, the conductor components 21 and the ground wire components 40, to improve the waterproof performance of the submarine photoelectric composite cable 100.

[0027] The ground wire components 40 are connected to a ground electrode of a underwater device or directly connected to water to effectively grounding, and thus effectively lead out a short-circuit current when the conductor components 21 are broken down. The ground wire components 40 include second conductors 41 and semi-conductive protective layers 42 sequentially from inside to outside. A cross section of each conductor 211 along a radial direction of the conductor components 21 is a first cross section, cross sections of the second conductors 41 along the radial direction of the ground wire components 40 are second cross sections, any one of the first cross sections has an area smaller than a total area of the second cross sections, so that the magnitude of current that the ground wire components 40 withstand is greater than or equal to the magnitude of current passed any one of the conductor components 21, thereby preventing the short-circuit current from burning out the ground wire components 40 when insulation breakdown occurs. In an implementation, the submarine photoelectric composite cable 100 includes six ground wire components 40, and each of the ground wire components 40 is filled in a gap close to the shield layer 30. The shield layer 30 is made of metal-plastic composite tape, metal-plastic composite foil and other equivalent materials. The second conductor 41 is made of one or more of copper, aluminum and other equivalent materials. It can be understood that the structure of the ground wire components 40 can be adjusted according to specific requirements, the ground wire components 40 only include the second

conductors 41, and the second conductors 41 are made of a metal conductor.

[0028] The protective layer 50 is extruded outside the shield layer 30. In an implementation, the protective layer 50 is made of one or more of polyethylene, polypropylene, polyvinyl chloride, ethylene propylene rubber, polyurethane and other equivalent materials.

[0029] In an implementation, the armor layer 60 includes a reinforcement member 61, and the reinforcement member 61 is twisted outside the protective layer 50 to form a multi-layer armor structure (not shown), so as to protect the submarine photoelectric composite cable 100. In an implementation, the reinforcement member 61 is made of steel wire or non-metallic reinforcement material. In other implementation, the reinforcement member 61 is made of one or more of steel strips, steel wires, non-metallic reinforcement materials and other equivalent materials. The number of layers of the armor structure is 1 to 6. The gap between the armor structures is filled with waterproof asphalt, so as to improve the waterproof capability of the submarine photoelectric composite cable 100.

[0030] The outer sheath layer 70 cladded outside the armor layer 60, to protect the submarine photoelectric composite cable 100. In an implementation, the outer sheath layer 70 is twisted outside the armor layer 60 by a polypropylene rope. In other implementation, the outer sheath layer 70 is extruded outside the armor layer 60 by one or more of polyethylene, polyurethane, polypropylene, and other equivalent materials.

[0031] In use, the submarine photoelectric composite cable 100 can be connected to a corresponding conductor component 21 according to different power requirements, to implement the use at different powers. The ground wire components 40 are connected to the ground electrode, and when insulation breakdown occurs, the short-circuit current is drained by the ground wire components 40, thereby protecting the backup wirecore and the underwater device.

[0032] In the above-mentioned submarine photoelectric composite cable 100, the ground wire components 40 are filled in the gaps between the conductor layer 20 and the shield layer 30 and/or between the conductor layer 20 and the optical fiber

component 10, to effectively lead out the short-circuit current when the insulation breakdown occurs, thereby protecting the backup wirecore and underwater device. Any one of the first cross section has an area smaller than a total area of the second cross section, so that the magnitude of current that the ground wire components 40 withstand is greater than or equal to the magnitude of current passed any one of the conductor components 21, thereby protecting the backup wirecore and the underwater device. The thermal insulation layer 12 cladded outside the first protective layer 112 to effectively block the heat emitted by the conductor layer 20 during operation, so that the temperature of the optical fiber 1111 is in a lower range, thereby avoid reduced service life and increased loss of the optical fiber due to high temperature, thereby preventing the transmission performance of the optical fiber 1111 from being reduced.

[0033] The above implementations are only used to illustrate the technical 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 of the technical solutions of the embodiments of the present invention.

CLAIMS

1. A submarine photoelectric composite cable, comprising an optical fiber component, a conductor layer, a shield layer, a protective layer, an armor layer and an outer sheath layer sequentially cladded from inside to outside, wherein the conductor layer comprises conductor components, the conductor components are twisted outside the optical fiber component, the submarine photoelectric composite cable further comprises ground wire components, the ground wire components are filled in gaps between the conductor layer and the shield layer and/or between the conductor layer and the optical fiber component, the conductor components comprise conductors, a cross section of each conductor along a radial direction of the conductor components is a first cross section, the ground wire components comprise second conductors, cross sections of the second conductors along a radial direction of the ground wire components are second cross sections, any one of the first cross sections has an area smaller than a total area of the second cross sections, the optical fiber component comprises an optical fiber unit and a thermal insulation layer, the thermal insulation layer is cladded outside the optical fiber unit.

2. The submarine photoelectric composite cable according to claim 1, wherein the submarine photoelectric composite cable further comprises a waterproof material, and the waterproof material is filled in twisted gaps between the optical fiber component, the conductor components and the ground wire components.

3. The submarine photoelectric composite cable according to claim 1, wherein the ground wire components further comprise semi-conductive protective layers, and the semi-conductive protective layers are cladded outside the second conductors.

4. The submarine photoelectric composite cable according to claim 1, wherein the optical fiber unit is distributed at an axis position of the submarine photoelectric composite cable.

5. The submarine photoelectric composite cable according to claim 4, wherein the optical fiber unit comprises an optical fiber tube and a first protective layer, and

the first protective layer is cladded outside the optical fiber tube, and the thermal insulation layer is cladded outside the first protective layer.

6. The submarine photoelectric composite cable according to claim 5, wherein the optical fiber tube comprises an optical fiber, a waterproof ointment and a stainless steel tube, the optical fiber is installed in the stainless steel tube, and the waterproof ointment is filled in the stainless steel tube.

7. The submarine photoelectric composite cable according to claim 1, wherein the conductor components further comprise insulation layers, and the insulation layers are cladded outside the conductors.

8. The submarine photoelectric composite cable according to claim 1, wherein the armor layer comprises a reinforcement member, and the reinforcement member is twisted outside the protective layer to form an armor structure.

9. The submarine photoelectric composite cable according to claim 8, wherein the number of layers of the armor structure is 1 to 6.

10. The submarine photoelectric composite cable according to claim 9, wherein a gap between the armor structures is filled with waterproof asphalt.