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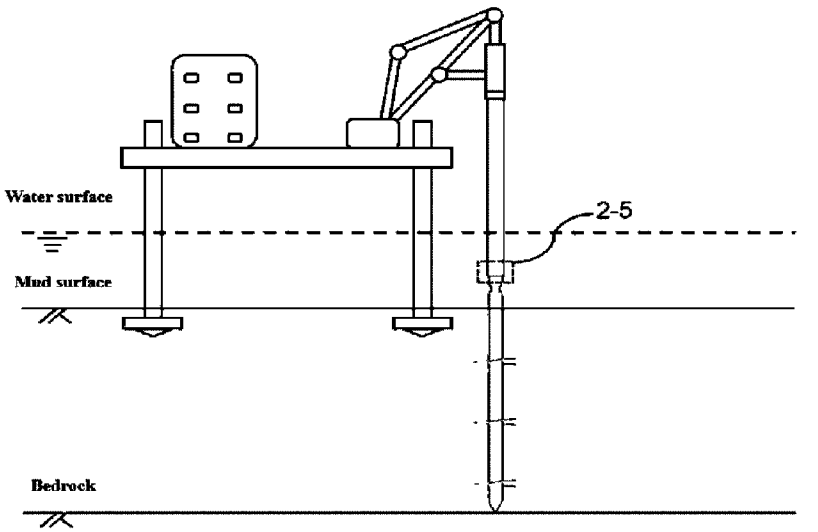
(54) **Titre : NOUVELLE FONDATION DE TURBINE EOLIENNE EN MER APPROPRIEE POUR UNE COUCHE DE REVETEMENT PEU PROFONDE ET SON PROCEDE DE CONSTRUCTION**
(54) **Title: NOVEL OFFSHORE WIND POWER FOUNDATION SUITABLE FOR SHALLOW OVERBURDEN LAYER AND CONSTRUCTION METHOD THEREOF**



(57) **Abrégé/Abstract:**
An offshore wind turbine foundation for a shallow covering layer and a construction method therefor, the offshore wind turbine foundation having a single pile. A gravity disc is fixedly mounted on the single pile. Multiple helical piles are evenly distributed on the periphery of the gravity disc. Adjacent helical piles are fixedly connected to each other to form an integral structure. The uplift-resisting bearing capacity and horizontal bearing capacity of the foundation are improved by the helical piles and the gravity disc. The horizontal displacement of the pile body and the bending moment of the pile body are reduced. The combination and rigid connection of the helical piles, gravity disc, and single pile improve various mechanical properties of the whole foundation. Thus, the construction requirement for safe and stable operation of an offshore wind turbine can be met without need to inserting the single pile into the bedrock.

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ABSTRACT

An offshore wind turbine foundation for a shallow covering layer and a construction method therefor, the offshore wind turbine foundation having a single pile. A gravity disc is fixedly mounted on the single pile. Multiple helical piles are evenly distributed on the periphery of the gravity disc. Adjacent helical piles are fixedly connected to each other to form an integral structure. The uplift-resisting bearing capacity and horizontal bearing capacity of the foundation are improved by the helical piles and the gravity disc. The horizontal displacement of the pile body and the bending moment of the pile body are reduced. The combination and rigid connection of the helical piles, gravity disc, and single pile improve various mechanical properties of the whole foundation. Thus, the construction requirement for safe and stable operation of an offshore wind turbine can be met without need to inserting the single pile into the bedrock.

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NOVEL OFFSHORE WIND POWER FOUNDATION SUITABLE FOR SHALLOW OVERBURDEN LAYER AND CONSTRUCTION METHOD THEREOF

TECHNICAL FIELD

[0001] The present invention relates to the technical field of offshore wind power, in particular to a novel offshore wind power foundation suitable for a shallow overburden layer and a construction method thereof.

BACKGROUND

[0002] Offshore wind turbine generator systems bear the coupling effect of wind, waves, currents and other environmental loads in the whole life cycle, and offshore wind power foundations are required to have good composite bearing performance, including a horizontal bearing capacity, a bending moment bearing capacity, a vertical bearing capacity and an uplift bearing capacity. At present, the cost of offshore wind power foundation construction in deep water sea areas accounts for about 30% of the total cost of offshore wind power farm construction. With the change of the national new energy subsidy policy, the subsidy for the on-grid power tariff of offshore wind power will be canceled by the end of 2021. Therefore, cost reduction and efficiency increase have become the top priority of the development of the offshore wind power industry, and a novel offshore wind power foundation needs to be developed urgently.

[0003] The geological conditions of various sea areas in China are quite different. For example, overburden layers in the sea areas of Guangdong and Fujian are relatively shallow. In order to meet the ever-increasing capacity of fan units, the bearing capacity of the offshore wind power foundations is also required to increase, resulting in a corresponding increase in the pile diameter of the foundations, and even the need of rock-socketed construction. At present, single pile foundations accounts for more than 80% of offshore wind power construction, which is regarded as the most mature foundation form and has the advantages of simple production, short construction period, etc. However, large-scale drilling equipment is needed for drilling in single-pile rock-socketed construction. Compared with pile driving construction in overburden layers, the technical process is more complex, the technical difficulty is greater, the risk of hole collapse is high, the construction progress control is difficult greatly, and the construction cost is higher. Meanwhile, a shallow overburden layer rock-socketed pile needs to be deeply socketed in order to improve the enough ability to resist a horizontal load, and a fixed end of a single pile is deeper, the single pile bears a larger bending moment, and the required strength of the single pile is higher. In addition, for shallow overburden layer sea areas, a gravity-based shallow foundation is widely used, has the characteristics of good economy and wide application range, has a very excellent vertical ultimate bearing capacity, and is a foundation form with good application prospects. However, compared with its vertical bearing performance, its anti-overturning capacity, anti-slipping capacity, especially

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anti-uplift capacity, are weak, and there is a certain degree of engineering risk in applying it to offshore wind power foundations.

[0004] Based on the shortcomings of existing offshore wind power foundations, it is urgent to propose a novel offshore wind power foundation, which can be suitable for a shallow overburden layer. Through the novel foundation, a single pile does not need to be deeply socketed in bedrock, and on the basis of meeting a vertical bearing capacity, the horizontal and bending moment bearing capacities can be better met, the difficulty and cost of construction are reduced, the construction speed is increased, and meanwhile, a certain anti-erosion ability is provided, and the safe and stable operation of a fan is ensured.

SUMMARY

[0005] Aiming at solving the problem of insufficient forms of current offshore wind power foundations for a shallow overburden layer and solving the difficult problems of high construction difficulty, high cost, and long construction period, etc. in rock-socketed construction of a single pile foundation, the present invention provides a novel offshore wind power foundation suitable for a shallow overburden layer and a construction method thereof. In the present invention, an anti-overturning ability and an anti-erosion ability of the foundation are improved mainly by adding a gravity disc and then increasing the rigidity of a soil body around a pile, and through screw piles and the gravity disc, an uplift bearing capacity and a horizontal bearing capacity of the foundation are improved, a horizontal displacement of a pile body is reduced, and a bending moment of the pile body is decreased; through splicing and rigid connection of the screw piles, the gravity disc and a single pile, various mechanical indicators of the entire foundation are improved, such that engineering needs of safe and stable operation of offshore wind power are met without a need for the single pile to be socketed in bedrock.

[0006] In order to implement the above technical features, purposes of the present invention are implemented as follows: a novel offshore wind power foundation suitable for a shallow overburden layer, the novel offshore wind power foundation includes a single pile, a gravity disc is fixedly mounted on the single pile, and a plurality of screw piles are evenly distributed and fixedly mounted on a periphery of the gravity disc; and the adjacent screw piles are fixedly connected to form an integral structure.

[0007] The single pile adopts a large-diameter steel pipe pile; a collar for fixing the gravity disc is arranged on the single pile, and a rigid connection is formed between the single pile and the gravity disc.

[0008] The gravity disc includes a gravity disc foundation, and a center ring is arranged at a center of the gravity disc foundation; the single pile passes through the center ring, and the single pile and the center ring form a contact fit; a plurality of connecting rods are evenly distributed and fixed on the gravity disc foundation centered on the center ring, the other ends of the connecting rods are

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fixedly provided with screw pile mounting seats for mounting the screw piles, and a plurality of pins are evenly distributed and arranged on inner side walls of the screw pile mounting seats.

[0009] The gravity disc foundation adopts a concrete structure or a filler structure; the concrete structure adopts a form of an on-shore integral prefabricated structure; the filler structure adopts a cemented rockfill body, and the cemented rockfill body is a cemented rockfill body and a structured cemented rockfill body with high water permeability formed by filling with a granular rockfill material by an underwater grouting technology.

[0010] Each of the screw piles includes a steel pipe pile, screw pile blades are arranged on an outer wall of the steel pipe pile in a length direction, a bottom end of the steel pipe pile is provided with a screw pile head, and a top end of the steel pipe pile is provided with screw pile pin holes for matching with the plurality of pins of the gravity disc.

[0011] A screw pile mounting and connecting part for quick disassembly and connection with pile body sinking construction equipment is arranged at a top of each of the screw piles, the screw pile mounting and connecting part includes a screw pile mounting key fixed at a top end of the steel pipe pile, and the screw pile mounting key is in fit connection with a screw pile mounting key slot at a bottom end of a transmission rod of the pile body sinking construction equipment, and is configured to transmit torque.

[0012] The screw pile blades are in an annular arc shape, and an inclination angle, number, interval and diameter of the screw pile blades are capable of being selected and used according to geological conditions and a load of a fan unit.

[0013] A structural form of the gravity disc and an array arrangement mode of the screw piles are capable of being a triangle, a square, a hexagon or a circle; the number and array arrangement mode of the screw piles are capable of being selected and adjusted for use according to different geological conditions and loads of a fan unit.

[0014] A section of the gravity disc foundation is rectangular or trapezoidal.

[0015] A construction method of the novel offshore wind power foundation suitable for the shallow overburden layer includes the following steps:

step 1: sinking all the screw piles to designed pile positions one by one by an offshore jack-up platform or an offshore wind power construction vessel, screwing the screw piles into an overburden layer by matching construction vessel connecting rods with the screw pile mounting and connecting part to be connected to top ends of the screw piles, and after a designed depth is reached, separating the screw pile mounting and connecting part by a reverse torsion connecting rod;

step 2: hoisting and sinking the gravity disc, making all the screw pile mounting seats pass through all the screw piles, and connecting the plurality of pins in the screw pile mounting seats with the screw pile pin holes in a butted mode by a self-weight or an external pressure of the gravity disc; and then, pouring hydraulic concrete into the screw pile mounting seats by underwater grouting

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equipment to realize a rigid connection between the screw piles and the gravity disc; and

step 3: hoisting and sinking the single pile and making the single pile pass through the center ring, making the single pile partially penetrate below a mud surface by a self-weight or an external pressure, then driving the single pile to a designed depth by pile sinking equipment, that is, when the collar of the single pile is in contact with the center ring of the gravity disc, then pouring hydraulic concrete into the center ring by underwater grouting equipment, and after the hydraulic concrete reaches enough strength, forming an integral load by the single pile, the screw piles and the gravity disc.

[0016] The present invention has the following beneficial effects.

1. The present invention provides a novel offshore wind power foundation suitable for a shallow overburden layer and a construction method thereof. The structure form combines a single pile, screw piles and a gravity disc, and makes full use of advantages of each component to form a novel composite foundation, which is suitable for sea areas with shallow overburden layers, so that the problem of rock-socketed construction of a single pile foundation can be avoided.

[0017] 2. The gravity disc increases the rigidity of a soil body around a pile, and improves the anti-overturning ability and anti-erosion ability of the foundation, and through the screw piles and the gravity disc, an uplift bearing capacity and a horizontal bearing capacity of the foundation are improved, a horizontal displacement of a pile body is reduced, and a bending moment of the pile body is decreased, so that the composite bearing capacity of the foundation under a long-term cyclic load and extreme working conditions is improved.

[0018] 3. In addition, the mounting and construction of the screw piles are flexible, safe and economical. The underwater grouting construction technology has been relatively mature, and can connect the single pile, the screw piles and the gravity disc.

[0019] 4. Finally, a variety of materials can be used for rockfill, and the rockfill can be connected into a rigid or flexible structure that is permeable or impermeable through materials such as gel.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] The present invention will be further described below in combination with accompanying drawings and embodiments.

[0021] FIG. 1 is a front view of a novel offshore wind power foundation suitable for a shallow overburden layer in the present invention.

[0022] FIG. 2 is a top view of the novel offshore wind power foundation in FIG. 1.

[0023] FIG. 3 is a front view of a single pile of the novel offshore wind power foundation in FIG. 1.

[0024] FIG. 4 is a top view of the single pile of the novel offshore wind power foundation in FIG. 3.

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[0025] FIG. 5 is a front view of a gravity disc of the novel offshore wind power foundation in FIG. 1.

[0026] FIG. 6 is a top view of a screw pile mounting seat of the gravity disc in FIG. 5.

[0027] FIG. 7 is a front view of a screw pile of the novel offshore wind power foundation in FIG. 1.

[0028] FIG. 8 is a schematic mounting diagram of the screw pile in FIG. 7.

[0029] FIG. 9 is a schematic diagram of a screw pile mounting and connecting part in FIG. 8.

[0030] FIG. 10 to FIG. 11 are sectional views of modified examples of the screw pile according to the embodiment of the present invention.

[0031] FIG 12 is a sectional view of a modified example of the gravity disc according to the embodiment of the present invention.

[0032] FIG. 13 to FIG. 15 are top views of modified examples of the gravity disc according to the embodiment of the present invention.

[0033] In FIGS.: Single pile 1, Screw pile 2, Gravity disc 3; Collar 1-1; Steel pipe pile 2-1, Screw pile blade 2-2, Screw pile head 2-3, Screw pile pin hole 2-4, Screw pile mounting and connecting part 2-5; Screw pile mounting key 2-5-1, Screw pile mounting key slot 2-5-2; Center ring 3-1, Connecting rod 3-2, Screw pile mounting seat 3-3, Gravity disc foundation 3-4, Pin 3-5.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0034] The implementations of the present invention will be further described below in combination with accompanying drawings.

[0035] Embodiment 1:

Referring to FIGS. 1 to 15, a novel offshore wind power foundation suitable for a shallow overburden layer includes a single pile 1, a gravity disc 3 is fixedly mounted on the single pile 1, and a plurality of screw piles 2 are evenly distributed and fixedly mounted on a periphery of the gravity disc 3; and the adjacent screw piles 2 are fixedly connected to form an integral structure. By using the foundation of the above structure, the screw piles, the gravity disc and the single pile are spliced and rigidly connected, so that various mechanical indicators of the entire foundation are improved. So engineering needs of safe and stable operation of offshore wind power are met without a need for the single pile to be socketed in bedrock.

[0036] Further, the single pile 1 adopts a large-diameter steel pipe pile; a collar 1-1 for fixing the gravity disc 3 is arranged on the single pile 1, and a rigid connection is formed between the single pile 1 and the gravity disc 3. The above collar 1-1 ensures that the single pile 1 can be reliably connected to the gravity disc 3.

[0037] Further, the gravity disc 3 includes a gravity disc foundation 3-4, and a center ring 3-1 is arranged at a center of the gravity disc foundation 3-4; the single pile 1 passes through the center

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ring 3-1, and the single pile 1 and the center ring 3-1 form a contact fit; a plurality of connecting rods 3-2 are evenly distributed and fixed on the gravity disc foundation 3-4 centered on the center ring 3-1, the other ends of the connecting rods 3-2 are fixedly provided with screw pile mounting seats 3-3 for mounting the screw piles 2, and a plurality of pins 3-5 are evenly distributed and arranged on inner side walls of the screw pile mounting seats 3-3. Though the above gravity disc 3, an anti-overturning ability of the single pile 1 is effectively enhanced, and a bearing capacity thereof is enhanced.

[0038] Further, the gravity disc foundation 3-4 adopts a concrete structure or a filler structure; the concrete structure adopts a form of an on-shore integral prefabricated structure; the filler structure adopts a cemented rockfill body, and the cemented rockfill body is a cemented rockfill body and a structured cemented rockfill body with high water permeability formed by filling with a granular rockfill material by an underwater grouting technology. By adopting the above various different structural forms, adaptability thereof is enhanced.

[0039] Further, each of the screw piles 2 includes a steel pipe pile 2-1, screw pile blades 2-2 are arranged on an outer wall of the steel pipe pile 2-1 in a length direction, a bottom end of the steel pipe pile 2-1 is provided with a screw pile head 2-3, and a top end of the steel pipe pile 2-1 is provided with screw pile pin holes 2-4 for matching with the plurality of pins 3-5 of the gravity disc 3. The above screw piles 2 drill below the overburden layer, thereby improving the bearing capacity of the gravity disc 3.

[0040] Further, a screw pile mounting and connecting part 2-5 for quick disassembly and connection with pile body sinking construction equipment is arranged at a top of each of the screw piles 2, the screw pile mounting and connecting part 2-5 includes a screw pile mounting key 2-5-1 fixed at a top end of the steel pipe pile 2-1, and the screw pile mounting key 2-5-1 is in fit connection with a screw pile mounting key slot 2-5-2 at a bottom end of a transmission rod of the pile body sinking construction equipment, and is configured to transmit torque. The above screw pile mounting and connecting part 2-5 ensures that the screw piles 2 can be quickly connected with the construction equipment during construction, and then transmits the torque.

[0041] Further, the screw pile blades 2-2 are in an annular arc shape, and an inclination angle, number, interval and diameter of the screw pile blades are capable of being selected and used according to geological conditions and a load of a fan unit. The above structure ensures that the screw pile blades can drill smoothly.

[0042] Further, a structural form of the gravity disc 3 and an array arrangement mode of the screw piles 2 are capable of being a triangle, a square, a hexagon or a circle; the number and array arrangement mode of the screw piles 2 are capable of being selected and adjusted for use according to different geological conditions and loads of a fan unit.

[0043] Further, a section of the gravity disc foundation 3-4 is rectangular or trapezoidal.

[0044] Embodiment 2:

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A construction method of a novel offshore wind power foundation suitable for a shallow overburden layer includes the following steps:

step 1: sinking all the screw piles 2 to designed pile positions one by one by an offshore jack-up platform or an offshore wind power construction vessel, screwing the screw piles 2 into an overburden layer by matching construction vessel connecting rods with the screw pile mounting and connecting part 2-5 to be connected to top ends of the screw piles 2, and after a designed depth is reached, separating the screw pile mounting and connecting part 2-5 by a reverse torsion connecting rod;

step 2: hoisting and sinking the gravity disc 3, making all the screw pile mounting seats 3-3 pass through all the screw piles 2, and connecting the plurality of pins 3-5 in the screw pile mounting seats 3-3 with the screw pile pin holes 2-4 in a butted mode by a self-weight or an external pressure of the gravity disc 3; and then, pouring hydraulic concrete into the screw pile mounting seats 3-3 by underwater grouting equipment to realize a rigid connection between the screw piles 2 and the gravity disc 3; and

step 3: hoisting and sinking the single pile 1 and making the single pile 1 pass through the center ring 3-1, making the single pile 1 partially penetrate below a mud surface by a self-weight or an external pressure, then driving the single pile 1 to a designed depth by pile sinking equipment, that is, when the collar 1-1 of the single pile is in contact with the center ring of the gravity disc, then pouring hydraulic concrete into the center ring 3-1 by underwater grouting equipment, and after the hydraulic concrete reaches enough strength, forming an integral load by the single pile, the screw piles and the gravity disc.

[0045] In the present invention, a plurality of screw piles with different lengths and different blade numbers form a combination by connecting rods and a center single pile foundation, and a center single pile is driven into a foundation, and the center single pile and a central cylinder are connected by grouting to form a whole; the connecting rods and the single pile foundation are anchored through grouting; and finally rockfill and a gel medium are added in a connecting groove to form a whole with the center single pile and the screw piles. Through implementation, it can be seen that a greater water depth can be adapted, but also the problem of high rock-socketed cost of the single pile foundation is avoided, and the larger anti-overturning and anti-uplift bearing capacities can be increased through the screw piles with different lengths and different blades. In addition, gel rockfill in the connecting groove is both water permeable and erosion proofing. Meanwhile, the present invention also has the advantages of low investment cost and high construction speed.

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Claims

1. A construction method of the novel offshore wind power foundation suitable for the shallow overburden layer, the novel offshore wind power foundation comprises a single pile (1), a gravity disc (3) is fixedly mounted on the single pile (1), and a plurality of screw piles (2) are evenly distributed and fixedly mounted on a periphery of the gravity disc (3); and the adjacent screw piles (2) are fixedly connected to form an integral structure;

the single pile (1) adopts a large-diameter steel pipe pile; a collar (1-1) for fixing the gravity disc (3) is arranged on the single pile (1), and a rigid connection is formed between the single pile (1) and the gravity disc (3);

the gravity disc (3) comprises a gravity disc foundation (3-4), and a center ring (3-1) is arranged at a center of the gravity disc foundation (3-4); the single pile (1) passes through the center ring (3-1), and the single pile (1) and the center ring (3-1) form a contact fit; a plurality of connecting rods (3-2) are evenly distributed and fixed on the gravity disc foundation (3-4) centered on the center ring (3-1), the other ends of the connecting rods (3-2) are fixedly provided with screw pile mounting seats (3-3) for mounting the screw piles (2), and a plurality of pins (3-5) are evenly distributed and arranged on inner side walls of the screw pile mounting seats (3-3);

wherein comprising the following steps:

step 1: sinking all the screw piles (2) to designed pile positions one by one by an offshore jack-up platform or an offshore wind power construction vessel, screwing the screw piles (2) into an overburden layer by matching construction vessel connecting rods with the screw pile mounting and connecting part (2-5) to be connected to top ends of the screw piles (2), and after a designed depth is reached, separating the screw pile mounting and connecting part (2-5) by a reverse torsion connecting rod;

step 2: hoisting and sinking the gravity disc (3), making all the screw pile mounting seats (3-3) pass through all the screw piles (2), and connecting the plurality of pins (3-5) in the screw pile mounting seats (3-3) with the screw pile pin holes (2-4) in a butted mode by a self-weight or an external pressure of the gravity disc (3); and then, pouring hydraulic concrete into the screw pile mounting seats (3-3) by underwater grouting equipment to realize a rigid connection between the screw piles (2) and the gravity disc (3); and

step 3: hoisting and sinking the single pile (1) and making the single pile (1) pass through the center ring (3-1), making the single pile (1) partially penetrate below a mud surface by a self-weight or an external pressure, then driving the single pile (1) to a designed depth by pile sinking equipment, that is, when the collar (1-1) of the single pile is in contact with the center ring of the gravity disc, then pouring hydraulic concrete into the center ring (3-1) by underwater grouting equipment, and after the hydraulic concrete reaches enough strength, forming an integral load by the single pile, the screw piles and the gravity disc.

2. The construction method of the novel offshore wind power foundation suitable for the shallow overburden layer according to claim 1, wherein the gravity disc foundation (3-4) adopts a concrete structure or a filler structure; the concrete structure adopts a form of an on-shore integral prefabricated structure; the filler structure adopts a cemented rockfill body, and the cemented rockfill body is a cemented rockfill body and a structured cemented rockfill body with high water permeability formed by filling with a granular rockfill material by an underwater grouting technology.

3. The construction method of the novel offshore wind power foundation suitable for the shallow overburden layer according to claim 1, wherein each of the screw piles (2) comprises a steel pipe pile (2-1), screw pile blades (2-2) are arranged on an outer wall of the steel pipe pile (2-1) in a length direction, a bottom end of the steel pipe pile (2-1) is provided with a screw pile head (2-3), and a top end of the steel pipe pile (2-1) is provided with screw pile pin holes (2-4) for matching with the plurality of pins (3-5) of the gravity disc (3).

4. The construction method of the novel offshore wind power foundation suitable for the shallow overburden layer according to claim 1 or 3, wherein a screw pile mounting and connecting part (2-5) for quick disassembly and connection with pile body sinking construction equipment is arranged at a top of each of the screw piles (2), the screw pile mounting and connecting part (2-5) comprises a screw pile mounting key (2-5-1) fixed at a top end of the steel pipe pile (2-1), and the screw pile mounting key (2-5-1) is in fit connection with a screw pile mounting key slot (2-5-2) at a bottom end of a transmission rod of the pile body sinking construction equipment, and is configured to transmit torque.

5. The construction method of the novel offshore wind power foundation suitable for the shallow overburden layer according to claim 3, wherein the screw pile blades (2-2) are in an annular arc shape, and an inclination angle, number, interval and diameter of the screw pile blades are capable of being selected and used according to geological conditions and a load of a fan unit.

6. The construction method of the novel offshore wind power foundation suitable for the shallow overburden layer according to claim 1, wherein a structural form of the gravity disc (3) and an array arrangement mode of the screw piles (2) are capable of being a triangle, a square, a hexagon or a circle; the number and array arrangement mode of the screw piles (2) are capable of being selected and adjusted for use according to different geological conditions and loads of a fan unit.

7. The construction method of the novel offshore wind power foundation suitable for the shallow overburden layer according to claim 1, wherein a section of the gravity disc foundation (3-4) is rectangular or trapezoidal.

DRAWINGS

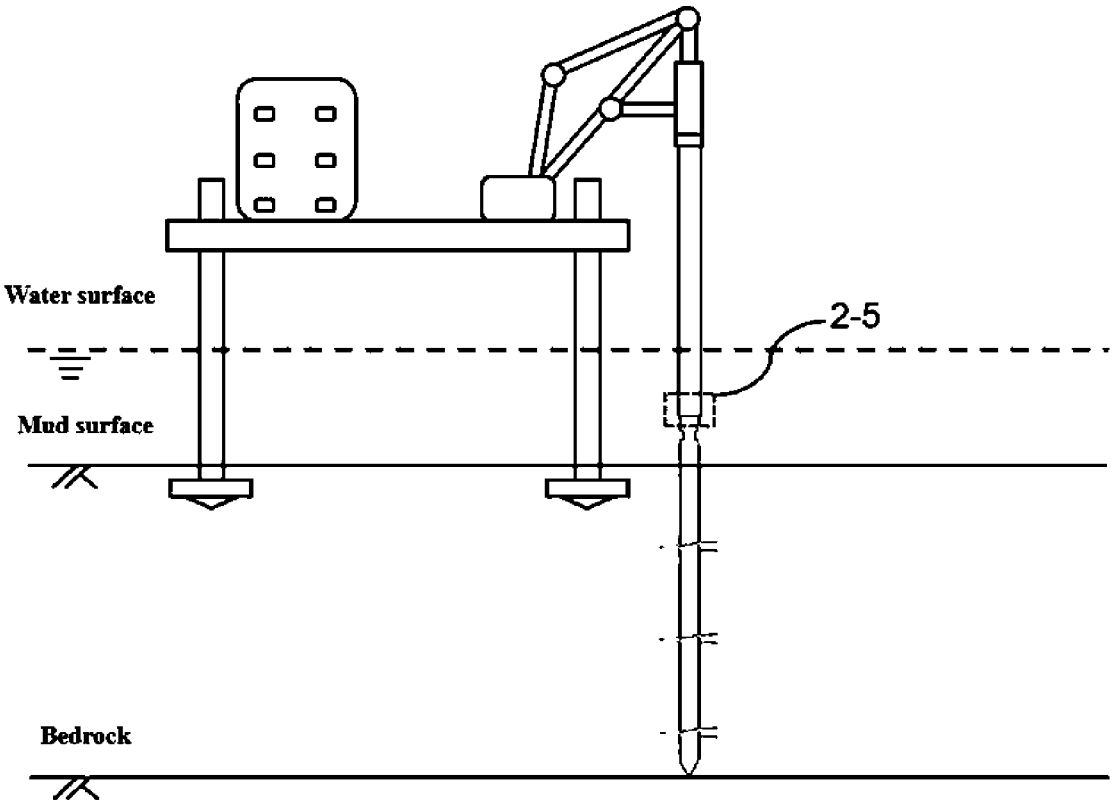

FIG. 1

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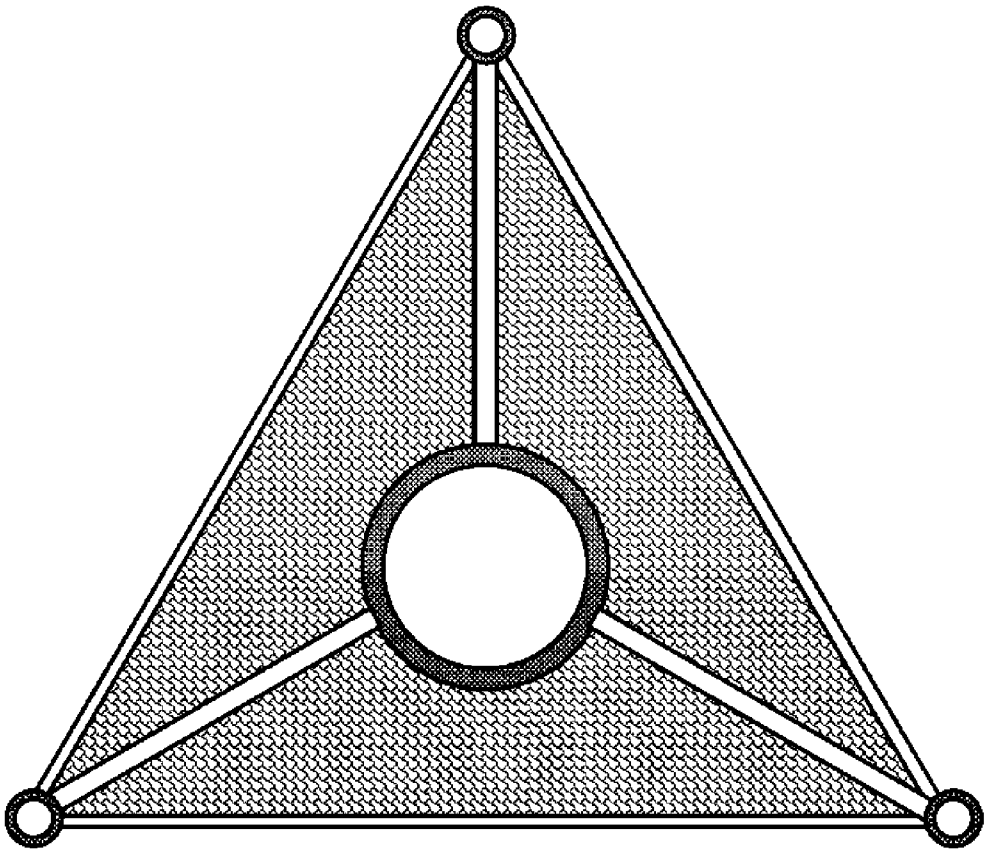

FIG. 2

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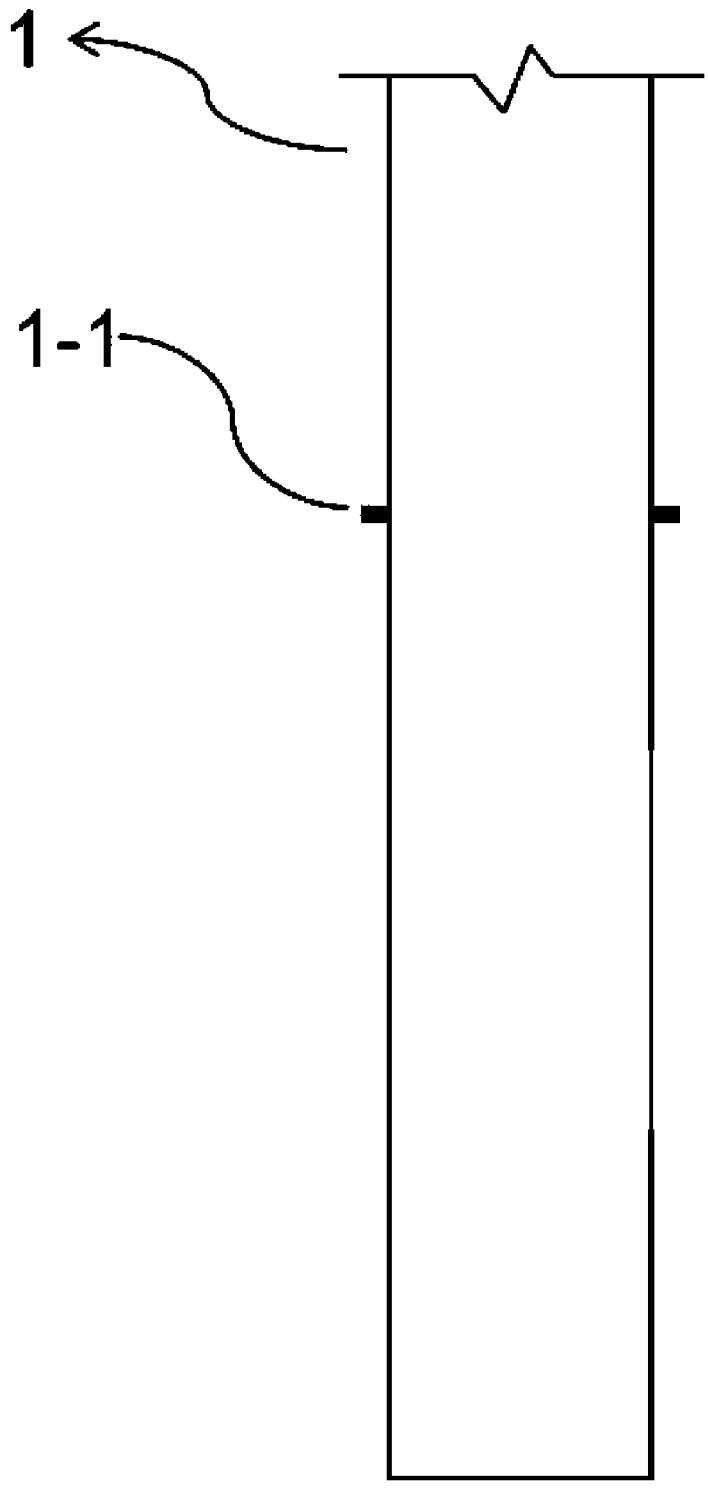

FIG. 3

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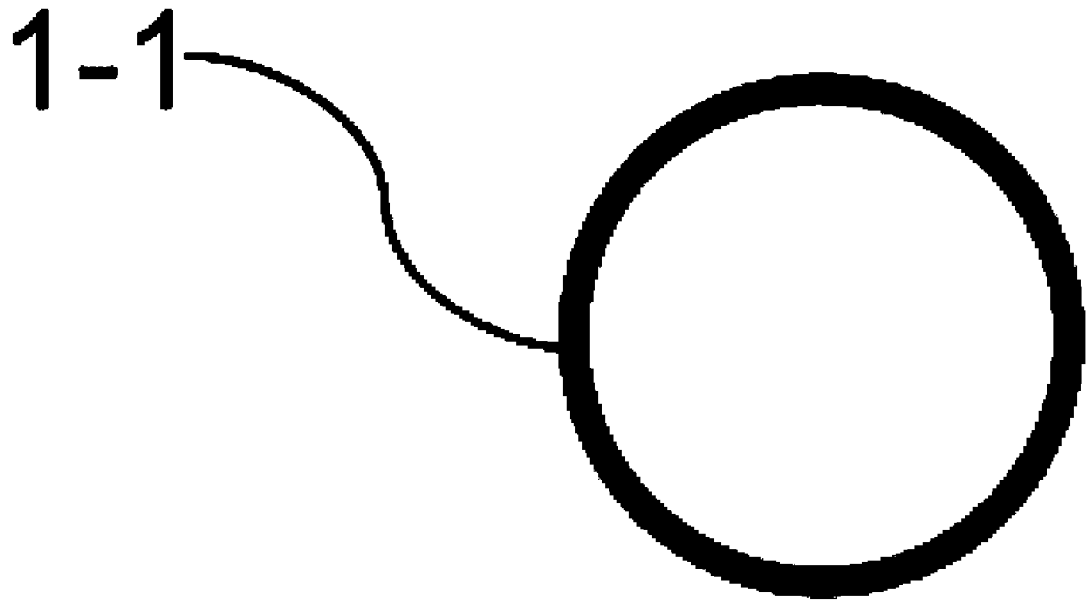

FIG. 4

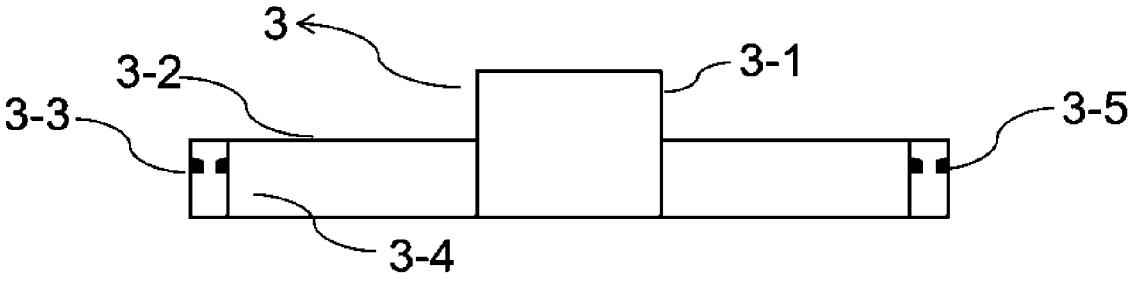

FIG. 5

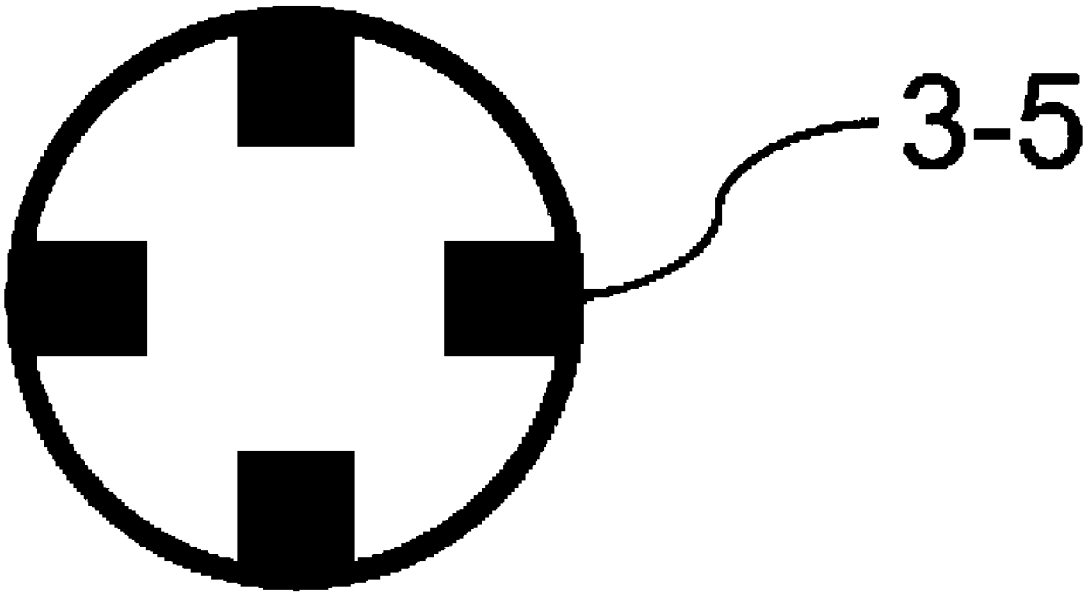

FIG. 6

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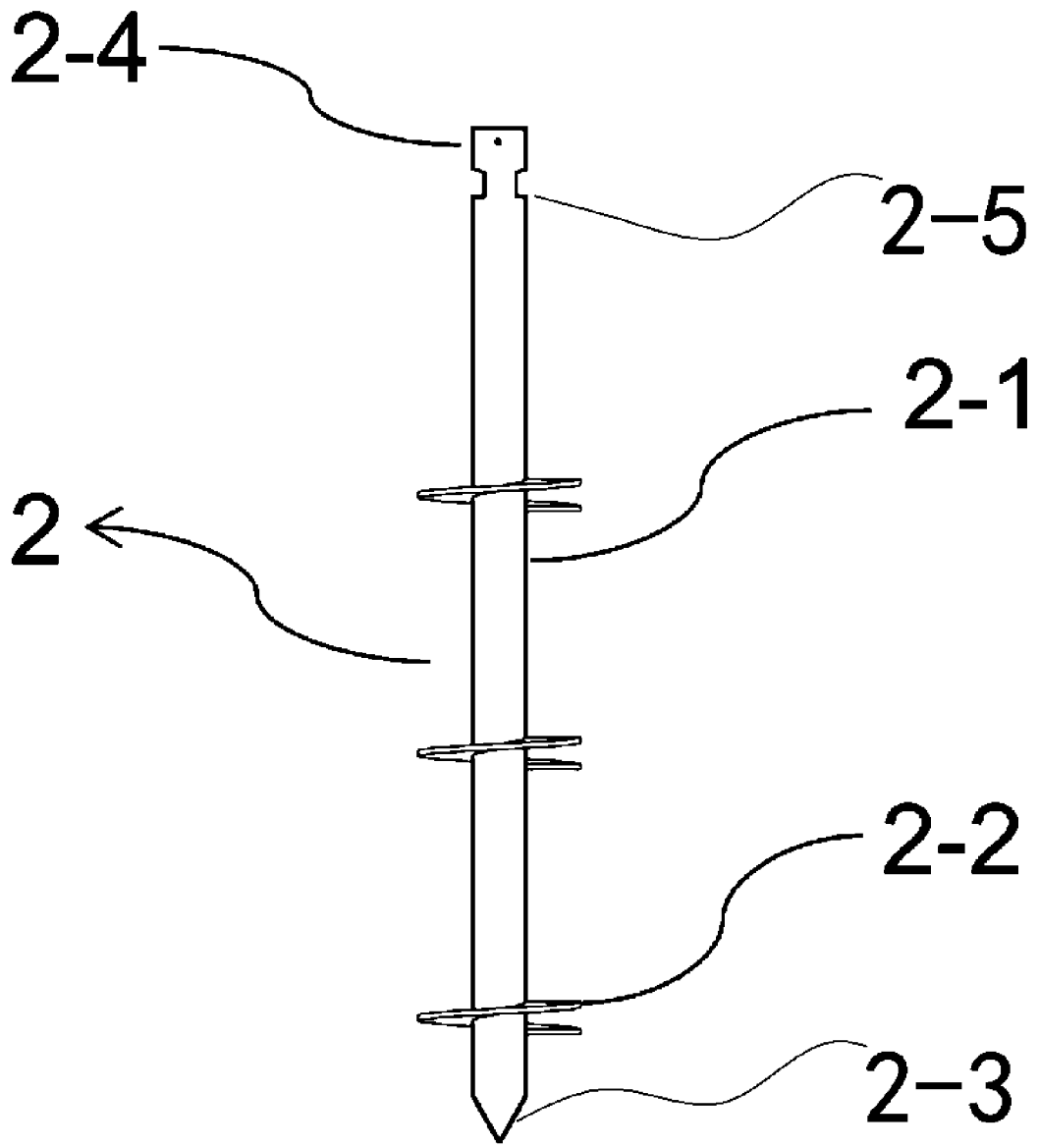

FIG.7

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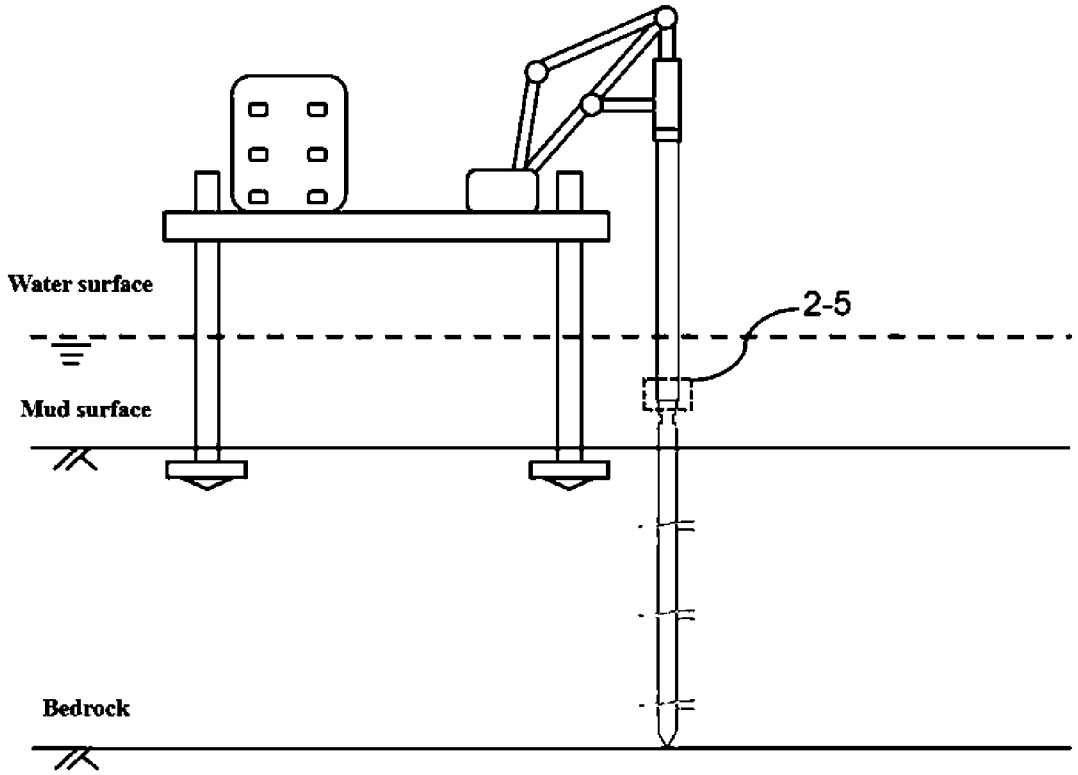

FIG. 8

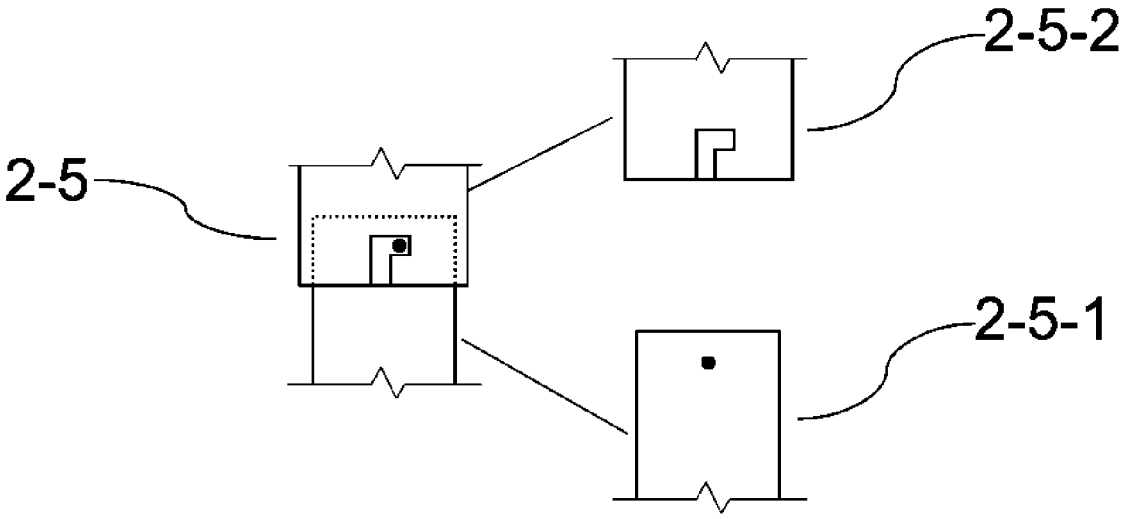

FIG. 9

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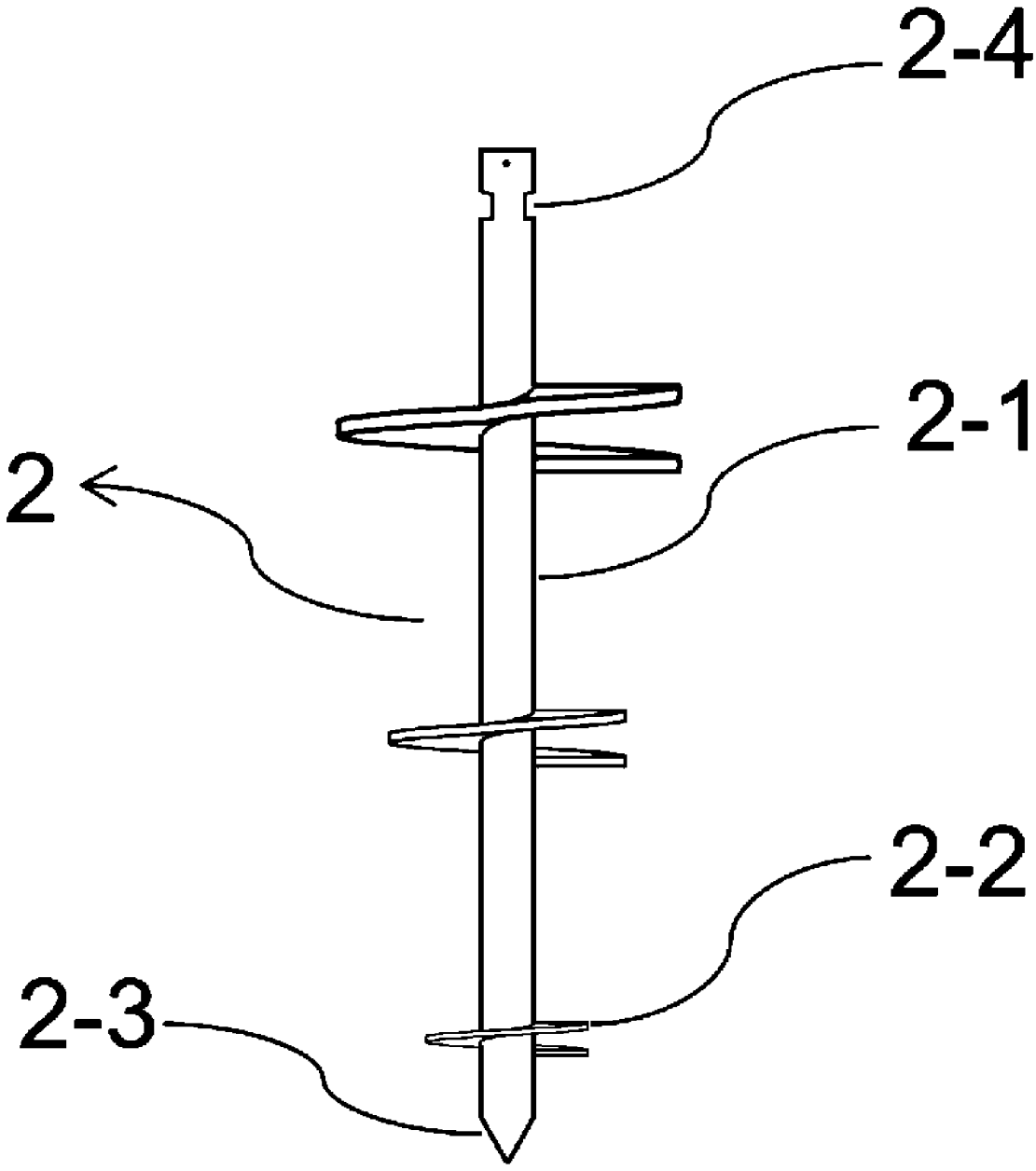

FIG. 10

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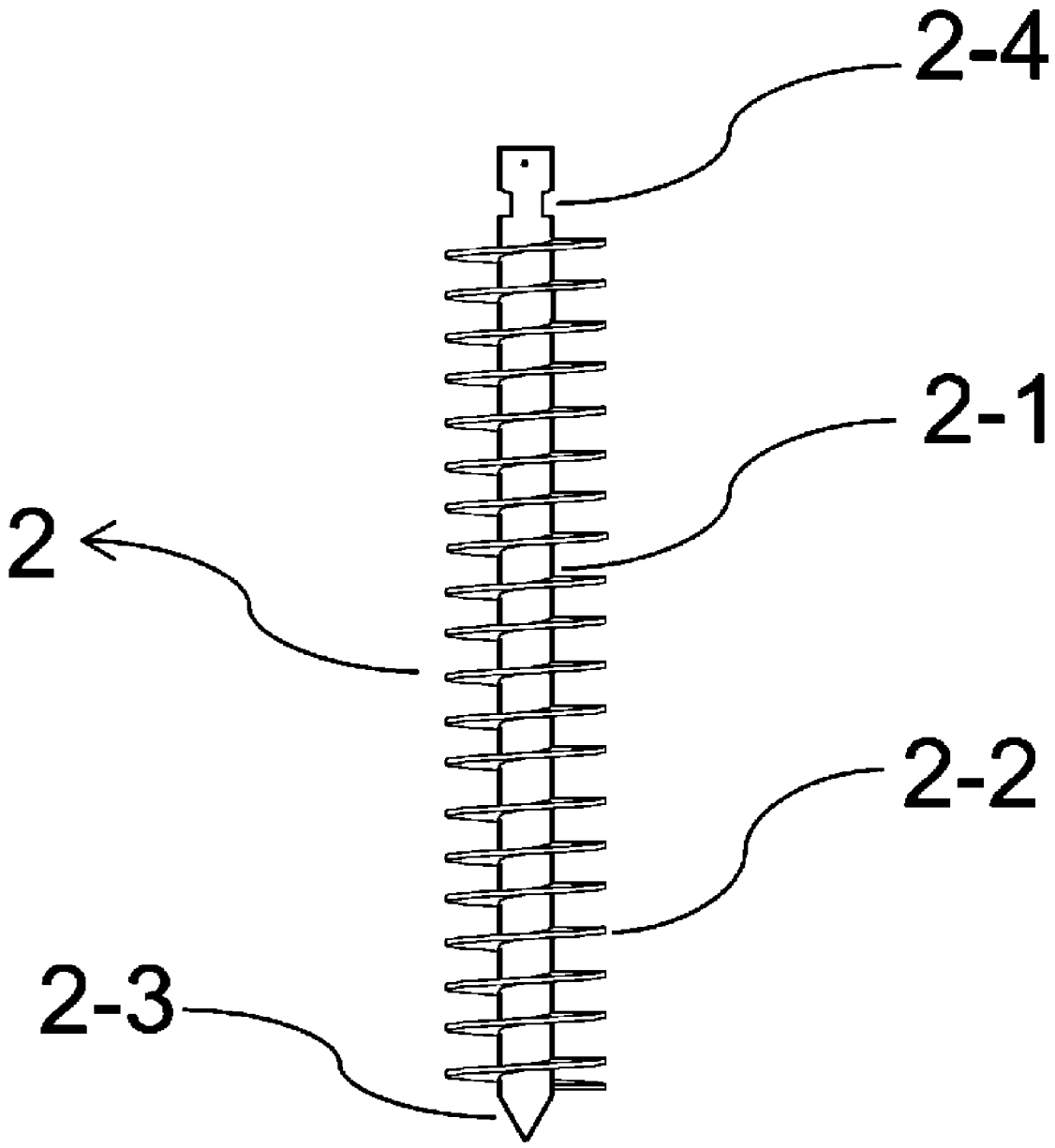

FIG. 11

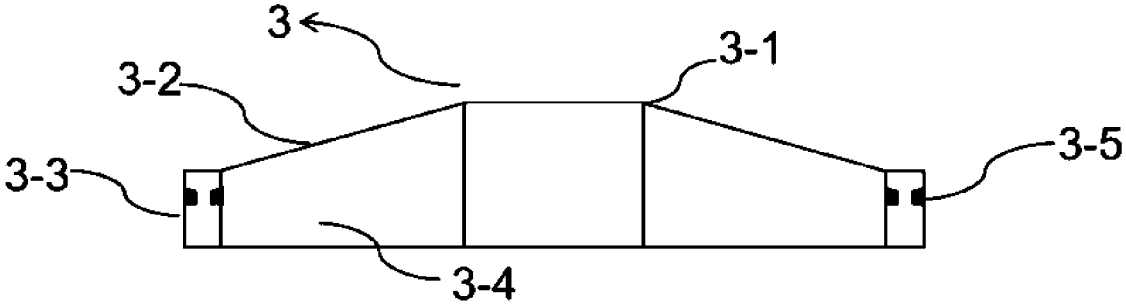

FIG. 12

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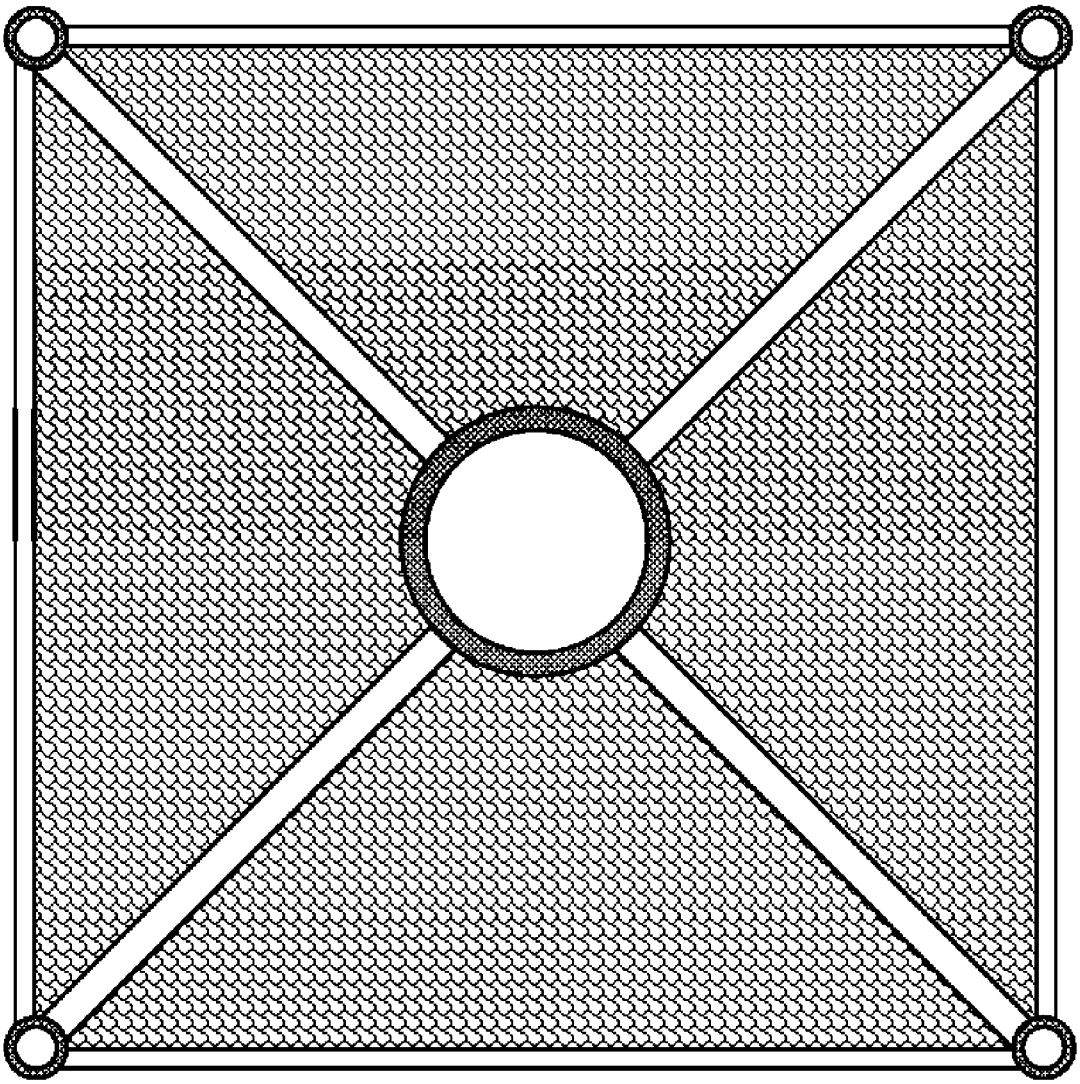


FIG. 13

CA 03177328 2022-10-28

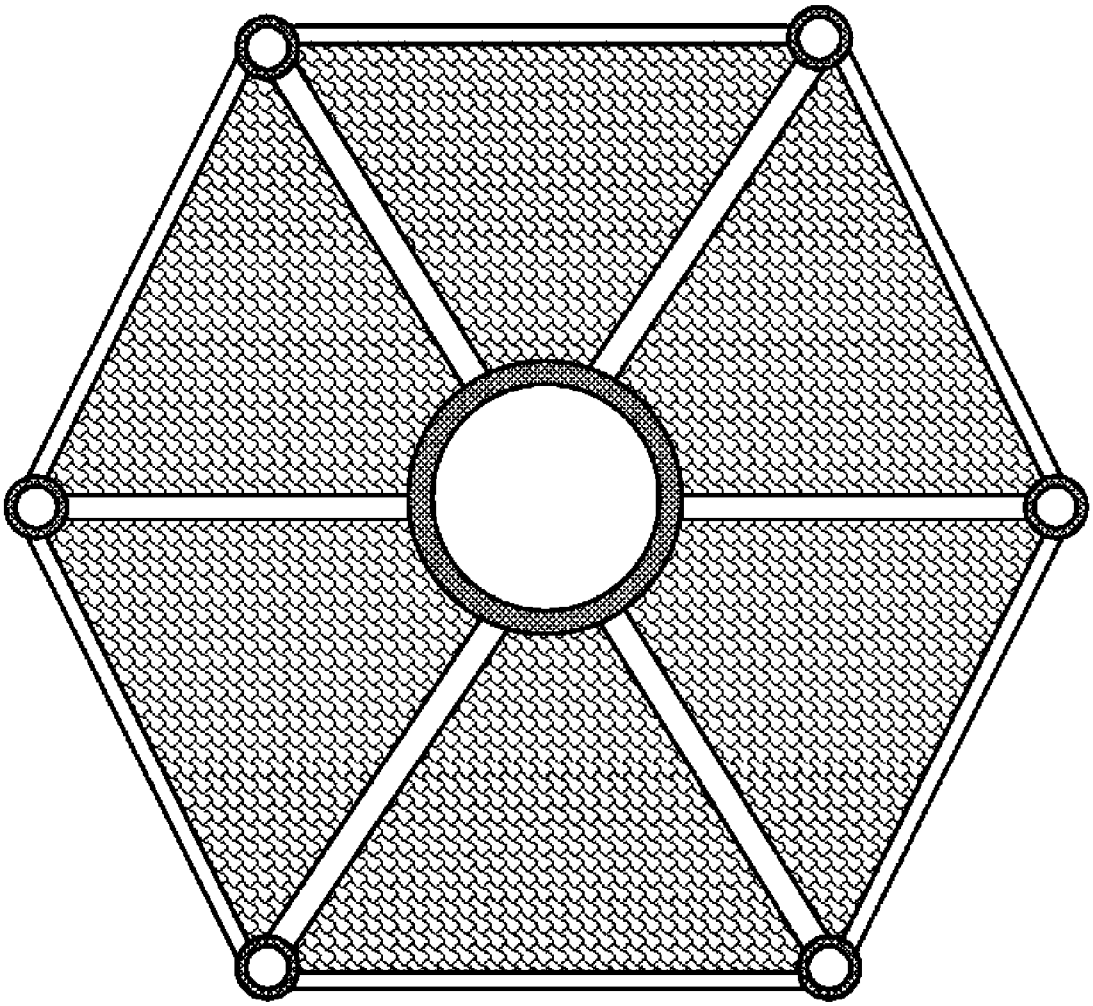


FIG. 14

CA 03177328 2022-10-28

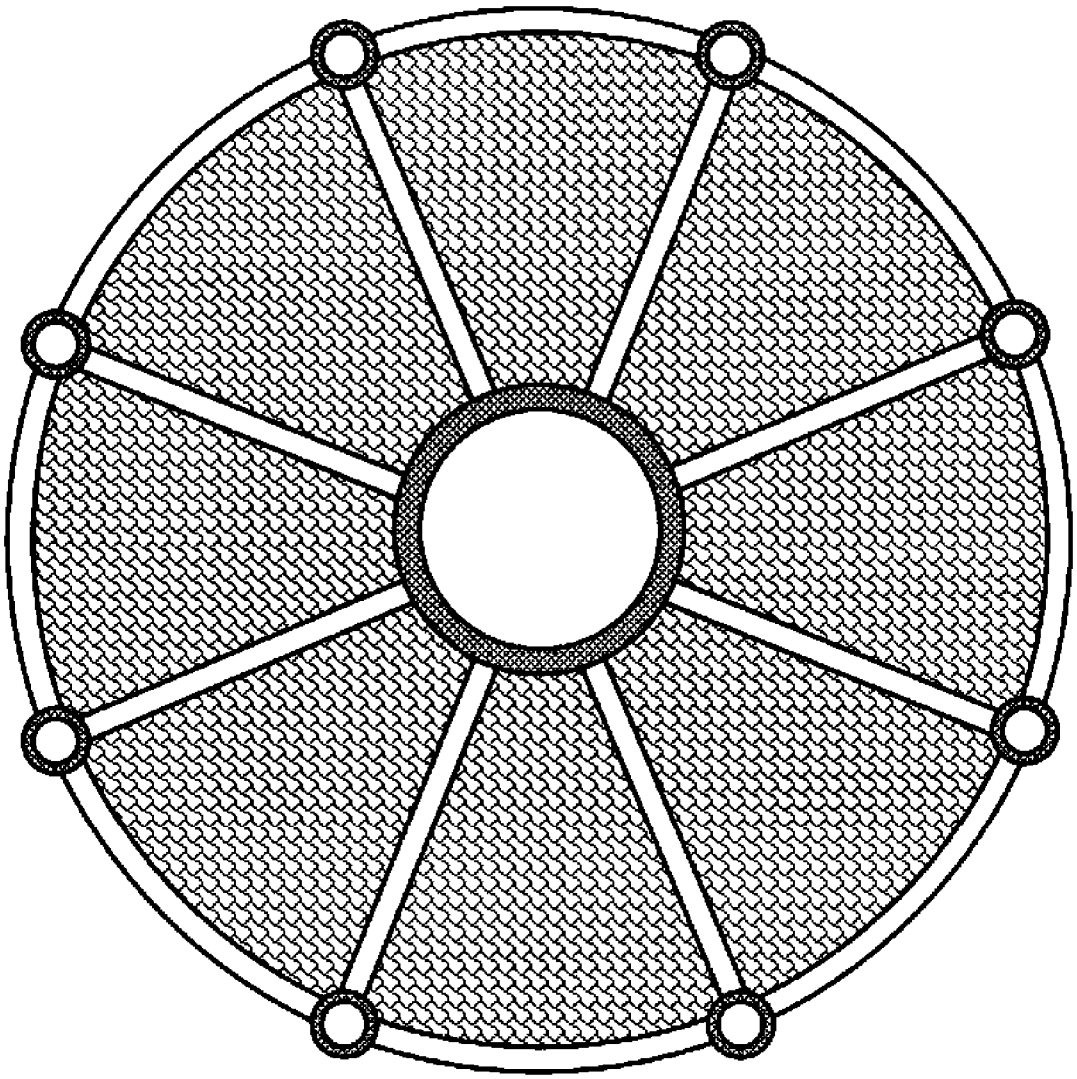
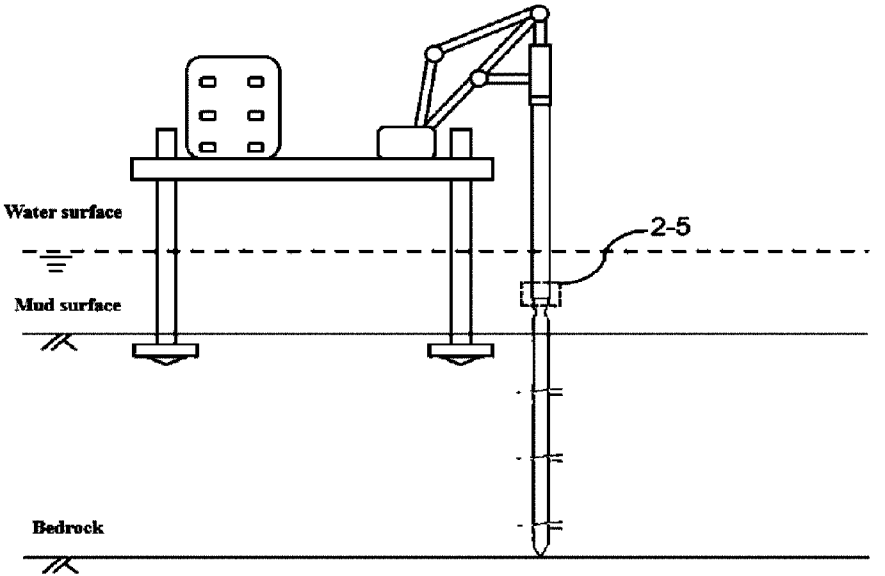


FIG. 15

CA 03177328 2022-10-28


Water surface
Mud surface
2-5
Bedrock