PHOTOELECTRIC COMPOSITE MEDIUM-VOLTAGE SHORE POWER CABLE AND MANUFACTURING METHOD THEREOF

[0001] The disclosure relates to a technical field of power cables, in particular to a photoelectric composite medium-voltage shore power cable and manufacturing method thereof.

BACKGROUND

[0002] Transportation by ship is advantageous because of large loading capacity and low cost. In recent years, the cargo throughput of major coastal ports has developed significantly. The cargo is loaded and unloaded by cranes, gantry cranes, shore-based cranes, and other large mobile loading and unloading equipment, which require shore power cables to provide higher power transmission capacity. The heavy oil and diesel fuel used by ships produces a large amount of sulfide and nitrogen oxides during combustion, causing pollution to the surrounding environment, so ships which are docked in port can instead connect by cable to a shore-based power supply. With the development of digital intelligent monitoring and communication functions, the current single-function shore power cable is lagging behind the current needs of development.

SUMMARY

[0003] In view of the above, a photoelectric composite medium-voltage shore power cable in one embodiment is disclosed together with a manufacturing method thereof, to provide a higher power transmission capacity. A bending radius of the cable is smaller, to improve the flexibility of the cable, and the current-carrying capacity of the cable is increased while achieving optical communication transmission function.

[0004] The photoelectric composite medium-voltage shore power cable is substantially oval or flatted-circle in section and includes a cable core, an inner sheath layer, a strengthening layer, and an outer layer. The cable core, the inner sheath layer, the strengthening layer, and the outer sheath layer are in that order from the inside to the outside of the cable. The inner sheath layer is wrapped around the cable core; the strengthening layer is wrapped around the inner sheath layer; and the outer sheath layer is wrapped around the strengthening layer.

[0005] The cable core includes three power cores and a flexible optical unit; the three power cores are positioned in parallel and are side by side. The flexible optical unit is positioned in one or more of the V-shaped valley (“gap”) extending out from the line of contact between adjacent power cores.

[0006] Alternatively, the cable core further includes a flexible grounding core; the flexible optical unit and the flexible grounding core are positioned in different gaps, and the flexible grounding core is in contact with two adjacent power cores.

[0007] Alternatively, there are two flexible grounding cores, the flexible grounding cores are in different gaps.

[0008] Alternatively, each of the power core includes a flexible power conductor core, a semi-conductive tape conductor shielding layer, a semi-conductive extruded conductor shielding layer, a high performance rubber insulation layer, a semi-conductive extruded insulation shielding layer, a semi-conductive tape insulation shielding layer, and a wire braided flexible insulation shielding layer positioned in that order from the inside to the outside of the power core.

[0009] Alternatively, technologies of conductor codirectional grouping stranding and integral double stranding in the same direction is applied in the flexible power conductor core.

[0010] Alternatively, the flexible grounding core includes a ground conductor core and a semi-conductive rubber insulation layer sequentially positioned from the inside to the outside of the flexible grounding core; the semi-conductive rubber insulation layer is in contact with two adjacent power cores.

[0011] Alternatively, the inner sheath layer is a flame-retardant thermoplastic elastomer inner sheath layer, the strengthening layer is a flexible high-strength fiber woven reinforcement layer, and the outer sheath layer is an oil-resistant flame-retardant outer sheath layer.

[0012] Alternatively, the flexible optical unit includes a high temperature resistant single-mode/multi-mode fiber, a flexible high-strength fiber reinforced core, and a flame-retardant thermoplastic sheath layer.

[0013] Alternatively, the cable core further includes a flexible control core unit; the flexible optical unit , the flexible grounding core, and the flexible control wire core unit are in different gaps, and the flexible control core unit is in contact with two adjacent power cores.

[0014] Alternatively, the flexible control core unit includes a control conductor core, a flexible rubber insulation layer, and an aluminum-plastic composite tape wrapping shielding layer.

[0015] A manufacturing method of the photoelectric composite medium-voltage shore power cable is disclosed in an embodiment of the present disclosure, the manufacturing method includes:

[0016] providing three power cores;

[0017] the three power cores are positioned in parallel and side by side;

outer sheath layer 40;
power cord 11;
flexible optical unit 12;
gap 110 (being the V-shaped void extending out from line of contact between shielding layers 116);
flexible grounding core 13;
flexible power conductor core 111;
semi-conductive tape conductor shielding layer 112;
semi-conductive extruded conductor shielding layer 113;
high performance rubber insulation layer114;
Semi-conductive extruded insulation shielding layer 115;
semi-conductive tape insulation shielding layer 116;
wire braided flexible insulation shielding layer 117;
grounding conductor core 131;
semi-conductive rubber insulation layer 132;
high temperature resistant single-mode/multi-mode fiber 121;
flexible high-strength fiber reinforced core 122;
flame-retardant thermoplastic sheath layer 123;
flexible control core unit 14;
control conductor core 141;
flexible rubber insulation layer 142;
Aluminum-plastic composite tape wrapping shielding layer 143.

DETAILED DESCRIPTION

[0027] To illustrate the above objectives, features and advantages of the present disclosure more clearly, the present disclosure will be described in detail below with reference to the accompanying drawings and specific embodiments. It should be noted that the embodiments of the application and the features in the embodiments can be combined with each other if there is no conflict.

[0028] In the following description, many specific details are explained for full understanding of the present disclosure. The described embodiments are only a part of the embodiments of the present disclosure, rather than all the embodiments. Based on the embodiments of the present disclosure, all other embodiments obtained by those of ordinary skill in the art without creative work shall fall within the protection scope of the present disclosure.

[0029] Unless otherwise defined, all technical and scientific terms used herein have the same meaning as commonly understood by one skilled in the art. The terms used herein are only for describing specific embodiments, and are not intended to limit the present disclosure.

CLAIMS

WHAT IS CLAIMED IS:

1. A photoelectric composite medium-voltage shore power cable, wherein:

the photoelectric composite medium-voltage shore power cable comprising a cable core, an inner sheath layer, a strengthening layer, and an outer layer positioned in that order from the inside to the outside of the cable; the inner sheath layer is wrapped around the cable core; the strengthening layer is wrapped around the inner sheath layer; the outer sheath layer is wrapped around the strengthening layer;

the cable core comprises three power cores and a flexible optical unit; the three power cores are positioned side by side and in contact with each other and are in a flatted-circle shape; gaps are formed between every two adjacent power cores and the inner sheath layer; the flexible optical unit is positioned in the gap and is in contact with two adjacent power cores.

2. The photoelectric composite medium-voltage shore power cable of claim 1, wherein: the cable core further comprises a flexible grounding core; the flexible optical unit and the flexible grounding core are in different gaps, and the flexible grounding core is in contact with two adjacent power cores.

3. The photoelectric composite medium-voltage shore power cable of claim 2, wherein: the quantity of the flexible grounding core is two, two flexible grounding cores are in different gaps.

4. The photoelectric composite medium-voltage shore power cable of claim 2, wherein: each of the power core comprises a flexible power conductor core, a semi-conductive tape conductor shielding layer, a semi-conductive extruded conductor shielding layer, a high performance rubber insulation layer, a semi-conductive extruded insulation shielding layer, a semi-conductive tape insulation shielding layer, and a wire braided flexible insulation shielding layer positioned in order from the inside to the outside of the power core.

5. The photoelectric composite medium-voltage shore power cable of claim 4, wherein: the semi-conductive extruded insulation shielding layer is extruded and attached to an outer surface of the high performance rubber insulation layer.

6. The photoelectric composite medium-voltage shore power cable of claim 4, wherein: an average thickness of the semi-conductive tape conductor shielding layer is 0.1 to 0.3 mm.

7. The photoelectric composite medium-voltage shore power cable of claim 4, wherein: a thickness of the semi-conductive extruded conductor shielding layer is 0.6 to 1.0 mm.

8. The photoelectric composite medium-voltage shore power cable of claim 4, wherein: the high performance rubber insulation layer comprises an EPR (Ethylene Propylene Rubber) insulation material, the semi-conductive extruded insulation shielding layer comprises a peelable semi-conductive layer electrical material, and a thickness of the semi-conductive extruded insulation shielding layer is about 0.8 to 1.2 mm.

9. The photoelectric composite medium-voltage shore power cable of claim 4, wherein: an average thickness of the semi-conductive tape insulation shielding layer is 0.1 to 0.3 mm.

10. The photoelectric composite medium-voltage shore power cable of claim 4, wherein the flexible grounding core comprises a ground conductor core and a semi-conductive rubber insulation layer that are sequentially positioned from the inside to the outside of the flexible grounding core; the semi-conductive rubber insulation layer is in contact with the two adjacent power cores.

11. The photoelectric composite medium-voltage shore power cable of claim 10, wherein the inner sheath layer is a flame-retardant thermoplastic elastomer inner sheath layer, the strengthening layer is a flexible high-strength fiber woven reinforcement layer, and the outer sheath layer is an oil-resistant flame-retardant outer sheath layer.

12. The photoelectric composite medium-voltage shore power cable of claim 11,wherein an extruded thickness of the inner sheath layer is at least 0.8-1.2 mm; the flexible high-strength fiber woven reinforcement layer comprises a multi-strand flexible high-strength fiber woven structure, and a woven coverage density of the flexible high-strength fiber woven reinforcement layer is $\geqslant$ 60%; the oil-resistant flame-retardant outer sheath layer is extruded outside the flexible high-strength fiber woven reinforcement layer, and an extruded thickness of the outer sheath layer is at least 1.0 to 1.4 mm.

13. The photoelectric composite medium-voltage shore power cable of claim 11, wherein the flexible optical unit comprises a high temperature resistant single-mode/multi-mode fiber, a flexible high-strength fiber reinforced core, and a flame-retardant thermoplastic sheath layer.

14. The photoelectric composite medium-voltage shore power cable of claim 13, wherein: the semi-conductive tape conductor shielding layer, the semi-conductive extruded conductor shielding layer, the high performance rubber insulation layer, the semi-conductive extruded insulation shielding layer, the semi-conductive tape insulation shielding layer, the flame-retardant thermoplastic elastomer inner sheath layer, the flexible high-strength fiber woven reinforcement layer, the oil-resistant flame-retardant outer sheath layer, the semi-conductive rubber insulation layer, the flexible high-strength fiber reinforced core, and the flame-retardant thermoplastic sheath layer are all non-metallic materials.

15. The photoelectric composite medium-voltage shore power cable of claim 13, wherein: the cable core further comprises a flexible control core unit; the flexible optical unit , the flexible grounding core, and the flexible control wire core unit are in different gaps, and the flexible control core unit is in contact with two adjacent power cores.

16. The photoelectric composite medium-voltage shore power cable of claim 15, wherein: the flexible control core unit comprises a control conductor core, a flexible rubber insulation layer, and an aluminum-plastic composite tape wrapping shielding layer.

17. A manufacturing method of a photoelectric composite medium-voltage shore power cable, wherein, the manufacturing method comprising:

providing three power cores;

three power cores are positioned in parallel and in contact and are in a flatted-circle structure;

embedding a flexible optical unit in a gap formed between the two adjacent power cores, and the flexible optical unit is in contact with the two adjacent power cores;

extruding a flame-retardant thermoplastic elastomer on a surface of the flatted-circle structure formed by the three power cores and the flexible optical unit to form an inner sheath layer;

weaving flexible high-strength fibers on the inner sheath layer to form a strengthening layer;

extruding an oil-resistant flame-retardant material on the strengthening layer to form an outer sheath layer.

18. The manufacturing method of claim 17, wherein: the step of embedding the flexible optical unit being embedded in the gap formed between two adjacent power cores and contacting the two adjacent power cores comprises:

embedding a flexible grounding core and the flexible optical unit in different gaps, and the flexible grounding core and the flexible optical unit is in contact with the two adjacent power cores.

19. The manufacturing method of claim 18, wherein: the step of extruding the flame-retardant thermoplastic elastomer on the surface of the flatted-circle structure formed by the three power cores and the flexible optical unit to form an inner sheath layer includes:

extruding the flame-retardant thermoplastic elastomer on the surface of a flatted-circle structure formed by the three power cores, the flexible optical unit, and the flexible grounding core to form an inner sheath layer.