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(54) **DYNAMIC AND STATIC SUBMARINE CABLE WITH CONTINUOUS WIRE CORE AND PRODUCTION METHOD THEREFOR**

(57) A dynamic and static submarine cable with a continuous wire core (10), the submarine cable having the continuous wire core (10), a static section (11), a dynamic section (12), and a transition section (13) positioned between the static section (11) and the dynamic section (12), wherein an inner jacket (101) is formed on the exterior of the wire core (10) through extrusion, and a part of the inner jacket (101) which is positioned at the transition section (13) is selected and marked as a transition point (131); armored steel wires are twisted on the inner jacket (101) to form at least one inner armored layer, and the position on the inner armored layer corresponding to the transition point (131) is marked; and the armored steel wires are twisted from the dynamic section

(12) to the transition section (13) to form at least one outer armored layer, the outer armored layer extends to the transition section (13), the inner armored layer and the outer armored layer are cut off at the transition point (131), and the parts of the inner armored layer and the outer armored layer at the transition section (13) are combined to install a sealing assembly. Further provided is a production method for the dynamic and static submarine cable with the continuous wire core (10), wherein the wire core (10) is continuously produced, the armored layer and a jacket layer are formed outside the wire core (10), the armored steel wires of the armored layer are cut off at the transition section (13), and the sealing assembly (20) is installed in a matching manner.

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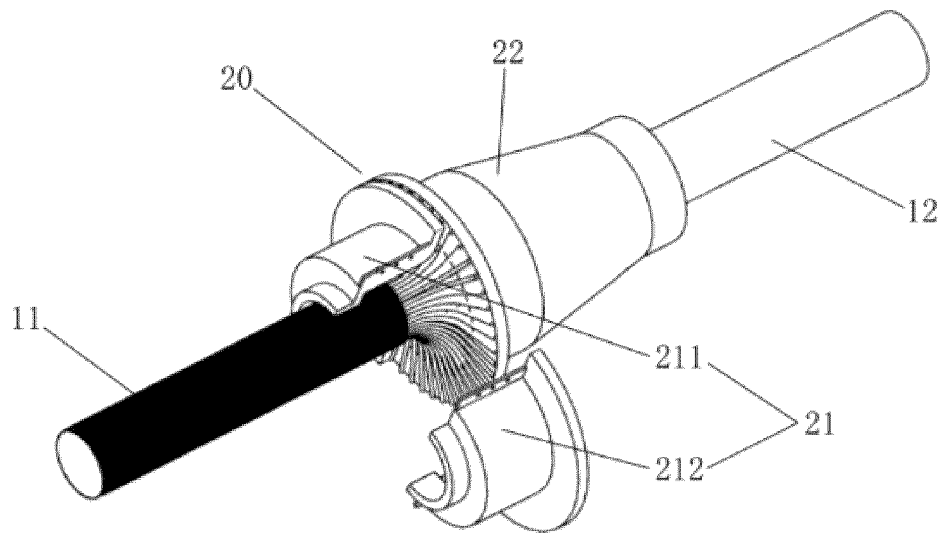


FIG. 1

Description

FIELD

[0001] The present application relates to the technical field of submarine cables, particularly, relates to dynamic and static submarine cable with continuous wire core and production method therefor.

BACKGROUND

[0002] With the development of offshore oil and gas resources and new offshore energy gradually being developed in the deep sea, submarine cables, which undertake the task of power and communication signal transmission, have gradually become the key and costly component of the whole system. The dynamic submarine cable in the prior art usually consists of a cable core for current transmission and an optical core for optical signal transmission, which are twisted to form the submarine wire core, and several sheath layers, armor layers, etc. are set outside. Dynamic submarine cables are gradually developing towards direction of large water depth, high voltage and large capacity signal transmission, and the corresponding protection requirements for dynamic submarine cables are also gradually improved. For example, when floating oil production platform and floating wind power generation equipment assemblies are applied to the ultra deep water environment below 800m, the dynamic submarine cable will bear a direct load caused by floating body shaking and wave current, which will increase the risk of damage to the dynamic submarine cable and supporting accessories. The distance from the floating body operating in deep water environment to the seabed or shore access equipment usually reaches hundreds of kilometers. The laying distance of the whole submarine cable is long. In order to ensure that voltage drop meets transmission requirements, section of cable conductor is usually designed to be large, and the cost increases sharply.

[0003] In prior art, in order to meet requirements of long-distance laying and reduce the cost, a dynamic section and a static section of the submarine cable are usually produced separately. The static section applies a single layer of armor without extruding the outer sheath. The static section and the dynamic section are connected through a joint box. The electrical cables in the joint box are connected through soft connectors or prefabricated hard connectors, and the optical cables are connected through a splice box. There are defects such as large transmission loss, easy to be affected by moisture, high breakdown risk under high electric field stress, etc. when connecting cables.

[0004] In order to avoid the defects of the connection, the dynamic section and the static section are considered to adopt a whole piece method. However, with the increase of the transmission distance, the whole piece method will lead to a significant increase in the cost. Un-

der the action of unstable seabed or anchor damage, the static section submarine cable is very easy to be broken during a sheath damage accident. Under high water pressure, seawater rapidly penetrates into the whole cable along the armor layer, and may be pressed into the electrical equipment cabin, causing a short circuit accident.

SUMMARY

[0005] A main purpose of the present application is to provide a dynamic and static submarine cable with a continuous wire core, which includes a static section and a dynamic section with uninterrupted wire core. A transition section is positioned between the static section and the dynamic section. A sealing assembly is installed on the transition section. Power and communication transmission systems can be connected without manual connectors to ensure stability and safety of long-distance transmission, while meeting requirements of submarine cable protection.

[0006] Another purpose of the present application is to provide a production method of dynamic and static submarine cable with continuous wire core. The wire core is continuously produced, an armor layer and a jacket layer are formed outside the wire core. The armor steel wires of the armor layer are cut off at the transition section, and the sealing assembly is installed in a matching manner to improve the manufacturing efficiency and reduce the manufacturing cost.

[0007] In order to achieve the above purpose, the present application provides a dynamic and static submarine cable with a continuous wire core, including the continuous wire core, a static section, a dynamic section, and a transition section positioned between the static section and the dynamic section, an inner jacket is formed on the exterior of the wire core through extrusion, and a part of the inner jacket positioned at the transition section is selected and marked as a transition point; armored steel wires are twisted on the inner jacket to form at least one inner armored layer, and the position on the inner armored layer corresponding to the transition point is marked; armored steel wires are twisted from the dynamic section to the transition section to form at least one outer armored layer, and the outer armor layer extends to the transition section, the inner armored layer and the outer armored layer are cut off at the transition point, and the parts of the inner armored layer and the outer armored layer at the transition section are combined to install a sealing assembly.

[0008] Furthermore, the static section includes a static inner armor layer and an outer covering layer, the static inner armor layer is wrapped on the exterior of the inner jacket, the outer covering layer is wrapped on the exterior of the static inner armor layer; the static inner armor layer extends to the transition point, the outer covering layer extends to the junction of the static section and the transition section, the static inner armor layer in the transition section is bent at 90 °.

[0009] Furthermore, the dynamic section includes a dynamic inner armor layer, a dynamic outer armor layer, and an outer sheath, the dynamic inner armor layer is wrapped on the exterior of the inner jacket, the dynamic outer armor layer is wrapped on the exterior the dynamic inner armor layer, and the outer sheath is wrapped on the exterior of the dynamic outer armor layer; the dynamic inner armor layer extends to the transition point, the dynamic inner armor layer and the dynamic outer armor layer in the transition section expand into an umbrella shape.

[0010] Furthermore, the sealing assembly comprises a static section anchor, a dynamic section anchor, and a sealing ring, the dynamic inner armor layer and the dynamic outer armor layer of the transition section are positioned in a cavity of the dynamic section anchor, the sealing ring is positioned in the cavity of the dynamic section anchor, and the sealing ring is installed on the inner jacket, an inner portion of the dynamic section anchor is filled with steel wire fastening glue; the static section anchor and the dynamic section anchor are matched to clamp the static inner armor layer in the transition section, and the static section anchor is locked with the dynamic section anchor through bolts, an inner portion the static section anchor is filled with resin glue.

[0011] Furthermore, the static section anchored is in Harvard-typed structure.

[0012] Furthermore, the armor steel wires of the inner armor layer and the outer armor layer are in medium carbon galvanized steel wires.

[0013] Furthermore, the armor steel wires are twisted on the inner jacket to form two layers of inner armor layers, and the armor steel wires are twisted from the dynamic section to the transition section to form two layers of outer armor layers.

[0014] The present application further provides a production method of dynamic and static submarine cables with continuous wire core, which is configured to produce the dynamic and static submarine cables with the continuous wire core, the producing method includes following steps:

(A) producing cable cores and optical cable cores continuously, stranding the cable cores and the optical cores into bundles to form the wire core, extruding the inner jacket with uniform specification and size on the exterior of the wire core, marking the transition point of the dynamic section and the static section on the inner jacket;

(B) continuously twisting the armor steel wires on the inner jacket to form the inner armor layer, and the transition point is marked on the dynamic section and the static section;

(C) starting from the dynamic section, the outer armor layer is twisted in an opposite direction to the inner armor layer, and the outer armor layer extends

to the end of the transition section, an end portion of the outer armor layer is fixed with steel tape;

(D) stranding the outer covering layer on the static section to the transition section;

(E) after finishing take-up, the dynamic section is extruded with the outer sheath, and the outer sheath extends to the end of the static section;

(F) cut off the armor steel wire of the inner armor layer and the outer armor layer at the transition point, the dynamic inner armor layer and the dynamic outer armor layer of the transition section expand to form an umbrella shape, and are put into the cavity of the dynamic section anchor, installing the sealing ring on the inner jacket, and inserting into the cavity of the dynamic section anchor, filling with the steel wire fastening glue into the dynamic section anchor;

(G) the static inner armor layer in the transition section is bent at 90 ° and paved all around, the static inner armor layer in the transition section is clamped by the static section anchor, and the static section anchor is locked with the dynamic section anchor by bolts;

(H) after the static section anchor and the dynamic section anchor are locked, the static section anchor is injected with resin glue, and the cavity of the static section anchor is filled.

[0015] Furthermore, the dynamic section anchor is fixed at a position where the dynamic section enters a take-up reel in step (E).

[0016] Furthermore, before the sealing ring in step (F) is installed on the inner jacket, the sealing ring is pre tensioned and deformed through stainless steel clips and bolts.

[0017] Compared with the prior art, the present application discloses a dynamic and static submarine cable with continuous wire core and its production method, which has the advantages of: the dynamic and static submarine cable with continuous wire core has no manual joint connection, low transmission loss, high stability and safety; the dynamic and static submarine cable with the continuous wire core has good protection performance and can effectively avoid operation accidents; the production method of the dynamic and static submarine cable with continuous wire core has high efficiency, can be achieved without modifying the existing production equipment, and has low cost.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] Many aspects of the disclosure can be better understood with reference to the following drawings. The drawings in the following description are some embodi-

ments of the present disclosure. For those of ordinary skill in the art, other drawings can be obtained based on these drawings without creative work.

FIG. 1 is a schematic drawing of a dynamic and static submarine cable with a continuous wire core of the present application.

FIG. 2 is a cross-sectional view of a dynamic section of the dynamic and static submarine cable with a continuous wire core connected with a Harvard-typed sealing ring and a dynamic section anchor.

FIG. 3 is a cross-sectional view of the dynamic and static submarine cable with a continuous wire without installing a sealing assembly.

DETAILED DESCRIPTION

[0019] In order to better understand the above purposes, features and advantages of embodiments of the application, the application is described below in combination with the drawings and specific embodiments. It should be noted that, in the case of no conflict, the features in the embodiments of the present application can be combined with each other.

[0020] Many specific details are described in the following description to understand the embodiments of the application. The described embodiments are only part of the embodiments of the application, not all of them.

[0021] Unless otherwise defined, all technical and scientific terms used herein have the same meanings as those commonly understood by those skilled in the technical field belonging to the embodiments of the application. The terms used in the specification of the application herein are only for the purpose of describing specific embodiments, and are not intended to limit embodiments of the application.

[0022] The following specific embodiments will further explain the embodiments of the application in combination with the above drawings.

[0023] Referring to FIG. 1, FIG. 2, and FIG. 3, a dynamic and static submarine cable with continuous wire core includes a continuous wire core 10, a static section 11, a dynamic section 12 and a transition section 13. The transition section 13 is positioned between the static section 11 and the dynamic section 12, and the transition section 13 is combined with a sealing assembly 20. The wire core 10 includes cable cores and optical cable cores. The cable cores and the optical cable cores are produced continuously and twisted into bundles by vertical cabling machine. An inner jacket 101 is formed on the exterior of the wire core 10 through extrusion, and a part of the inner jacket 101 positioned at the transition section 13 is selected and marked as a transition point 131. Armor steel wires are twisted on the inner jacket 101 to form at least one inner armored layer, and the position on the inner armored layer corresponding to the transition point

131 is marked. Armor steel wires are twisted from the dynamic section 12 to the transition section 13 to form at least one outer armored layer, and the outer armor layer extends to the transition section 13. The inner armored layer and the outer armored layer are cut off at the transition point 131, and the parts of the inner armored layer and the outer armored layer at the transition section are combined to install the sealing assembly 20. The sealing assembly 20 can be used as a fixing pin to butt and fix with a seabed fixing device, so as to prevent large underwater offset of the dynamic submarine cable due to external loads. Furthermore, the armor steel wires are twisted on the inner jacket 101 to form two layers of inner armor layers, and the armor steel wires are twisted from the dynamic section 12 to the transition section 13 to form two layers of outer armor layers, increasing the unit weight and strength of the submarine cable, improving service environment adaptability of the submarine cable, so as to meet the requirements of large water depth and severe environmental loads.

[0024] The static section 11 includes a static inner armor layer 111 and an outer covering layer 112. The static inner armor layer 111 is wrapped on the exterior of the inner jacket 101, and the outer covering layer 112 is wrapped on the exterior of the static inner armor layer 111. The static inner armor layer 111 extends to the transition point 131, and the outer covering layer 112 extends to the junction of the static section 11 and the transition section 13. The static inner armor layer 111 in the transition section 13 is bent at 90°, perpendicular to the axis of the wire core 10, and the armor steel wires of the static inner armor layer 111 is paved all around. The outer covering layer 112 is formed by stranding PP rope, and the armor steel wires are medium carbon galvanized steel wire.

[0025] The dynamic section 12 includes a dynamic inner armor layer 121, a dynamic outer armor layer 122, and an outer sheath 123. The dynamic inner armor layer 121 is wrapped on the exterior of the inner jacket 101, the dynamic outer armor layer 122 is wrapped on the exterior the dynamic inner armor layer 121, and the outer sheath 123 is wrapped on the exterior of the dynamic outer armor layer 122. The dynamic inner armor layer 121 extends to the transition point 131, and the outer sheath 123 extends to the junction of the dynamic section 12 and the transition section 13. The dynamic inner armor layer 121 and the dynamic outer armor layer 122 in the transition section 13 expand into an umbrella shape. The outer sheath 123 is formed through extrusion.

[0026] The seal assembly 20 includes a static section anchor 21, a dynamic section anchor 22, and a seal ring 23. The static section anchor 21 is installed from one side of the static section 11 to the transition section 13, and the dynamic section anchor 22 is installed from one side of the dynamic section 12 to the transition section 13. The dynamic inner armor layer 121 and the dynamic outer armor layer 122 of the transition section 13 are positioned in a cavity of the dynamic section anchor 22. The sealing

ring 23 is positioned in the cavity of the dynamic section anchor 22, and the sealing ring 23 is installed on the inner jacket 101, which is located inside the dynamic inner armor layer 121 and the dynamic outer armor layer 122 of the transition section 13. An inner portion of the dynamic section anchor 22 is filled with steel wire fastening glue. The sealing ring 23 is a Harvard-typed sealing ring, including two symmetrical parts 231 and 232. The sealing ring 23 adopts high elastic modulus to meet the requirements of large deformation and undamaged rubber materials. The sealing ring 23 is pre tensioned by stainless steel clips and bolts to meet the sealing requirements. The static section anchor 21 is matched with the dynamic section anchor 22 to clamp the armor steel wires of the static inner armor layer 111 in the transition section 13, and the static section anchor 21 is locked with the dynamic cable anchor 22 through bolts. After locking, the static section anchor 21 is filled with resin glue, and a cavity of the static section anchor 21 is filled. The static section anchor 21 is in Harvard-typed structure, including two parts 211 and 212. In other embodiments, the static section anchor 21 can also be an integral structure.

[0027] The present application further discloses a production method of dynamic and static submarine cables with continuous wire core, which is configured to produce the dynamic and static submarine cables with continuous wire core, including the following steps:

(A) producing cable cores and optical cable cores continuously, stranding the cable cores and the optical cable cores into bundles to form the wire core, extruding the inner jacket with uniform specification and size on the exterior of the wire core, marking the transition point of dynamic section and static section on the inner jacket;

(B) twisting the armor steel wires on the inner jacket continuously to form the inner armor layer, and the transition point is marked on the dynamic section and the static section;

(C) starting from the dynamic section, the outer armor layer is twisted in an opposite direction to the inner armor layer, and the outer armor layer extends to the end of the transition section, an end portion of the outer armor layer is fixed with steel tape;

(D) stranding the outer covering layer on the static section to the end of transition section closing to the dynamic section;

(E) after finishing take-up, the dynamic section is extruded with the outer sheath, and the outer sheath extends to the end of the static section;

(F) cut off the armor steel wire of the inner armor layer and the outer armor layer at the transition point, the dynamic inner armor layer and the dynamic outer

armor layer of the transition section expand to form an umbrella shape, and are put into the cavity of the dynamic section anchor, installing the sealing ring on the inner jacket, and inserting into the cavity of the dynamic section anchor, filling with the steel wire fastening glue into the dynamic section anchorage;

(G) the static inner armor layer in the transition section is bent at 90 ° and paved all around, the static inner armor layer in the transition section is clamped by the static section anchor, and the static section anchor is locked with the dynamic section anchor by bolts;

(H) after the static section anchor and the dynamic section anchor are locked, the static section anchor is injected with resin glue, and the cavity of the static section anchor is filled.

[0028] Furthermore, in step (E), the dynamic section anchor is fixed at the position where the dynamic section enters a take-up reel, so that the dynamic section can pass through an anchor hole smoothly. Before the sealing ring in step (F) is installed on the inner jacket, the sealing ring is pre tensioned and deformed through stainless steel clips and bolts to improve the sealing performance.

[0029] The above embodiments are only used to describe the technical solution of the embodiments of the application, not the limitations. Although the embodiments of the application have been described in detail with reference to the above preferred embodiments, ordinary technicians in the art should understand that the technical solution of the embodiments of the application can be modified or replaced equivalently, which should not be divorced from the spirit and scope of the technical solution of the embodiments of the application.

Claims

1. A dynamic and static submarine cable with a continuous wire core, **characterized in that**, comprising the continuous wire core, a static section, a dynamic section and a transition section positioned between the static section and the dynamic section, an inner jacket is formed on the exterior of the wire core through extrusion, and a part of the inner jacket positioned at the transition section is selected and marked as a transition point; armored steel wires are twisted on the inner jacket to form at least one inner armored layer, and the position on the inner armored layer corresponding to the transition point is marked; armored steel wires are twisted from the dynamic section to the transition section to form at least one outer armored layer, and the outer armor layer extends to the transition section, the inner armored layer and the outer armored layer are cut off at the tran-

sition point, and the parts of the inner armored layer and the outer armored layer at the transition section are combined to install a sealing assembly.

2. The dynamic and static submarine cable with the continuous wire core of claim 1, **characterized in that**, the static section comprises a static inner armor layer and an outer covering layer, the static inner armor layer is wrapped on the exterior of the inner jacket, the outer covering layer is wrapped on the exterior of the static inner armor layer; the static inner armor layer extends to the transition point, the outer covering layer extends to the junction of the static section and the transition section, the static inner armor layer in the transition section is bent at 90 °. 5
3. The dynamic and static submarine cable with the continuous wire core of claim 2, **characterized in that**, the dynamic section comprises a dynamic inner armor layer, a dynamic outer armor layer, and an outer sheath, the dynamic inner armor layer is wrapped on the exterior of the inner jacket, the dynamic outer armor layer is wrapped on the exterior of the dynamic inner armor layer, and the outer sheath is wrapped on the exterior of the dynamic outer armor layer; the dynamic inner armor layer extends to the transition point, the dynamic inner armor layer and the dynamic outer armor layer in the transition section expand into an umbrella shape. 10 15 20 25 30
4. The dynamic and static submarine cable with the continuous wire core of claim 3, **characterized in that**, the sealing assembly comprises a static section anchor, a dynamic section anchor, and a sealing ring, the dynamic inner armor layer and the dynamic outer armor layer of the transition section are positioned in a cavity of the dynamic section anchor, the sealing ring is positioned in the cavity of the dynamic section anchor, and the sealing ring is installed on the inner jacket, an inner portion of the dynamic section anchor is filled with steel wire fastening glue; the static section anchor and the dynamic section anchor are matched to clamp the static inner armor layer in the transition section, and the static section anchor is locked with the dynamic section anchor through bolts, an inner portion the static section anchor is filled with resin glue. 35 40 45 50
5. The dynamic and static submarine cable with the continuous wire core of claim 4, **characterized in that**, the static section anchored is in Harvard-typed structure. 50
6. The dynamic and static submarine cable with the continuous wire core of claim 1, **characterized in that**, the armor steel wires of the inner armor layer and the outer armor layer are in medium carbon galvanized steel wires. 55

7. The dynamic and static submarine cable with the continuous wire core of claim 1, **characterized in that**, the armor steel wires are twisted on the inner jacket to form two layers of inner armor layers, and the armor steel wires are twisted from the dynamic section to the transition section to form two layers of outer armor layers.

8. A production method of dynamic and static submarine cables with continuous wire core, which is configured to produce the dynamic and static submarine cables with the continuous wire core as claimed in claim 4, **characterized in that**, the producing method comprising following steps:

(A) producing cable cores and optical cable cores continuously, stranding the cable cores and the optical cores into bundles to form the wire core, extruding the inner jacket with uniform specification and size on the exterior of the wire core, marking the transition point of the dynamic section and the static section on the inner jacket;

(B) continuously twisting the armor steel wires on the inner jacket to form the inner armor layer, and the transition point is marked on the dynamic section and the static section;

(C) starting from the dynamic section, the outer armor layer is twisted in an opposite direction to the inner armor layer, and the outer armor layer extends to the end of the transition section, an end portion of the outer armor layer is fixed with steel tape;

(D) stranding the outer covering layer on the static section to the transition section;

(E) after finishing take-up, the dynamic section is extruded with the outer sheath, and the outer sheath extends to the end of the static section;

(F) cut off the armor steel wire of the inner armor layer and the outer armor layer at the transition point, the dynamic inner armor layer and the dynamic outer armor layer of the transition section expand to form an umbrella shape, and are put into the cavity of the dynamic section anchor, installing the sealing ring on the inner jacket, and inserting into the cavity of the dynamic section anchor, filling with the steel wire fastening glue into the dynamic section anchor;

(G) the static inner armor layer in the transition section is bent at 90 ° and paved all around, the static inner armor layer in the transition section is clamped by the static section anchor, and the static section anchor is locked with the dynamic section anchor by bolts;

(H) after the static section anchor and the dynamic section anchor are locked, the static section anchor is injected with resin glue, and the cavity of the static section anchor is filled.

9. The production method of dynamic and static submarine cables with continuous wire core as claimed in claim 8, **characterized in that**, the dynamic section anchor is fixed at a position where the dynamic section enters a take-up reel in step (E). 5
10. The production method of dynamic and static submarine cables with continuous wire core as claimed in claim 8, **characterized in that**, before the sealing ring in step (F) is installed on the inner jacket, the sealing ring is pre tensioned and deformed through stainless steel clips and bolts. 10

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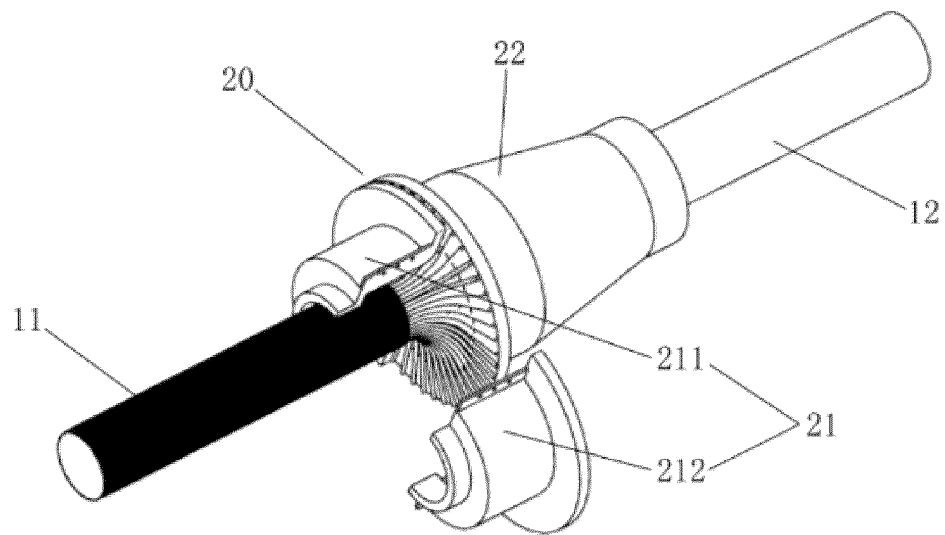


FIG. 1

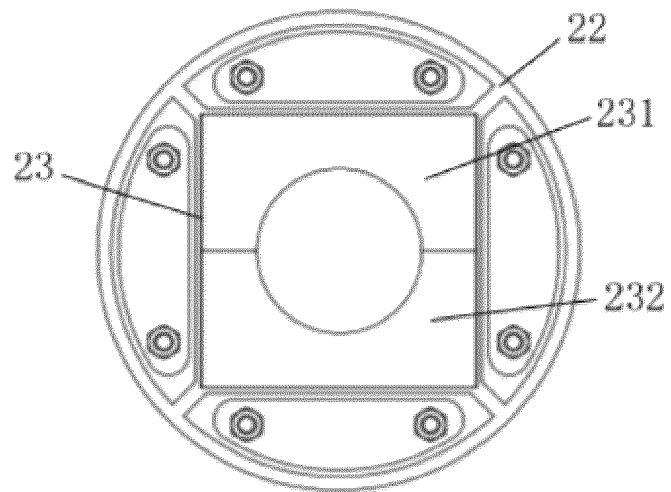


FIG. 2

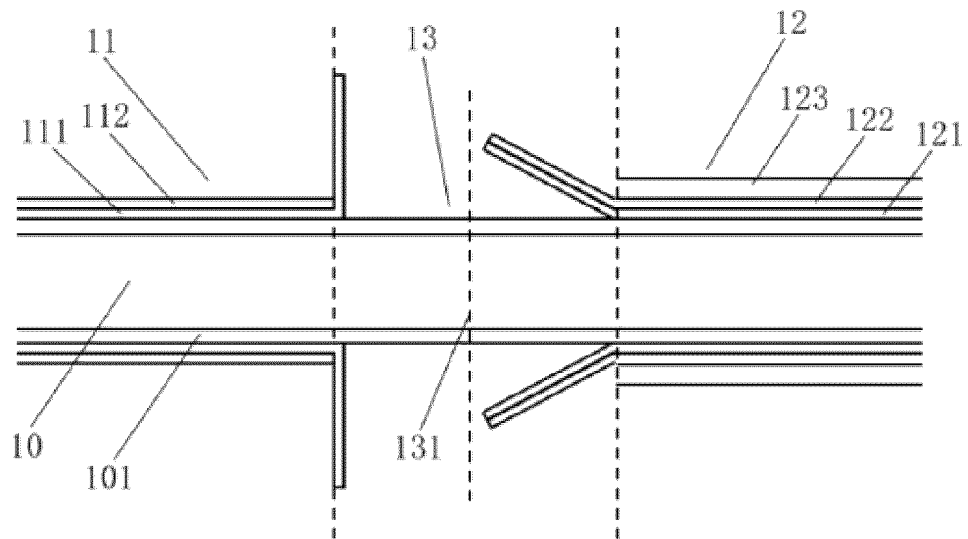


FIG. 3

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2020/126783

A. CLASSIFICATION OF SUBJECT MATTER H01B 7/17(2006.01)i; H01B 13/00(2006.01)i; H01B 13/22(2006.01)i According to International Patent Classification (IPC) or to both national classification and IPC																					
B. FIELDS SEARCHED																					
Minimum documentation searched (classification system followed by classification symbols) H01B																					
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched																					
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C. DOCUMENTS CONSIDERED TO BE RELEVANT																					
<table border="1"> <thead> <tr> <th>Category*</th> <th>Citation of document, with indication, where appropriate, of the relevant passages</th> <th>Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td>X</td> <td>CN 111292889 A (ZHONGTIAN TECHNOLOGY SUBMARINE CABLES CO., LTD. et al.) 16 June 2020 (2020-06-16) description, paragraphs 0028-0074, figures 1-5</td> <td>1-3, 6, 7</td> </tr> <tr> <td>Y</td> <td>CN 111292889 A (ZHONGTIAN TECHNOLOGY SUBMARINE CABLES CO., LTD. et al.) 16 June 2020 (2020-06-16) description, paragraphs 0028-0074, figures 1-5</td> <td>4-5, 8-10</td> </tr> <tr> <td>Y</td> <td>CN 202084895 U (ZHENG, Bingwen) 21 December 2011 (2011-12-21) description, paragraph 0015, and figures 1 and 2</td> <td>4-5, 8-10</td> </tr> <tr> <td>A</td> <td>CN 205595098 U (JIANGSU HENG TONG HIGH VOLTAGE CABLE CO., LTD.) 21 September 2016 (2016-09-21) entire document</td> <td>1-10</td> </tr> <tr> <td>A</td> <td>CN 110632724 A (JIANGSU HENG TONG OCEAN OPTICAL NETWORK SYSTEM CO., LTD.) 31 December 2019 (2019-12-31) entire document</td> <td>1-10</td> </tr> <tr> <td>A</td> <td>CN 205283073 U (JIANGSU HENG TONG MARINE CABLE SYSTEMS CO., LTD. et al.) 01 June 2016 (2016-06-01) entire document</td> <td>1-10</td> </tr> </tbody> </table>	Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	X	CN 111292889 A (ZHONGTIAN TECHNOLOGY SUBMARINE CABLES CO., LTD. et al.) 16 June 2020 (2020-06-16) description, paragraphs 0028-0074, figures 1-5	1-3, 6, 7	Y	CN 111292889 A (ZHONGTIAN TECHNOLOGY SUBMARINE CABLES CO., LTD. et al.) 16 June 2020 (2020-06-16) description, paragraphs 0028-0074, figures 1-5	4-5, 8-10	Y	CN 202084895 U (ZHENG, Bingwen) 21 December 2011 (2011-12-21) description, paragraph 0015, and figures 1 and 2	4-5, 8-10	A	CN 205595098 U (JIANGSU HENG TONG HIGH VOLTAGE CABLE CO., LTD.) 21 September 2016 (2016-09-21) entire document	1-10	A	CN 110632724 A (JIANGSU HENG TONG OCEAN OPTICAL NETWORK SYSTEM CO., LTD.) 31 December 2019 (2019-12-31) entire document	1-10	A	CN 205283073 U (JIANGSU HENG TONG MARINE CABLE SYSTEMS CO., LTD. et al.) 01 June 2016 (2016-06-01) entire document	1-10
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Y	CN 202084895 U (ZHENG, Bingwen) 21 December 2011 (2011-12-21) description, paragraph 0015, and figures 1 and 2	4-5, 8-10																			
A	CN 205595098 U (JIANGSU HENG TONG HIGH VOLTAGE CABLE CO., LTD.) 21 September 2016 (2016-09-21) entire document	1-10																			
A	CN 110632724 A (JIANGSU HENG TONG OCEAN OPTICAL NETWORK SYSTEM CO., LTD.) 31 December 2019 (2019-12-31) entire document	1-10																			
A	CN 205283073 U (JIANGSU HENG TONG MARINE CABLE SYSTEMS CO., LTD. et al.) 01 June 2016 (2016-06-01) entire document	1-10																			
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PCT/CN2020/126783

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP H02168805 A (FURUKAWA ELECTRIC CO., LTD.) 28 June 1990 (1990-06-28) entire document	1-10

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2020/126783

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)			Publication date (day/month/year)
CN	111292889	A	16 June 2020	None			
CN	202084895	U	21 December 2011	None			
CN	205595098	U	21 September 2016	None			
CN	110632724	A	31 December 2019	CN	210720828	U	09 June 2020
CN	205283073	U	01 June 2016	None			
JP	H02168805	A	28 June 1990	None			

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