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(54) **Piling barge**

(57) A piling barge is disclosed by the present invention. In the piling barge disclosed, a supporting leg includes a supporting arm extended in vertical direction. Differing from the prior art, the supporting leg further includes a supporting base. The supporting base has a transverse section larger than that of the supporting arm, an end of the supporting arm is fixed with the upper surface of the supporting base. The supporting base of the supporting leg having a larger transverse section may receive support from a larger area of mollisol ground and thus provide a larger supporting force for the hull, which enables the piling barge to perform the piling operation on sea areas with mollisol ground. A piling device of the piling barge has pile frame adjusting mechanisms, such as a luffing oil cylinder, a luffing winch mechanism and a turntable, etc., which may adjust the incline angle and the position of the pile frame, therefore the working efficiency of piling operation of the piling barge can be improved.

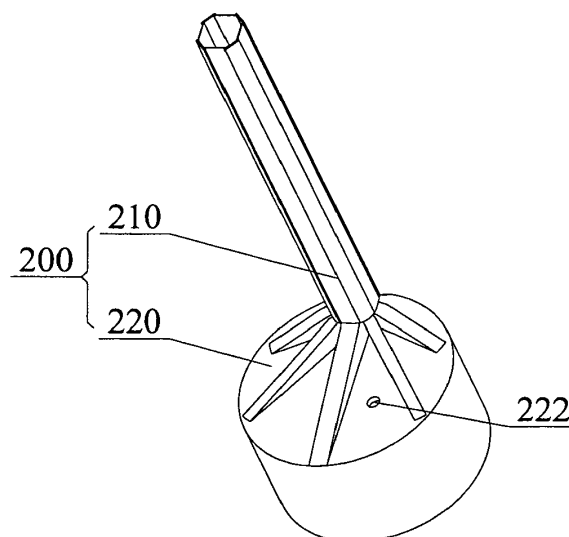


Figure 8

Description

FIELD OF THE INVENTION

[0001] The present invention relates to offshore engineering technology, and in particular, to a piling barge used for offshore piling.

THE RELATED ART

[0002] Currently, in the exploitation of marine resources, it is necessary to build some functions in a tidal flat (including transfer areas of water and land, such as inland rivers, inland lakes, and marshes) or a neritic zone. For example, wind farms are built in predetermined sea areas to make full use of offshore wind energy. Based on characteristics of offshore engineering operations, particular attention should be paid on basic construction in offshore engineering, so as to provide foundations for subsequent constructions. During the basic construction in a predetermined sea area, a piling barge is commonly used to establish pile foundations for an offshore engineering construction. As an important machine in basic construction, the construction efficiency of the piling barge determines the length of the whole construction period.

[0003] Generally, a piling barge includes a hull, supporting legs and a piling device. The supporting legs are slidably mounted at the periphery of the hull. When the piling barge needs to be positioned, the supporting legs are lowered all the way to the seabed by means of a suitable hoisting mechanism, and are supported on the ground to provide a supporting force for the hull of the piling barge, such that the piling barge can perform predetermined piling operations. The piling device includes a pile frame that can fix a pile for positioning the pile, sinking the pile to a predetermined position at a predetermined area and thus forming a pile foundation.

[0004] The piling process of an existing piling barge includes the following steps:

1. The piling barge itself moves to fetch a pile near a pile-stop at a pile-sinking zone and then carries the pile back to a predetermined sea area.

2. The piling barge is positioned in the predetermined pile-sinking sea area. Specifically, at first, the piling barge is initially positioned by a windlass vessel, then the supporting legs of the piling barge are sunk through into the seabed ground, therefore achieving positioning of the piling barge and thus providing a foundation for the subsequent pile-turning and pile-sinking operations.

3. After being positioned, the piling barge turns the pile, i.e., transfers the position of the pile from a horizontal state to a vertical state or a predetermined state, so as to provide a precondition for pile sinking.

4. The Pile-sinking operation is performed, the pile is sunk into the seabed ground by applying a predetermined force thereon through a suitable mechanism, thereby, a predetermined pile foundation is formed. After that, the positioning of the piling barge is removed, it then moves to the pile-sinking zone to fetch a pile for another cycle of piling operation.

[0005] The existing piling barge presents the following disadvantages:

1. It is difficult for the piling barge to perform piling for sea areas with mollisol ground at the seabed. The seabed ground of a tidal flat or a neritic zone usually has silt layers, which form mollisol ground. Reference is made to Fig.1, which is a schematic diagram of the load bearing of a supporting leg of the existing piling barge when being supported on the seabed ground. If the ground of the operating sea area is a mollisol ground, the supporting leg 200 will be trapped into the mollisol ground 300, which in turn generates two force acting on the lower end of the supporting leg 200, i.e., a supporting force F1 to a bottom surface of the supporting leg 200, and a friction force F2 to side surfaces of the supporting leg 200, the resultant force of these two forces being the supporting force that could be provided to the hull 100 by the supporting leg 200. Due to the fact that the mollisol ground has fluidity, ground grains at the bottom surface of the supporting leg 200 will flow to the periphery when receiving force from the supporting leg 200. At this point, the mollisol ground 300 fails to generate a large force to act on the bottom surface of the supporting leg 200, which results a smaller supporting force F1; and for the same reason, the friction force F2 is also severely limited by the fluidity of the mollisol ground 300. As a result, when the operating sea area is a mollisol ground 300, it is difficult for the supporting leg 200 to provide a large supporting force to the hull 100, and thus the piling device on the piling barge could not operate stably, and it would be difficult to implement the piling operation on sea areas with mollisol ground. Moreover, when the supporting leg 200 is to be extracted from the mollisol ground 300, the friction force F2 would be applied to the supporting leg 200 in an opposite direction to make it difficult to extract the supporting leg 200 from the mollisol ground 300, resulting in difficulty in relocating of the piling barge.

Although it is possible, in theory, to increase F2 through elongating the length of the supporting leg 200 and thus enlarging the contact surface between the supporting leg 200 and the mollisol ground 300, or to increase the supporting force F1 through extending the bottom portion of the supporting leg 200 all the way to a harder ground. However, they both are impractical, because this may not only bring about increase in the overall size and thus the man-

ufacturing and using costs of the piling barge, but also make it difficult to extract the supporting leg 200 out of the mollisol ground 300 and thus make it impossible to relocate the the piling barge due to a large friction force F2.

2. Low working efficiency. In the pile-turning or pile-sinking of the existing piling barge, the positioning is usually made by way of windlassing, which leads to long positioning period and reduced operating efficiency of the piling barge.

SUMMARY OF THE INVENTION

[0006] In view of the preceding problems, a first object of the present invention is to provide a piling barge that can perform piling on a mollisol ground.

[0007] A second object of the present invention is to provide a piling barge with high piling efficiency.

[0008] The piling barge provided by the present invention includes a transversely extended hull, a piling device and a plurality of supporting legs, the piling device includes a pile frame mounted on the hull, differing from the prior art in that, the supporting leg includes a supporting arm and a supporting base; the supporting arm is extended in vertical direction and is mounted on the body of the base to be slidable in vertical direction; and the supporting base has a transverse section larger than that of the supporting arm, a lower end of the supporting arm is fixed with an upper surface of the supporting base.

[0009] Preferably, the supporting base includes a cavity having an opening at an bottom surface of the supporting base; and the piling barge further includes a charging and discharging pump communicated with the cavity through a pipe.

[0010] Preferably, the supporting leg also has a charging and discharging passage, which has an outer port positioned on an outer surface of the supporting base and an inner port positioned on a wall surface of the cavity; and the charging and discharging pump is communicated with the outer port of the charging and discharging passage.

[0011] Alternatively, the piling barge also has a charging and discharging passage, which has an outer port positioned on an outer surface of the supporting arm and an inner port positioned on an upper wall surface of the cavity; and the charging and discharging pump is communicated with the outer port of the charging and discharging passage.

[0012] Preferably, the charging and discharging passage has a plurality of outer ports positioned at a side surface of the supporting arm, which outer ports have different distances from an upper end of the supporting arm.

[0013] Preferably, the piling device further includes a luffing oil cylinder, a boom, hanging hooks and a hoisting winch mechanism; one end of the luffing oil cylinder is hingedly connected with an lower hinge point of the pile

frame while the other end thereof is hingedly connected with the hull, an upper end of the boom is hingedly connected with an upper hinge point of the pile frame while an lower end thereof is mounted on the hull, the upper hinge point and the lower hinge point are respectively adjacent to the upper end and the lower end of the pile frame; and the hanging hook is suspended from a fixed pulley block at the upper end of the pile frame, the hoisting winch drum is mounted on a turntable and is connected with the fixed pulley block via a hoisting steel wire rope.

[0014] Preferably, the piling barge further includes a luffing steel wire rope and a luffing winch drum; the lower end of the boom is hingedly connected with the hull; and the luffing winch drum is mounted on the hull, one end of the luffing steel wire rope is connected with the luffing winch drum while the other end thereof is fixed with the upper end of the boom.

[0015] Preferably, the piling device further includes a turntable, on which the pile frame is mounted, the turntable is mounted on the hull by means of a turning mechanism so as to rotate around a vertical axis relative to the hull.

[0016] Preferably, the piling device further includes a luffing oil cylinder, a boom, hanging hooks and a hoisting winch mechanism; one end of the luffing oil cylinder is hingedly connected with an lower hinge point of the pile frame while the other end thereof is hingedly connected with the turntable, an upper end of the boom is hingedly connected with an upper hinge point of the pile frame while an lower end thereof is mounted on the turntable; the upper hinge point and lower hinge point are respectively adjacent to the upper end and the lower end of the pile frame; and the hanging hook is suspended from a fixed pulley block at the upper end of the pile frame, the hoisting winch drum is mounted on the turntable and is connected with the fixed pulley block via a hoisting steel wire rope.

[0017] Preferably, the piling barge further includes a luffing steel wire rope and a luffing winch drum; the lower end of the boom is hingedly connected with the turntable; and the luffing winch drum is mounted on the turntable, one end of the luffing steel wire rope is connected with the luffing winch drum while the other end thereof is fixed with the upper end of the boom.

[0018] Compared with the prior art, in the piling barge provided by the present invention, besides a supporting arm extending in vertical direction, the supporting leg includes a supporting base, which is fixed with the lower end of the supporting arm and has a transverse section larger than that of the supporting arm. Therefore, when piling operation is performed in a predetermined sea area with mollisol ground, the supporting base having larger transverse section may receive support from a larger area of mollisol ground and thus provide a larger supporting force for the hull, which increases stability of the piling barge and enables the piling barge to perform the piling operation on sea areas with mollisol ground. Moreover, due to the fact that the supporting base is arranged at

the lower end of the supporting arm, the supporting arm is allowed to have a smaller transverse section, and thus the supporting leg is allowed to maintain a smaller overall weight.

[0019] In a further preferable technical solution, the supporting base includes a cavity having an opening at the bottom surface of the supporting base. Thus, when the supporting leg needs to be lowered and supported on the seabed ground, a charging and discharging pump may be used to depressurize the cavity, establish a negative pressure in the cavity, and discharge air and water from the cavity, which allows the base of the supporting arm to be sunk into sea water smoothly and enables grains of mollisol ground to flow into the cavity. Therefore, the supporting base is sunk through into the mollisol ground and enables the supporting leg to provide supporting force for the hull. When the supporting leg needs to be lifted up, the charging and discharging pump may be used to pressurize in the cavity, charge water or air into the cavity and establish a positive pressure in the cavity. Therefore, under the pressure of the water and air, the supporting base is separated from the mollisol ground and the supporting leg is extracted smoothly from the mollisol ground, so as to facilitate relocating of the piling barge.

[0020] In a further preferable technical solution, the supporting base also has a charging and discharging passage, which has an outer port on the outer surface of the supporting base and an inner port on the wall surface of the cavity. In this technical solution, the charging and discharging pump may be connected with the cavity through the charging and discharging passage, which facilitates pressurize and depressurize the cavity.

[0021] In an alternative technical solution, the outer port of the charging and discharging passage is located on the outer surface of the supporting arm. In this way, a suitable charging and discharging pump may be provided on the hull, then, depressurizing and pressurizing the cavity and thus establishing a negative or positive pressure therewithin may be implemented through the charging and discharging pump on the hull. At the same time, the inner port is located at an upper wall surface of the cavity, such that, it is possible to discharge more thoroughly the air and water inside the cavity as the supporting leg is sunk; and it is possible to charge air and/or water from the upper portion of the cavity as the supporting leg is lifted, therefore the supporting leg is lifted more smoothly.

[0022] In another technical solution, the charging and discharging passage has a plurality of outer ports, which are located on the side surface of the supporting arm, the plurality of outer ports have different distances from the upper end of the supporting arm. In this case, when pressurizing and depressurizing the cavity, it is possible to connect the charging and discharging pump with a suitable outer port according to practical requirement, so as to facilitate connection between the charging and discharging pump and the outer ports.

[0023] In order to improve the working efficiency of the piling barge, in a further technical solution, the piling device further includes a turntable mounted on the hull through a turning mechanism, and a pile frame is mounted on the turntable. The piling device of the piling barge provided by this technical solution may rotate around a vertical axis relative to the hull. Thus, it would be possible to adjust, in a horizontal plane, the contact point between the pile and the seabed ground by the turntable, which facilitates the adjustment of the pile position and thus improves the working efficiency of the piling barge.

[0024] In a further technical solution, the piling device further includes a luffing oil cylinder, with both ends thereof being hingedly connected with the upper end portion of the pile frame and the turntable respectively, and, the upper end portion of the pile frame is hingedly connected with the boom. In this technical solution, with the position of the hull remains unchanged, it is possible to change the contact point between the pile and the seabed ground and also the inclination of the pile by changing the length of the luffing oil cylinder, which may not only facilitate adjusting of the pile position and positioning of the pile and thus further increase the working efficiency of the piling barge, but also may improve accuracy of positioning of the pile.

[0025] In a still further technical solution, the lower end of the boom is hingedly connected, and the piling barge also has a luffing winch mechanism, through which the luffing angle of the boom, i.e., the angle between the boom and the hull may be changed; the combination of the luffing winch mechanism and the luffing oil cylinder allows to further precisely adjust the contacting point between the pile and the seabed ground as well as the inclination angle of the pile, therefore improving the working efficiency of the piling barge.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026] FIG 1 is a schematic diagram of the load bearing of a supporting leg of the existing piling barge when being supported on the seabed ground;

[0027] Fig. 2 is an overall structural view of the piling barge provided by the present invention;

[0028] Fig. 3 is a perspective structural schematic view of a first embodiment of the supporting leg in the piling barge provided by the present invention;

[0029] Fig. 4 is a structural schematic view of the longitudinal section of the first embodiment of the supporting leg;

[0030] Fig. 5 is a schematic view of the piling barge provided by the present invention in a positioned state;

[0031] Fig. 6 is a schematic view of the piling barge provided by the present invention in another state;

[0032] Fig. 7 is a structural schematic view of a second embodiment of the supporting leg in the piling barge provided by the present invention;

[0033] Fig. 8 is a structural schematic view of a third embodiment of the supporting leg in the piling barge pro-

vided by the prevent invention;

[0034] Fig. 9 is a structural schematic view of a fourth embodiment of the supporting leg in the piling barge provided by the prevent invention;

[0035] Fig. 10 is a side structural schematic view of the piling barge provided by the present invention;

[0036] Fig. 11 is a schematic diagram of position adjustment of the pile frame of the piling device, in which the position of the pile frame in original state is indicated by solid lines, and the adjusted position of the pile frame in operating state is indicated by broken lines.

DETAILED DESCRIPTION OF THE INVENTION

[0037] Next, the technical solution provided by the present invention will be described in detail through description of specific embodiments. Hereinafter, taking a vertical direction as reference, a longitudinal direction is a direction parallel to the vertical direction, while a transverse direction is a direction perpendicular to the vertical direction.

[0038] Now reference is made to Fig. 2, which an overall structural view of the piling barge provided by the present invention. The piling barge includes a hull 100 extended transversely, a plurality of supporting legs 200, anchor windlasses 400 and a piling device 500. The supporting legs 200 are respectively mounted on the periphery of the hull 100. The anchor windlasses 400 are located at four corners of a deck of the hull 100. The piling device 500 is mounted on the deck of the hull 100.

[0039] The essential idea for improving the supporting leg 200 of the piling barge is to increase the contact area between the lower end surface of the supporting leg and the ground and thus increase the supporting force applied to the supporting leg by the seabed ground, therefore the supporting force provided by the supporting leg is increased substantially without a substantial change in the weight of the supporting leg. Referring to Figs. 3 and 4, Fig. 3 is a perspective structural schematic view of a first embodiment of the supporting leg in the piling barge provided by the prevent invention. Fig. 4 is a structural schematic view of the longitudinal section of the first embodiment of the supporting leg.

[0040] The supporting leg 200 includes a supporting arm 210 and a supporting base 220. In this embodiment, the supporting arm 210 is formed of a hollow steel pipe extended in a vertical direction, and the supporting base 220 is a plate-like body extended in a transverse direction, which has a transverse section larger than that of the supporting arm 210. The lower end of the supporting arm 210 is fixed with the upper surface of the supporting base 220. In order to improve the reliability of the fixation between the both, a plurality of reinforcing ribs 211 are provided between the side surface of the supporting arm 210 adjacent to its lower end and the upper surface of the supporting base 220. The ends of the reinforcing ribs 211 are fixed with the side surface of the supporting arm 210, and the bottom surfaces thereof are fixed with the

supporting base 220. The plurality of reinforcing ribs 211 are arranged radially around the lower end of the supporting arm 210. Further, in order to facilitate the assembly of the supporting leg 200 and the hull 100, the connection between the supporting arm 210 and the supporting base 220 is deviated from the center of the supporting base 220 and toward one side of the supporting base 220.

[0041] Referring to Fig. 2, the hull 100 is provided with a plurality of sliding sleeves 110 protruding outward, within which sliding tracks extending in vertical direction are provided. Each of the supporting arms 210 of the plurality of supporting legs 200 cooperates with the sliding track in one sliding sleeve 110. A hoisting mechanism (not shown in the drawing) is further provided between the supporting arm 210 and sliding sleeve 110 for driving the supporting arm 210 to slide in vertical direction relative to the sliding sleeve 110, therefore the supporting legs 200 is allowed to move upward and downward. The slidable connection between the supporting arms 210 and the hull 100 can also be realized in other ways, for example, a "T"-shaped sliding rail may be provided on the supporting arm 210 and a "T"-shaped sliding groove complementary with the rail is provided on the hull 100.

[0042] The hoisting mechanism may be a hydraulic cylinder with its two ends being respectively connected with the supporting arm 210 and the sliding sleeve 110, for driving the supporting arm 210 to move in vertical direction relative to the sliding sleeve 110 as the hydraulic cylinder is stretched or contracted. The hoisting mechanism may also be a worm gear and a worm screw that are respectively fixed to the supporting arm 210 and the sliding sleeve 110 and cooperates with each other. When rotating, the worm screw may drive the worm gear to rotate and thus drive the supporting arm 210 to move in vertical direction relative to the sliding sleeve 110. The hoisting mechanism may also be other structures in prior art for driving the supporting leg 200 to slide relative to the sliding sleeve 110 (the hull 100).

[0043] The process for positioning the piling barge described above at a predetermined sea area includes the following steps:

1. Tow the piling barge to the predetermined sea area, which may be a predetermined wind turbine installation operating zone of offshore wind farm, by means of a suitable towing vessel.
2. Drop the anchor of the piling barge through an anchoring boat when arriving at the predetermined sea area, and then implement original positioning of the piling barge in a manner of windlassing through the windlasses 400.
3. Lower the supporting leg 200 such that the supporting base 220 thereof is supported on the seabed ground. Referring to Fig.5, a schematic view of the piling barge provided by the present invention in a

positioned state is shown, wherein the piling device is removed for clear illustration of the structure of the supporting leg and the hull. In such a state, it is the supporting base 220 with larger transverse section that receives the supporting force by the ground. When the piling operation is performed in the predetermined sea area of mollisol ground 300, the supporting base 220 with larger transverse section may receive support from a larger area of mollisol ground 300. Under the resultant effect of a supporting force F1 and a friction force F2, the supporting leg 200 can provide a larger supporting force for the hull 100, thus the stability and reliability of the piling barge is improved, allowing the piling barge to perform piling operation stably. Moreover, due to the fact that the supporting base 220 is located at the lower end of the supporting arm 210, the supporting arm 210 is maintained to have a smaller transverse section, therefore, the supporting leg 200 is maintained to have a smaller overall weight.

[0044] Further, because of the diversity of ground forms of a sea area, the bottom surface of the hull 100 may be made with a flat configuration. As such, when the piling operation is performed at a predetermined sea area or tidal flat where the water level is shallow, the piling barge may be stably positioned by resting on the ground.

[0045] In order to accommodate the diversity of operating conditions of sea areas, the piling barge provided by the present invention may also be adapted to different conditions by adjusting its operating state according to the variation of the condition. When it is impossible for the piling barge to rest on the ground with deep water level and calm water, as shown in Fig.5, the supporting leg 200 is allowed to be supported on the seabed ground, with a part of the hull 100 being submerged below water surface and the hull 100 is in a semi-submerged state, therefore the bearing capacity of the piling barge may be improved. When the hull 100 is subjected to large impact by seawater from the sea with deep water and heavy wind, as shown in a schematic view of the piling barge provided by the present invention in another state of Fig. 6, the hull 100 may be moved upward in relative to the supporting leg 200 through the hoisting mechanism. Since the supporting leg 200 is able to provide a larger supporting force, which allows the hull 100 to be maintained above the water surface, therefore the impact to the hull 100 from sea waves may be avoid and the positioning of the piling barge is stably maintained.

[0046] Although the above-described supporting leg 200 is capable of providing a larger supporting force for the piling barge and thus meets the requirement for piling operation. However, when the piling barge is to be relocated, the supporting leg 200 needs to be extracted from the seabed ground. Accordingly, to facilitate separation of the supporting leg 200 from the seabed ground, especially from the mollisol ground 300, a supporting leg 200

with another structure is further provided by the prevent invention.

[0047] Reference is made to Fig.7, which is a structural schematic view of a second embodiment of the supporting leg in the piling barge provided by the prevent invention.

[0048] As compared with the first supporting leg, one of the differences in the second supporting leg is that the supporting base 220 includes a cavity 221 having an opening at the bottom surface of the supporting base 220. Following is the working principle of the supporting leg 200. When the supporting leg 200 needs to be lowered and supported on the seabed ground, a suitable charging and discharging pump may be used to depressurize the cavity 221, discharge air and water inside the cavity 221, and thus establish a negative pressure therein, such that the supporting leg 200 is lowered smoothly and sunk through to the seabed ground, therefore providing a supporting force for the hull 100; when the supporting leg 200 needs to be separated from the mollisol ground 300 after a predetermined offshore operation being finished, the charging and discharging pump may be used to pressurize the cavity 221, charge water or air into the cavity 221, and gradually establish a positive pressure inside the cavity 221, such that the supporting base 220 is separated from the mollisol ground 300 and then the supporting leg 200 is raised smoothly.

[0049] The charging and discharging pump may be a vacuum pump, a centrifugal pump or any other pumps with other structures that can discharge water and/or air from the cavity 221 and charge water and/or air into the cavity 221.

[0050] There are many alternatives in the implement of charging and discharging water and/or air. As shown in Fig.7, a suitable hole is provided on the upper portion of the cavity 221 as a charging and discharging passage 222 for discharging or charging water and/or air from or into the cavity 221. The charging and discharging passage 222 has an outer port at the lower end inside the supporting arm 210. Herein, one end of a delivery pipe 230 is inserted from an opening at the upper end of the supporting arm 210, through a central cavity of the supporting arm 210 and is connected with the charging and discharging passage 222, the other end of the delivery pipe 230 is connected with a charging and discharging port of the charging and discharging pump on the hull 100. In this way, when the charging and discharging pump operates, it can depressurize or pressurize the cavity 221, establish a negative or positive pressure therein, and discharge or charge water and/or air from or into the cavity 221, therefore the supporting leg 200 will be moved downward and upward smoothly.

[0051] It can be appreciated that the cavity 221 may be pressurized or depressurized, as long as the outer port of the charging and discharging passage 222 is positioned on the outer surface of the supporting base 220 and the inner port thereof is on the wall of the cavity 221. Therefore, the outer port of the charging and discharging

passage 222 may be positioned at other portions of the outer surface of the supporting base 220. As shown in the structural schematic view of a third embodiment of the supporting leg in the piling barge provided by the present invention in Fig. 8, herein, the outer port of the charging and discharging passage 222 is positioned between the reinforcing ribs 211 at the outer surface of the supporting base 220. In this way, the charging and discharging passage 222 can be connected with the charging and discharging pump provided on the hull 100 through the delivery pipe 230. Also, the charging and discharging pump may be disposed directly on the supporting base 220 under predetermined condition.

[0052] Arranging the charging and discharging pump on the hull 100 is a preferable technical solution. At this time, in order to facilitate the connection between the charging and discharging pump and the charging and discharging passage 222, the charging and discharging passage 222 may be provided with a plurality of outer ports on the side surface of the supporting arm, which have different distances from the upper end of the supporting arm, for example, the plurality of outer ports may be arranged in vertical direction on the side surface of the supporting arm 210. In this case, it is possible in practice to choose a suitable outer port to communicate with the charging and discharging pump while keep the other outer ports closed.

[0053] As to the inner port of the charging and discharging passage 222, it is preferred to arrange it on the upper wall surface of the cavity 221, such that, it is possible to discharge water and/or air in the cavity 221 more thoroughly when a negative pressure is established in the cavity 221, and it is also possible to remove ground grains and/or water in the cavity 221 more thoroughly when a positive pressure is established in the cavity 221.

[0054] Further, in specific conditions, it is also possible not to provide a charging and discharging passage, as shown in the structural schematic view of a fourth embodiment of the supporting leg in the piling barge provided by the present invention in Fig. 9. In the supporting leg, the purpose of pressurizing and depressurizing the cavity 221 may also be achieved with the delivery pipe 230 entering into the cavity 221 across the bottom surface of the supporting base 220.

[0055] The structure of the piling device in the piling barge will be described below.

[0056] Reference is made to Fig.10, which is a side structural schematic view of the piling barge provided by the present invention. The piling device 500 includes a pile frame 510, a hanging hook 520, a boom 530, a turntable 550 and a luffing oil cylinder 540. The turntable 550 is mounted on the hull 100 by means of a turning mechanism, and may be driven to rotate around a vertical axis relative to the hull 100 by a hydraulic motor. One end of the luffing oil cylinder 540 is hingedly connected with a lower hinge point of the pile frame 510 while the other end thereof is hingedly connected to the turntable 550. An upper end of the boom 530 is hingedly connected with

an upper hinge point of the pile frame 510 while a lower end thereof is hingedly connected on the turntable 550. Axes of hinge shafts at all hinge joints are parallel to each other and to a horizontal plane. The upper and lower hinge points of the pile frame 510 are respectively positioned near the upper and lower end thereof. The hanging hook 520 is suspended from a fixed pulley block at the top end of the pile frame 510.

[0057] In addition, the piling device 500 includes a hoisting winch mechanism and a luffing winch mechanism (not shown in the drawings). A hoisting winch drum of the hoisting winch mechanism is rotatably mounted on the turntable 550 and is connected with the fixed pulley block at the top end of the pile frame 510 via a hoisting steel wire rope 561. Thus, when being driven to rotate by a driving mechanism, the hoisting winch drum may drive the fixed pulley block to act, so that the up and down of the hanging hook 520 is achieved, and thus the pile fetching, pile-turning and pile-sinking are facilitated. The luffing winch mechanism includes a luffing steel wire rope and a luffing winch drum rotatably mounted on the turntable 550. One end of the luffing steel wire rope 571 is connected to the luffing winch drum while the other end thereof is fixed to the upper end of the boom. When the luffing winch drum rotates, it may drive the boom 530 to rotate by a predetermined angle relative to the hull 100, and thus the luffing angle of the boom 530 is changed to adjust the position of the pile frame 510.

[0058] The piling device described above may provide convenience for the position adjustment of the pile in three aspects.

[0059] In a first aspect, the turntable 550 is connected with the hull 100 by means of the tuning mechanism, such that the whole piling device 500 may be turned relative to the hull 100 in a horizontal plane. Therefore, the position of the pile frame 510 and thus the contacting point between the pile and the seabed ground may be adjusted in a horizontal plane. The adjustment of the operating position is achieved, facilitating the piling operation.

[0060] In a second aspect, reference is made to Fig. 11, which is the schematic diagram of position adjustment of the pile frame of the piling device, and in which the position of the pile frame in original state is indicated by solid lines, and the adjusted position of the pile frame in operating state is indicated by broken lines. Through the luffing oil cylinder 540, that is, through stretching the luffing oil cylinder 540, the distance between two ends of the luffing oil cylinder 540 and thus the inclination of the pile frame 510 are changed, such that the pile frame 510 is transferred from a state A0 to a state A1. Therefore, the contacting position between the pile and the seabed ground and also the inclination angle of the pile can be changed, meeting requirements for offshore foundation engineering operation.

[0061] In a third aspect, reference is again made to Fig.11. The lower end of the boom 530 is hingedly connected, therefore, the luffing angle of the boom 530, i.e.,

the angle between the boom 530 and the hull 100 may be changed by means of the luffing winch mechanism. With the luffing oil cylinder remaining unchanged, the pile frame 510 will be transferred from the state A0 to a state A2, thereby the contacting position between the pile and the seabed ground and also the inclination angle of the pile is changed, meeting requirements for offshore foundation engineering operation.

[0062] Combining the second and third aspects described above and referring to Fig. 11, through increasing the luffing angle of the boom 530 and contracting the luffing oil cylinder 540, the pile frame 510 may be transferred from the state A0 to a state A3. Accordingly, the contact position between the pile and the seabed ground is changed, while the inclination angle of the pile may also be adjusted, so that the position of the pile frame 510 may be adjusted in a wider range and in more aspects, which provides more conveniences for the position adjustment of the pile. In combination of the above described three aspects, adjustments for the pile frame 510 in all directions may be achieved. During pile turning and pile sinking, the position of the pile frame 510 can be adjusted within a wide range through the turntable 550, the luffing oil cylinder 540 and the luffing winch mechanism, thus repeatedly positioning for the piling barge is no longer needed. Therefore, the working efficiency of the piling barge is improved.

[0063] It may be appreciated according to the above description that, in order to obtain the technical effect of the adjustment to the pile frame 510 as in the second aspect, the luffing oil cylinder 540 may be directly hingedly connected with the hull 100. Likely, In order to obtain the technical effect of the adjustment to the pile frame 510 as in the third aspect, the lower end of the boom 530 may also be directly hingedly connected to the hull 100 and the luffing winch mechanism is mounted on the hull 100, which may also change the luffing angle of the boom 530 and thus adjust the position of the pile frame 510.

[0064] The above description only involves preferred embodiments of the present invention. It should be noted that an ordinary skilled person in art may make many improvements and modifications without departing from principles of the present invention, which improvements and modifications should also be construed as within the scope of protection of the present invention.

Claims

1. A piling barge comprising a transversely extended hull (100), a piling device (500) and a plurality of supporting legs (200), the piling device (500) comprising a pile frame (510) mounted on the hull (100), **characterized in that,** the supporting leg (200) comprises a supporting arm (210) and a supporting base (220); the supporting arm (210) extends in a vertical direction and is mounted on a body of the base (220) so

as to be slidable in the vertical direction; and the supporting base (220) has a transverse section larger than a transverse section of the supporting arm (210), a lower end of the supporting arm (210) is fixed to an upper surface of the supporting base (220).

2. The piling barge according to claim 1, wherein, the supporting base (220) comprises a cavity (221), which has an opening formed in an bottom surface of the supporting base (220); and the piling barge further comprises a charging and discharging pump communicated with the cavity (221) via a pipe (230).
3. The piling barge according to claim 2, wherein, the supporting leg (200) further has a charging and discharging passage (222) therein, which has an outer port positioned at an outer surface of the supporting base (220) and an inner port positioned at a wall of the cavity (221); and the charging and discharging pump is communicated with the outer port of the charging and discharging passage (222).
4. The piling barge according to claim 2, wherein, the piling barge further has a charging and discharging passage (222), which has an outer port positioned at an outer surface of the supporting arm (210) and an inner port positioned at an upper wall of the cavity (221); and the charging and discharging pump is communicated with the outer port of the charging and discharging passage (222).
5. The piling barge according to claim 4, wherein, the charging and discharging passage (222) has a plurality of outer ports positioned at a side surface of the supporting arm (210), and the plurality of outer ports have different distances from an upper end of the supporting arm (210).
6. The piling barge according to any one of claims 1 to 5, wherein, the piling device (500) further comprises a luffing oil cylinder (540), a boom (530), a hanging hook (520) and a hoisting winch drum; one end of the luffing oil cylinder (540) is hingedly connected to a lower hinge point of the pile frame (510) while the other end thereof is hingedly connected to the hull (100), an upper end of the boom (530) is hingedly connected to an upper hinge point of the pile frame (510) while a lower end thereof is mounted on the hull (100), the upper hinge point and the lower hinge point are respectively adjacent to the upper end and the lower end of the pile frame (510); and the hanging hook (520) is suspended from a fixed

pulley block provided at the upper end of the pile frame (510), the hoisting winch drum is mounted on a turntable (550) and is connected to the fixed pulley block via a hoisting steel wire rope (561).

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7. The piling barge according to claim 6, wherein, the piling barge further comprises a luffing steel wire rope (571) and a luffing winch drum; the lower end of the boom (530) is hingedly connected to the hull (100); and
the luffing winch drum is mounted on the hull (100), one end of the luffing steel wire rope (571) is connected to the luffing winch drum while the other end thereof is fixed to the upper end of the boom (530).
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8. The piling barge according to any one of claims 1 to 5, wherein, the piling device (500) further comprises a turntable (550), on which the pile frame (510) is mounted, the turntable (550) is mounted on the hull (100) via a turning mechanism so as to rotate relative to the hull (100) around a vertical axis.
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9. The piling barge according to claim 8, wherein, the piling device (500) further comprises a luffing oil cylinder (540), a boom (530), a hanging hook (520) and a hoisting winch drum; one end of the luffing oil cylinder (540) is hingedly connected to an lower hinge point of the pile frame (510) while the other end thereof is hingedly connected to the turntable (550), an upper end of the boom (530) is hingedly connected to an upper hinge point of the pile frame (510) while an lower end thereof is mounted on the turntable (550);
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30
the upper hinge point and lower hinge point are respectively adjacent to the upper end and the lower end of the pile frame (510); and
35
the hanging hook (520) is suspended from a fixed pulley block provided at the upper end of the pile frame (510), and the hoisting winch drum is mounted on the turntable (550) and is connected to the fixed pulley block via a hoisting steel wire rope (561).
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10. The piling barge according to claim 9, wherein, the piling barge further comprises a luffing steel wire rope (571) and a luffing winch drum;
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the lower end of the boom (530) is hingedly connected to the turntable (550); and
the luffing winch drum is mounted on the turntable (550), one end of the luffing steel wire rope (571) is connected to the luffing winch drum while the other end thereof is fixed to the upper end of the boom (530).
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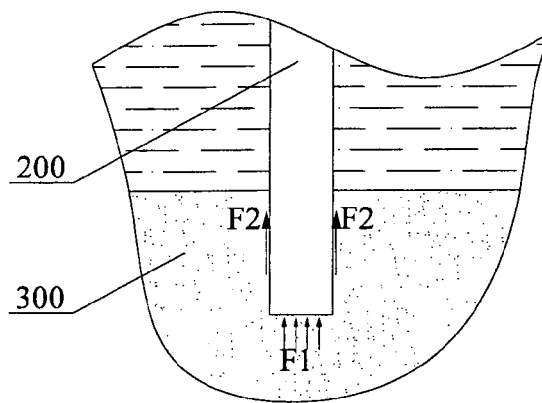


Figure 1

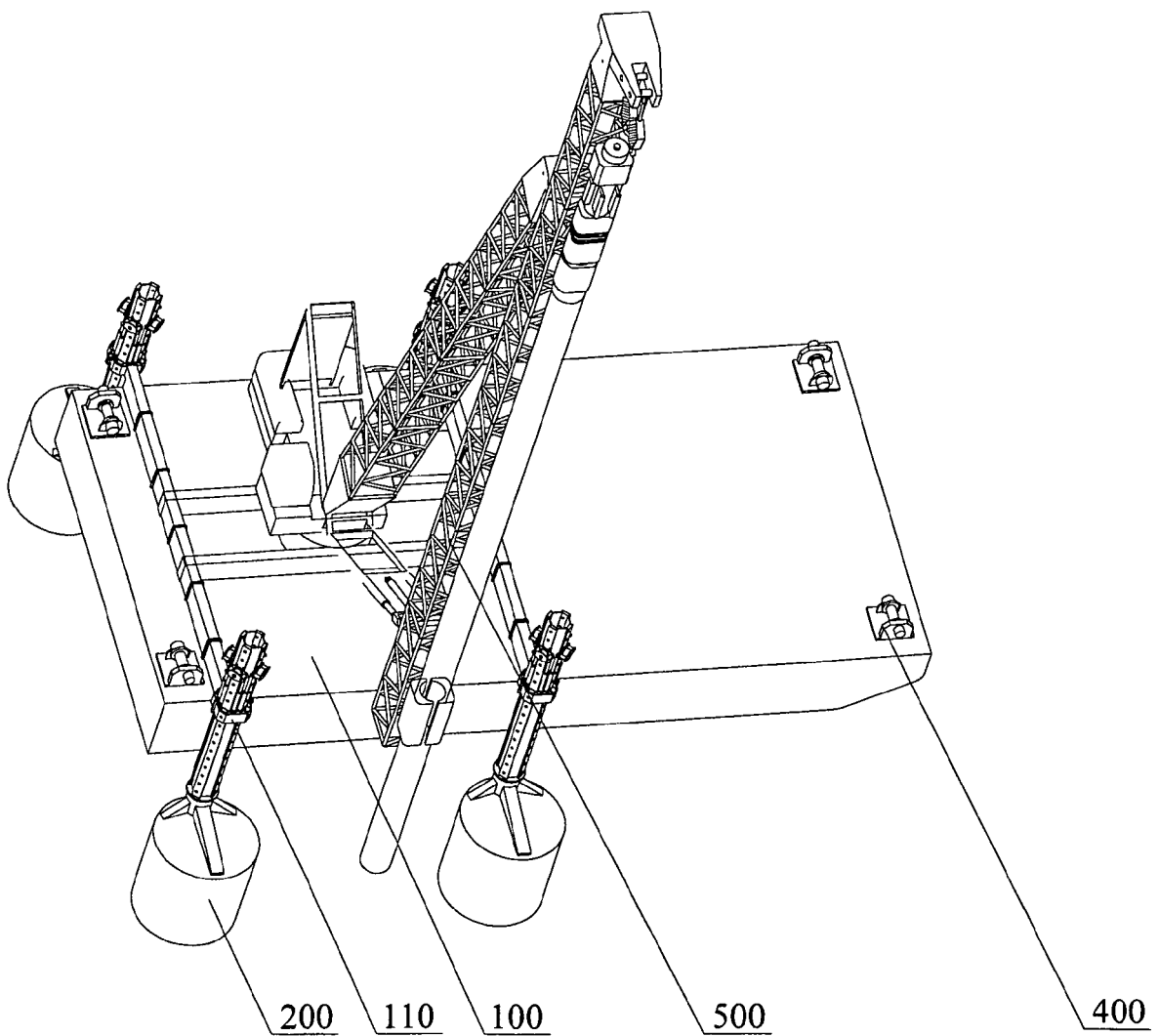


Figure 2

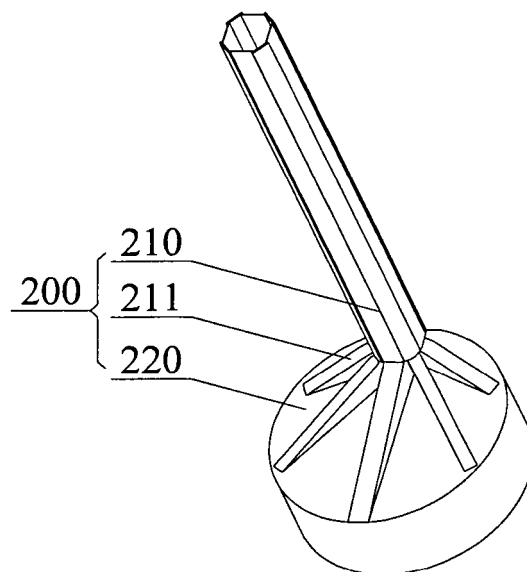


Figure3

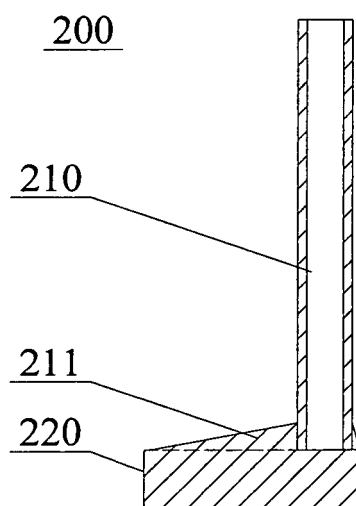


Figure 4

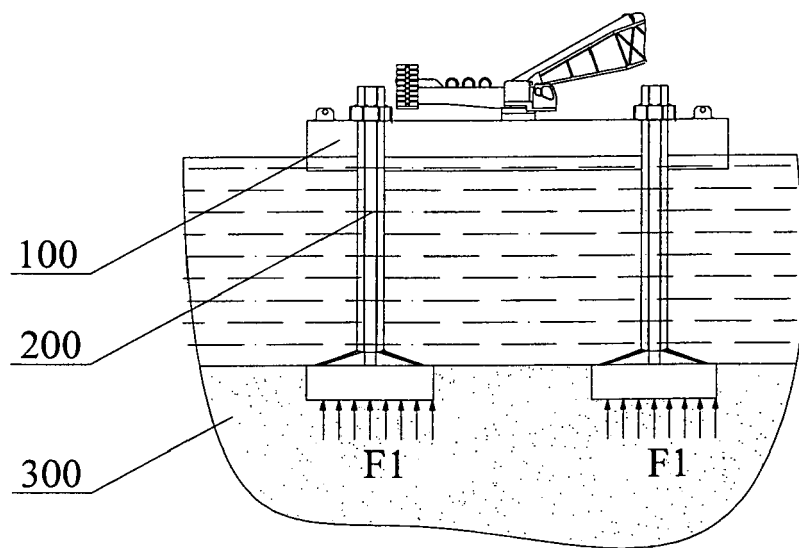


Figure 5

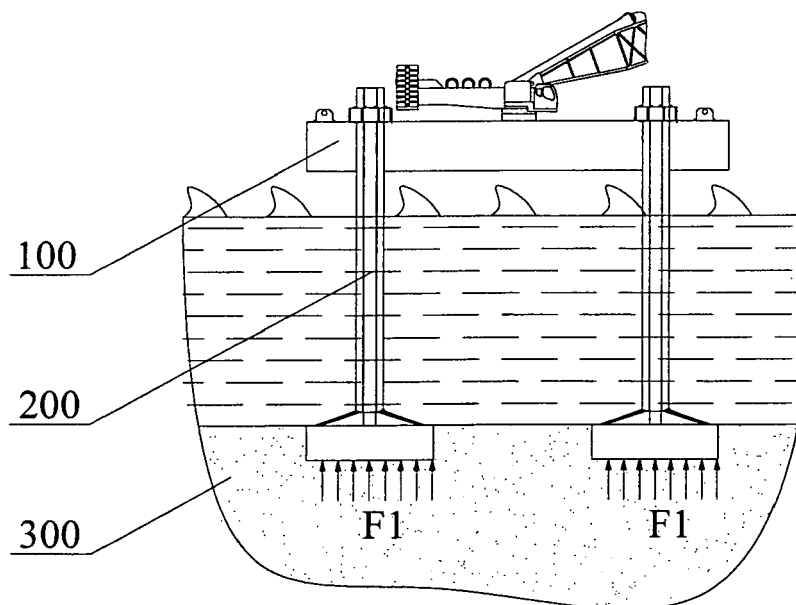


Figure 6

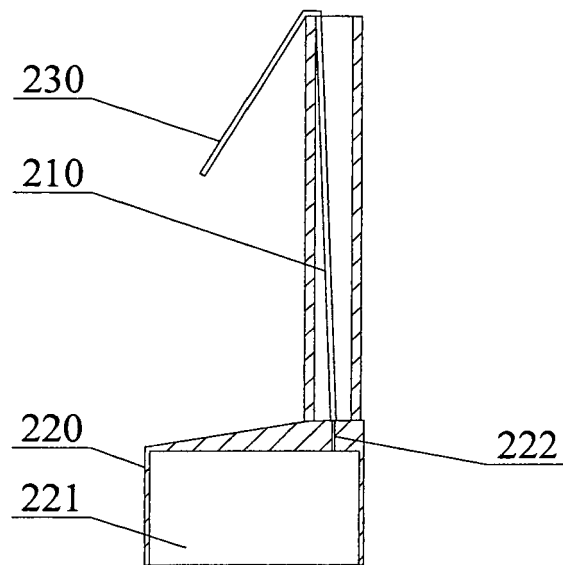


Figure 7

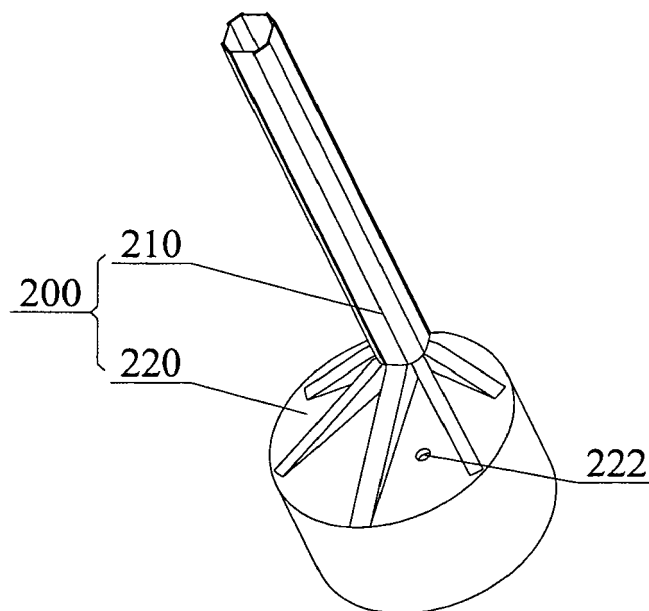


Figure 8

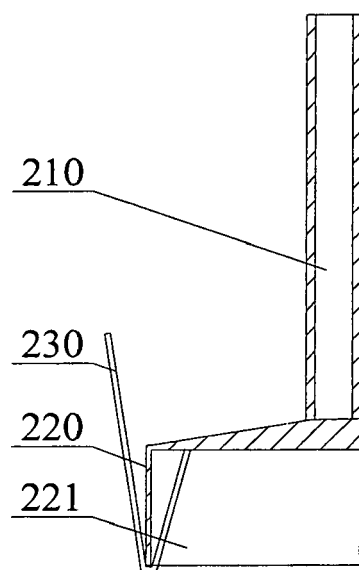


Figure 9

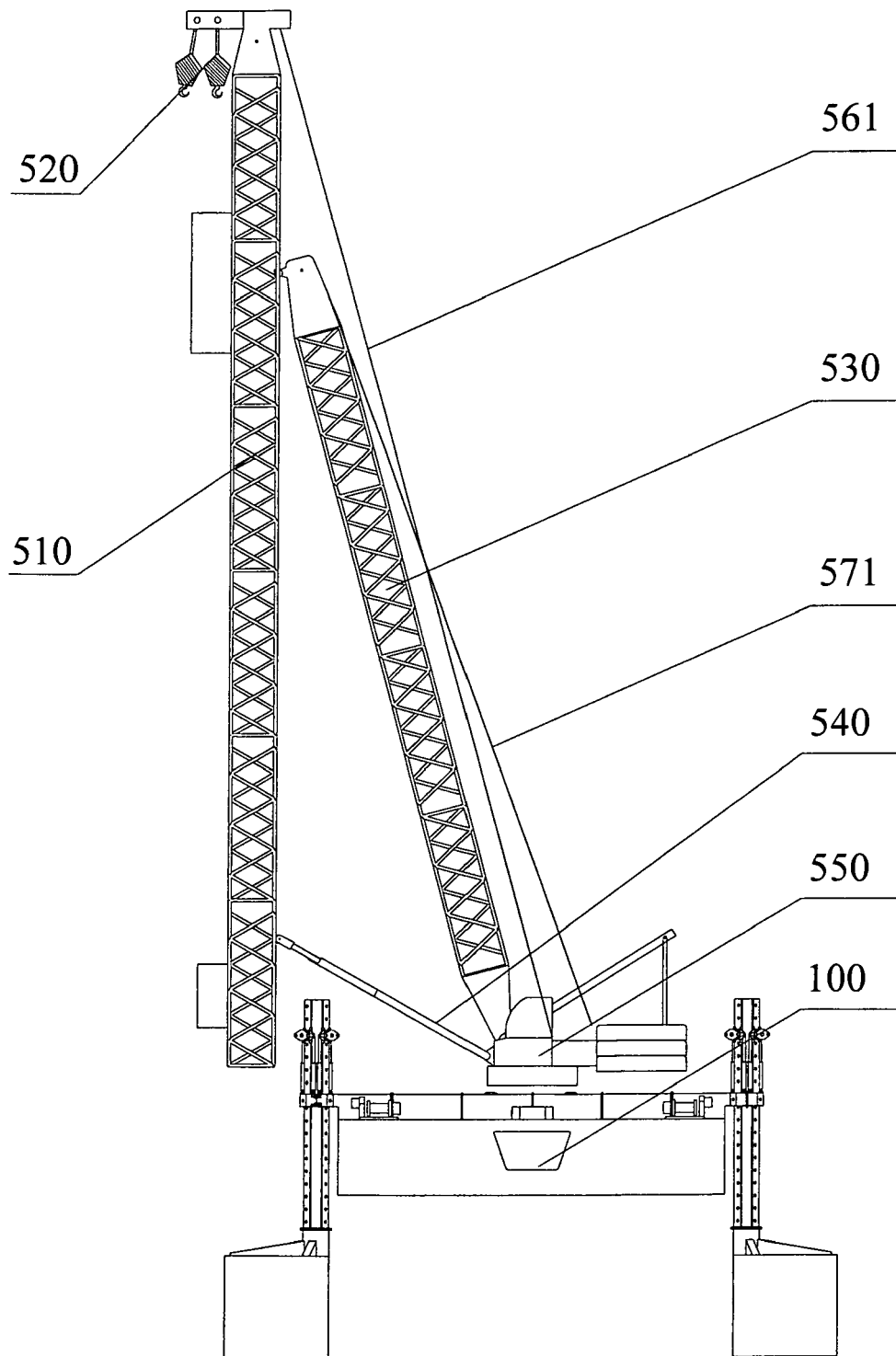


Figure 10

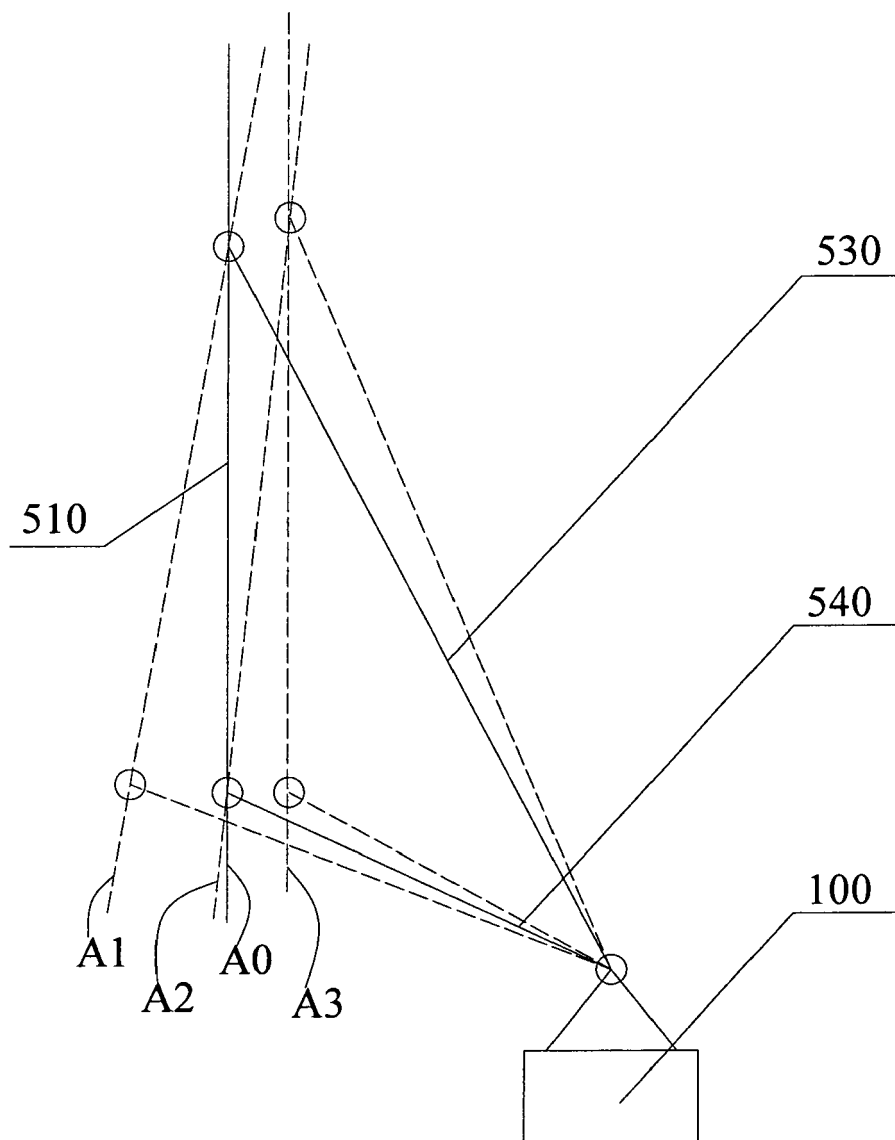


Figure 11