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

UNTERWASSERKABEL UND HERSTELLUNGSVERFAHREN DAFÜR

CÂBLE SOUS-MARIN ET SON PROCÉDÉ DE FABRICATION

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Description**TECHNICAL FIELD**

[0001] 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

[0002] 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.

[0003] 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.

[0004] 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.

[0005] JP2012022820A relates to a connection method and structure for a submarine cable, which is used to reduce the cost by a satisfactory connection of cables having different conductor section areas.

[0006] CN110993154A relates to an ultra-high-voltage submarine cable flexible joint, which comprises a conductor welding segment, a conductor shielding recovery layer, an insulation recovery layer, an insulation shielding recovery layer, a metal sheath recovery layer and an outer sheath recovery layer.

[0007] CN102664380A discloses a flexible joint for 220kV crosslinked polyethylene submarine cables and a method for manufacturing the flexible joint, which is suitable for manufacturing long 220kV submarine cables, meeting the clients' demand on integral long submarine

cables.

SUMMARY

[0008] The present invention is set out in the appended set of claims. 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.

[0009] In order to achieve the above purpose, embodiments of the present invention provide following technical solutions.

[0010] 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 welding 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 welding 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.

[0011] 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 welding 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 outside 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.

[0012] 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.

[0013] 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.

[0014] 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 sec-

tion 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.

[0015] 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.

[0016] 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.

[0017] 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.

[0018] 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.

[0019] 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.

[0020] 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.

[0021] 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.

[0022] 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 welding 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.

[0023] 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.

[0024] 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 welding monofilament layers.

[0025] 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 outermost layer of the first monofilament layers, so that a connection between the winding end and the outermost layer of the first monofilament layers is firm and smooth.

[0026] 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.

[0027] In the method for manufacturing the submarine cable as described above, following a step of forming the conductor shielding recovery layer, the method for man-

ufacturing 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.

[0028] 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.

[0029] 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.

[0030] 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-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 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.

[0031] 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)

[0032] 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 armoring 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:

[0033]

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

[0034] 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 cable 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.

[0035] 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.

[0036] 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 inven-

tion. 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.

[0037] 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.

[0038] The submarine cable section 1 includes a first conductor 11, and the first conductor 11 includes n first monofilament layers 111 sequentially arranged from inside 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 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.

[0039] 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.

[0040] 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.

[0041] 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 211 within the same layers are welded in a one-to-one relationship.

[0042] 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.

[0043] 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 welding 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 212 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 .

[0044] 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, 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 .

[0045] 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} .

[0046] 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 .

[0047] 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 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, 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_2 wound outside layer a_3 covers a portion of layer c_1 wound outside layer a_3 .

[0048] 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.

[0049] 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.

[0050] 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).

[0051] According to the invention, 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 welding 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 welding 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.

[0052] Further, for any two adjacent second welding monofilament layers 211, a second welding monofilament layer 211 located outside covers a secondary welding area 311 between a second welding 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 welding 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.

[0053] 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.

[0054] 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.

[0055] 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.

[0056] 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.

[0057] 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.

[0058] 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.

[0059] 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.

[0060] 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.

[0061] 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.

[0062] 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 arrangement 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.

[0063] 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.

[0064] 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.

[0065] 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.

ery 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.

[0066] 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.

[0067] 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.

[0068] 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.

[0069] 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 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, 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.

[0070] 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.

[0071] 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.

[0072] 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.

[0073] 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.

[0074] 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.

[0075] 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.

[0076] 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.

[0077] 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.

[0078] 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 monofilament layers with a center of an innermost layer of the m second monofilament layers. Such arrangement can reduce an error in a welding process.

[0079] 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 welding monofilament layers of the m second monofilament layers in a one-to-one relationship.

[0080] 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.

[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] 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 winding monofilament layers.

[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] 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 outermost layer of the first monofilament layers, so that a connection between the winding end and the outermost layer of the first monofilament layers is firm and smooth.

[0085] 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.

[0086] 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 .

[0087] The conductor welding area of the joint can be formed by the above steps.

[0088] 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.

[0089] 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.

[0090] 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.

[0091] 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.

[0092] 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.

[0093] 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.

[0094] 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.

[0095] 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.

[0096] 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.

[0097] 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.

[0098] 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-metallic 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.

[0099] 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.

[0100] 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.

[0101] 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.

[0102] 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.

[0103] 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.

[0104] 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.

[0105] 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.

[0106] 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.

[0107] 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.

[0108] 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.

[0109] 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.

Claims

1. A submarine cable, comprising:

a submarine cable section (1) which comprises a first conductor (11), wherein the first conductor (11) comprises n first monofilament layers (111) sequentially arranged from inside to outside in a radial direction of the submarine cable; and a landing cable section (2) which comprises a second conductor (21), wherein the second conductor (21) comprises m second monofilament layers (210) sequentially arranged from inside to outside in the radial direction of the submarine

cable, and 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), wherein m and n are both positive integers, and $m \geq n$, $h = m - n$, $h \geq 2$;

wherein the n first monofilament layers (111), from inside to outside in the radial direction of the submarine cable, are welded to the n second welding monofilament layers (211) in a one-to-one relationship;

wherein 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); 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; wherein 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); and

wherein an area in which the n first monofilament layers (111) are connected to the m second monofilament layers (210) forms a conductor welding area (31) of a joint (3);

wherein 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; and

wherein the stranding part refers to a portion of each of the second winding monofilament layers (212) stranded outside an outermost layer of the second welding 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.

2. The submarine cable according to claim 1, wherein for any two adjacent second welding monofilament layers (211), a second welding monofilament layer (211) located outside covers a secondary welding area (311) between a second welding monofilament layer (211) located inside and a corresponding first monofilament layer (111);

wherein 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 welding monofilament layers (211); and

wherein the secondary welding area (311) is an area in which the first monofilament layers (111) are welded to the second monofilament layers (210).

3. The submarine cable according to claim 2, wherein the submarine cable section (1) further comprises a first conductor shielding layer (12), and the first conductor shielding layer (12) covers part of the first conductor (11);

wherein the landing cable section (2) further comprises a second conductor shielding layer (22), and the second conductor shielding layer (22) covers part of the second conductor (21); and

wherein the joint (3) further comprises a conductor shielding recovery layer (32), 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 the conductor shielding recovery layer (32) has one end connected to the first conductor shielding layer (12) and the other end connected to the second conductor shielding layer (22).

4. The submarine cable according to claim 3, wherein the submarine cable section (1) further comprises a first insulating layer (13), and the first insulating layer (13) covers the first conductor shielding layer (12);

wherein the landing cable section (2) further comprises a second insulating layer (23), and the second insulating layer (23) covers the second conductor shielding layer (22); and

wherein the joint (3) further comprises an insulating recovery layer (33), the insulating recovery layer (33) covers the conductor shielding recovery layer (32), and the insulating recovery layer (33) has one end connected to the first insulating layer (13) and the other end connected to the second insulating layer (23).

5. The submarine cable according to claim 4, wherein the submarine cable section (1) further comprises a first insulation shielding layer (14), and the first insulation shielding layer (14) covers the first insulating layer (13);

wherein the landing cable section (2) further comprises a second insulation shielding layer (24), and the second insulation shielding layer (24) covers the second insulating layer (23); and wherein the joint (3) further comprises an insulation shielding recovery layer (34), the insulation shielding recovery layer (34) covers the insulating recovery layer (33), and the insulation

shielding recovery layer (34) has one end connected to the first insulation shielding layer (14) and the other end connected to the second insulation shielding layer (24).

6. The submarine cable according to claim 5, wherein the submarine cable section (1) further comprises a first longitudinal water blocking layer (15), and the first longitudinal water blocking layer (15) covers part of the first insulation shielding layer (14);

wherein the landing cable section (2) further comprises a second longitudinal water blocking layer (25), and the second longitudinal water blocking layer (25) covers part of the second insulation shielding layer (24); and

wherein the joint (3) further comprises 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 the longitudinal water-blocking recovery layer (35) 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);

optionally, the submarine cable section (1) further comprises 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);

wherein the landing cable section (2) further comprises 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); and wherein the joint (3) further comprises 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 the radial water-blocking recovery layer (36) 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);

optionally, the submarine cable section (1) further comprises 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);

wherein the landing cable section (2) further

comprises 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); and wherein the joint (3) further comprises a non-metallic sheath recovery layer (37), and 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 the non-metallic sheath recovery layer (37) 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); and

optionally, the submarine cable further comprises an armor inner cushion layer (4), an armor layer (5), and an armor outer coating layer (6), and 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); and wherein the armor layer (5) covers the armor inner cushion layer (4), and the armor outer coating layer (6) covers the armor layer (5).

7. A method for manufacturing a submarine cable, comprising:

providing a submarine cable section (1) and a landing cable section (2), wherein the submarine cable section (1) comprises a first conductor (11), and the first conductor (11) comprises n first monofilament layers (111) arranged from inside to outside in a radial direction of the submarine cable; and the landing cable section (2) comprises a second conductor (21), the second conductor (21) comprises m second monofilament layers (210) sequentially arranged from inside to outside in the radial direction of the submarine cable, and 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), wherein m and n are both positive integers, and $m \geq n$, $h = m - n$, $h \geq 2$; welding, sequentially from inside to outside in the radial direction of the submarine cable, the n first monofilament layers (111) to the n second welding monofilament layers (211) 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 (212) outside an outermost layer of the n first monofilament layers (111).

ment layers (111), wherein 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; wherein 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); so that an area in which the n first monofilament layers (111) are connected to the m second monofilament layers (210) forms a conductor welding area (31) of a joint (3); wherein in a step of winding sequentially from inside to outside the h second winding monofilament layers (212) outside the outermost layer of the n first monofilament layers (111), 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; and wherein the stranding part refers to a portion of each of the second winding monofilament layers (212) stranded outside an 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.

8. The method for manufacturing the submarine cable according to claim 7, wherein a step of welding the n first monofilament layers (111) to the n second winding monofilament layers (211) in a one-to-one relationship further comprises:

covering, by a second welding monofilament layer (211) located outside, a secondary welding area (311) between a second welding monofilament layer (211) located inside and a corresponding first monofilament layer (111), wherein the secondary welding area (311) is an area in which the first monofilament layers (111) are welded to the second monofilament layers (210); 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 (212) outside the outermost layer of the n first monofilament layers (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); optionally, the step of winding, sequentially from inside to outside in the radial direction of the

submarine cable, the h second winding monofilament layers (212) outside the outermost layer of the n first monofilament layers (111) further comprises:

welding a winding end of the winding part of each of the second winding monofilament layers (212) to the outermost layer of the first monofilament layers (111), and performing a polishing operation on a welding area between the winding end and the outermost layer of the first monofilament layers (111), so that a connection between the winding end and the outermost layer of the first monofilament layers (111) is firm and smooth.

9. The method for manufacturing the submarine cable according to claim 8, wherein following a step of forming the conductor welding area (31), 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 (31) and a exposed portion of the first conductor (11) and a exposed portion of the second conductor (21) to form a conductor shielding recovery layer (32), and making the conductor shielding recovery layer (32) have one end connected to a first conductor shielding layer (12) of the submarine cable section (1) and the other end connected to a second conductor shielding layer (22) of the landing cable section (2).

10. The method for manufacturing the submarine cable according to claim 9, wherein following a step of forming the conductor shielding recovery layer (32), the method for manufacturing the submarine cable further comprises:

cutting a 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 a second insulating layer (23) of the landing cable section (2) 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 (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).

11. The method for manufacturing the submarine cable according to claim 10, wherein following a step of forming the insulating recovery layer (33), the method for manufacturing the submarine cable further

comprises:

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).

- 12.** The method for manufacturing the submarine cable according to claim 11, wherein following a step of forming the radial water-blocking recovery layer (36), the method for manufacturing the submarine cable further comprises:

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 that of 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) with 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 that of the first non-metallic 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 a non-metallic sheath recovery layer (37) with the non-metallic sheath recovery layer (37), the first non-metallic sheath layer (17) and the second non-metallic sheath layer (27) integrated.

- 13.** The method for manufacturing the submarine cable according to claim 12, wherein following a step of 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, by way of extrusion molding with the non-metallic sheath material same as that of the first non-metallic 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), 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 (17), winding a cross-linked polyethylene tape at a junction between 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); and
 when the non-metallic sheath material is same as the material of the second non-metallic sheath layer (27), winding a cross-linked polyethylene tape at a junction between 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);
 optionally, following a step of forming the non-metallic sheath recovery layer (37), the method for manufacturing the submarine cable further comprises:

arranging, by using an armoring tool, an armor layer (5) outside the non-metallic sheath recovery layer (37), the first non-metallic sheath layer (17), and the second non-metallic sheath layer (27);

wherein the armoring tool comprises a hydraulic cylinder (7), a pressure sensor (8), an inner mould layer (9), and an outer mould layer (10), wherein 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, and 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).

Patentansprüche

1. Unterwasserkabel, umfassend:

einen Unterwasserkabelabschnitt (1), der einen ersten Leiter (11) umfasst, wobei der erste Leiter (11) n erste Monofilamentschichten (111) umfasst, die aufeinanderfolgend von innen nach außen in radialer Richtung des Unterwasserkabels angeordnet sind; und einen Landungskabelabschnitt (2), der einen zweiten Leiter (21) umfasst, wobei der zweite Leiter (21) m zweite Monofilamentschichten (210) umfasst, die aufeinanderfolgend von innen nach außen in radialer Richtung des Unterwasserkabels angeordnet sind, und wobei die m zweiten Monofilamentschichten (210) aufeinanderfolgend von innen nach außen in radialer Richtung des Unterwasserkabels in n zweite Schweißmonofilamentschichten (211) und h zweite gewickelte Monofilamentschichten (212) geteilt sind, wobei m und n beide positive Ganzzahlen sind, und $m \geq n$, $h = m - n$, $h \geq 2$; wobei die n ersten Monofilamentschichten (111), von innen nach außen in radialer Richtung des Unterwasserkabels, mit den n zweiten Schweißmonofilamentschichten (211) in einer Eins-zu-Eins-Beziehung verschweißt sind; wobei die h zweiten gewickelten Monofilamentschichten (212), aufeinanderfolgend von innen nach außen in radialer Richtung des Unterwasserkabels, außerhalb einer äußersten Schicht der n ersten Monofilamentschichten (111) gewickelt sind; und für zwei beliebige benachbarte zweite gewickelte Monofilamentschichten (212) ein Wicklungsteil einer zweiten gewickelten Monofilamentschicht (212), die sich außen befindet, einen Wicklungsteil einer zweiten gewickelten Monofilamentschicht (212) bedeckt, die sich innen befindet; wobei sich der Wicklungsteil auf einen Anteil jeder der zweiten gewickelten Monofilamentschichten (212) bezieht, der außer-

halb der äußersten Schicht der ersten Monofilamentschichten (111) gewickelt ist; und wobei ein Bereich, in dem die n ersten Monofilamentschichten (111) mit den m zweiten Monofilamentschichten (210) verbunden sind, einen Leiterschweißbereich (31) einer Verbindung (3) bildet; wobei eine Differenz zwischen einer Wicklungssteigung des Wicklungsteils jeder der zweiten gewickelten Monofilamentschichten (212) und einer Verseilungssteigung eines Verseilungsteils jeder der zweiten gewickelten Monofilamentschichten (212) kleiner ist als eine voreingestellte Differenz; und wobei sich der Verseilungsteil auf einen Anteil jeder der zweiten gewickelten Monofilamentschichten (212) bezieht, der außerhalb einer äußersten Schicht der zweiten Schweißmonofilamentschichten (211) verseilt ist, und die voreingestellte Differenz 10 % der Verseilungssteigung des Verseilungsteils jeder der zweiten gewickelten Monofilamentschichten beträgt.

2. Unterwasserkabel nach Anspruch 1, wobei für zwei beliebige benachbarte zweite Schweißmonofilamentschichten (211) eine zweite Schweißmonofilamentschicht (211), die sich außen befindet, einen sekundären Schweißbereich (311) zwischen einer zweiten Schweißmonofilamentschicht (211), die sich innen befindet, und einer entsprechenden ersten Monofilamentschicht (111) bedeckt;

wobei eine innerste Schicht der zweiten gewickelten Monofilamentschichten (212) einen sekundären Schweißbereich (311) zwischen der äußersten Schicht der ersten Monofilamentschichten (111) und der äußersten Schicht der zweiten Schweißmonofilamentschichten (211) bedeckt; und wobei der sekundäre Schweißbereich (311) ein Bereich ist, in dem die ersten Monofilamentschichten (111) mit den zweiten Monofilamentschichten (210) verschweißt sind.

3. Unterwasserkabel nach Anspruch 2, wobei der Unterwasserkabelabschnitt (1) ferner eine erste Leiterabschirmungsschicht (12) umfasst, und die erste Leiterabschirmungsschicht (12) einen Teil des ersten Leiters (11) bedeckt;

wobei der Landungskabelabschnitt (2) ferner eine zweite Leiterabschirmungsschicht (22) umfasst, und die zweite Leiterabschirmungsschicht (22) einen Teil des zweiten Leiters (21) bedeckt; und wobei die Verbindung (3) ferner eine Leiterabschirmungs-Rückgewinnungsschicht (32) umfasst, wobei die Leiterabschirmungs-Rückge-

- winnungsschicht (32) einen Teil des ersten Leiters (11), einen Teil des zweiten Leiters (21) und den Leiterschweißbereich (31) bedeckt, und die Leiterabschirmungs-Rückgewinnungsschicht (32) mit einem Ende mit der ersten Leiterabschirmungsschicht (12) verbunden ist und mit dem anderen Ende mit der zweiten Leiterabschirmungsschicht (22) verbunden ist. 5
4. Unterwasserkabel nach Anspruch 3, wobei der Unterwasserkabelabschnitt (1) ferner eine erste Isolierschicht (13) umfasst, und die erste Isolierschicht (13) die erste Leiterabschirmungsschicht (12) bedeckt; 10
- wobei der Landungskabelabschnitt (2) ferner eine zweite Isolierschicht (23) umfasst, und die zweite Isolierschicht (23) die zweite Leiterabschirmungsschicht (22) bedeckt; und 15
- wobei die Verbindung (3) ferner eine isolierende Rückgewinnungsschicht (33) umfasst, wobei die isolierende Rückgewinnungsschicht (33) die Leiterabschirmungs-Rückgewinnungsschicht (32) bedeckt, und die isolierende Rückgewinnungsschicht (33) mit einem Ende mit der ersten Isolierschicht (13) verbunden ist und mit dem anderen Ende mit der zweiten Isolierschicht (23) verbunden ist. 20 25
5. Unterwasserkabel nach Anspruch 4, wobei der Unterwasserkabelabschnitt (1) ferner eine erste Isolierabschirmungsschicht (14) umfasst, und die erste Isolierabschirmungsschicht (14) die erste Isolierschicht (13) bedeckt; 30
- wobei der Landungskabelabschnitt (2) ferner eine zweite Isolierabschirmungsschicht (24) umfasst, und die zweite Isolierabschirmungsschicht (24) die zweite Isolierschicht (23) bedeckt; und 35
- wobei die Verbindung (3) ferner eine Isolierabschirmungs-Rückgewinnungsschicht (34) umfasst, wobei die Isolierabschirmungs-Rückgewinnungsschicht (34) die isolierende Rückgewinnungsschicht (33) bedeckt, und die Isolierabschirmungs-Rückgewinnungsschicht (34) mit einem Ende mit der ersten Isolierabschirmungsschicht (14) verbunden ist und mit dem anderen Ende mit der zweiten Isolierabschirmungsschicht (24) verbunden ist. 40 45 50
6. Unterwasserkabel nach Anspruch 5, wobei der Unterwasserkabelabschnitt (1) ferner eine erste längslaufende wasserblockierende Schicht (15) umfasst, und die erste längslaufende wasserblockierende Schicht (15) einen Teil der ersten Isolierabschirmungsschicht (14) bedeckt; 55
- wobei der Landungskabelabschnitt (2) ferner

eine zweite längslaufende wasserblockierende Schicht (25) umfasst, und die zweite längslaufende wasserblockierende Schicht (25) einen Teil der zweiten Isolierabschirmungsschicht (24) bedeckt; und

wobei die Verbindung (3) ferner eine längslaufende wasserblockierende Rückgewinnungsschicht (35) umfasst, wobei die längslaufende wasserblockierende Rückgewinnungsschicht (35) einen Teil der ersten Isolierabschirmungsschicht (14), einen Teil der zweiten Isolierabschirmungsschicht (24) und die Isolierabschirmungs-Rückgewinnungsschicht (34) bedeckt, und wobei die längslaufende wasserblockierende Rückgewinnungsschicht (35) mit einem Ende mit der ersten längslaufenden wasserblockierenden Schicht (15) verbunden ist und mit dem anderen Ende mit der zweiten längslaufenden wasserblockierenden Schicht (25) verbunden ist;

optional, wobei der Unterwasserkabelabschnitt (1) ferner eine erste radiale wasserblockierende Schicht (16) umfasst, und die erste radiale wasserblockierende Schicht (16) einen Teil der ersten längslaufenden wasserblockierenden Schicht (15) bedeckt;

wobei der Landungskabelabschnitt (2) ferner eine zweite radiale wasserblockierende Schicht (26) umfasst, und die zweite radiale wasserblockierende Schicht (26) einen Teil der zweiten längslaufenden wasserblockierenden Schicht (25) bedeckt; und

wobei die Verbindung (3) ferner eine radiale wasserblockierende Rückgewinnungsschicht (36) umfasst, wobei die radiale wasserblockierende Rückgewinnungsschicht (36) einen Teil der ersten längslaufenden wasserblockierenden Schicht (15), einen Teil der zweiten längslaufenden wasserblockierenden Schicht (25) und die längslaufende wasserblockierende Rückgewinnungsschicht (35) bedeckt, und die radiale wasserblockierende Rückgewinnungsschicht (36) mit einem Ende mit der ersten radialen wasserblockierenden Schicht (16) verbunden ist und mit dem anderen Ende mit der zweiten radialen wasserblockierenden Schicht (26) verbunden ist;

optional, wobei der Unterwasserkabelabschnitt (1) ferner eine erste nicht-metallische Mantelschicht (17) umfasst, und die erste nicht-metallische Mantelschicht (17) einen Teil der ersten radialen wasserblockierenden Schicht (16) bedeckt;

wobei der Landungskabelabschnitt (2) ferner eine zweite nicht-metallische Mantelschicht (27) umfasst, und die zweite nicht-metallische Mantelschicht (27) einen Teil der zweiten radialen wasserblockierenden Schicht (26) bedeckt;

und
 wobei die Verbindung (3) ferner eine nicht-metallische Mantelrückgewinnungsschicht (37) umfasst, und die nicht-metallische Mantelrückgewinnungsschicht (37) einen Teil der ersten radialen wasserblockierenden Schicht (16), einen Teil der zweiten radialen wasserblockierenden Schicht (26) und die radiale wasserblockierende Rückgewinnungsschicht (36) bedeckt, und die nicht-metallische Mantelrückgewinnungsschicht (37) mit einem Ende mit der ersten nicht-metallischen Mantelschicht (17) verbunden ist und mit dem anderen Ende mit der zweiten nicht-metallischen Mantelschicht (27) verbunden ist; und
 optional, wobei das Unterwasserkabel ferner eine innere Panzerungspolsterschicht (4), eine Panzerungsschicht (5) und eine äußere Panzerungsüberzugsschicht (6) umfasst, und die innere Panzerungspolsterschicht (4) die erste nicht-metallische Mantelschicht (17), die zweite nicht-metallische Mantelschicht (27) und die nicht-metallische Mantelrückgewinnungsschicht (37) bedeckt; und
 wobei die Panzerungsschicht (5) die innere Panzerungspolsterschicht (4) bedeckt, und die äußere Panzerungsüberzugsschicht (6) die Panzerungsschicht (5) bedeckt.

7. Verfahren zur Herstellung eines Unterwasserkabels, umfassend:

Bereitstellen eines Unterwasserkabelabschnitts (1) und eines Landungskabelabschnitts (2), wobei der Unterwasserkabelabschnitt (1) einen ersten Leiter (11) umfasst, und der erste Leiter (11) n erste Monofilamentschichten (111) umfasst, die von innen nach außen in radialer Richtung des Unterwasserkabels angeordnet sind; und der Landungskabelabschnitt (2) einen zweiten Leiter (21) umfasst, wobei der zweite Leiter (21) m zweite Monofilamentschichten (210) umfasst, die aufeinanderfolgend von innen nach außen in radialer Richtung des Unterwasserkabels in n zweite Schweißmonofilamentschichten (211) und h zweite gewickelte Monofilamentschichten (212) geteilt sind, wobei m und n beide positive Ganzzahlen sind, und $m \geq n$, $h = m - n$, $h \geq 2$;
 Verschweißen, aufeinanderfolgend von innen nach außen in radialer Richtung des Unterwasserkabels, der n ersten Monofilamentschichten (111) mit den n zweiten Schweißmonofilamentschichten (211) in einer Eins-zu-Eins-Beziehung; und

Wickeln, aufeinanderfolgend von innen nach außen in radialer Richtung des Unterwasserkabels, der h zweiten gewickelten Monofilamentschichten (212) außerhalb einer äußersten Schicht der n ersten Monofilamentschichten (111), wobei für zwei beliebige benachbarte zweite gewickelte Monofilamentschichten (212) ein Wicklungsteil einer zweiten gewickelten Monofilamentschicht (212), die sich außen befindet, einen Wicklungsteil einer zweiten gewickelten Monofilamentschicht (212) bedeckt, die sich innen befindet; wobei sich der Wicklungsteil auf einen Anteil jeder der zweiten gewickelten Monofilamentschichten (212) bezieht, der außerhalb der äußersten Schicht der ersten Monofilamentschichten (111) gewickelt ist; so dass ein Bereich, in dem die n ersten Monofilamentschichten (111) mit den m zweiten Monofilamentschichten (210) verbunden sind, einen Leiterschweißbereich (31) einer Verbindung (3) bildet;

wobei in einem Schritt des Wickelns, aufeinanderfolgend von innen nach außen, der h zweiten gewickelten Monofilamentschichten (212) außerhalb der äußersten Schicht der n ersten Monofilamentschichten (111), eine Differenz zwischen einer Wicklungssteigung des Wicklungsteils jeder der zweiten gewickelten Monofilamentschichten (212) und einer Verseilungssteigung eines Verseilungsteils jeder der zweiten gewickelten Monofilamentschichten (212) kleiner ist als eine voreingestellte Differenz; und wobei sich der Verseilungsteil auf einen Anteil jeder der zweiten gewickelten Monofilamentschichten (212) bezieht, der außerhalb einer äußersten Schicht der zweiten Schweißmonofilamentschichten (211) verseilt ist, und die voreingestellte Differenz 10 % der Verseilungssteigung des Verseilungsteils jeder der zweiten gewickelten Monofilamentschichten beträgt.

8. Verfahren zur Herstellung des Unterwasserkabels nach Anspruch 7, wobei ein Schritt des Verschweißens der n ersten Monofilamentschichten (111) mit den n zweiten Schweißmonofilamentschichten (211) in einer Eins-zu-Eins-Beziehung ferner umfasst:

Bedecken, durch eine zweite Schweißmonofilamentschicht (211), die sich außen befindet, eines sekundären Schweißbereichs (311) zwischen einer zweiten Schweißmonofilamentschicht (211), die sich innen befindet, und einer entsprechenden ersten Monofilamentschicht (111), wobei der sekundäre Schweißbereich (311) ein Bereich ist, in dem die ersten Monofilamentschichten (111) mit den zweiten Monofilamentschichten (210) verschweißt sind; und wobei in dem Schritt des Wickelns, aufeinander-

- folgend von innen nach außen in radialer Richtung des Unterwasserkabels, der h zweiten gewickelten Monofilamentschichten (212) außerhalb der äußersten Schicht der n ersten Monofilamentschichten (111), eine innerste Schicht der zweiten gewickelten Monofilamentschichten (212) einen sekundären Schweißbereich (311) zwischen der äußersten Schicht der ersten Monofilamentschichten (111) und der äußersten Schicht der zweiten Schweißmonofilamentschichten (211) bedeckt; und optional wobei der Schritt des Wickelns, aufeinanderfolgend von innen nach außen in radialer Richtung des Unterwasserkabels, der h zweiten gewickelten Monofilamentschichten (212) außerhalb der äußersten Schicht der n ersten Monofilamentschichten (111) ferner umfasst: Verschweißen eines Wicklungsendes des Wicklungssteils jeder der zweiten gewickelten Monofilamentschichten (212) mit der äußersten Schicht der ersten Monofilamentschichten (111), und Durchführen eines Poliervorgangs an einem Schweißbereich zwischen dem Wicklungsende und der äußersten Schicht der ersten Monofilamentschichten (111), so dass eine Verbindung zwischen dem Wicklungsende und der äußersten Schicht der ersten Monofilamentschichten (111) fest und glatt ist.
9. Verfahren zur Herstellung des Unterwasserkabels nach Anspruch 8, wobei nach einem Schritt des Bildens des Leiterschweißbereichs (31) das Verfahren zur Herstellung des Unterwasserkabels ferner umfasst: Bedecken, durch Wickeln oder Strangpressen mit einem gleichen Material wie eine Leiterabschirmungsschicht, des Leiterschweißbereichs (31) und eines freiliegenden Anteils des ersten Leiters (21), um eine Leiterabschirmungs-Rückgewinnungsschicht (32) zu bilden, und Machen, dass die Leiterabschirmungs-Rückgewinnungsschicht (32) mit einem Ende mit einer ersten Leiterabschirmungsschicht (12) des Unterwasserkabelabschnitts (1) verbunden ist und mit dem anderen Ende mit einer zweiten Leiterabschirmungsschicht (22) des Landungskabelabschnitts (2) verbunden ist.
10. Verfahren zur Herstellung des Unterwasserkabels nach Anspruch 9, wobei nach einem Schritt des Bildens der Leiterabschirmungs-Rückgewinnungsschicht (32) das Verfahren zur Herstellung des Unterwasserkabels ferner umfasst:
- Schneiden einer ersten Isolierschicht (13) des Unterwasserkabelabschnitts (1), um eine Konusoberfläche mit einem Konuswinkel von nicht mehr als 60° zu erhalten, und Schneiden einer

zweiten Isolierschicht (23) des Landungskabelabschnitts (2), um eine Konusoberfläche mit einem Konuswinkel von nicht mehr als 60° zu erhalten; und

Bedecken, durch Strangpressen mit einem gleichen Material wie die erste Isolierschicht (13) und die zweite Isolierschicht (23), der Leiterabschirmungs-Rückgewinnungsschicht (32), um eine isolierende Rückgewinnungsschicht (33) zu bilden, und Machen, dass die isolierende Rückgewinnungsschicht (33) mit einem Ende mit der ersten Isolierschicht (13) verbunden ist und mit dem anderen Ende mit der zweiten Isolierschicht (23) verbunden ist.

11. Verfahren zur Herstellung des Unterwasserkabels nach Anspruch 10, wobei nach einem Schritt des Bildens der isolierenden Rückgewinnungsschicht (33) das Verfahren zur Herstellung des Unterwasserkabels ferner umfasst:

Bedecken, mit einem gleichen Material wie die erste Isolierabschirmungsschicht (14) des Unterwasserkabelabschnitts (1) und eine zweite Isolierabschirmungsschicht (24) des Landungskabelabschnitts (2), die isolierende Rückgewinnungsschicht (33), um eine Isolierabschirmungs-Rückgewinnungsschicht (34) zu bilden, und Machen, dass die Isolierabschirmungs-Rückgewinnungsschicht (34) mit einem Ende mit der ersten Isolierabschirmungsschicht (14) verbunden ist und mit dem anderen Ende mit der zweiten Isolierabschirmungsschicht (24) verbunden ist;

Bedecken, mit einem gleichen Material wie eine erste längslaufende wasserblockierende Schicht (15) des Unterwasserkabelabschnitts (1) und eine zweite längslaufende wasserblockierende Schicht (25) des Landungskabelabschnitts (2), der Isolierabschirmungs-Rückgewinnungsschicht (34), um eine längslaufende wasserblockierende Rückgewinnungsschicht (35) zu bilden, und Machen, dass die längslaufende wasserblockierende Rückgewinnungsschicht (35) mit einem Ende mit der ersten längslaufenden wasserblockierenden Schicht (15) verbunden ist und mit dem anderen Ende mit der zweiten längslaufenden wasserblockierenden Schicht (25) verbunden ist; und

Bedecken, mit einem gleichen Material wie eine erste radiale wasserblockierende Schicht (16) des Unterwasserkabelabschnitts (1) und eine zweite radiale wasserblockierende Schicht (26) des Landungskabelabschnitts (2), der längslaufenden wasserblockierenden Rückgewinnungsschicht (35), um eine radiale wasserblockierende Rückgewinnungsschicht (36) zu bilden, und Machen, dass die radiale wasser-

blockierende Rückgewinnungsschicht (36) mit einem Ende mit der ersten radialen wasserblockierenden Schicht (16) verbunden ist und mit dem anderen Ende mit der zweiten radialen wasserblockierenden Schicht (26) verbunden ist.

12. Verfahren zur Herstellung des Unterwasserkabels nach Anspruch 11, wobei nach einem Schritt des Bildens der radialen wasserblockierenden Rückgewinnungsschicht (36) das Verfahren zur Herstellung des Unterwasserkabels ferner umfasst:

wenn ein Material einer ersten nicht-metallischen Mantelschicht (17) des Unterwasserkabelabschnitts (1) dasselbe ist wie das einer zweiten nicht-metallischen Mantelschicht (27) des Landungskabelabschnitts (2), Bedecken, mit einem nicht-metallischen Mantelmaterial, das dasselbe ist wie das der ersten nicht-metallischen Mantelschicht (17) und der zweiten nicht-metallischen Mantelschicht (27), der radialen wasserblockierenden Rückgewinnungsschicht (36), und Erwärmen des nicht-metallischen Mantelmaterials, um eine nicht-metallische Mantelrückgewinnungsschicht (37) mit der nicht-metallischen Mantelrückgewinnungsschicht (37) zu bilden, wobei die erste nicht-metallische Mantelschicht (17) und die zweite nicht-metallische Mantelschicht (27) integriert sind; und
wenn sich das Material der ersten nicht-metallischen Mantelschicht (17) des Unterwasserkabelabschnitts (1) von dem der zweiten nicht-metallischen Mantelschicht (27) des Landungskabelabschnitts (2) unterscheidet, Bedecken, mit einem nicht-metallischen Mantelmaterial, das dasselbe ist wie das der ersten nicht-metallischen Mantelschicht (17) oder der zweiten nicht-metallischen Mantelschicht (27), der radialen wasserblockierenden Rückgewinnungsschicht (36), und Erwärmen des nicht-metallischen Mantelmaterials, um eine nicht-metallische Mantelrückgewinnungsschicht (37) mit der nicht-metallischen Mantelrückgewinnungsschicht (37) zu bilden, wobei die erste nicht-metallische Mantelschicht (17) und die zweite nicht-metallische Mantelschicht (27) integriert sind.

13. Verfahren zur Herstellung des Unterwasserkabels nach Anspruch 12, wobei nach einem Schritt, bei dem sich das Material der ersten nicht-metallischen Mantelschicht (17) des Unterwasserkabelabschnitts (1) von dem der zweiten nicht-metallischen Mantelschicht (27) des Landungskabelabschnitts (2) unterscheidet, Bedecken, durch Strangpressen mit dem nicht-metallischen Mantelmaterial, das dasselbe ist

wie das der ersten nicht-metallischen Mantelschicht (17) oder der zweiten nicht-metallischen Mantelschicht (27), der radialen wasserblockierenden Rückgewinnungsschicht (36), und Erwärmen des nicht-metallischen Mantelmaterials, um die nicht-metallische Mantelrückgewinnungsschicht (37) zu bilden, wobei das Verfahren zur Herstellung des Unterwasserkabels ferner umfasst:

wenn das nicht-metallische Mantelmaterial dasselbe ist wie das Material der ersten nicht-metallischen Mantelschicht (17), Wickeln eines vernetzten Polyethylenbandes an einer Verbindungsstelle zwischen der nicht-metallischen Mantelrückgewinnungsschicht (37) und der zweiten nicht-metallischen Mantelschicht (27), und Erwärmen des vernetzten Polyethylenbandes, um das vernetzte Polyethylenband, die nicht-metallische Mantelrückgewinnungsschicht (37) und die zweite nicht-metallische Mantelschicht (27) zu integrieren; und
wenn das nicht-metallische Mantelmaterial dasselbe ist wie das Material der zweiten nicht-metallischen Mantelschicht (27), Wickeln eines vernetzten Polyethylenbandes an einer Verbindungsstelle zwischen der nicht-metallischen Mantelrückgewinnungsschicht (37) und der ersten nicht-metallischen Mantelschicht (17), und Erwärmen des vernetzten Polyethylenbandes, um das vernetzte Polyethylenband, die nicht-metallische Mantelrückgewinnungsschicht (37) und die erste nicht-metallische Mantelschicht (17) zu integrieren;
wobei optional nach einem Schritt des Bildens der nicht-metallischen Mantelrückgewinnungsschicht (37), das Verfahren zur Herstellung des Unterwasserkabels ferner umfasst:

Anordnen, durch Verwenden eines Panzerungswerkzeugs, einer Panzerungsschicht (5) außerhalb der nicht-metallischen Mantelrückgewinnungsschicht (37), der ersten nicht-metallischen Mantelschicht (17) und der zweiten nicht-metallischen Mantelschicht (27);
wobei das Panzerungswerkzeug einen Hydraulikzylinder (7), einen Drucksensor (8), eine innere Formschicht (9) und eine äußere Formschicht (10) umfasst, wobei die innere Formschicht (9) innerhalb der äußeren Formschicht (10) angeordnet ist, wobei der Hydraulikzylinder (7) mit der inneren Formschicht (9) verbunden ist, um ein Anziehen oder Lösen der inneren Formschicht (9) zu steuern, und der Drucksensor (8) in Signalverbindung mit jeweils der inneren Formschicht (9) und dem Hydraulikzylinder (7) steht, um eine Bewegung des

Hydraulikzylinders (7) entsprechend einem Druck auf die innere Formschicht (9) zu steuern.

Revendications

1. Câble sous-marin, comprenant :

une section de câble sous-marin (1) qui comprend un premier conducteur (11), dans lequel le premier conducteur (11) comprend n premières couches de monofilament (111) agencées séquentiellement de l'intérieur vers l'extérieur dans une direction radiale du câble sous-marin ; et

une section de câble d'atterrissage (2) qui comprend un second conducteur (21), dans lequel le second conducteur (21) comprend m secondes couches de monofilament (210) agencées séquentiellement de l'intérieur vers l'extérieur dans la direction radiale du câble sous-marin, et les m secondes couches de monofilament (210) sont séquentiellement divisées de l'intérieur vers l'extérieur dans la direction radiale du câble sous-marin en n secondes couches de monofilament de soudage (211) et h secondes couches de monofilament d'enroulement (212), dans lequel m et n sont tous deux des nombres entiers positifs, et $m \geq n$, $h = m - n$, $h \geq 2$;

dans lequel les n premières couches de monofilament (111), de l'intérieur vers l'extérieur dans la direction radiale du câble sous-marin, sont soudées aux n secondes couches de monofilament de soudage (211) selon une correspondance biunivoque ;

dans lequel les h secondes couches de monofilament d'enroulement (212) sont, séquentiellement de l'intérieur vers l'extérieur dans la direction radiale du câble sous-marin, enroulées à l'extérieur d'une couche la plus externe des n premières couches de monofilament (111) ; et

pour deux quelconques secondes couches de monofilament d'enroulement (212) adjacentes, une partie d'enroulement d'une seconde couche de monofilament d'enroulement (212) située à l'extérieur recouvre une partie d'enroulement d'une seconde couche de monofilament d'enroulement (212) située à l'intérieur ; dans lequel la partie d'enroulement fait référence à une portion de chacune des secondes couches de monofilament d'enroulement (212) enroulées à l'extérieur de la couche la plus externe des premières couches de monofilament (111) ; et

dans lequel une zone dans laquelle les n premières couches de monofilament (111) sont

reliées aux m secondes couches de monofilament (210) forme une zone de soudage de conducteur (31) d'un joint (3) ;

dans lequel une différence entre un pas d'enroulement de la partie d'enroulement de chacune des secondes couches de monofilament d'enroulement (212) et un pas de toronnage d'une partie de toronnage de chacune des secondes couches de monofilament d'enroulement (212) est inférieure à une différence prédéfinie ; et

dans lequel la partie de toronnage fait référence à une portion de chacune des secondes couches de monofilament d'enroulement (212) toronnées à l'extérieur d'une couche la plus externe des secondes couches de monofilament de soudage (211), et la différence prédéfinie représente 10 % du pas de toronnage de la partie de toronnage de chacune des secondes couches de monofilament d'enroulement.

2. Câble sous-marin selon la revendication 1, dans lequel pour deux quelconques secondes couches de monofilament de soudage (211) adjacentes, une seconde couche de monofilament de soudage (211) située à l'extérieur recouvre une zone de soudage secondaire (311) entre une seconde couche de monofilament de soudage (211) située à l'intérieur et une première couche de monofilament (111) correspondante ;

dans lequel une couche la plus interne des secondes couches de monofilament d'enroulement (212) recouvre une zone de soudage secondaire (311) entre la couche la plus externe des premières couches de monofilament (111) et la couche la plus externe des secondes couches de monofilament de soudage (211) ; et

dans lequel la zone de soudage secondaire (311) est une zone dans laquelle les premières couches de monofilament (111) sont soudées aux secondes couches de monofilament (210).

3. Câble sous-marin selon la revendication 2, dans lequel la section de câble sous-marin (1) comprend en outre une première couche de blindage de conducteur (12), et la première couche de blindage de conducteur (12) recouvre une partie du premier conducteur (11) ;

dans lequel la section de câble d'atterrissage (2) comprend en outre une seconde couche de blindage de conducteur (22), et la seconde couche de blindage de conducteur (22) recouvre une partie du second conducteur (21) ; et

dans lequel le joint (3) comprend en outre une couche de récupération de blindage de conducteur (32), la couche de récupération de blindage

- de conducteur (32) recouvre une partie du premier conducteur (11), une partie du second conducteur (21) et la zone de soudage de conducteur (31), et la couche de récupération de blindage de conducteur (32) a une extrémité 5 reliée à la première couche de blindage de conducteur (12) et l'autre extrémité reliée à la seconde couche de blindage de conducteur (22).
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4. Câble sous-marin selon la revendication 3, dans lequel la section de câble sous-marin (1) comprend en outre une première couche isolante (13), et la première couche isolante (13) recouvre la première couche de blindage de conducteur (12) ; 15
- dans lequel la section de câble d'atterrissage (2) comprend en outre une seconde couche isolante (23), et la seconde couche isolante (23) recouvre la seconde couche de blindage de conducteur (22) ; et 20
- dans lequel le joint (3) comprend en outre une couche de récupération isolante (33), la couche de récupération isolante (33) recouvre la couche de récupération de blindage de conducteur (32), et la couche de récupération isolante (33) a 25 une extrémité reliée à la première couche isolante (13) et l'autre extrémité reliée à la seconde couche isolante (23).
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5. Câble sous-marin selon la revendication 4, dans lequel la section de câble sous-marin (1) comprend en outre une première couche de blindage d'isolation (14), et la première couche de blindage d'isolation (14) recouvre la première couche isolante (13) ; 35
- dans lequel la section de câble d'atterrissage (2) comprend en outre une seconde couche de blindage d'isolation (24), et la seconde couche de blindage d'isolation (24) recouvre la seconde couche isolante (23) ; et 40
- dans lequel le joint (3) comprend en outre une couche de récupération de blindage d'isolation (34), la couche de récupération de blindage d'isolation (34) recouvre la couche de récupération isolante (33), et la couche de récupération de blindage d'isolation (34) a une extrémité 45 reliée à la première couche de blindage d'isolation (14) et l'autre extrémité reliée à la seconde couche de blindage d'isolation (24).
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6. Câble sous-marin selon la revendication 5, dans lequel la section de câble sous-marin (1) comprend en outre une première couche de blocage d'eau longitudinale (15), et la première couche de blocage d'eau longitudinale (15) recouvre une partie de la première couche de blindage d'isolation (14) ; 55

dans lequel la section de câble d'atterrissage (2) comprend en outre une seconde couche de blocage d'eau longitudinale (25), et la seconde couche de blocage d'eau longitudinale (25) recouvre une partie de la seconde couche de blindage d'isolation (24) ; et

dans lequel le joint (3) comprend en outre une couche de récupération de blocage d'eau longitudinale (35), la couche de récupération de blocage d'eau longitudinale (35) recouvre une partie de la première couche de blindage d'isolation (14), une partie de la seconde couche de blindage d'isolation (24), et la couche de récupération de blindage d'isolation (34), et la couche de récupération du blocage d'eau longitudinale (35) a une extrémité reliée à la première couche de blocage d'eau longitudinale (15) et l'autre extrémité reliée à la seconde couche de blocage d'eau longitudinale (25) ;

facultativement, la section de câble sous-marin (1) comprend en outre une première couche de blocage d'eau radiale (16), et la première couche de blocage d'eau radiale (16) recouvre une partie de la première couche de blocage d'eau longitudinale (15) ;

dans lequel la section de câble d'atterrissage (2) comprend en outre une seconde couche de blocage d'eau radiale (26), et la seconde couche de blocage d'eau radiale (26) recouvre une partie de la seconde couche de blocage d'eau longitudinale (25) ; et

dans lequel, le joint (3) comprend en outre une couche de récupération de blocage d'eau radiale (36), la couche de récupération de blocage d'eau radiale (36) recouvre une partie de la première couche de blocage d'eau longitudinale (15), une partie de la seconde couche de blocage d'eau longitudinale (25), et la couche de récupération de blocage d'eau longitudinale (35), et la couche de récupération de blocage d'eau radiale (36) a une extrémité reliée à la première couche de blocage d'eau radiale (16) et l'autre extrémité reliée à la seconde couche de blocage d'eau radiale (26) ;

facultativement, la section de câble sous-marin (1) comprend en outre une première couche de gaine non métallique (17), et la première couche de gaine non métallique (17) recouvre une partie de la première couche de blocage d'eau radiale (16) ;

dans lequel la section de câble d'atterrissage (2) comprend en outre une seconde couche de gaine non métallique (27), et la seconde couche de gaine non métallique (27) recouvre une partie de la seconde couche de blocage d'eau radiale (26) ; et

dans lequel le joint (3) comprend en outre une couche de récupération de gaine non métallique

(37), et la couche de récupération de gaine non métallique (37) recouvre une partie de la première couche de blocage d'eau radiale (16), une partie de la seconde couche de blocage d'eau radiale (26), et la couche de récupération de blocage d'eau radiale (36), et la couche de récupération de gaine non métallique (37) a une extrémité reliée à la première couche de gaine non métallique (17) et l'autre extrémité reliée à la seconde couche de gaine non métallique (27) ; et
 facultativement, le câble sous-marin comprend en outre une couche de coussin interne d'armure (4), une couche d'armure (5) et une couche de revêtement externe d'armure (6), et la couche de coussin interne d'armure (4) recouvre la première couche de gaine non métallique (17), la seconde couche de gaine non métallique (27) et la couche de récupération de gaine non métallique (37) ; et
 dans lequel la couche d'armure (5) recouvre la couche de coussin interne d'armure (4), et la couche de revêtement externe d'armure (6) recouvre la couche d'armure (5).

7. Procédé de fabrication d'un câble sous-marin, comprenant :

la fourniture d'une section de câble sous-marin (1) et d'une section de câble d'atterrissage (2), dans lequel la section de câble sous-marin (1) comprend un premier conducteur (11), et le premier conducteur (11) comprend n premières couches de monofilament (111) agencées de l'intérieur vers l'extérieur dans une direction radiale du câble sous-marin ; et la section de câble d'atterrissage (2) comprend un second conducteur (21), le second conducteur (21) comprend m secondes couches de monofilament (210) agencées séquentiellement de l'intérieur vers l'extérieur dans la direction radiale du câble sous-marin, et les m secondes couches de monofilament (210) sont séquentiellement divisées de l'intérieur vers l'extérieur dans la direction radiale du câble sous-marin en n secondes couches de monofilament de soudage (211) et h secondes couches de monofilament d'enroulement (212),
 dans lequel m et n sont tous deux des nombres entiers positifs, et $m \geq n$, $h = m - n$, $h \geq 2$;
 le soudage, séquentiellement de l'intérieur vers l'extérieur dans la direction radiale du câble sous-marin, des n premières couches de monofilament (111) aux n secondes couches de monofilament de soudage (211) selon une correspondance biunivoque ; et
 l'enroulement, séquentiellement de l'intérieur vers l'extérieur dans la direction radiale du câble

sous-marin, des h secondes couches de monofilament d'enroulement (212) à l'extérieur d'une couche la plus externe des n premières couches de monofilament (111), dans lequel pour deux quelconques secondes couches de monofilament d'enroulement (212) adjacentes, une partie d'enroulement d'une seconde couche de monofilament d'enroulement (212) située à l'extérieur recouvre une partie d'enroulement d'une seconde couche de monofilament d'enroulement (212) située à l'intérieur ; dans lequel la partie d'enroulement fait référence à une portion de chacune des secondes couches de monofilament d'enroulement (212) enroulées à l'extérieur de la couche la plus externe des premières couches de monofilament (111) ; de sorte qu'une zone dans laquelle les n premières couches de monofilament (111) sont reliées aux m secondes couches de monofilament (210) forme une zone de soudage de conducteur (31) d'un joint (3) ;
 dans lequel, lors d'une étape d'enroulement, séquentiellement de l'intérieur vers l'extérieur, des h secondes couches de monofilament d'enroulement (212) à l'extérieur de la couche la plus externe des n premières couches de monofilament (111), une différence entre un pas d'enroulement de la partie d'enroulement de chacune des secondes couches de monofilament d'enroulement (212) et un pas de toronnage d'une partie de toronnage de chacune des secondes couches de monofilament d'enroulement (212) est inférieure à une différence prédéfinie ; et
 dans lequel la partie de toronnage fait référence à une portion de chacune des secondes couches de monofilament d'enroulement (212) toronnées à l'extérieur d'une couche la plus externe des secondes couches de monofilament de soudage (211), et la différence prédéfinie représente 10 % du pas de toronnage de la partie de toronnage de chacune des secondes couches de monofilament d'enroulement.

8. Procédé de fabrication du câble sous-marin selon la revendication 7, dans lequel une étape de soudage des n premières couches de monofilament (111) aux n secondes couches de monofilament de soudage (211) selon une correspondance biunivoque comprend en outre :

le recouvrement, par une seconde couche de monofilament de soudage (211) située à l'extérieur, d'une zone de soudage secondaire (311) entre une seconde couche de monofilament de soudage (211) située à l'intérieur et une première couche de monofilament (111) correspondante, dans lequel la zone de soudage secondaire (311) est une zone dans laquelle les pre-

mières couches de monofilament (111) sont soudées aux secondes couches de monofilament (210) ; et

dans lequel, lors de l'étape d'enroulement, séquentiellement de l'intérieur vers l'extérieur dans la direction radiale du câble sous-marin, des h secondes couches de monofilament d'enroulement (212) à l'extérieur de la couche la plus externe des n premières couches de monofilament (111), une couche la plus interne des secondes couches de monofilament d'enroulement (212) recouvre une zone de soudage secondaire (311) entre la couche la plus externe des premières couches de monofilament (111) et la couche la plus externe des secondes couches de monofilament de soudage (211) ; facultativement, l'étape d'enroulement, séquentiellement de l'intérieur vers l'extérieur dans la direction radiale du câble sous-marin, des h secondes couches de monofilament d'enroulement (212) à l'extérieur de la couche la plus externe des n premières couches de monofilament (111) comprend en outre :

le soudage d'une extrémité d'enroulement de la partie d'enroulement de chacune des secondes couches de monofilament d'enroulement (212) à la couche la plus externe des premières couches de monofilament (111), et la réalisation d'une opération de polissage sur une zone de soudage entre l'extrémité d'enroulement et la couche la plus externe des premières couches de monofilament (111), de sorte qu'une liaison entre l'extrémité d'enroulement et la couche la plus externe des premières couches de monofilament (111) soit ferme et lisse.

9. Procédé de fabrication du câble sous-marin selon la revendication 8, dans lequel après une étape de formation de la zone de soudage de conducteur (31), le procédé de fabrication du câble sous-marin comprend en outre :

le recouvrement, par enroulement ou moulage par extrusion avec un même matériau qu'une couche de blindage de conducteur, de la zone de soudage de conducteur (31) et d'une portion exposée du premier conducteur (11) et d'une portion exposée du second conducteur (21) pour former une couche de récupération de blindage de conducteur (32), et le fait d'amener la couche de récupération de blindage de conducteur (32) à avoir une extrémité reliée à une première couche de blindage de conducteur (12) de la section de câble sous-marin (1) et l'autre extrémité reliée à une seconde couche de blindage de conducteur (22) de la section de câble d'atterrissage (2).

10. Procédé de fabrication du câble sous-marin selon la revendication 9, dans lequel après une étape de

formation de la couche de recouvrement de blindage de conducteur (32), le procédé de fabrication du câble sous-marin comprend en outre :

la découpe d'une première couche isolante (13) de la section de câble sous-marin (1) pour obtenir une surface de cône avec un angle de cône non supérieur à 60° , et la découpe d'une seconde couche isolante (23) de la section de câble d'atterrissage (2) pour obtenir une surface de cône avec un angle de cône non supérieur à 60° ; et

le recouvrement, par moulage par extrusion avec un même matériau que la première couche isolante (13) et la seconde couche isolante (23), de la couche de recouvrement de blindage de conducteur (32) pour former une couche de recouvrement isolante (33), et le fait d'amener la couche de recouvrement isolante (33) à avoir une extrémité reliée à la première couche isolante (13) et l'autre extrémité reliée à la seconde couche isolante (23).

11. Procédé de fabrication du câble sous-marin selon la revendication 10, dans lequel après une étape de formation de la couche de recouvrement isolante (33), le procédé de fabrication du câble sous-marin comprend en outre :

le recouvrement, avec un même matériau qu'une première couche de blindage d'isolation (14) de la section de câble sous-marin (1) et qu'une seconde couche de blindage d'isolation (24) de la section de câble d'atterrissage (2), de la couche de recouvrement isolante (33) pour former une couche de recouvrement de blindage d'isolation (34), et le fait d'amener la couche de recouvrement de blindage d'isolation (34) à avoir une extrémité reliée à la première couche de blindage d'isolation (14) et l'autre extrémité reliée à la seconde couche de blindage d'isolation (24) ;

le recouvrement, avec un même matériau qu'une première couche de blocage d'eau longitudinale (15) de la section de câble sous-marin (1) et qu'une seconde couche de blocage d'eau longitudinale (25) de la section de câble d'atterrissage (2), de la couche de récupération de blindage d'isolation (34) pour former une couche de récupération de blocage d'eau longitudinale (35), et le fait d'amener la couche de récupération de blocage d'eau longitudinale (35) à avoir une extrémité reliée à la première couche de blocage d'eau longitudinale (15) et l'autre extrémité reliée à la seconde couche de blocage d'eau longitudinale (25) ; et

le recouvrement, avec un même matériau qu'une première couche de blocage d'eau ra-

diale (16) de la section de câble sous-marin (1) et qu'une seconde couche de blocage d'eau radiale (26) de la section de câble d'atterrissage (2), de la couche de récupération de blocage d'eau longitudinale (35) pour former une couche de récupération de blocage d'eau radiale (36), et le fait d'amener la couche de récupération de blocage d'eau radiale (36) à avoir une extrémité reliée à la première couche de blocage d'eau radiale (16) et l'autre extrémité reliée à la seconde couche de blocage d'eau radiale (26).

12. Procédé de fabrication du câble sous-marin selon la revendication 11, dans lequel après une étape de formation de la couche de récupération de blocage d'eau radiale (36), le procédé de fabrication du câble sous-marin comprend en outre :

lorsqu'un matériau d'une première couche de gaine non métallique (17) de la section de câble sous-marin (1) est le même que celui d'une seconde couche de gaine non métallique (27) de la section de câble d'atterrissage (2), le recouvrement, avec un même matériau de gaine non métallique que celui de la première couche de gaine non métallique (17) et celui de la seconde couche de gaine non métallique (27), de la couche de récupération de blocage d'eau radiale (36), et le chauffage du matériau de gaine non métallique, pour former une couche de récupération de gaine non métallique (37) avec la couche de récupération de gaine non métallique (37), la première couche de gaine non métallique (17) et la seconde couche de gaine non métallique (27) intégrées ; et lorsque le matériau de la première couche de gaine non métallique (17) de la section de câble sous-marin (1) est différent de celui de la seconde couche de gaine non métallique (27) de la section de câble d'atterrissage (2), le recouvrement, avec un même matériau de gaine non métallique que celui de la première couche de gaine non métallique (17) ou celui de la seconde couche de gaine non métallique (27), de la couche de récupération de blocage d'eau radiale (36), et le chauffage du matériau de gaine non métallique, pour former une couche de récupération de gaine non métallique (37) avec la couche de récupération de gaine non métallique (37), la première couche de gaine non métallique (17) et la seconde couche de gaine non métallique (27) intégrées.

13. Procédé de fabrication du câble sous-marin selon la revendication 12, dans lequel après une étape, où le matériau de la première couche de gaine non métallique (17) de la section de câble sous-marin (1) est différent de celui de la seconde couche de gaine non

métallique (27) de la section de câble d'atterrissage (2), de recouvrement, par moulage par extrusion avec le même matériau de gaine non métallique que celui de la première couche de gaine non métallique (17) ou celui de la seconde couche de gaine non métallique (27), de la couche de récupération de blocage d'eau radiale (36), et de chauffage du matériau de gaine non métallique, pour former la couche de récupération de gaine non métallique (37), le procédé de fabrication du câble sous-marin comprend en outre :

lorsque le matériau de gaine non métallique est le même que le matériau de la première couche de gaine non métallique (17), l'enroulement d'un ruban de polyéthylène réticulé à une jonction entre la couche de récupération de gaine non métallique (37) et la seconde couche de gaine non métallique (27), et le chauffage du ruban de polyéthylène réticulé pour intégrer le ruban de polyéthylène réticulé, la couche de récupération de gaine non métallique (37) et la seconde couche de gaine non métallique (27) ; et lorsque le matériau de gaine non métallique est le même que le matériau de la seconde couche de gaine non métallique (27), l'enroulement d'un ruban de polyéthylène réticulé à une jonction entre la couche de récupération de gaine non métallique (37) et la première couche de gaine non métallique (17), et le chauffage du ruban de polyéthylène réticulé pour intégrer le ruban de polyéthylène réticulé, la couche de récupération de gaine non métallique (37) et la première couche de gaine non métallique (17) ; facultativement, après une étape de formation de la couche de récupération de gaine non métallique (37), le procédé de fabrication du câble sous-marin comprend en outre :

l'agencement, à l'aide d'un outil d'armure, d'une couche d'armure (5) à l'extérieur de la couche de récupération de gaine non métallique (37), de la première couche de gaine non métallique (17) et de la seconde couche de gaine non métallique (27) ; dans lequel l'outil d'armure comprend un vérin hydraulique (7), un capteur de pression (8), une couche de moule interne (9), et une couche de moule externe (10), dans lequel la couche de moule interne (9) est située au sein de la couche de moule externe (10), le vérin hydraulique (7) est relié à la couche de moule interne (9) pour piloter le serrage ou le desserrage de la couche de moule interne (9), et le capteur de pression (8) est en liaison de signal avec la couche de moule interne (9) et le vérin hydraulique (7), respectivement pour piloter un mouvement

du vérin hydraulique (7) selon une pression
sur la couche de moule interne (9).

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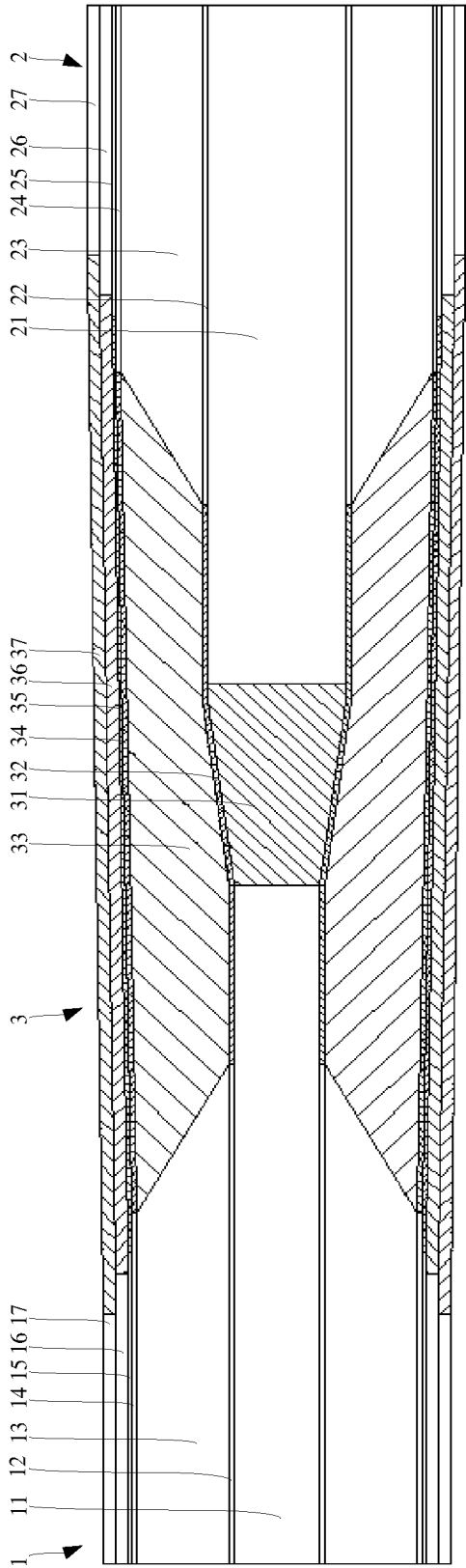


FIG. 1

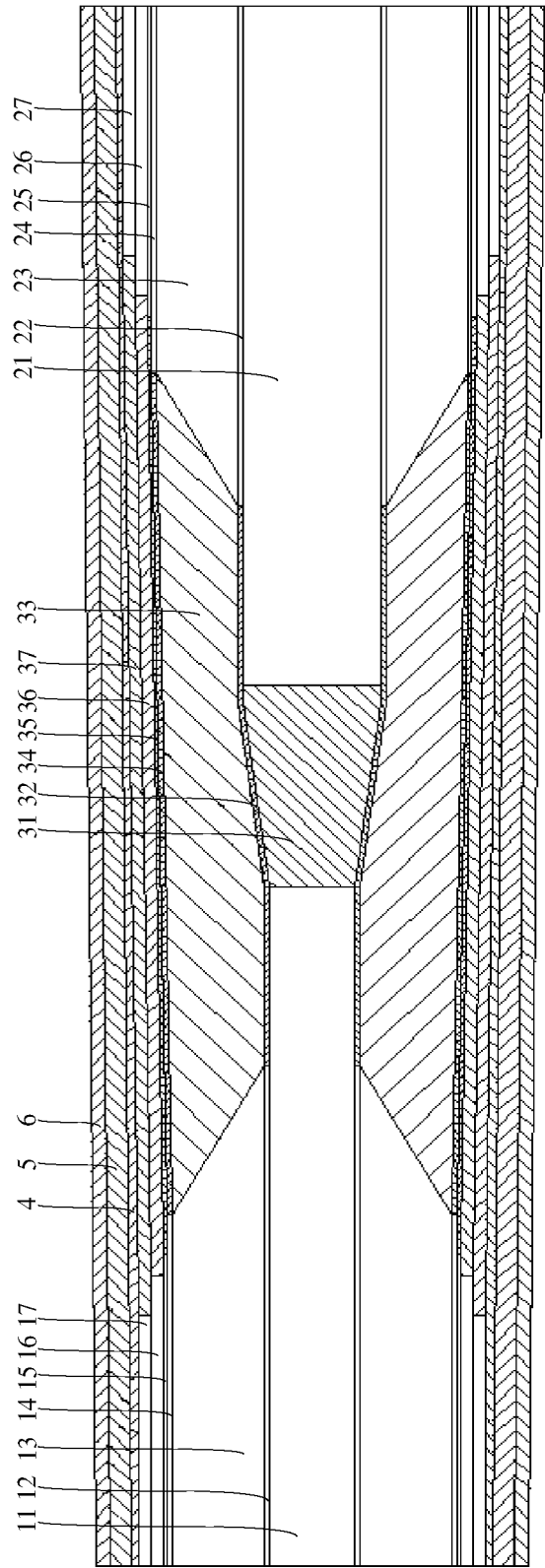


FIG. 2

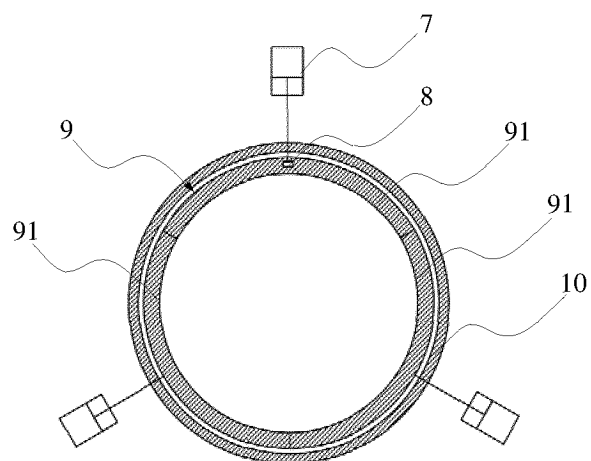


FIG. 3

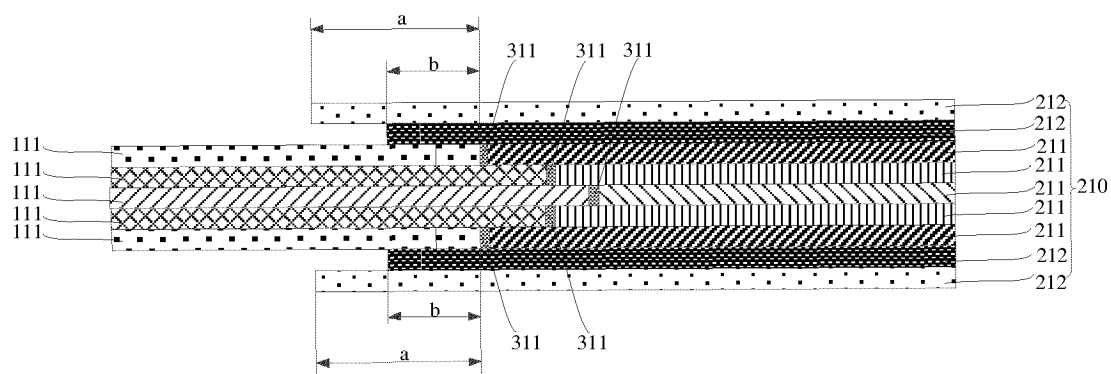


FIG. 4

REFERENCES CITED IN THE DESCRIPTION

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