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(54) **SUBMARINE CABLE AND MANUFACTURING METHOD THEREFOR**

(57) The invention provides a submarine cable and a method for manufacturing the same, relates to the field of cable technologies and is directed to solve the technical problem of poor bendability, flexibility and electrical performance of the submarine cable. The submarine cable includes a submarine cable section and a landing cable section, where the submarine cable section includes a first conductor, the first conductor includes n first monofilament layers, the landing cable section includes a second conductor, and the second conductor includes m second monofilament layers, the m second monofilament layers are divided into n second welding monofilament layers and h second winding monofilament layers; the n first monofilament layers are welded to the n second welding monofilament layers in a one-to-one relationship; and the h second winding monofilament layers are, sequentially from inside to outside in the radial direction of the submarine cable, wound outside an outermost layer of the n first monofilament layers. The submarine cable and the method for manufacturing the same

provided by the invention are directed to improve the bendability, flexibility and electrical performance of the submarine cable.

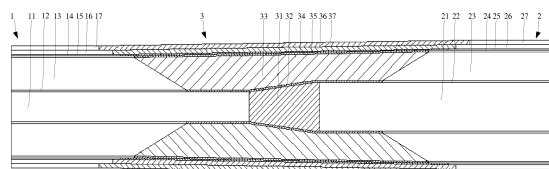


FIG. 1

Description

[0001] This application claims priority to a Chinese invention patent application No. 202011568968.6 filed with the China Patent Office on December 25, 2020, entitled "SUBMARINE CABLE AND METHOD FOR MANUFACTURING THE SAME", which is hereby incorporated by reference in its entirety.

TECHNICAL FIELD

[0002] The present invention relates to the field of cable technologies, and in particular, to a submarine cable and a method for manufacturing the same.

BACKGROUND

[0003] Submarine cable is a current-carrying device for power transmission under the sea, which is applicable in power supply for offshore drilling platforms, offshore islands, etc. Generally, the submarine cable includes a submarine cable section, a landing cable section and a joint connecting the submarine cable section and the landing cable section. The submarine cable section refers to a portion of the submarine cable located in deep water, and the landing cable section refers to a portion of the submarine cable located between the shallow water near the shore and a joint at the beach.

[0004] Due to the impact of environmental changes and human activities, the current-carrying capacity of the landing cable section is relatively low. Therefore, in order to solve the current-carrying capacity bottleneck problem of the landing cable section, it is generally designed that a cross-section of a conductor of the landing cable section is greater than that of a conductor of the submarine cable section and that the landing cable section is connected to the submarine cable section through a joint. The landing cable section and the submarine cable section are generally connected through a service joint. The service joint includes a crimping sleeve, a prefabricated insulating part, and a waterproof casing. For connecting the landing cable section and the submarine cable section through the service joint, the conductors of both the landing cable section and the submarine cable section are placed into the crimping sleeve so as to be connected by way of crimping.

[0005] However, the submarine cable presents poor bendability, flexibility and electrical performance when the landing cable section and the submarine cable section are connected through the service joint.

SUMMARY

[0006] In view of the above problems, embodiments of the present invention provide a submarine cable and a method for manufacturing the same, to improve the bendability, flexibility and electrical performance of the submarine cable.

[0007] In order to achieve the above purpose, embodiments of the present invention provide following technical solutions.

[0008] Embodiments of the present invention provide a submarine cable, including:

a submarine cable section which includes a first conductor, where the first conductor includes n first monofilament layers sequentially arranged from inside to outside in a radial direction of the submarine cable; and

a landing cable section which includes a second conductor, where the second conductor includes m second monofilament layers sequentially arranged from inside to outside in the radial direction of the submarine cable, and the m second monofilament layers are sequentially divided from inside to outside in the radial direction of the submarine cable into n second winding monofilament layers and h second winding monofilament layers, where m and n are both positive integers, and $m \geq n$, $h = m - n$;

where the n first monofilament layers, from inside to outside in the radial direction of the submarine cable, are welded to the n second winding monofilament layers in a one-to-one relationship;

where the h second winding monofilament layers are, sequentially from inside to outside in the radial direction of the submarine cable, wound outside an outermost layer of the n first monofilament layers; and for any two adjacent second winding monofilament layers, a winding part of a second winding monofilament layer located outside covers a winding part of a second winding monofilament layer located inside; where the winding part refers to a portion of each of the second winding monofilament layers wound outside the outermost layer of the first monofilament layers; and

where an area in which the n first monofilament layers are connected to the m second monofilament layers forms a conductor welding area of a joint.

[0009] The submarine cable provided by the embodiments of the present invention has following advantages: the submarine cable provided by the embodiments of the present invention includes the submarine cable section and the landing cable section, the n first monofilament layers of the first conductor of the submarine cable section, from inside to outside in the radial direction of the submarine cable, are welded to the n second winding monofilament layers in the m second monofilament layers of the second conductor of the landing cable section in a one-to-one relationship. The h second winding monofilament layers in the m second monofilament layers are, sequentially from inside to outside in the radial direction of the submarine cable, wound outside the outermost layer of the n first monofilament layers. For any two adjacent second winding monofilament layers, a winding part of a second winding monofilament layer located out-

side covers a winding part of a second winding monofilament layer located inside, and the area in which the n first monofilament layers are connected to the m second monofilament layers forms the conductor welding area of the joint. With such arrangement, the first monofilament layers of the first conductor and the second monofilament layers of the second conductor are connected together by way of welding and winding, without using a crimping sleeve. This can improve the bendability and flexibility of the submarine cable, and in comparison to connecting the conductors of the landing cable section and the submarine cable section by crimping, connecting them by welding and winding offers a stronger bonding force between the conductors of the landing cable section and the submarine cable section, which results in less easy separation of the conductors of the landing cable section and the submarine cable section and thus improves the electrical performance of the submarine cable.

[0010] In the submarine cable as described above, a difference between a winding pitch of the winding part of each of the second winding monofilament layers and a stranding pitch of a stranding part of each of the second winding monofilament layers is less than a preset difference, and the stranding part refers to a portion of each of the second winding monofilament layers stranded outside an outermost layer of the second welding monofilament layers.

[0011] In the submarine cable as described above, for any two adjacent second welding monofilament layers, a second welding monofilament layer located outside covers a secondary welding area between a second welding monofilament layer located inside and a corresponding first monofilament layer;

an innermost layer of the second winding monofilament layers covers a secondary welding area between the outermost layer of the first monofilament layers and the outermost layer of the second welding monofilament layers; and
the secondary welding area is an area in which the first monofilament layers are welded to the second monofilament layers.

[0012] In the submarine cable as described above, the submarine cable section further includes a first conductor shielding layer, and the first conductor shielding layer covers part of the first conductor; the landing cable section further includes a second conductor shielding layer, and the second conductor shielding layer covers part of the second conductor; and the joint further includes a conductor shielding recovery layer, the conductor shielding recovery layer covers part of the first conductor, part of the second conductor, and the conductor welding area, and the conductor shielding recovery layer has one end connected to the first conductor shielding layer and the other end connected to the second conductor shielding layer.

[0013] In the submarine cable as described above, the submarine cable section further includes a first insulating layer, and the first insulating layer covers the first conductor shielding layer; the landing cable section further includes a second insulating layer, and the second insulating layer covers the second conductor shielding layer; and the joint further includes an insulating recovery layer, the insulating recovery layer covers the conductor shielding recovery layer, and the insulating recovery layer has one end connected to the first insulating layer and the other end connected to the second insulating layer.

[0014] In the submarine cable as described above, the submarine cable section further includes a first insulation shielding layer, and the first insulation shielding layer covers the first insulating layer; the landing cable section further includes a second insulation shielding layer, and the second insulation shielding layer covers the second insulating layer; and the joint further includes an insulation shielding recovery layer, the insulation shielding recovery layer covers the insulating recovery layer, and the insulation shielding recovery layer has one end connected to the first insulation shielding layer and the other end connected to the second insulation shielding layer.

[0015] In the submarine cable as described above, the submarine cable section further includes a first longitudinal water blocking layer, and the first longitudinal water blocking layer covers part of the first insulation shielding layer; the landing cable section further includes a second longitudinal water blocking layer, and the second longitudinal water blocking layer covers part of the second insulation shielding layer; and the joint further includes a longitudinal water-blocking recovery layer, the longitudinal water-blocking recovery layer covers part of the first insulation shielding layer, part of the second insulation shielding layer, and the insulation shielding recovery layer, and the longitudinal water-blocking recovery layer has one end connected to the first longitudinal water blocking layer and the other end connected to the second longitudinal water blocking layer.

[0016] In the submarine cable as described above, the submarine cable section further includes a first radial water blocking layer, and the first radial water blocking layer covers part of the first longitudinal water blocking layer; the landing cable section further includes a second radial water blocking layer, and the second radial water blocking layer covers part of the second longitudinal water blocking layer; and the joint further includes a radial water-blocking recovery layer, the radial water-blocking recovery layer covers part of the first longitudinal water blocking layer, part of the second longitudinal water blocking layer, and the longitudinal water-blocking recovery layer, and the radial water-blocking recovery layer has one end connected to the first radial water blocking layer and the other end connected to the second radial water blocking layer.

[0017] In the submarine cable as described above, the submarine cable section further includes a first non-metallic sheath layer, and the first non-metallic sheath layer

covers part of the first radial water blocking layer; the landing cable section further includes a second non-metallic sheath layer, and the second non-metallic sheath layer covers part of the second radial water blocking layer; and the joint further includes a non-metallic sheath recovery layer, and the non-metallic sheath recovery layer covers part of the first radial water blocking layer, part of the second radial water blocking layer, and the radial water-blocking recovery layer, and the non-metallic sheath recovery layer has one end connected to the first non-metallic sheath layer and the other end connected to the second non-metallic sheath layer.

[0018] In the submarine cable as described above, the submarine cable further includes an armor inner cushion layer, an armor layer, and an armor outer coating layer, and the armor inner cushion layer covers the first non-metallic sheath layer, the second non-metallic sheath layer, and the non-metallic sheath recovery layer; and the armor layer covers the armor inner cushion layer, and the armor outer coating layer covers the armor layer.

[0019] Embodiments of the present invention further provide a method for manufacturing a submarine cable, including:

providing a submarine cable section and a landing cable section, where the submarine cable section includes a first conductor, the first conductor includes n first monofilament layers arranged from inside to outside in a radial direction of the submarine cable, the landing cable section includes a second conductor, the second conductor includes m second monofilament layers sequentially arranged from inside to outside in the radial direction of the submarine cable, and the m second monofilament layers are sequentially divided from inside to outside in the radial direction of the submarine cable into n second welding monofilament layers and h second winding monofilament layers, where m and n are both positive integers, and $m \geq n$, $h = m - n$;

welding, sequentially from inside to outside in the radial direction of the submarine cable, the n first monofilament layers to the n second welding monofilament layers in a one-to-one relationship; and winding, sequentially from inside to outside in the radial direction of the submarine cable, the h second winding monofilament layers outside an outermost layer of the n first monofilament layers, where for any two adjacent second winding monofilament layers, a winding part of a second winding monofilament layer located outside covers a winding part of a second winding monofilament layer located inside, the winding part refers to a portion of each of the second winding monofilament layers wound outside the outermost layer of the first monofilament layers, so that an area in which the n first monofilament layers are connected to the m second monofilament layers forms a conductor welding area of a joint.

[0020] The method for manufacturing the submarine cable provided by the embodiments of the present invention has following advantages:

in the method for manufacturing the submarine cable provided by the embodiments of the present invention, firstly the submarine cable section with part of the first conductor exposed and the landing cable section with part of the second conductor exposed are provided, secondly the n first monofilament layers of the first conductor of the submarine cable section, from inside to outside in the radial direction of the submarine cable, are welded to the n second monofilament layers in the m second monofilament layers of the second conductor of the landing cable section in a one-to-one relationship, and then the h second winding monofilament layers in the m second monofilament layers are, sequentially from inside to outside in the radial direction of the submarine cable, wound outside the outermost layer of the n first monofilament layers. For any two adjacent second winding monofilament layers, a winding part of a second winding monofilament layer located outside covers a winding part of a second winding monofilament layer located inside. Therefore, the area in which the n first monofilament layers are connected to the m second monofilament layers forms the conductor welding area of the joint. With the above steps, the first monofilament layers of the first conductor and the second monofilament layers of the second conductor can be connected together by way of welding and winding, without using a crimping sleeve. This can improve the bendability and flexibility of the submarine cable, and in comparison to connecting the conductors of the landing cable section and the submarine cable section by crimping, connecting them by welding and winding offers a stronger bonding force between the conductors of the landing cable section and the submarine cable section, which results in less easy separation of the conductors of the landing cable section and the submarine cable section and thus improves the electrical performance of the submarine cable.

[0021] In the method for manufacturing the submarine cable as described above, in a step of winding sequentially from inside to outside the h second winding monofilament layers outside the outermost layer of the n first monofilament layers, a difference between a winding pitch of the winding part of each of the second winding monofilament layers and a stranding pitch of a stranding part of each of the second winding monofilament layers is less than a preset difference; and

the stranding part refers to a portion of each of the second winding monofilament layers stranded outside an outermost layer of the second welding monofilament layers.

[0022] In the method for manufacturing the submarine cable as described above, a step of welding the n first monofilament layers to the n second welding monofilament layers in a one-to-one relationship further includes:

covering, by a second welding monofilament layer located outside, a secondary welding area between

a second welding monofilament layer located inside and a corresponding first monofilament layer, where the secondary welding area is an area in which the first monofilament layers are welded to the second monofilament layers; and

in the step of winding, sequentially from inside to outside in the radial direction of the submarine cable, the h second winding monofilament layers outside the outermost layer of the n first monofilament layers, an innermost layer of the second winding monofilament layers covers a secondary welding area between the outermost layer of the first monofilament layers and the outermost layer of the second winding monofilament layers.

[0023] In the method for manufacturing the submarine cable as described above, the step of winding, sequentially from inside to outside in the radial direction of the submarine cable, the h second winding monofilament layers outside the outermost layer of the n first monofilament layers further includes:

welding a winding end of the winding part of each of the second winding monofilament layers to the outermost layer of the first monofilament layers, and performing a polishing operation on a welding area between the winding end and the first monofilament layer, so that a connection between the winding end and the first monofilament layer is firm and smooth.

[0024] In the method for manufacturing the submarine cable as described above, following a step of forming the conductor welding area, the method for manufacturing the submarine cable further includes: covering, by way of winding or extrusion molding with a same material as a conductor shielding layer, the conductor welding area and a exposed portion of the first conductor and a exposed portion of the second conductor to form a conductor shielding recovery layer, and making the conductor shielding recovery layer have one end connected to a first conductor shielding layer of the submarine cable section and the other end connected to a second conductor shielding layer of the landing cable section.

[0025] In the method for manufacturing the submarine cable as described above, following a step of forming the conductor shielding recovery layer, the method for manufacturing the submarine cable further includes: cutting a first insulating layer of the submarine cable section to obtain a cone surface with a cone angle not greater than 60° , and cutting a second insulating layer of the landing cable section to obtain a cone surface with a cone angle not greater than 60° ; and covering, by way of extrusion molding with a same material as the first insulating layer and the second insulating layer, the conductor shielding recovery layer to form an insulating recovery layer, and making the insulating recovery layer have one end connected to the first insulating layer and the other end connected to the second insulating layer.

[0026] In the method for manufacturing the submarine cable as described above, following a step of forming the

insulating recovery layer, the method for manufacturing the submarine cable further includes: covering, with a same material as a first insulation shielding layer of the submarine cable section and a second insulation shielding layer of the landing cable section, the insulating recovery layer to form an insulation shielding recovery layer, and making the insulation shielding recovery layer have one end connected to the first insulation shielding layer and the other end connected to the second insulation shielding layer; covering, with a same material as a first longitudinal water blocking layer of the submarine cable section and a second longitudinal water blocking layer of the landing cable section, the insulation shielding recovery layer to form a longitudinal water-blocking recovery layer, and making the longitudinal water-blocking recovery layer have one end connected to the first longitudinal water blocking layer and the other end connected to the second longitudinal water blocking layer; and covering, with a same material as a first radial water blocking layer of the submarine cable section and a second radial water blocking layer of the landing cable section, the longitudinal water-blocking recovery layer to form a radial water-blocking recovery layer, and making the radial water-blocking recovery layer have one end connected to the first radial water blocking layer and the other end connected to the second radial water blocking layer.

[0027] In the method for manufacturing the submarine cable as described above, following a step of forming the radial water-blocking recovery layer, the method for manufacturing the submarine cable further includes: when a material of a first non-metallic sheath layer of the submarine cable section is same as that of a second non-metallic sheath layer of the landing cable section, covering, with a non-metallic sheath material same as that of the first non-metallic sheath layer and the second non-metallic sheath layer, the radial water-blocking recovery layer, and heating the non-metallic sheath material, to form a non-metallic sheath recovery layer with the non-metallic sheath recovery layer, the first non-metallic sheath layer and the second non-metallic sheath layer integrated; and when the material of the first non-metallic sheath layer of the submarine cable section is different from that of the second non-metallic sheath layer of the landing cable section, covering, with a non-metallic sheath material same as that of the first non-metallic sheath layer or the second non-metallic sheath layer, the radial water-blocking recovery layer, and heating the non-metallic sheath material, to form a non-metallic sheath recovery layer with the non-metallic sheath recovery layer, the first non-metallic sheath layer and the second non-metallic sheath layer integrated.

[0028] In the method for manufacturing the submarine cable as described above, following a step of when the material of the first non-metallic sheath layer of the submarine cable section is different from that of the second non-metallic sheath layer of the landing cable section, covering, by way of extrusion molding with the non-me-

tallic sheath material same as that of the first non-metallic sheath layer or the second non-metallic sheath layer, the radial water-blocking recovery layer, and heating the non-metallic sheath material, to form the non-metallic sheath recovery layer, the method for manufacturing the submarine cable further includes: when the non-metallic sheath material is same as the material of the first non-metallic sheath layer, winding a cross-linked polyethylene tape at a junction between the non-metallic sheath recovery layer and the second non-metallic sheath layer, and heating the cross-linked polyethylene tape to integrate the cross-linked polyethylene tape, the non-metallic sheath recovery layer, and the second non-metallic sheath layer; and when the non-metallic sheath material is same as the material of the second non-metallic sheath layer, winding a cross-linked polyethylene tape at a junction between the non-metallic sheath recovery layer and the first non-metallic sheath layer, and heating the cross-linked polyethylene tape to integrate the cross-linked polyethylene tape, the non-metallic sheath recovery layer, and the first non-metallic sheath layer.

[0029] In the method for manufacturing the submarine cable as described above, following a step of forming the non-metallic sheath recovery layer, the method for manufacturing the submarine cable further includes: arranging, by using an armoring tool, an armor layer outside the non-metallic sheath recovery layer, the first non-metallic sheath layer, and the second non-metallic sheath layer, where the armoring tool includes a hydraulic cylinder, a pressure sensor, an inner mould layer, and an outer mould layer, the inner mould layer is located within the outer mould layer, the hydraulic cylinder is connected with the inner mould layer for controlling the inner mould layer to be tightened or loosened, and the pressure sensor is in signal connection with the inner mould layer and the hydraulic cylinder, respectively for controlling a movement of the hydraulic cylinder according to a pressure on the inner mould layer.

BRIEF DESCRIPTION OF DRAWING(S)

[0030] To illustrate the technical solutions in the embodiments of the present invention or in the prior art more clearly, the drawings required for describing the embodiments or the prior art will be briefly introduced below. Apparently, the accompanying drawings described below show some embodiments of the present invention, and persons of ordinary skill in the art may still derive other drawings from these accompanying drawings without creative efforts.

FIG. 1 is a schematic structural diagram of a submarine cable in an embodiment of the present invention. FIG. 2 is a schematic structural diagram of an armor inner cushion layer, an armor layer, an armor outer coating layer in an embodiment of the present invention.

FIG. 3 is a schematic structural diagram of an armor-

ing tool in an embodiment of the present invention. FIG. 4 is a schematic structural diagram of first monofilament layers and second monofilament layers after welded and before wound in an embodiment of the present invention.

Description of reference numerals:

[0031]

1: submarine cable section; 11: first conductor; 111: first monofilament layer; 12: first conductor shielding layer; 13: first insulating layer; 14: first insulation shielding layer; 15: first longitudinal water blocking layer; 16: first radial water blocking layer; 17: first non-metallic sheath layer; 2: landing cable section; 21: second conductor; 210: second monofilament layer; 211: second welding monofilament layer; 212: second winding monofilament layer; 22: second conductor shielding layer; 23: second insulating layer; 24: second insulation shielding layer; 25: second longitudinal water blocking layer; 26: second radial water blocking layer; 27: second non-metallic sheath layer; 3: joint; 31: conductor welding area; 311: secondary welding area; 32: conductor shielding recovery layer; 33: insulating recovery layer; 34: insulation shielding recovery layer; 35: longitudinal water-blocking recovery layer; 36: radial water-blocking recovery layer; 37: non-metallic sheath recovery layer; 4: armor inner cushion layer; 5: armor layer; 6: armor outer coating layer; 7: hydraulic cylinder; 8: pressure sensor; 9: inner mould layer; 91: arc-shaped part; 10: outer mould layer.

DESCRIPTION OF EMBODIMENTS

[0032] In the related art, a landing cable section and a submarine cable section are generally connected through a service joint. The service joint includes a crimping sleeve. For connecting the landing cable section and the submarine cable section through the service joint, conductors of both the landing cable section and the submarine cable section are placed into the crimping sleeve so as to be connected by way of crimping. However, when the landing cable section and the submarine cable section are connected through the service joint, the submarine cable presents poor bendability and flexibility due to the crimping sleeve incapable of being bent, and the bonding force between the conductors of the landing ca-

ble section and of the submarine cable section is relatively weak as the conductors are connected by way of crimping, which results in easy separation of the conductors of the landing cable section and of the submarine cable section and thus poor electrical performance of the submarine cable.

[0033] In view of the above problems, a submarine cable provided by an embodiment of the present invention includes a submarine cable section and a landing cable section, n first monofilament layers of the submarine cable section, from inside to outside in a radial direction of the submarine cable, are welded to n second welding monofilament layers in m second monofilament layers of the landing cable section in a one-to-one relationship, and h second winding monofilament layers that are extra layers in the m second monofilament layers relative to the n first monofilament layers are, sequentially from inside to outside in the radial direction of the submarine cable, wound outside an outermost layer of the n first monofilament layers. With such arrangement, the first monofilament layers of a first conductor and the second monofilament layers of a second conductor are connected together by way of welding and winding, without using a crimping sleeve. This can improve the bendability and flexibility of the submarine cable, and in comparison to connecting the conductors of the landing cable section and the submarine cable section by crimping, connecting them by welding and winding offers a stronger bonding force between the conductors of the landing cable section and the submarine cable section, which results in less easy separation of the conductors of the landing cable section and the submarine cable section and thus improves the electrical performance of the submarine cable.

[0034] To make the above objectives, features, and advantages of the embodiments according to the present invention clearer and understandable, the following clearly and completely describes the technical solutions in the embodiments according to the present invention with reference to the accompanying drawings in the embodiments according to the present invention. Apparently, the described embodiments are only some but not all of the embodiments according to the present invention. All other embodiments obtained by persons of ordinary skill in the art based on the embodiments according to the present invention without creative efforts shall fall within the protection scope of the present invention.

[0035] As shown in FIGS. 1-4, a submarine cable provided by an embodiment of the present invention includes a submarine cable section 1 and a landing cable section 2. The submarine cable section 1 refers to a portion of the submarine cable located in deep water, and the landing cable section 2 refers to a portion of the submarine cable located between the shallow water near the shore and a joint at the beach.

[0036] The submarine cable section 1 includes a first conductor 11, and the first conductor 11 includes n first monofilament layers 111 sequentially arranged from in-

side to outside in a radial direction of the submarine cable. The landing cable section 2 includes a second conductor 21, and the second conductor 21 the second conductor includes m second monofilament layers 210 sequentially arranged from inside to outside in the radial direction of the submarine cable. The m second monofilament layers 210 are sequentially divided from inside to outside in the radial direction of the submarine cable into n second welding monofilament layers 211 and h second winding monofilament layers 212, where m and n are both positive integers, and $m \geq n$, $h = m - n$. Each of the first monofilament layers 111 and of the second monofilament layers 210 may include multiple monofilaments, and the monofilaments may be copper monofilaments, or aluminum monofilaments, etc.

[0037] The first conductor 11 and the second conductor 21, which may be multi-layer tightly-compressed stranded circular copper conductors or multi-layer tightly-compressed stranded circular aluminum conductors, are each a water-blocking conductor with a water-blocking material that may be one or more of a water-blocking tape, a water-blocking yarn, water-blocking glue, and water-blocking powder. The first conductor 11 and the second conductor 21 may have a same or different cross-sectional area. In this embodiment, the first conductor 11 has a smaller cross-sectional area than the second conductor 21.

[0038] As shown in FIG. 4, the n first monofilament layers 111 are, from inside to outside in the radial direction of the submarine cable, welded to the n second welding monofilament layers 211 in a one-to-one relationship, and the h second winding monofilament layers 212 are, sequentially from inside to outside in the radial direction of the submarine cable, wound outside an outermost layer of the n first monofilament layers 111. For any two adjacent second winding monofilament layers 212, a winding part of a second winding monofilament layer 212 located outside covers a winding part of a second winding monofilament layer 212 located inside. The winding part refers to a portion of each of the second winding monofilament layers 212 wound outside the outermost layer of the first monofilament layers 111. An area where the n first monofilament layers 111 are connected to the m second monofilament layers 210 forms a conductor welding area of a joint.

[0039] In some embodiments, from inside to outside in the radial direction of the submarine cable, first monofilament layers 111 and second welding monofilament layers 211 within same layers have the same number of monofilaments. At this point, corresponding welding of the first monofilament layers 111 and the second welding monofilament layers means that, from inside to outside in the radial direction of the submarine cable, monofilaments of the first monofilament layers 111 and monofilaments of the second welding monofilament layers 21 within the same layers are welded in a one-to-one relationship.

[0040] It should be noted that winding of each of the

second winding monofilament layers 212 outside the outermost layer of the first monofilament layers 111 does not mean that each of the second winding monofilament layers 212 along its whole length is wound outside the outermost layer of the first monofilament layers 111, but instead a portion of each of the second winding monofilament layers 212, which is beyond a welding area between the first monofilament layers 111 and the second monofilament layers 210, such as a section *a* and a section *b* in FIG. 4, is wound outside the outermost layer of the first monofilament layers 111. Furthermore, in some embodiments, a portion of each of the second winding monofilament layers 212, which is not beyond the welding area between the first monofilament layers 111 and the second monofilament layers 210 is stranded outside an outermost layer of the second winding monofilament layers 211.

[0041] For ease of understanding, the *n* first monofilament layers 111 are divided sequentially from inside to outside in the radial direction of the submarine cable into layers $a_1, a_2, a_3, \dots$, and a_n , the *n* second winding monofilament layers 211 are divided sequentially from inside to outside in the radial direction of the submarine cable into layers $b_1, b_2, b_3, \dots$, and b_n , and the *h* second winding monofilament layers 211 are divided sequentially from inside to outside in the radial direction of the submarine cable into layers $c_1, c_2, c_3, \dots$, and c_h , where layer c_1 is located outside layer b_n .

[0042] The *n* first monofilament layers 111 are, from inside to outside in the radial direction of the submarine cable, welded to the *n* second winding monofilament layers 211 in a one-to-one relationship, that is, the layers $a_1, a_2, a_3, \dots$, and a_n are welded to the layers $b_1, b_2, b_3, \dots$, and b_n in a one-to-one relationship, that is, layer a_1 is welded to layer b_1 , layer a_2 is welded to layer b_2 , layer a_3 is welded to layer b_3 , ..., layer a_n is welded to layer b_n .

[0043] The *h* second winding monofilament layers 212 are, sequentially from inside to outside in the radial direction of the submarine cable, wound outside the outermost layer of the *n* first monofilament layers 111; and for any two adjacent second winding monofilament layers 212, a winding part of a second winding monofilament layer 212 located outside covers a winding part of a second winding monofilament layer 212 located inside. The winding part refers to a portion of each of the second winding monofilament layers 212 wound outside the outermost layer of the first monofilament layers 111. This means that layer c_1 is wound outside layer a_n first, and a portion of layer c_1 wound outside layer a_n is the winding part of layer c_1 , and then layer c_2 is wound outside layer a_n , and a portion of layer c_2 wound outside layer a_n is the winding part of layer c_2 , and the winding part of layer c_2 covers the winding part of layer c_1 . By analogy, finally, layer c_h is wound outside layer a_n , and a portion of layer c_h wound outside layer a_n is the winding part of layer c_h , and the winding part of layer c_h covers the winding part of layer c_{h-1} .

[0044] When *m* is equal to *n*, taking a value of both *m*

and *n* equal to 3 as an example, the first monofilament layers 111 are layers a_1, a_2 and a_3 sequentially from inside to outside, and the second monofilament layers 210 are layers b_1, b_2 and b_3 sequentially from inside to outside. At this point, within the submarine cable, layer a_1 is welded to layer b_1 , layer a_2 is welded to layer b_2 , and layer a_3 is welded to layer b_3 .

[0045] As shown in FIG. 3, when *m* is greater than *n*, taking the value of *m* equal to 5 and the value of *n* equal to 4 as an example, the first monofilament layers 111 are layers a_1, a_2 and a_3 sequentially from inside to outside, and the second monofilament layers 210 are layers b_1, b_2, b_3, c_1 , and c_2 sequentially from inside to outside. At this point, within the submarine cable, layer a_1 is welded to layer b_1 , layer a_2 is welded to layer b_2 , layer a_3 is welded to layer b_3 , layer c_1 is wound outside layer a_3 , layer c_2 is wound outside layer a_3 and a portion of layer c_1 wound outside layer a_3 covers a portion of layer c_2 wound outside layer a_3 .

[0046] With such arrangement, the first monofilament layers 111 of the first conductor 11 and the second monofilament layers 210 of the second conductor 21 are connected together by way of welding and winding, without using a crimping sleeve. This can improve the bendability and flexibility of the submarine cable, and in comparison to connecting the conductors of the landing cable section 2 and the submarine cable section 1 by crimping, connecting them by welding and winding offers a stronger bonding force between the conductors of the landing cable section and the submarine cable section, which results in less easy separation of the conductors of the landing cable section and the submarine cable section and thus improves the electrical performance of the submarine cable.

[0047] Further, when the cross-sectional area of the second conductor 21 differs from the cross-sectional area of the first conductor 11 by more than one standard size, joints of the factory in the related art fail to connect the first conductor 11 to the second conductor 21. However, in this embodiment, by winding the second winding monofilament layers 212 in the second monofilament layers 210, on the outermost layer of the first monofilament layers 111, extra monofilament layers of the second conductor 21 relative to the first conductor 11 can be connected to the first monofilament layers 111 by way of winding, which thereby solves the technical problem that the first conductor 11 cannot be connected to the second conductor 21 when the cross-sectional area of the second conductor 21 differs from the cross-sectional area of the first conductor 11 by more than one standard size. In addition, for any two adjacent second winding monofilament layers 212, a winding part of a second winding monofilament layer 212 located outside covers a winding part of a second winding monofilament layer 212 located inside. Such arrangement enables protection of the winding part located inside, and an outer surface of a conductor welding area 31 of the joint can be smoother by layer upon layer covering.

[0048] It should be noted that, in a specific embodiment, respective standard sizes of the cross-sectional areas of the first conductor 11 and the second conductor 21, in ascending order, are 50-185, 240, 300, 400, 500, 630 and 800 (unit: square millimeters).

[0049] In a specific embodiment, a difference between a winding pitch of the winding part of each of the second winding monofilament layers 212 and a stranding pitch of a stranding part of each of the second winding monofilament layers 212 is less than a preset difference. The stranding part refers to a portion of each of the second winding monofilament layers 212 stranded outside the outermost layer of the second winding monofilament layers 211, and the preset difference is 10% of the stranding pitch of the stranding part of each of the second winding monofilament layers. This means that the difference between the winding pitch of the winding part of layer c_i from aforementioned layers $c_1, c_2, c_3, \dots$, and c_h wound outside layer a_n and the stranding pitch of the stranding part of layer c_i stranded outside layer b_n is less than 10% of the stranding pitch of the stranding part of layer c_i stranded outside layer b_n . Here, c_i may be any one of layers $c_1, c_2, c_3, \dots$, and c_h . With such arrangement, the winding part of layer c_i wound outside layer a_n and the part of layer c_i stranded outside the outermost layer of the second winding monofilament layers 211 are similar in size, so that the conductor welding area 31 of the joint 3 formed by the connection of the first conductor 11 and the second conductor 21 presents a smooth transition.

[0050] Further, for any two adjacent second winding monofilament layers 211, a second winding monofilament layer 211 located outside covers a secondary welding area 311 between a second winding monofilament layer 211 located inside and a first monofilament layer 111. An innermost layer of the second winding monofilament layers 212 covers a secondary welding area 311 between the outermost layer of the first monofilament layers 111 and the outermost layer of the second winding monofilament layers 211. The secondary welding area 311 is an area where a first monofilament layer 111 and a second monofilament layer 210 are welded. Such arrangement enables protection of the welding area and prevention of two adjacent secondary welding areas 311 from contacting each other, thereby improving the electrical performance of the submarine cable.

[0051] In some embodiments, a winding end of the winding part of each of the second winding monofilament layers 212 is welded to the outermost layer of the first monofilament layers 111, so that a connection between each of the second winding monofilament layers 212 and the outermost layer of the first monofilament layers 111 is firmer. Further, a polishing operation may be performed on the welding area between the winding end and the outermost layer of the first monofilament layers 111 so as to make the connection between the winding end and the outermost layer of the first monofilament layers 111 smoother. Here, the winding end refers to an end of a part, wound on the outermost layer of the first monofilament layers 111, of each monofilament in each of the second winding monofilament layers 212.

ment layers 111, of each monofilament in each of the second winding monofilament layers 212.

[0052] The submarine cable provided by the embodiments of the present invention may be different types of submarine cables such as a single-core submarine cable and a three-core submarine cable, etc., and when the submarine cable provided by the embodiments of the present invention is a three-core submarine cable, a distance between any two joints 3 is greater than 10 meters, so that the mechanical performance of the submarine cable can be improved.

[0053] As shown in FIG. 1, in a specific embodiment, the submarine cable section 1 further includes a first conductor shielding layer 12, and the first conductor shielding layer 12 covers part of the first conductor 11. The landing cable section 2 further includes a second conductor shielding layers 22, and the second conductor shielding layer 22 covers part of the second conductor 21. The joint 3 further includes a conductor shielding recovery layer 32, and the conductor shielding recovery layer 32 covers part of the first conductor 11, part of the second conductor 21, and the conductor welding area 31, and has one end connected to the first conductor shielding layer 12 and the other end connected to the second conductor shielding layer 22. External interference can be shielded by arranging the first conductor shielding layer 12, the second conductor shielding layer 22, and the conductor shielding recovery layer 32.

[0054] Each of the first conductor shielding layer 12 and the second conductor shielding layer 22 may be formed by covering by way of extrusion molding with a semi-conductive polyethylene shielding material, or by covering by way of winding with a water-blocking tape combined with covering by way of extrusion molding with semi-conductive polyethylene. The conductor shielding recovery layer 32, the first conductor shielding layer 12, and the second conductor shielding layer 22 are of a same material. Such arrangement can strengthen the bonding force between the conductor shielding recovery layer 32 and the first conductor shielding layer 12, and that between the conductor shielding recovery layer 32 and the second conductor shielding layer 22.

[0055] As shown in FIG. 1, the submarine cable section 1 further includes a first insulating layer 13, and the first insulating layer 13 covers the first conductor shielding layer 12. The landing cable section 2 further includes a second insulating layer 23, and the second insulating layer 23 covers the second conductor shielding layer 22. The joint 3 further includes an insulating recovery layer 33. The insulating recovery layer 33 covers the conductor shielding recovery layer 32, and has one end connected to the first insulating layer 13 and the other end connected to the second insulating layer 23. Such arrangement can insulate the first conductor 11, the second conductor 21 and the conductor welding area 31 from the outside.

[0056] Each of the first insulating layer 13 and the second insulating layer 23 may be formed by covering by way of extrusion molding with cross-linked polyethylene.

The insulating recovery layer 33, the first insulating layer 13 and the second insulating layer 23 are of a same material. Such arrangement can strengthen the bonding force between the insulating recovery layer 33 and the first insulating layer 13, and between the insulating recovery layer 33 and the second insulating layer 23.

[0057] As shown in FIG. 1, the submarine cable section 1 further includes a first insulation shielding layer 14, and the first insulation shielding layer 14 covers the first insulating layer 13. The landing cable section 2 further includes a second insulation shielding layer 24, and the second insulation shielding layer 24 covers the second insulating layer 23. The joint 3 further includes an insulation shielding recovery layer 34. The insulation shielding recovery layer 34 covers the insulating recovery layer 33, and has one end connected to the first insulation shielding layer 14 and the other end connected to the second insulation shielding layer 24. Such arrangement can further shield external interference and improve insulating property of the first conductor 11, the second conductor 21, and the conductor welding area 31 against the outside.

[0058] Each of the first insulation shielding layer 14 and the second insulation shielding layer 24 may be formed by covering by way of extrusion molding with a semi-conductive polyethylene shielding material. The insulation shielding recovery layer 34, the first insulation shielding layer 14 and the second insulation shielding layer 24 are of a same material. Such arrangement can strengthen the bonding force between the insulation shielding recovery layer 34 and the first insulation shielding layer 14, and between the insulation shielding recovery layer 34 and the second insulation shielding layer 24.

[0059] As shown in FIG. 1, the submarine cable section 1 further includes a first longitudinal water blocking layer 15, and the first longitudinal water blocking layer 15 covers part of the first insulation shielding layer 14. The landing cable section 2 further includes a second longitudinal water blocking layer 25, and the second longitudinal water blocking layer 25 covers part of the second insulation shielding layer 24. The joint 3 further includes a longitudinal water-blocking recovery layer 35. The longitudinal water-blocking recovery layer 35 covers part of the first insulation shielding layer 14, part of the second insulation shielding layer 24 and the insulation shielding recovery layer 34, and has one end connected to the first longitudinal water blocking layer 15 and the other end connected to the second longitudinal water blocking layer 25. Such arrangement can prevent external moisture from penetrating into the interior of the submarine cable along a longitudinal direction.

[0060] Each of the first longitudinal water blocking layer 15 and the second longitudinal water blocking layer 25 may be formed by covering by way of winding with a semi-conductive water-blocking tape. The longitudinal water-blocking recovery layer 35, the first longitudinal water blocking layer 15 and the second longitudinal water blocking layer 25 are of a same material. Such arrange-

ment can strengthen the bonding force between the longitudinal water-blocking recovery layer 35 and the first longitudinal water blocking layer 15, and between the longitudinal water-blocking recovery layer 35 and the second longitudinal water blocking layer 25.

[0061] As shown in FIG. 1, the submarine cable section 1 further includes a first radial water blocking layer 16, and the first radial water blocking layer 16 covers part of the first longitudinal water blocking layer 15. The landing cable section 2 further includes a second radial water blocking layer 26, and the second radial water blocking layer 26 covers part of the second longitudinal water blocking layer 25. The joint 3 further includes a radial water-blocking recovery layer 36. The radial water-blocking recovery layer 36 covers part of the first longitudinal water blocking layer 15, part of the second longitudinal water blocking layer 25 and the longitudinal water-blocking recovery layer 35, and has one end connected to the first radial water blocking layer 16 and the other end connected to the second radial water blocking layer 26. Such arrangement can prevent external moisture from penetrating into the interior of the submarine cable in the radial direction.

[0062] Each of the first radial water blocking layer 16 and the second radial water blocking layer 26 may be formed by covering by way of extrusion molding with a lead alloy sheath. The radial water-blocking recovery layer 36, the first radial water blocking layer 16 and the second radial water blocking layer 26 are of a same material. Such arrangement can strengthen the bonding force between the radial water-blocking recovery layer 36 and the first radial water blocking layer 16, and between the radial water-blocking recovery layer 36 and the second radial water blocking layer 26.

[0063] As shown in FIG. 1, the submarine cable section 1 further includes a first non-metallic sheath layer 17, and the first non-metallic sheath layer 17 covers part of the first radial water-blocking layer 16. The landing cable section 2 further includes a second non-metallic sheath layer 27, and the second non-metallic sheath layer 27 covers part of the second radial water blocking layer 26. The joint 3 further includes a non-metallic sheath recovery layer 37. The non-metallic sheath recovery layer 37 covers part of the first radial water blocking layer 16, part of the second radial water blocking layer 26 and the radial water-blocking recovery layer 36, and has one end connected to the first non-metallic sheath layer 17 and the other end connected to the second non-metallic sheath layer 27. Such arrangement can protect the submarine cable structure located in the non-metallic sheaths.

[0064] The first non-metallic sheath layer 17 and the second non-metallic sheath layer 27 may be of a same or different material. In a specific embodiment, the first non-metallic sheath layer 17 may be formed by covering by way of extrusion molding with semi-conductive polyethylene, and the second non-metallic sheath layer 27 may be formed by covering by way of extrusion molding with insulating polyethylene. With such arrangement, the

submarine cable section 1 with the first non-metallic sheath layer 17 can avoid an underwater induced voltage problem, and the landing cable section 2 with the second non-metallic sheath layer 27 can meet insulation requirements. The material of the non-metallic sheath recovery layer 37 may be insulating polyethylene or semi-conductive polyethylene.

[0065] As shown in FIG. 2, the submarine cable further includes an armor inner cushion layer 4, an armor layer 5, and an armor outer coating layer 6. The armor inner cushion layer 4 covers the first non-metallic sheath layer 17, the second non-metallic sheath layer 27 and the non-metallic sheath recovery layer 37. The armor layer 5 covers the armor inner cushion layer 4, and the armor outer coating layer 6 covers the armor layer 5. Such arrangement can increase mechanical strength of the submarine cable.

[0066] The armor inner cushion layer 4 and the armor outer coating layer 6 are formed by winding with a polypropylene PP rope, and the armor layer 5 may adopt round steel wire armor, flat steel wire armor, round copper wire armor or flat copper wire armor.

[0067] The embodiments of the present invention further provide a method for manufacturing a submarine cable, including:

providing a submarine cable section and a landing cable section, where the submarine cable section includes a first conductor, the first conductor includes n first monofilament layers arranged from inside to outside in a radial direction of the submarine cable, the landing cable section includes a second conductor, the second conductor includes m second monofilament layers sequentially arranged from inside to outside in the radial direction of the submarine cable, and the m second monofilament layers are sequentially divided from inside to outside in the radial direction of the submarine cable into n second welding monofilament layers and h second winding monofilament layers, where m and n are both positive integers, and $m \geq n$, $h = m - n$;
following the step of providing the submarine cable section and the landing cable section, the following is further included:

welding, sequentially from inside to outside in the radial direction of the submarine cable, the n first monofilament layers to the n second welding monofilament layers in a one-to-one relationship; and

winding, sequentially from inside to outside in the radial direction of the submarine cable, the h second winding monofilament layers outside an outermost layer of the n first monofilament layers, where for any two adjacent second winding monofilament layers, a winding part of a second winding monofilament layer located outside covers a winding part of a second winding mono-

filament layer located inside, the winding part refers to a portion of each of the second winding monofilament layers wound outside the outermost layer of the first monofilament layers, and an area in which the n first monofilament layers are connected to the m second monofilament layers thus forms a conductor welding area of a joint.

[0068] With the above steps, the first monofilament layers of the first conductor and the second monofilament layers of the second conductor can be connected together by way of welding and winding, without using a crimping sleeve. This can improve the bendability and flexibility of the submarine cable, and in comparison to connecting the conductors of the landing cable section and the submarine cable section by crimping, connecting them by welding and winding offers a stronger bonding force between the conductors of the landing cable section and the submarine cable section, which results in less easy separation of the conductors of the landing cable section and the submarine cable section and thus improves the electrical performance of the submarine cable.

[0069] Further, when the cross-sectional area of the second conductor differs from the cross-sectional area of the first conductor by more than one standard size, joints of the factory in the related art fail to connect the first conductor to the second conductor. However, in this embodiment, by winding the second winding monofilament layers in the second monofilament layers, on the outermost layer of the first monofilament layers, extra monofilament layers of the second conductor relative to the first conductor can be connected to the first monofilament layers by way of winding, which thereby solves the technical problem that the first conductor cannot be connected to the second conductor when the cross-sectional area of the second conductor differs from the cross-sectional area of the first conductor by more than one standard size. In addition, for any two adjacent second winding monofilament layers, a winding part of a second winding monofilament layer located outside covers a winding part of a second winding monofilament layer located inside. Such arrangement enables protection of the winding part located inside, and an outer surface of a conductor welding area of the joint can be smoother by layer upon layer covering.

[0070] Exemplarily, reference for this embodiment may be made to the above-mentioned device embodiments, and they are similar in principles and technical effects which are therefore not repeated here.

[0071] In a specific embodiment, after the submarine cable section and the landing cable section are provided, cutting off part of an end to be connected, of the submarine cable section and cutting off part of an end to be connected, of the landing cable section are further included, so that the parts with poor quality caused by damp, oxidation and other factors in the end to be connected of the submarine cable section and in the end to

be connected of the landing cable section are removed, and the electrical performance of the submarine cable is thereby improved.

[0072] A length of the removed part of the end of the submarine cable section and a length of the removed part of the end of the landing cable section may be arranged according to actual conditions. In this embodiment, both the length of the removed part of the end of the submarine cable section and the length of the removed part of the end of the landing cable section are 10 cm.

[0073] After part of the end of the submarine cable section and part of the end of the landing cable section are cut off, the following is further included:

stripping off the first non-metallic sheath layer and the second non-metallic sheath layer both of which have a first preset length, and stripping off the first radial water blocking layer and the second radial water blocking layer both of which have a second preset length, where the first preset length is greater than the second preset length. Such arrangement facilitates a subsequent operation of connecting the submarine cable section and the landing cable section. In a specific embodiment, the first preset length is 100 cm, and the second preset length is 80 cm.

[0074] After the first non-metallic sheath layer and the second non-metallic sheath layer both of which have the first preset length are stripped off and the first radial water blocking layer and the second radial water blocking layer both of which have the second preset length are stripped off, the following is further included:

heating to straighten the first conductor and the second conductor. A deviation in a subsequent welding process can be reduced though the straightening by means of heating, thus improving the reliability of the submarine cable. Further, an internal stress of the submarine cable can be reduced through the straightening by means of heating, thus making the connection between the submarine cable section and the landing cable section more stable.

[0075] After the straightening by means of heating, the following is further included:

removing a covering layer outside the first conductor at the end to be connected of the submarine cable section, and removing a covering layer outside the second conductor at the end to be connected of the landing cable section, so as to expose the first conductor and the second conductor. The first conductor and the second conductor may have a same exposed length. In this embodiment, both the first conductor and the second conductor have an exposed length of about 15 cm.

[0076] After the step of exposing the first conductor and the second conductor, and before the step of forming the conductor welding area of the joint by the area where the n first monofilament layers and the m second monofilament layers are connected, the following is further included:

aligning a center of an innermost layer of the n first mono-

filament layers with a center of an innermost layer of the m second monofilament layers. Such arrangement can reduce an error in a welding process.

[0077] In a specific embodiment, in the step of welding the n first monofilament layers to the n second welding monofilament layers in the m second monofilament layers in a one-to-one relationship, ends of the n first monofilament layers are welded to ends of the n second monofilament layers, of the n second welding monofilament layers in a one-to-one relationship.

[0078] In a step of winding sequentially from inside to outside the h second winding monofilament layers outside the outermost layer of the n first monofilament layers, a difference between a winding pitch of the winding part of each of the second winding monofilament layers and a stranding pitch of a stranding part of each of the second winding monofilament layers is less than a preset difference, where the preset difference is 10% of the stranding pitch of the stranding part of each of the second winding monofilament layers, and the stranding part refers to a portion of each of the second winding monofilament layers stranded outside the outermost layer of the second welding monofilament layers. With such arrangement, the conductor welding area of the joint formed by the area where the first conductor and the second conductor are connected can present a smooth transition.

[0079] Exemplarily, reference for this embodiment may be made to the above-mentioned device embodiments, and they are similar in principles and technical effects which are therefore not repeated here.

[0080] In a possible embodiment, the step of welding the n first monofilament layers to the n second welding monofilament layers in a one-to-one relationship further includes: covering, by a second welding monofilament layer located outside, a secondary welding area between a second welding monofilament layer located inside and a corresponding first monofilament layer, where the secondary welding area is an area where the individual first monofilament layers and the individual second monofilament layers are welded. In the step of winding, sequentially from inside to outside in the radial direction of the submarine cable, the h second winding monofilament layers outside the outermost layer of the n first monofilament layers, an innermost layer of the second winding monofilament layers covers a secondary welding area between the outermost layer of the first monofilament layers and the outermost layer of the second welding monofilament layers.

[0081] Exemplarily, reference for this embodiment may be made to the above-mentioned device embodiments, and they are similar in principles and technical effects which are therefore not repeated here.

[0082] Further, the step of winding, sequentially from inside to outside in the radial direction of the submarine cable, the h second winding monofilament layers outside the outermost layer of the n first monofilament layers further includes:

welding a winding end of the winding part of each of the

second winding monofilament layers to the outermost layer of the first monofilament layers, and performing a polishing operation on a welding area between the winding end and the first monofilament layer, so that a connection between the winding end and the first monofilament layer is firm and smooth.

[0083] Exemplarily, reference for this embodiment may be made to the above-mentioned device embodiments, and they are similar in principles and technical effects which are therefore not repeated here.

[0084] In order to better understand the solution, the following description is given taking a value of m equal to 5 and a value of n equal to 3 as an example. The first monofilament layers are a_1 , a_2 and a_3 sequentially from inside to outside, and the second monofilament layers are layers b_1 , b_2 , b_3 , c_1 , and c_2 sequentially from inside to outside. At this point, a sequence of welding and winding for the first monofilament layers and the second monofilament layers is:

- step 1: layer a_1 is welded to layer b_1 ;
- step 2: layer a_2 is welded to layer b_2 ;
- step 3: layer a_3 is welded to layer b_3 ;
- step 4: layer c_1 is wound on layer a_3 ;
- step 5: layer c_2 is wound on layer a_3 and a portion of layer c_2 wound on layer a_3 covers a portion of layer c_1 wound on layer a_3 .

[0085] The conductor welding area of the joint can be formed by the above steps.

[0086] Further, after the conductor welding area is formed, the following is further included:

polishing an outer surface of the conductor welding area with a polishing tool, and wiping and smoothing the outer surface of the conductor welding area with fine sandpaper, so as to ensure that the surface of the conductor welding section is smooth, burr-free, and oxidation-free.

[0087] Further, after the conductor welding area is formed, the method for manufacturing the submarine cable further includes:

covering, by way of winding or extrusion molding with a same material as a conductor shielding layer, the conductor welding area and a exposed portion of the first conductor and a exposed portion of the second conductor, to form a conductor shielding recovery layer, and making the conductor shielding recovery layer have one end connected to a first conductor shielding layer of the submarine cable section and the other end connected to a second conductor shielding layer of the landing cable section.

[0088] With such arrangement, the first conductor shielding layer and the second conductor shielding layer can be connected. After the conductor shielding recovery layer is formed, the quality of the surface of the conductor shielding recovery layer may further be checked to ensure that there are no defects such as bubbles or cracks.

[0089] Exemplarily, reference for the materials used for each layer in this embodiment and technical effects

thereof may be made to the above-mentioned device embodiments, which are not repeated here.

[0090] After the conductor shielding recovery layer is formed, the method for manufacturing the submarine cable further includes:

cutting the first insulating layer 13 of the submarine cable section 1 to obtain a cone surface with a cone angle not greater than 60° , and cutting the second insulating layer 23 of the landing cable section 2 to obtain a cone surface with a cone angle not greater than 60° , as shown in FIG. 1. Such arrangement facilitates subsequent connection of the first insulating layer 13 and the second insulating layer 23.

[0091] After the first insulating layer 13 of the submarine cable section 1 is cut to obtain a cone surface with a cone angle not greater than 60° and the second insulating layer 23 of the landing cable section 2 is cut to obtain a cone surface with a cone angle not greater than 60° , the following is further included:

covering, by way of extrusion molding with a same material as the first insulating layer 13 and the second insulating layer 23, the conductor shielding recovery layer 32, to form an insulating recovery layer 33, and making the insulating recovery layer 33 have one end connected to the first insulating layer 13 and the other end connected to the second insulating layer 23. During actual operation, an insulating extruder may be used to extrude the material of the insulating recovery layer 33 to cover the conductor shielding recovery layer 32.

[0092] With such arrangement, the first insulating layer 13 and the second insulating layer 23 can be connected. Reference for the materials used for each layer in this embodiment and technical effects thereof may be made to the above-mentioned device embodiments, which are not repeated here.

[0093] After the insulating recovery layer 33 is formed, the insulating recovery layer 33 may further be fully crosslinked by a crosslinking machine to ensure that there are no bubbles, pits or cracks on the surface of the insulating recovery layer. The thickness, eccentricity, and the presence or absence of visible pores, protrusions or impurities of the insulating recovery layer 33 are detected by an X-ray machine. The insulating recovery layer 33 is polished with an abrasive belt to ensure that the surface of the insulating recovery layer 33 is smooth and its outer diameter is larger than that of the first insulating layer 13 and of the second insulating layer 23, and a difference between the outer diameter of the insulating recovery layer 33 and the larger outer diameter in the outer diameter of the first insulating layer 13 and the outer diameter of the second insulating layer 23 is about 5 mm.

[0094] After the insulating recovery layer 33 is formed, the method for manufacturing the submarine cable further includes:

covering, with a same material as a first insulation shielding layer 14 of the submarine cable section 1 and a second insulation shielding layer 24 of the

landing cable section 2, the insulating recovery layer 33, to form an insulation shielding recovery layer 34, and making the insulation shielding recovery layer 34 have one end connected to the first insulation shielding layer 14 and the other end connected to the second insulation shielding layer 24; covering, with a same material as a first longitudinal water blocking layer 15 of the submarine cable section 1 and a second longitudinal water blocking layer 25 of the landing cable section 2, the insulation shielding recovery layer 34, to form a longitudinal water-blocking recovery layer 35, and making the longitudinal water-blocking recovery layer 35 have one end connected to the first longitudinal water blocking layer 15 and the other end connected to the second longitudinal water blocking layer 25; and covering, with a same material as a first radial water blocking layer 16 of the submarine cable section 1 and a second radial water blocking layer 26 of the landing cable section 2, the longitudinal water-blocking recovery layer 35, to form a radial water-blocking recovery layer 36, and making the radial water-blocking recovery layer 36 have one end connected to the first radial water blocking layer 16 and the other end connected to the second radial water blocking layer 26.

[0095] With such arrangement, the first insulation shielding layer 14 and the second insulation shielding layer 24, the first longitudinal water blocking layer 15 and the second longitudinal water blocking layer 25, and the first radial water blocking layer 16 and the second radial water blocking layer 26 can be connected respectively. Reference for the materials used for each layer in this embodiment and technical effects thereof may be made to the above-mentioned device embodiments, which are not repeated here.

[0096] After the radial water-blocking recovery layer 36 is formed, the method for manufacturing the submarine cable further includes:

when a material of a first non-metallic sheath layer 17 of the submarine cable section 1 is same as that of a second non-metallic sheath layer 27 of the landing cable section 2, covering, with a non-metallic sheath material same as the first non-metallic sheath layer 17 and the second non-metallic sheath layer 27, the radial water-blocking recovery layer 36, and heating the non-metallic sheath material to form a non-metallic sheath recovery layer 37, and making the non-metallic sheath recovery layer 37, the first non-metallic sheath layer 17 and the second non-metallic sheath layer 27 integrated; and when the material of the first non-metallic sheath layer 17 of the submarine cable section 1 is different from that of the second non-metallic sheath layer 27 of the landing cable section 2, covering, with a non-metallic sheath material same as the first non-me-

talic sheath layer 17 or the second non-metallic sheath layer 27, the radial water-blocking recovery layer 36, and heating the non-metallic sheath material, to form the non-metallic sheath recovery layer 37, and making the non-metallic sheath recovery layer 37, the first non-metallic sheath layer 17 and the second non-metallic sheath layer 27 integrated.

[0097] With such arrangement, the first non-metallic sheath layer 17 and the second non-metallic sheath layer 27 can be connected. Reference for the materials used for each layer in this embodiment and technical effects thereof may be made to the above-mentioned device embodiments, which are not repeated here.

[0098] When the material of the first non-metallic sheath layer 17 is different from that of the second non-metallic sheath layer 27, and the non-metallic sheath material is the same as the material of the first non-metallic sheath layer 17, the method for manufacturing the submarine cable further includes:

Winding a cross-linked polyethylene tape at a junction of the non-metallic sheath recovery layer 37 and the second non-metallic sheath layer 27, and heating the cross-linked polyethylene tape to integrate the cross-linked polyethylene tape, the non-metallic sheath recovery layer 37, and the second non-metallic sheath layer 27.

[0099] When the material of the first non-metallic sheath layer 17 is different from that of the second non-metallic sheath layer 27, and the non-metallic sheath material is the same as the material of the second non-metallic sheath layer 27, the method for manufacturing the submarine cable further includes:

winding a cross-linked polyethylene tape at a junction of the non-metallic sheath recovery layer 37 and the first non-metallic sheath layer 17, and heating the cross-linked polyethylene tape to integrate the cross-linked polyethylene tape, the non-metallic sheath recovery layer 37, and the first non-metallic sheath layer 17.

[0100] Tools such as heat guns may be used in a process of heating the non-metallic sheath material and the cross-linked polyethylene. A problem of weak connection occurring when the material of the non-metallic sheath recovery layer 37 is different from that of the first non-metallic sheath layer 17 or of the second non-metallic sheath layer 27 can be solved by the above steps.

[0101] In view of further improving the mechanical strength of the submarine cable, an outer diameter of the joint 3 of the submarine cable is greater than an outer diameter of the submarine cable section 1 and an outer diameter of the landing cable section 2, and an outer diameter of the armor layer 5 of the joint 3 generally exceeds the outer diameter of the joint 3 by 10 mm, the method for manufacturing the submarine cable provided by the embodiment of the present invention, after the non-metallic sheath recovery layer 37 is formed, further includes:

arranging, with an armoring tool, an armor layer outside the non-metallic sheath recovery layer 37, the first non-

metallic sheath layer 17, and the second non-metallic sheath layer 27. Here, reference for the material of the armor layer 5 may be made to the above-mentioned device embodiments, which is not repeated here.

[0102] As shown in FIG. 3, the armoring tool includes a hydraulic cylinder 7, a pressure sensor 8, an inner mould layer 9 and an outer mould layer 10. The inner mould layer 9 is located within the outer mould layer 10. The hydraulic cylinder 7 is connected with the inner mould layer 9, for controlling the inner mould layer 9 to be tightened or loosened. The pressure sensor 8 is in signal connection with the inner mould layer 9 and the hydraulic cylinder 7 respectively for controlling a movement of the hydraulic cylinder 7 according to a pressure on the inner mould layer 9.

[0103] In a specific embodiment, the inner mould layer 9 includes 3 arc-shaped parts 91, and corresponding centers of the 3 arc-shaped parts 91 are at a same point during the tightening and loosening process of the mould. Such arrangement can improve the uniformity of the armor layer 5.

[0104] An inner diameter of the inner mould layer 9 is 2-3 mm larger than the outer diameter of the armor layer 5. During a process of arranging the armor layer 5, the submarine cable passes through the inner mould layer 9 gradually. When a pressure value measured by the pressure sensor 8 exceeds a first tightening force that is set, the pressure sensor 8 controls an action of the hydraulic cylinder 7, so that the hydraulic cylinder 7 releases the inner mould layer 9 until the pressure value is less than or equal to the first tightening force that is set. When the pressure value is less than a second tightening force that is set, the pressure sensor 8 controls the action of the hydraulic cylinder 7, and the hydraulic cylinder 7 tightens the inner mould layer 9 until the pressure value is equal to the second tightening force that is set. Generally, an outer diameter of the first non-metallic sheath layer 17 of the submarine cable section 1 < an outer diameter of the second non-metallic sheath layer 27 < an outer diameter of the non-metallic sheath recovery layer 37. Therefore, the first tightening force can be a pressure applied to the inner mould layer 9 when the joint 3 passes through the inner mould layer 9, and the second tightening force can be a pressure applied to the inner mould layer 9 when the submarine cable section 1 passes through the inner mould layer 9. With such arrangement, there is no need to replace the mould in the process of armoring the submarine cable of which the outer diameter varies, which simplifies the armoring process of the submarine cable.

[0105] Embodiments or implementations in the present specification are described in a progressive manner. Description of each embodiment focuses on a difference from other embodiments, and references may be made to each other for same or similar parts among respective embodiments.

[0106] Those skilled in the art should understand that in the disclosure of the present invention, terms such as

"upper", "lower", "front", "rear", "left", "right", "vertical", "horizontal", "top", "bottom", "inner", and "outer", etc. refer to orientations or positional relationships based on orientations or positional relationships illustrated in the accompanying drawings, which are only to facilitate and simplify descriptions of the present invention, rather than to indicate or imply that the system or element referred to must be of a particular orientation, or must be constructed and operated in a particular orientation, and therefore the above terms should not be construed as limiting the present invention.

[0107] Reference throughout the present specification to "an embodiment," "some embodiments," "an illustrative embodiment," "an example," "a specific example," or "some examples" means that a particular feature, structure, material, or characteristic described in connection with the embodiment or example is included in at least one embodiment or example of the present invention. Thus, the indicative description of the above terms in the present specification are not necessarily referring to the same embodiment or example. Furthermore, the particular features, structures, materials, or characteristics described may be combined in any suitable manner in one or more embodiments or examples.

[0108] Finally, it should be noted that: the above embodiments are merely intended for describing the technical solutions of the present invention, but not for limiting the present invention. Although the present invention is described in detail with reference to the foregoing embodiments, persons of ordinary skill in the art should understand that they may still make modifications to the technical solutions described in the foregoing embodiments or make equivalent replacements to some or all technical features thereof, and these modifications or replacements do not make the essence of corresponding technical solutions depart from the scope of the technical solutions of the embodiments of the present invention.

Claims

1. A submarine cable, comprising:

a submarine cable section which comprises a first conductor, wherein the first conductor comprises n first monofilament layers sequentially arranged from inside to outside in a radial direction of the submarine cable; and

a landing cable section which comprises a second conductor, wherein the second conductor comprises m second monofilament layers sequentially arranged from inside to outside in the radial direction of the submarine cable, and the m second monofilament layers are sequentially divided from inside to outside in the radial direction of the submarine cable into n second welding monofilament layers and h second winding monofilament layers, wherein m and n are both

- positive integers, and $m \geq n$, $h = m - n$;
 wherein the n first monofilament layers, from inside to outside in the radial direction of the submarine cable, are welded to the n second welding monofilament layers in a one-to-one relationship;
 wherein the h second winding monofilament layers are, sequentially from inside to outside in the radial direction of the submarine cable, wound outside an outermost layer of the n first monofilament layers; and for any two adjacent second winding monofilament layers, a winding part of a second winding monofilament layer located outside covers a winding part of a second winding monofilament layer located inside; wherein the winding part refers to a portion of each of the second winding monofilament layers wound outside the outermost layer of the first monofilament layers; and
 wherein an area in which the n first monofilament layers are connected to the m second monofilament layers forms a conductor welding area of a joint.
2. The submarine cable according to claim 1, wherein a difference between a winding pitch of the winding part of each of the second winding monofilament layers and a stranding pitch of a stranding part of each of the second winding monofilament layers is less than a preset difference; and
 wherein the stranding part refers to a portion of each of the second winding monofilament layers stranded outside an outermost layer of the second welding monofilament layers.
3. The submarine cable according to claim 2, wherein for any two adjacent second welding monofilament layers, a second welding monofilament layer located outside covers a secondary welding area between a second welding monofilament layer located inside and a corresponding first monofilament layer;
- wherein an innermost layer of the second winding monofilament layers covers a secondary welding area between the outermost layer of the first monofilament layers and the outermost layer of the second welding monofilament layers; and
 wherein the secondary welding area is an area in which the first monofilament layers are welded to the second monofilament layers.
4. The submarine cable according to claim 3, wherein the submarine cable section further comprises a first conductor shielding layer, and the first conductor shielding layer covers part of the first conductor;
- wherein the landing cable section further com-

prises a second conductor shielding layer, and the second conductor shielding layer covers part of the second conductor; and
 wherein the joint further comprises a conductor shielding recovery layer, the conductor shielding recovery layer covers part of the first conductor, part of the second conductor, and the conductor welding area, and the conductor shielding recovery layer has one end connected to the first conductor shielding layer and the other end connected to the second conductor shielding layer.

5. The submarine cable according to claim 4, wherein the submarine cable section further comprises a first insulating layer, and the first insulating layer covers the first conductor shielding layer;

wherein the landing cable section further comprises a second insulating layer, and the second insulating layer covers the second conductor shielding layer; and
 wherein the joint further comprises an insulating recovery layer, the insulating recovery layer covers the conductor shielding recovery layer, and the insulating recovery layer has one end connected to the first insulating layer and the other end connected to the second insulating layer.

6. The submarine cable according to claim 5, wherein the submarine cable section further comprises a first insulation shielding layer, and the first insulation shielding layer covers the first insulating layer;

wherein the landing cable section further comprises a second insulation shielding layer, and the second insulation shielding layer covers the second insulating layer; and
 wherein the joint further comprises an insulation shielding recovery layer, the insulation shielding recovery layer covers the insulating recovery layer, and the insulation shielding recovery layer has one end connected to the first insulation shielding layer and the other end connected to the second insulation shielding layer.

7. The submarine cable according to claim 6, wherein the submarine cable section further comprises a first longitudinal water blocking layer, and the first longitudinal water blocking layer covers part of the first insulation shielding layer;

wherein the landing cable section further comprises a second longitudinal water blocking layer, and the second longitudinal water blocking layer covers part of the second insulation shielding layer; and
 wherein the joint further comprises a longitudinal water-blocking recovery layer, the longitudinal

- water-blocking recovery layer covers part of the first insulation shielding layer, part of the second insulation shielding layer, and the insulation shielding recovery layer, and the longitudinal water-blocking recovery layer has one end connected to the first longitudinal water blocking layer and the other end connected to the second longitudinal water blocking layer.
8. The submarine cable according to claim 7, wherein the submarine cable section further comprises a first radial water blocking layer, and the first radial water blocking layer covers part of the first longitudinal water blocking layer;
- wherein the landing cable section further comprises a second radial water blocking layer, and the second radial water blocking layer covers part of the second longitudinal water blocking layer; and
- wherein the joint further comprises a radial water-blocking recovery layer, the radial water-blocking recovery layer covers part of the first longitudinal water blocking layer, part of the second longitudinal water blocking layer, and the longitudinal water-blocking recovery layer, and the radial water-blocking recovery layer has one end connected to the first radial water blocking layer and the other end connected to the second radial water blocking layer.
9. The submarine cable according to claim 8, wherein the submarine cable section further comprises a first non-metallic sheath layer, and the first non-metallic sheath layer covers part of the first radial water blocking layer;
- wherein the landing cable section further comprises a second non-metallic sheath layer, and the second non-metallic sheath layer covers part of the second radial water blocking layer; and
- wherein the joint further comprises a non-metallic sheath recovery layer, and the non-metallic sheath recovery layer covers part of the first radial water blocking layer, part of the second radial water blocking layer, and the radial water-blocking recovery layer, and the non-metallic sheath recovery layer has one end connected to the first non-metallic sheath layer and the other end connected to the second non-metallic sheath layer.
10. The submarine cable according to claim 9, wherein the submarine cable further comprises an armor inner cushion layer, an armor layer, and an armor outer coating layer, and the armor inner cushion layer covers the first non-metallic sheath layer, the second
- non-metallic sheath layer, and the non-metallic sheath recovery layer; and
- wherein the armor layer covers the armor inner cushion layer, and the armor outer coating layer covers the armor layer.
11. A method for manufacturing a submarine cable, comprising:
- providing a submarine cable section and a landing cable section, wherein the submarine cable section comprises a first conductor, and the first conductor comprises n first monofilament layers arranged from inside to outside in a radial direction of the submarine cable; and the landing cable section comprises a second conductor, the second conductor comprises m second monofilament layers sequentially arranged from inside to outside in the radial direction of the submarine cable, and the m second monofilament layers are sequentially divided from inside to outside in the radial direction of the submarine cable into n second winding monofilament layers and h second winding monofilament layers, wherein m and n are both positive integers, and $m \geq n$, $h = m - n$;
- welding, sequentially from inside to outside in the radial direction of the submarine cable, the n first monofilament layers to the n second winding monofilament layers in a one-to-one relationship; and
- winding, sequentially from inside to outside in the radial direction of the submarine cable, the h second winding monofilament layers outside an outermost layer of the n first monofilament layers, wherein for any two adjacent second winding monofilament layers, a winding part of a second winding monofilament layer located outside covers a winding part of a second winding monofilament layer located inside; wherein the winding part refers to a portion of each of the second winding monofilament layers wound outside the outermost layer of the first monofilament layers; so that an area in which the n first monofilament layers are connected to the m second monofilament layers forms a conductor welding area of a joint.
12. The method for manufacturing the submarine cable according to claim 11, wherein in a step of winding sequentially from inside to outside the h second winding monofilament layers outside the outermost layer of the n first monofilament layers, a difference between a winding pitch of the winding part of each of the second winding monofilament layers and a stranding pitch of a stranding part of each of the second winding monofilament layers is less than a preset difference; and

wherein the stranding part refers to a portion of each of the second winding monofilament layers stranded outside an outermost layer of the second welding monofilament layers.

13. The method for manufacturing the submarine cable according to claim 12, wherein a step of welding the n first monofilament layers to the n second welding monofilament layers in a one-to-one relationship further comprises:

covering, by a second welding monofilament layer located outside, a secondary welding area between a second welding monofilament layer located inside and a corresponding first monofilament layer, wherein the secondary welding area is an area in which the first monofilament layers are welded to the second monofilament layers; and

wherein in the step of winding, sequentially from inside to outside in the radial direction of the submarine cable, the h second winding monofilament layers outside the outermost layer of the n first monofilament layers, an innermost layer of the second winding monofilament layers covers a secondary welding area between the outermost layer of the first monofilament layers and the outermost layer of the second welding monofilament layers.

14. The method for manufacturing the submarine cable according to claim 13, wherein the step of winding, sequentially from inside to outside in the radial direction of the submarine cable, the h second winding monofilament layers outside the outermost layer of the n first monofilament layers further comprises: welding a winding end of the winding part of each of the second winding monofilament layers to the outermost layer of the first monofilament layers, and performing a polishing operation on a welding area between the winding end and the first monofilament layer, so that a connection between the winding end and the first monofilament layer is firm and smooth.

15. The method for manufacturing the submarine cable according to claim 14, wherein following a step of forming the conductor welding area, the method for manufacturing the submarine cable further comprises:

covering, by way of winding or extrusion molding with a same material as a conductor shielding layer, the conductor welding area and a exposed portion of the first conductor and a exposed portion of the second conductor to form a conductor shielding recovery layer, and making the conductor shielding recovery layer have one end connected to a first conductor shielding layer of the submarine cable section and the other end connected to a second conductor

shielding layer of the landing cable section.

16. The method for manufacturing the submarine cable according to claim 15, wherein following a step of forming the conductor shielding recovery layer, the method for manufacturing the submarine cable further comprises:

cutting a first insulating layer of the submarine cable section to obtain a cone surface with a cone angle not greater than 60° , and cutting a second insulating layer of the landing cable section to obtain a cone surface with a cone angle not greater than 60° ; and

covering, by way of extrusion molding with a same material as the first insulating layer and the second insulating layer, the conductor shielding recovery layer to form an insulating recovery layer, and making the insulating recovery layer have one end connected to the first insulating layer and the other end connected to the second insulating layer.

17. The method for manufacturing the submarine cable according to claim 16, wherein following a step of forming the insulating recovery layer, the method for manufacturing the submarine cable further comprises:

covering, with a same material as a first insulation shielding layer of the submarine cable section and a second insulation shielding layer of the landing cable section, the insulating recovery layer to form an insulation shielding recovery layer, and making the insulation shielding recovery layer have one end connected to the first insulation shielding layer and the other end connected to the second insulation shielding layer; covering, with a same material as a first longitudinal water blocking layer of the submarine cable section and a second longitudinal water blocking layer of the landing cable section, the insulation shielding recovery layer to form a longitudinal water-blocking recovery layer, and making the longitudinal water-blocking recovery layer have one end connected to the first longitudinal water blocking layer and the other end connected to the second longitudinal water blocking layer; and

covering, with a same material as a first radial water blocking layer of the submarine cable section and a second radial water blocking layer of the landing cable section, the longitudinal water-blocking recovery layer to form a radial water-blocking recovery layer, and making the radial water-blocking recovery layer have one end connected to the first radial water blocking layer and the other end connected to the second radial

water blocking layer.

18. The method for manufacturing the submarine cable according to claim 17, wherein following a step of forming the radial water-blocking recovery layer, the method for manufacturing the submarine cable further comprises:

when a material of a first non-metallic sheath layer of the submarine cable section is same as that of a second non-metallic sheath layer of the landing cable section, covering, with a non-metallic sheath material same as that of the first non-metallic sheath layer and the second non-metallic sheath layer, the radial water-blocking recovery layer, and heating the non-metallic sheath material, to form a non-metallic sheath recovery layer with the non-metallic sheath recovery layer, the first non-metallic sheath layer and the second non-metallic sheath layer integrated; and

when the material of the first non-metallic sheath layer of the submarine cable section is different from that of the second non-metallic sheath layer of the landing cable section, covering, with a non-metallic sheath material same as that of the first non-metallic sheath layer or the second non-metallic sheath layer, the radial water-blocking recovery layer, and heating the non-metallic sheath material, to form a non-metallic sheath recovery layer with the non-metallic sheath recovery layer, the first non-metallic sheath layer and the second non-metallic sheath layer integrated.

19. The method for manufacturing the submarine cable according to claim 18, wherein following a step of when the material of the first non-metallic sheath layer of the submarine cable section is different from that of the second non-metallic sheath layer of the landing cable section, covering, by way of extrusion molding with the non-metallic sheath material same as that of the first non-metallic sheath layer or the second non-metallic sheath layer, the radial water-blocking recovery layer, and heating the non-metallic sheath material, to form the non-metallic sheath recovery layer, the method for manufacturing the submarine cable further comprises:

when the non-metallic sheath material is same as the material of the first non-metallic sheath layer, winding a cross-linked polyethylene tape at a junction between the non-metallic sheath recovery layer and the second non-metallic sheath layer, and heating the cross-linked polyethylene tape to integrate the cross-linked polyethylene tape, the non-metallic sheath recovery layer, and the second non-metallic sheath

layer; and

when the non-metallic sheath material is same as the material of the second non-metallic sheath layer, winding a cross-linked polyethylene tape at a junction between the non-metallic sheath recovery layer and the first non-metallic sheath layer, and heating the cross-linked polyethylene tape to integrate the cross-linked polyethylene tape, the non-metallic sheath recovery layer, and the first non-metallic sheath layer.

20. The method for manufacturing the submarine cable according to any one of claim 18 or 19, wherein following a step of forming the non-metallic sheath recovery layer, the method for manufacturing the submarine cable further comprises:

arranging, by using an armoring tool, an armor layer outside the non-metallic sheath recovery layer, the first non-metallic sheath layer, and the second non-metallic sheath layer;

wherein the armoring tool comprises a hydraulic cylinder, a pressure sensor, an inner mould layer, and an outer mould layer, wherein the inner mould layer is located within the outer mould layer, the hydraulic cylinder is connected with the inner mould layer for controlling the inner mould layer to be tightened or loosened, and the pressure sensor is in signal connection with the inner mould layer and the hydraulic cylinder, respectively for controlling a movement of the hydraulic cylinder according to a pressure on the inner mould layer.

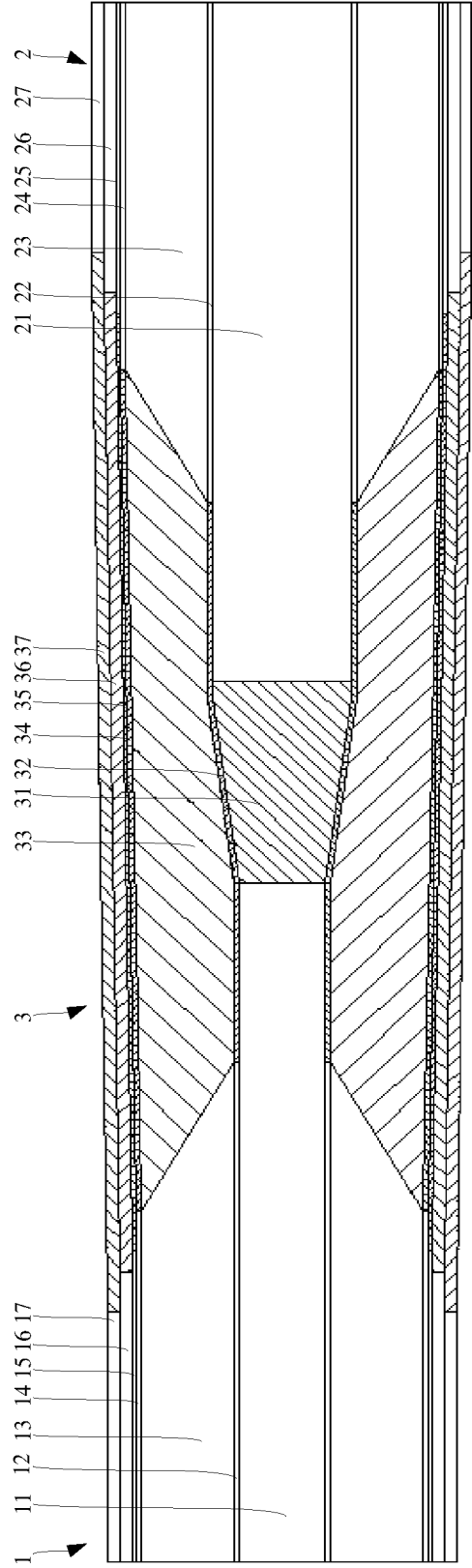


FIG. 1

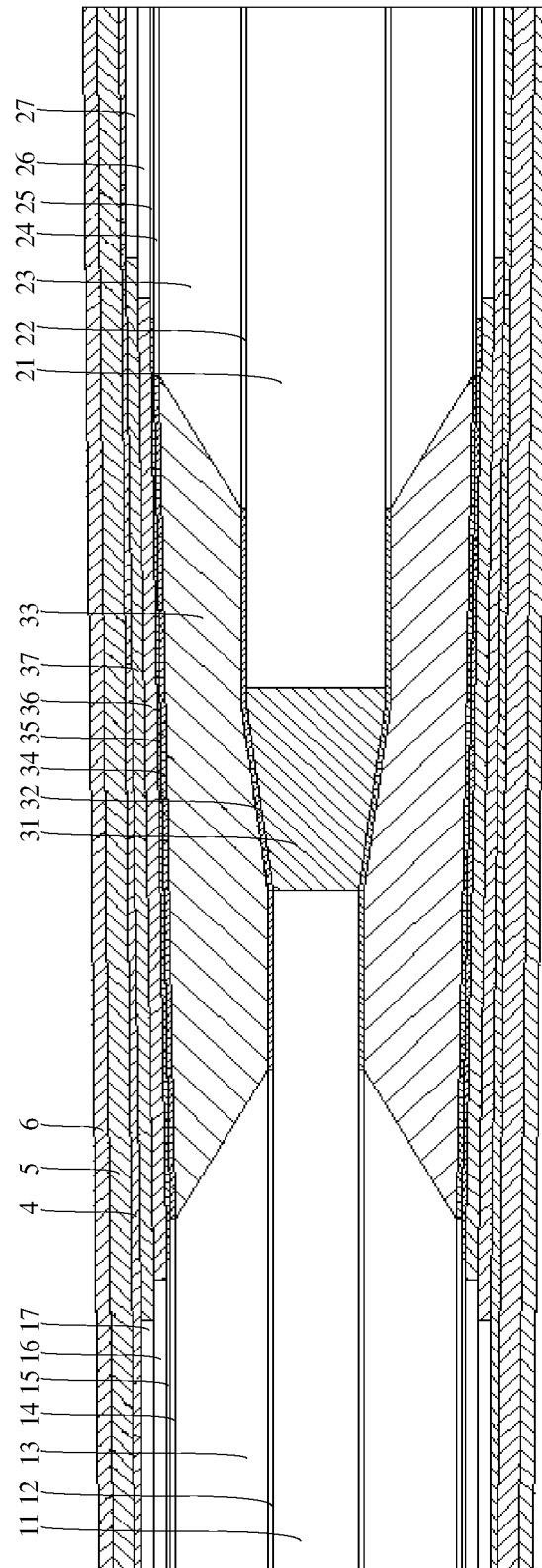


FIG. 2

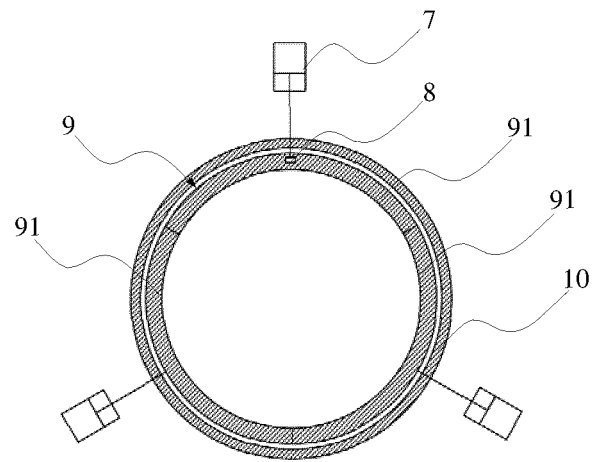


FIG. 3

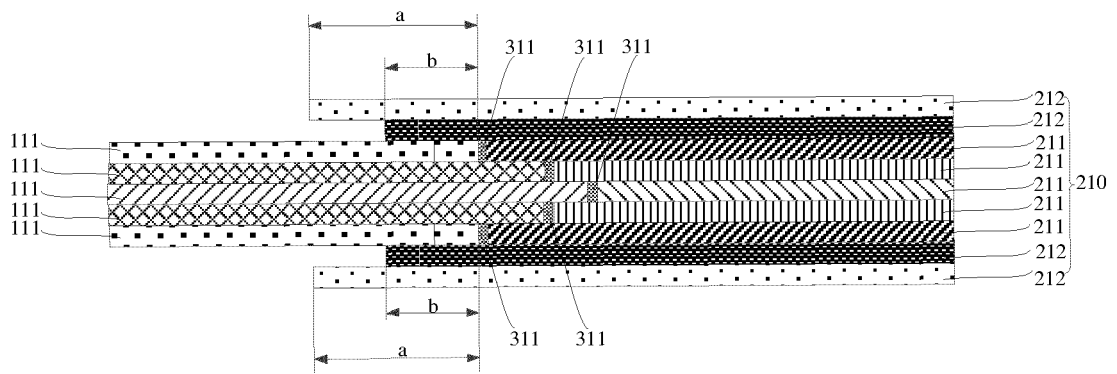


FIG. 4

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2021/087591

5	A. CLASSIFICATION OF SUBJECT MATTER H01B 7/00(2006.01)i; H01B 7/04(2006.01)i; H01B 7/14(2006.01)i; H01B 9/00(2006.01)i; H01B 9/02(2006.01)i; H01B 13/00(2006.01)i According to International Patent Classification (IPC) or to both national classification and IPC		
10	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		
15	Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) CNTXT; CNABS; CNKI; SIPOABS; DWPI; EPTXT; WOTXT; USTXT: 海底, 登陆, 电缆, 导体, 焊接, 缠绕, 接头, submarine, land, cable, conductor, weld, winding		
20	C. DOCUMENTS CONSIDERED TO BE RELEVANT		
	Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	A	CN 110993154 A (ZHONGTIAN TECHNOLOGY SUBMARINE CABLES CO., LTD. et al.) 10 April 2020 (2020-04-10) description, paragraphs [0031]-[0053], and figure 1	1-20
25	A	CN 102664380 A (ZHONGTIAN TECHNOLOGY SUBMARINE CABLES CO., LTD.) 12 September 2012 (2012-09-12) entire document	1-20
	A	JP 2016010215 A (VISCAS CORP.) 18 January 2016 (2016-01-18) entire document	1-20
30	A	JP 2001112139 A (ELECTRIC POWER DEV CO. et al.) 20 April 2001 (2001-04-20) entire document	1-20
35	☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
40	* Special categories of cited documents: “A” document defining the general state of the art which is not considered to be of particular relevance “E” earlier application or patent but published on or after the international filing date “L” document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) “O” document referring to an oral disclosure, use, exhibition or other means “P” document published prior to the international filing date but later than the priority date claimed “T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention “X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone “Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art “&” document member of the same patent family		
45	Date of the actual completion of the international search 26 August 2021		
	Date of mailing of the international search report 16 September 2021		
50	Name and mailing address of the ISA/CN China National Intellectual Property Administration (ISA/CN) No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088, China		
55	Authorized officer Facsimile No. (86-10)62019451 Telephone No.		

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CN2021/087591

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REFERENCES CITED IN THE DESCRIPTION

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