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(71) Applicants:
- **Shandong Marine Energy Co., Ltd.**
  Qingdao, Shandong 266000 (CN)
- **Shandong Offshore Equipment Co., Ltd.**
  Qingdao, Shandong 266000 (CN)
- **Shandong Offshore Research Institute Co., Ltd.**
  Qingdao, Shandong 266000 (CN)

(72) Inventors:
- **BAO, Jianying**
  Qingdao, Shandong 266000 (CN)
- **ZHAO, Xianfu**
  Qingdao, Shandong 266000 (CN)
- **YU, Bing**
  Qingdao, Shandong 266000 (CN)
- **LI, Yadong**
  Qingdao, Shandong 266000 (CN)
- **SUN, Yuanhui**
  Qingdao, Shandong 266000 (CN)
- **LIU, Xiquan**
  Qingdao, Shandong 266000 (CN)
- **LI, Yunfeng**
  Qingdao, Shandong 266000 (CN)
- **XIN, Peng**
  Qingdao, Shandong 266000 (CN)
- **LV, Tao**
  Qingdao, Shandong 266000 (CN)
- **LV, Xiaohui**
  Qingdao, Shandong 266000 (CN)

(74) Representative: **Bayramoglu et al.**
Mira Office
Kanuni Sultan Süleyman Boulevard 5387
Street Beytepe, floor 12, no:50
06800 Cankaya, Ankara (TR)

(54) INTEGRATED DISASSEMBLY SYSTEM AND DISASSEMBLY METHOD FOR LARGE OFFSHORE STRUCTURE

(57) An integrated disassembling and assembling system includes a semi-submersible vessel I (1), a semi-submersible vessel II (3), multiple lifting arms I (2), multiple lifting arms II (4), and an offshore structure (5), where a support I (6) and a support II (7) for the lifting arms I (2) are mounted on the semi-submersible vessel I (1) through bolts; a support I (6) and a support II (7) for the lifting arms II (4) are mounted on the semi-submersible vessel II (3) through bolts; the lifting arms I (2) are arranged on the semi-submersible vessel I (1) in parallel; the lifting arms II (4) are arranged on the semi-submersible vessel II (3) in parallel; the lifting arms I (2) and the lifting arms II (4) are provided with a lifting system having a three-way motion compensation function.

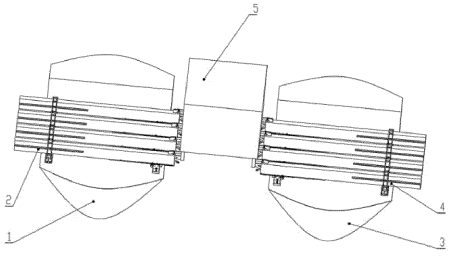

FIG. 1

EP 4 053 012 A1

Description

TECHNICAL FIELD

[0001] The present disclosure relates to an integrated disassembling and assembling system for a large offshore structure and a disassembling and assembling method, and belongs to the technical field of ocean engineering.

BACKGROUND

[0002] At present, people are experienced in disassembling and assembling methods for small offshore oilfield facilities in the world, and these facilities are usually disassembled or assembled by using a floating crane. However, oilfield facilities for mainstream seas represented by the North Sea in Europe are obviously large and complex. A blocked hoisting method and a single-vessel float-over method are usually used to disassemble or assemble these facilities. The blocked hoisting method requires offshore overall docking and system debugging, which take a long time. In addition, offshore debugging costs are far higher than onshore debugging costs. The single-vessel float-over method has a great limitation on an ultra-large offshore platform exceeding 10,000 tons. First, weight of the ultra-large offshore platform is limited by loading capacity of a single vessel. Second, applicability of the single-vessel float-over method is limited by a platform span, a support structure, space, and the like.

SUMMARY

[0003] To overcome the above defects in the prior art, the present disclosure provides an integrated disassembling and assembling system for a large offshore structure and a disassembling and assembling system to implement lifting jointly through fast de-ballasting for an entire vessel and fast lifting of hydraulic systems of lifting arms, such that an entire disassembling process takes a short time and has high efficiency.

[0004] The integrated disassembling and assembling system for a large offshore structure provided by the present disclosure may include a semi-submersible vessel I, a semi-submersible vessel II, multiple lifting arms I, multiple lifting arms II, and an offshore structure. A support I and a support II for the lifting arms I may be mounted on the semi-submersible vessel I through bolts. A support I and a support II for the lifting arms II may be mounted on the semi-submersible vessel II through bolts. The lifting arms I may be arranged on the semi-submersible vessel I in parallel. The lifting arms II may be arranged on the semi-submersible vessel II in parallel. The lifting arms I and the lifting arms II may be provided with a lifting system having a three-way motion compensation function. The lifting system may be provided with locking mechanisms for the lifting arms I and the lifting arms II. Before lifting, the locking mechanisms lock the lifting arms I and the lifting arms II may be in a front-back direction and a left-right direction; then, a lifting mechanism may lift the offshore structure up.

[0005] Preferably, the lifting system having the three-way motion compensation function further include a mobile cart I and a mobile cart II. A bottom at a front end of each of the lifting arms I/lifting arms II may be mounted at an upper end of the mobile cart I. A rear end of each of the lifting arms I/lifting arms II may be mounted at an upper end of the mobile cart II. A lower end of the mobile cart I is mounted on the support I. A lower end of the mobile cart II is mounted on the support II. The support I and the support II are respectively fixed on the semi-submersible vessel I and the semi-submersible vessel II. The lifting mechanism for driving a lifted object to move up and down is hinged to the front end of each of the lifting arms I/lifting arms II.

[0006] Preferably, a road wheel set and a road wheel are mounted on each of the mobile cart I and the mobile cart II. The road wheel set is mounted on rails that are of the lifting arms I/lifting arms II and are used for limiting up-down movement of a main arm. The road wheel is mounted on a rail of the support I or the support II. The lifting arms I/lifting arms II move left and right through the road wheel set, and move front and back through the road wheel. A locking mechanism meshed with a fixing rack of each of the lifting arms I/lifting arms II is mounted at the upper end of the mobile cart I; a locking mechanism meshed with a fixing rack of the support I is mounted at the lower end of the mobile cart I.

[0007] Preferably, each of the locking mechanisms includes a locking rack whose section takes the shape of an inverted trapezoid. The locking rack is disposed on a side of the fixing rack. Two adjustment hydraulic cylinders are hinged to a bottom of the locking rack. A structure defined by the adjustment hydraulic cylinders has a certain included angle and takes the shape of inverted V. Two locking sliders are movably disposed on a left side and a right side of the locking rack. Each of the locking sliders slides uni-directionally along a slide rail and is provided with an inclined surface matched with the locking rack. The adjustment hydraulic cylinders push the locking rack into the fixing rack; the locking rack and the fixing rack are meshed with each other. When the two locking sliders approach the locking rack, the inclined surfaces of the two locking sliders are fitted with inclined surfaces of the locking rack.

[0008] Preferably, a dynamic positioning (DP) system is provided on each of the semi-submersible vessel I and the semi-submersible vessel II that are respectively disposed on two sides of the offshore structure.

[0009] Preferably, the lifting mechanism is static relative to the offshore structure before the DP systems having a positioning function and the lifting arms having a compensation function jointly implement lifting.

[0010] Preferably, the integrated disassembling and assembling system further includes a semi-submersible vessel III. The lifting arms of the semi-submersible vessel

I and the semi-submersible vessel II act simultaneously to unload the offshore structure to the semi-submersible vessel III.

[0011] Preferably, multiple controllable cabins are provided on each of the semi-submersible vessel I and the semi-submersible vessel II, and a waterline of each of the cabins is controlled by a pneumatic pump.

[0012] Preferably, the cabins include a bottom cabin, as well as a middle cabin, a left cabin, and a right cabin that are disposed above the bottom cabin; each of the left cabin and the right cabin includes a high-position cabin and a low-position cabin.

[0013] The disassembling and assembling method for the integrated disassembling and assembling system for a large offshore structure in the present disclosure may include the following steps:

step 1: before joint lifting, ballasting the semi-submersible vessel I and the semi-submersible vessel II to achieve a specified waterline;

step 2: when joint lifting starts, de-ballasting the semi-submersible vessel I and the semi-submersible vessel II fast by using the pneumatic pumps, such that 90% of the weight of the offshore structure can be borne without changing a waterline of an entire vessel;

step 3: during joint lifting, instantly lifting the offshore structure to a specified height by using the lifting arms I and the lifting arms II of the semi-submersible vessel I and the semi-submersible vessel II, where ballast water is transferred from the high-position cabins to the low-position cabins under the action of aerodynamic force and water gravity at this time, thereby leveling the offshore structure and the entire vessel; and

step 4: fast transferring ballast water from the high-position cabins to the low-position cabins when unloading the offshore structure, thereby keeping the entire vessel in a leveled state.

[0014] The present disclosure has the following beneficial effects:

(1) Owing to the combined action of the two vessels in the present disclosure, the system and the method are theoretically unconstrained by a size of the offshore structure.

(2) The number of the lifting arms on the two vessels can be adjusted based on weight of the offshore structure; and an extended length and an extended position of each of the lifting arms can be adjusted based on a configuration of the offshore structure and space where the offshore structure is.

(3) The offshore structure is static relative to the offshore structure before the DP systems that have the positioning function and are of the semi-submersible vessels and the lifting arms that have the compensation function jointly implement lifting.

(4) According to the present disclosure, the lifting arms are fixedly connected to the vessel bodies through the bolts. When there is no need for disassembly and assembly, the lifting arms can be removed, such that the semi-submersible vessels can be used as transport vessels.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015]

FIG. 1 is a schematic structural diagram of the present disclosure;

FIG. 2 is a schematic structural diagram of a lifting system having a three-way motion compensation function;

FIG. 3 is a three-dimensional diagram of an upper portion of a mobile cart I;

FIG. 4 is a three-dimensional diagram of a bottom of a mobile cart I;

FIG. 5 is a schematic structural diagram of a locking mechanism;

FIG. 6 is a diagram of a state I of a semi-submersible vessel I and a semi-submersible vessel II;

FIG. 7 is a diagram of a state II of a semi-submersible vessel I and a semi-submersible vessel II;

FIG. 8 is a diagram of a state of a semi-submersible vessel III; and

FIG. 9(a) to FIG. 9(d) are diagrams of states in different steps of ballast water-based load adjustment.

[0016] Reference numerals in the accompanying drawings are as follows: 1-semi-submersible vessel I; 2-lifting arm I; 3-semi-submersible vessel II; 4-lifting arm II; 5-offshore structure; 6-support I; 7-support II; 8-lifting mechanism; 9-semi-submersible vessel III; 10-mobile cart I; 11-mobile cart II; 12-locking rack; 13-fixing rack; 14-adjustment hydraulic cylinder; and 15-locking slider.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0017] The technical solutions in the embodiments of the present disclosure will be described below clearly and completely with reference to the accompanying drawings in the embodiments of the present disclosure. Apparently, the described embodiments are merely some rather than all of the embodiments of the present disclosure. All other examples obtained by a person of ordinary skill in the art based on the examples of the present disclosure without creative efforts shall fall within the protection scope of the present disclosure.

Embodiment 1:

[0018] As shown in FIG. 1 to FIG. 8, an integrated disassembling and assembling system for a large offshore structure includes a semi-submersible vessel I 1, a semi-submersible vessel II 3, multiple lifting arms I 2, multiple

lifting arms II 4, and an offshore structure 5, where a support I 6 and a support II 7 for the lifting arms I 2 are mounted on the semi-submersible vessel I 1 through bolts. A support I 6 and a support II 7 for the lifting arms II 4 are mounted on the semi-submersible vessel II 3 through bolts. The lifting arms I 2 are arranged on the semi-submersible vessel I 1 in parallel; the lifting arms II 4 are arranged on the semi-submersible vessel II 3 in parallel. The lifting arms I 2 and the lifting arms II 4 are provided with a lifting system having a three-way motion compensation function. The lifting system is provided with locking mechanisms for the lifting arms I 2 and the lifting arms II 4. Before lifting, the locking mechanisms lock the lifting arms I 2 and the lifting arms II 4 in a front-back direction and a left-right direction, and then, a lifting mechanism 8 lifts the offshore structure 5 up.

[0019] As shown in FIG. 2, the lifting system having the three-way motion compensation function further includes a mobile cart I 10 and a mobile cart II 11, where a bottom at a front end of each of the lifting arms I 2/lifting arms II 4 is mounted at an upper end of the mobile cart I 10. A rear end of each of the lifting arms I 2/lifting arms II 4 is mounted at an upper end of the mobile cart II 11. A lower end of the mobile cart I 10 is mounted on the support I 6. A lower end of the mobile cart II 11 is mounted on the support II 7. The support I 6 and the support II 7 are respectively fixed on the semi-submersible vessel I 1 and the semi-submersible vessel II 3. The lifting mechanism 8 for driving a lifted object to move up and down is hinged to the front end of each of the lifting arms I 2/lifting arms II 4.

[0020] As shown in FIG. 3 and FIG. 4, a road wheel set and a road wheel are mounted on each of the mobile cart I 10 and the mobile cart II 11.The road wheel set is mounted on rails that are on the lifting arms I 2/lifting arms II 4 and are used for limiting up-down movement of a main arm. The road wheel is mounted on a rail of the support I 6 or the support II 7. The lifting arms I 2/lifting arms II 4 move left and right through the road wheel set and move front and back through the road wheel. A locking mechanism meshed with a fixing rack 13 of each of the lifting arms I 2/lifting arms II 4 is mounted at the upper end of the mobile cart I 10. A locking mechanism meshed with a fixing rack 13 of the support I 6 is mounted at the lower end of the mobile cart I 10.

[0021] As shown in FIG. 5, each of the locking mechanisms includes a locking rack 12 whose section takes the shape of an inverted trapezoid, where the locking rack 12 is disposed on a side of the fixing rack 13. Two adjustment hydraulic cylinders 14 are hinged to a bottom of the locking rack 12. A structure defined by the adjustment hydraulic cylinders has a certain included angle and takes the shape of inverted V. Two locking sliders 15 are movably disposed on a left side and a right side of the locking rack 12. Each of the locking sliders 15 slides unidirectionally along a slide rail and is provided with an inclined surface matched with the locking rack 12. The adjustment hydraulic cylinders 14 push the locking rack 12 into the fixing rack 13; the locking rack 12 and the fixing rack 13 are meshed with each other. When the two locking sliders 15 approach the locking rack 12, the inclined surfaces of the two locking sliders 15 are fitted with inclined surfaces of the locking rack 12.

[0022] As shown in FIG. 6, a dynamic positioning (DP) system is provided on each of the semi-submersible vessel I 1 and the semi-submersible vessel II 3 that are respectively disposed on two sides of the offshore structure 5.

[0023] The offshore structure 5 is static relative to the offshore structure 5 before the DP systems having a positioning function and the lifting arms having a compensation function jointly implement lifting.

[0024] As shown in FIG. 7 and FIG. 8, the integrated disassembling and assembling system further includes a semi-submersible vessel III 9. The lifting arms of the semi-submersible vessel I 1 and the semi-submersible vessel II 3 act simultaneously to unload the offshore structure 5 to the semi-submersible vessel III 9.

[0025] Multiple controllable cabins are provided on each of the semi-submersible vessel I 1 and the semi-submersible vessel II 3, and a waterline of each of the cabins is controlled by a pneumatic pump.

[0026] As shown in FIG. 9(a) to 9(d), the cabins include a bottom cabin, as well as a middle cabin, a left cabin, and a right cabin that are disposed above the bottom cabin; each of the left cabin and the right cabin includes a high-position cabin and a low-position cabin.

[0027] A process of using the system is as follows: To disassemble the offshore structure 5, the semi-submersible vessel I 1 and the semi-submersible vessel II 3 approach the offshore structure 5 from two sides. The two semi-submersible vessels are positioned relative to the offshore structure 5 by using the DP systems of the semi-submersible vessels. The lifting arms I 2 and the lifting arms II 4 reach a lifting point of the offshore structure 5 through front-back and left-right movements. Because the positioning function of the DP systems of the semi-submersible vessels is insufficient to make the offshore structure 5 static, a three-way compensation function of the lifting arms needs to be enabled at this time. The semi-submersible vessel I 1 and the semi-submersible vessel II 3 are de-ballasted, such that 5% of the load of the offshore structure is transferred to the lifting arms and the semi-submersible vessels. Before lifting, the locking mechanisms lock the lifting arms I 2 and lifting arms II 4 in the front-back direction and the left-right direction; and then, the lifting mechanism 8 lifts the offshore structure 5 up fast. The semi-submersible vessel I 1 and the semi-submersible vessel II 3 carry the offshore structure 5 and move synchronously to leave a supporting position of the offshore structure 5. The semi-submersible vessel III 9 moves to a position between the semi-submersible vessel I 1 and the semi-submersible vessel II 3; and then, the lifting arms of the semi-submersible vessel I 1 and the semi-submersible vessel II 3 synchronously unload, to the semi-submersible vessel III 9, the offshore struc-

ture 5 that has been disassembled. The semi-submersible vessel III 9 carrying the offshore structure 5 moves to a wharf and slides ashore.

Embodiment 2:

[0028] An objective of the present disclosure is to provide an integrated disassembling and assembling method for a large offshore structure 5, which can implement disassembling or assembling of offshore structures 5, such as a jacket platform, a pile group platform, or a column leg platform, and is particularly suitable for disassembling or assembling an ultra-large platform block that exceeds one ton.

[0029] The disassembling and assembling method for the integrated disassembling and assembling system for an offshore oilfield facility in the present disclosure may include the following steps:

Step 1: Before joint lifting, ballast the semi-submersible vessel I 1 and the semi-submersible vessel II 3 to achieve a specified waterline, as shown in FIG. 9(a).

Step 2: When joint lifting starts, de-ballast the semi-submersible vessel I and the semi-submersible vessel II fast by using the pneumatic pumps, such that 90% of the weight of the offshore structure 5 can be borne without changing a waterline of an entire vessel, as shown in FIG. 9(b).

Step 3: During joint lifting, instantly lift the heavy object to a specified height by using the lifting arms of the semi-submersible vessel I 1 and the semi-submersible vessel II 3, where ballast water is transferred from the high-position cabins to the low-position cabins under the action of aerodynamic force and water gravity at the same time, thereby leveling the offshore structure 5 and the entire vessel, as shown in FIG. 9(c).

Step 4: Fast transfer ballast water from the high-position cabins to the low-position cabins when unloading the offshore structure 5, thereby keeping the entire vessel in a leveled state, as shown in FIG. 9(d).

(1) Owing to the combined action of the two vessels in the present disclosure, the system and the method are theoretically unconstrained by a size of the offshore structure 5.

(2) The number of the lifting arms on the two vessels can be adjusted based on weight of the offshore structure 5; an extended length and an extended position of each of the lifting arms can be adjusted based on a structure of the offshore structure 5 and space where the offshore structure 5 is.

(3) The offshore structure 5 is static before the DP systems that have the positioning function and are of the semi-submersible vessels and the lifting arms that have the compensation function jointly implement lifting.

(4) According to the present disclosure, the lifting arms are fixedly connected to the vessel bodies through the bolts. When there is no need for disassembly and assembly, the lifting arms can be removed, such that the semi-submersible vessels can be used as transport vessels.

[0030] It should be noted that in this specification, relational terms such as first and second are used only to differentiate an entity or operation from another entity or operation, and do not require or imply that any actual relationship or sequence exists between these entities or operations. In addition, terms "include", "comprise", or any other variants thereof are intended to cover a non-exclusive inclusion, such that a process, a method, an article, or a device that includes a list of elements not only includes those elements, but also includes other elements that are not explicitly listed, or further includes elements inherent to the process, the method, the article, or the device.

[0031] Although the embodiments of the present disclosure have been illustrated and described, it should be understood that those of ordinary skill in the art may make various changes, modifications, replacements, and variations to the above embodiments without departing from the principle and spirit of the present disclosure, and the scope of the present disclosure is limited by the appended claims and their equivalents.

Claims

1. An integrated disassembling and assembling system for a large offshore structure, comprising

a semi-submersible vessel I (1),
a semi-submersible vessel II (3),
multiple lifting arms I (2), multiple lifting arms II (4), and
an offshore structure (5), **characterized in that**
a support I (6) and a support II (7) for the lifting arms I (2) are mounted on the semi-submersible vessel I (1) through bolts;
a support I (6) and a support II (7) for the lifting arms II (4) are mounted on the semi-submersible vessel II (3) through bolts;
the lifting arms I (2) are arranged on the semi-submersible vessel I (1) in parallel;
the lifting arms II (4) are arranged on the semi-submersible vessel II (3) in parallel;
the lifting arms I (2) and the lifting arms II (4) are provided with a lifting system having a three-way motion compensation function;
the lifting system is provided with locking mechanisms;
before lifting, the locking mechanisms is configured to lock the lifting arms I (2) and the lifting

arms II (4) in a front-back direction and a left-right direction, and a lifting mechanism (8) is configured to lift the offshore structure (5) up.

2. The integrated disassembling and assembling system for a large offshore structure according to claim 1, **characterized in that** the lifting system having the three-way motion compensation function further comprises

a mobile cart I (10) and
a mobile cart II (11);
a bottom at a front end of each of the lifting arms I (2)/lifting arms II (4) is mounted at an upper end of the mobile cart I (10);
a rear end of each of the lifting arms I (2)/lifting arms II (4) is mounted at an upper end of the mobile cart II (11);
a lower end of the mobile cart I (10) is mounted on the support I (6);
a lower end of the mobile cart II (11) is mounted on the support II (7);
the support I (6) and the support II (7) are respectively fixed on the semi-submersible vessel I (1) and the semi-submersible vessel II (3); and
the lifting mechanism (8) is configured for driving a lifted object to move up and down and is hinged to the front end of each of the lifting arms I (2)/lifting arms II (4).

3. The integrated disassembling and assembling system for a large offshore structure according to claim 2, **characterized in that**

a road wheel set and a road wheel are mounted on each of the mobile cart I (10) and the mobile cart II (11);
the road wheel set is mounted on rails of the lifting arms I (2)/lifting arms II (4) and the rail are configured for limiting up-down movement of a main arm;
the road wheel is mounted on a rail of the support I (6) or the support II (7); and
the lifting arms I (2)/lifting arms II (4) move left and right through the road wheel set, and move front and back through the road wheel; and
a locking mechanism meshed with a fixing rack (13) of each of the lifting arms I (2)/lifting arms II (4) is mounted at the upper end of the mobile cart I (10); and
a locking mechanism meshed with a fixing rack (13) of the support I (6) is mounted at the lower end of the mobile cart I (10).

4. The integrated disassembling and assembling system for a large offshore structure according to claim 3, **characterized in that**

each of the locking mechanisms comprises a locking rack (12) having a shape of an inverted trapezoid;
the locking rack (12) is disposed on a side of the fixing rack (13);
two adjustment hydraulic cylinders (14) are hinged to a bottom of the locking rack (12);
a structure defined by the adjustment hydraulic cylinders has a certain included angle and takes the shape of inverted V;
two locking sliders (15) are movably disposed on a left side and a right side of the locking rack (12);
each of the locking sliders (15) slides uni-directionally along a slide rail, and is provided with an inclined surface matched with the locking rack (12);
the adjustment hydraulic cylinders (14) push the locking rack (12) into the fixing rack (13);
the locking rack (12) and the fixing rack (13) are meshed with each other;
the two locking sliders (15) approach the locking rack (12); and
the inclined surfaces of the two locking sliders (15) are configured to fit with inclined surfaces of the locking rack (12).

5. The integrated disassembling and assembling system for a large offshore structure according to claim 1, **characterized in that**
a dynamic positioning (DP) system is provided on each of the semi-submersible vessel I (1) and the semi-submersible vessel II (3) that are respectively disposed on two sides of the offshore structure (5).

6. The integrated disassembling and assembling system for a large offshore structure according to claim 5, **characterized in that** the lifting mechanism (8) is static relative to the offshore structure (5) before the DP systems performing a positioning function and the lifting arms performing a compensation function jointly implement lifting.

7. The integrated disassembling and assembling system for a large offshore structure according to claim 1, **characterized in that** the integrated disassembling and assembling system further comprises

a semi-submersible vessel III (9); and
the lifting arms of the semi-submersible vessel I (1) and the semi-submersible vessel II (3) are configured to act simultaneously to unload the offshore structure (5) to the semi-submersible vessel III (9).

8. The integrated disassembling and assembling system for a large offshore structure according to claim 1, **characterized in that**

controllable cabins are provided on each of the semi-submersible vessel I (1) and the semi-submersible vessel II (3); and
a waterline of each of the cabins is controlled by a pneumatic pump.

9. The integrated disassembling and assembling system for a large offshore structure according to claim 8, **characterized in that** the cabins comprise a bottom cabin, a middle cabin, a left cabin, and a right cabin, wherein the middle cabin, the left cabin and the right cabin are disposed above the bottom cabin; and each of the left cabin and the right cabin comprises a high-position cabin and a low-position cabin.

10. A disassembling and assembling method based on the integrated disassembling and assembling system for a large offshore structure according to any one of claims 1 to 9, **characterized by** comprising the following steps:

step 1: before joint lifting, ballasting the semi-submersible vessel I (1) and the semi-submersible vessel II (3) to achieve a specified waterline;
step 2: when joint lifting starts, quickly de-ballasting the semi-submersible vessel I (1) and the semi-submersible vessel II (3) by using the pneumatic pumps, such that 90% of weight of the offshore structure (5) can be borne without changing a waterline of an entire vessel;
step 3: during joint lifting, instantly lifting the offshore structure (5) to a specified height by using the lifting arms I (2) and the lifting arms II (4) of the semi-submersible vessel I (1) and the semi-submersible vessel II (3), wherein ballast water is transferred from the high-position cabins to the low-position cabins under the action of aerodynamic force and water gravity at this time, to level the offshore structure (5) and the entire vessel; and
step 4: quickly transferring ballast water from the high-position cabins to the low-position cabins when unloading the offshore structure (5), to keep the entire vessel in a leveled state.

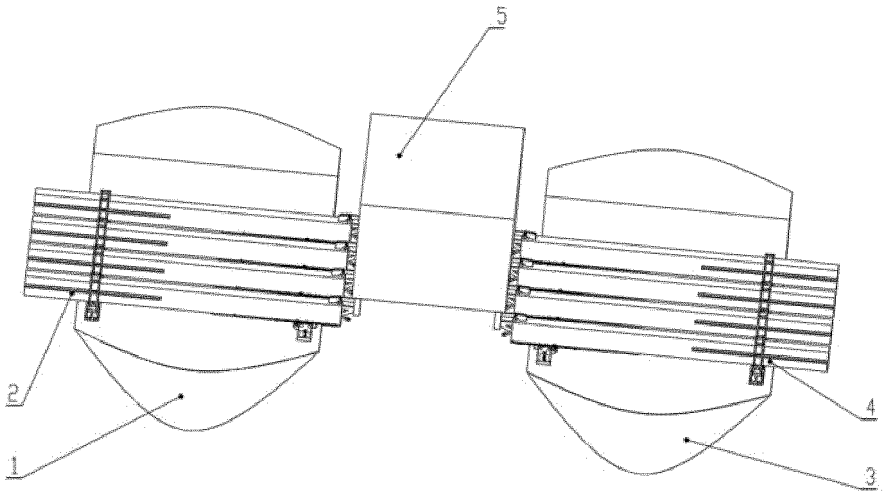

FIG. 1

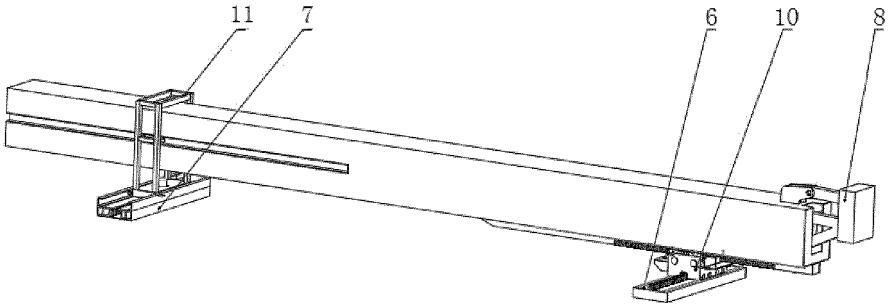

FIG. 2

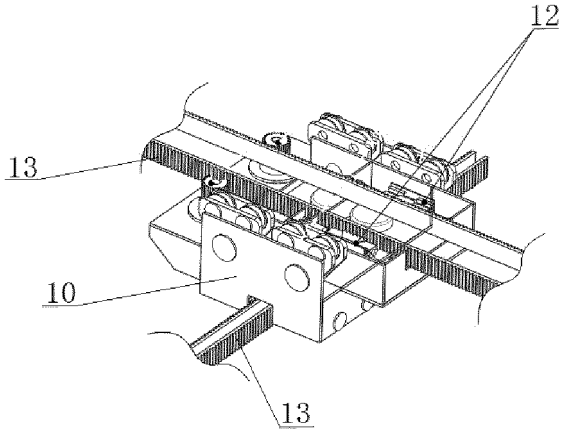

FIG. 3

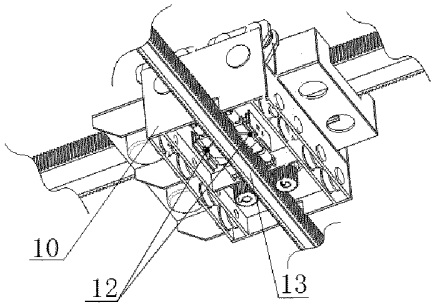

FIG. 4

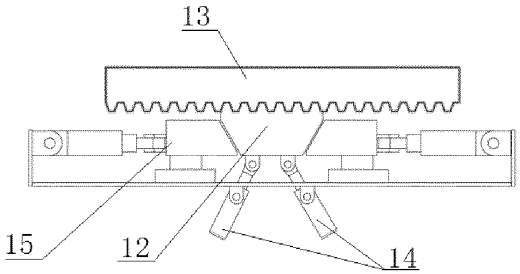

FIG. 5

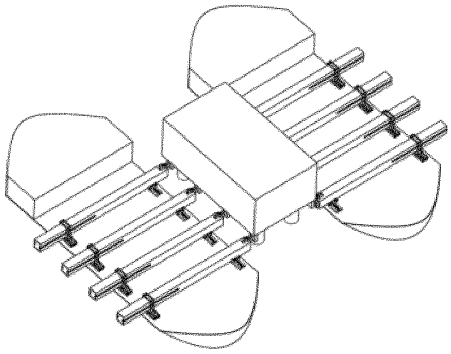

FIG. 6

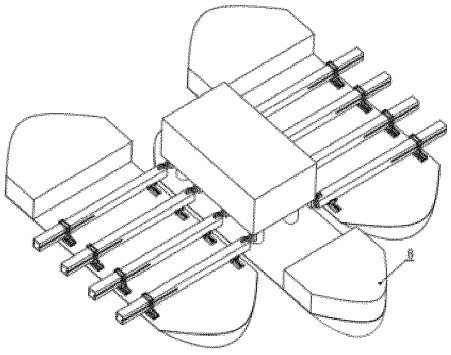

FIG. 7

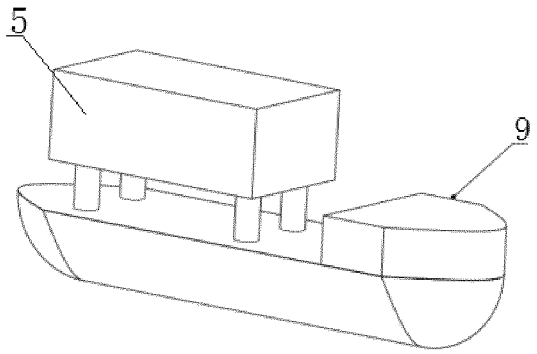

FIG. 8

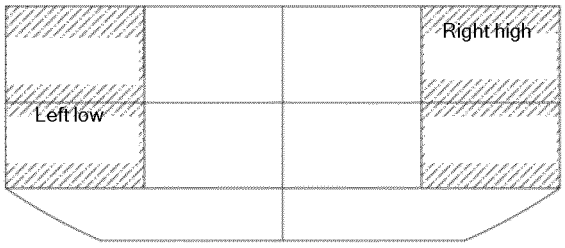

FIG. 9(a)

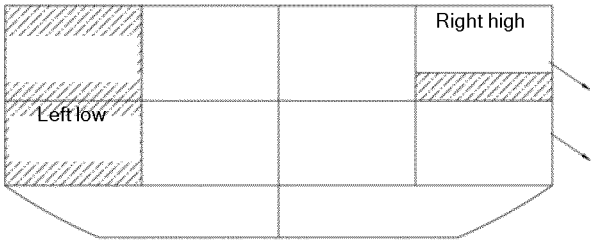

FIG. 9(b)

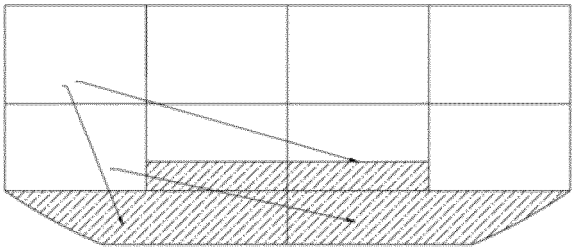

FIG. 9(c)

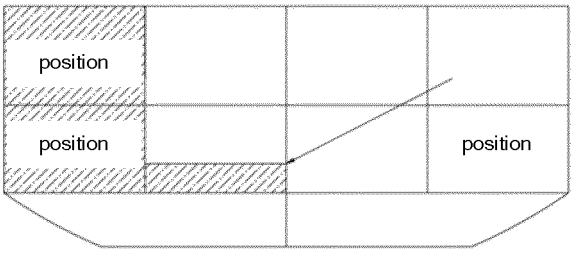

FIG. 9(d)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2020/136068

A. CLASSIFICATION OF SUBJECT MATTER

B63B 75/00(2020.01)i; B63B 85/00(2020.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B63B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNPAT, WPI, EPODOC, CNKI: 拆装, 拆卸, 装卸, 拆除, 海上, 海洋, 举升, 提升, 抬升, 抬起, 双船, 两船, 俩船, 两条船, 两只船, 半潜, 移动小车, 三向移动补偿, 控制, 调整; dismount+, detach+, +hoist+, sea, +lift+, rise?, rising, rised, rais+, put+ up, doubl+, two+, dual+, semi-submersible, control+, adjust+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 111038662 A (SHANDONG MARINE ENERGY CO., LTD. et al.) 21 April 2020 (2020-04-21) claims, description, specific embodiments, figures 1-9	1-10
PX	CN 211364878 U (SHANDONG MARINE ENERGY CO., LTD. et al.) 28 August 2020 (2020-08-28) claims, description, specific embodiments, figures 1-9	1-10
X	CN 109799519 A (SHANGHAI JIAO TONG UNIVERSITY) 24 May 2019 (2019-05-24) description, paragraph 5, specific embodiments, figures 1-5	1, 5-10
X	CN 105151239 A (CHINA NATIONAL OFFSHORE OIL CORPORATION et al.) 16 December 2015 (2015-12-16) description, specific embodiments, and figures 1-5	1, 5-10
X	CN 105035260 A (CHINA NATIONAL OFFSHORE OIL CORPORATION et al.) 11 November 2015 (2015-11-11) description, specific embodiments, and figures 1-5	1, 5-10

☑ Further documents are listed in the continuation of Box C. ☑ See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
26 February 2021	**15 March 2021**
Name and mailing address of the ISA/CN **China National Intellectual Property Administration (ISA/CN)** **No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088** **China**	Authorized officer
Facsimile No. **(86-10)62019451**	Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2020/136068

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	CN 110155273 A (DALIAN MARITIME UNIVERSITY) 23 August 2019 (2019-08-23) entire document	1-10
A	US 2018312222 A1 (VERSABAR INC.) 01 November 2018 (2018-11-01) entire document	1-10

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
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Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
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CN 203473191 U	12 March 2014	None	
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