

DESCRIPTION

FLOATING INSTALLATION PROVIDED WITH RISER SUPPORT STRUCTURE

5 TECHNICAL FIELD

[0001] The present invention relates to a mounting structure for a riser support structure mounted on a shell plate of a floating installation.

BACKGROUND ART

10 [0002] A Floating Production Storage and Offloading Installation (FPSO Installation) and a Tension-Leg Platform (TLP) are provided with a number of riser pipes that interconnect the seabed and the marine facility so that fluid such as crude oil, gas, sea water, etc., can be transported
15 through the riser pipes. The riser pipes have flexibility and are led in through a guide provided on a shell plate near a keel and fixed in the horizontal direction (see Patent Document 1).

PRIOR ART DOCUMENT

20 PATENT DOCUMENT

[0003] PATENT DOCUMENT 1: NATIONAL PUBLICATION OF THE TRANSLATED VERSION No. 2006-519137

SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

25 [0004] In the configuration disclosed in Patent Document 1,

the risers are laterally supported by keel guides provided below water and vertically suspended by a tenser provided on a deck above water. However, also known is a configuration that horizontally and vertically supports the risers by a riser support structure provided on a shell plate of a floating installation above or below the draft. In such a configuration, a high structural strength is required to support a riser that connects the oil well at the seabed and the floating installation. Therefore, it is preferable to configure a riser support structure as a steel structure integrated with the shell plate of the floating installation. The configuration of a riser support structure depends on types and arrangement of risers, on the other hand, it generally takes time to decide the final arrangement of the risers. Thereby, in some occasions, the types and arrangement of the risers may be changed after the construction of the floating installation has started, and in that case, reconfiguring is required.

[0005] The present invention aims to efficiently construct a floating installation provided with a riser support structure, even though the type and arrangement of the riser pipes have not been decided.

MEANS TO SOLVE THE PROBLEMS

[0006] A floating installation of the present invention comprises a shell plate and a riser support structure that is

mounted on the outside of the shell plate, wherein a mounting-base structure for mounting the riser support structure is provided on the shell plate.

[0007] The floating installation comprises a web frame
5 provided vertically along an inner side of the shell plate and preferably, the web frame is structurally reinforced at a position where the riser support structure is attached. The riser support structure may comprise a riser-pipe support portion through which the riser is inserted for retaining and
10 fixing the riser and the mounting-base structure is configured as a structure supporting the riser-pipe support portion. Further, the configuration of the riser support may be divided into a riser-pipe support portion through which the riser is inserted for retaining and fixing the riser and
15 a structure attached to the shell plate via the mounting-base structure for supporting the riser-pipe support portion. The structure supporting the riser-pipe support portion may be configured as a bracket member.

[0008] For example, the riser-pipe support portion is
20 attached to the structure supporting the riser-pipe support portion after the structure supporting the riser pipe support portion is attached to the shell plate of the floating installation. The riser-pipe support portion may have a unit structure comprising two risers in a unit. Further, the
25 riser-pipe support portion may also have a unit structure

comprising one riser in a unit. For example, the riser-pipe support portion comprises a top plate and two of the unit structures can be attached to the top plate; the top plate is provided with an opening in which both ends in the longitudinal direction are arc shaped, and the unit structure is attached to each of the arc-shaped ends. In such case, the unit structure comprises a half-circumferential flange portion adapted to the arcuate shape. The riser-pipe support portion may be disposed above the draft. Further, the riser-pipe support portion may be disposed below the draft.

[0009] A method of the present invention is for constructing the floating installation that includes the shell plate and the riser support structure attached to the outside of the shell plate. The method comprises providing the mounting-base structure for attaching the riser support portion to the shell plate; configuring the riser support portion by dividing it into the riser-pipe support portion through which a riser is inserted for retaining and fixing the riser and the structure attached to the shell plate via the mounting-base structure for supporting the riser-pipe support portion; and attaching the riser-pipe support portion to a structure supporting the riser-pipe support portion after attaching the structure supporting the riser-pipe support portion to the shell plate.

EFFECT OF THE INVENTION

[0010] According to the present invention, a floating installation provided with a riser support-structure can be efficiently constructed even though the type and arrangement of the riser pipes have not been decided.

5 BRIEF DESCRIPTION OF THE DRAWINGS

[0011]

[FIG. 1] A partial cross-sectional view of a floating installation according to a first embodiment of the present invention.

10 [FIG. 2] A view showing a manner in which a riser-support structure is attached to the floating installation in the first embodiment.

[FIG. 3] An enlarged view of a portion surrounded by a frame "A" in FIG. 1 when there is no opening such as a manhole.

15 [FIG. 4] An enlarged view of a portion surrounded by a frame "A" in FIG. 1 when there is an opening such as a manhole.

[FIG. 5] A view showing a manner in which the riser support structure is attached to the floating installation in a first variation.

20 [FIG. 6] A view showing a manner in which the riser support structure is attached to the floating installation in a second variation.

[FIG. 7] A perspective view showing a configuration of a riser-pipe support portion unit of a second embodiment.

25 [FIG. 8] A plan view showing a manner of attaching the riser-

pipe support portion unit of FIG. 7.

[FIG. 9] A perspective view showing a configuration of a riser-pipe support portion unit of a third embodiment.

[FIG. 10] A plan view showing a manner of attaching the
5 riser-pipe support portion unit of FIG. 9.

[FIG. 11] A partial cross-sectional view of a floating installation of a fourth embodiment.

DESCRIPTION OF THE EMBODIMENTS

[0012] Embodiments of the present invention will be described
10 below with reference to the accompanying drawings. FIG. 1 is a partial cross-sectional view of a floating installation according to a first embodiment of the present invention.

[0013] The floating installation 10 of the present embodiment is a ship-shaped FPSO installation provided with processing
15 facilities for processing hydrocarbons such as crude oil and gas. For example, the floating installation 10 is constructed by means of a modular construction method where the body is divided into blocks in the longitudinal direction and each block is joined together in the final step to
20 configure the entire body. After construction, the floating installation 10 is transported to an installation sea area (or fresh-water area), by self-propulsion or by towing, and a large number of flexible riser pipes R are attached after mooring in the sea area (fresh-water area).

25 [0014] The riser pipe R is led to the seabed along the shell

plate 12 of the floating installation 10, and on the outside of the shell plate 12, a riser-support structure 14 for fixing the horizontal and vertical positions of each riser pipe R is attached. The riser-support structure 14 is disposed on the upper side of the shell plate 12 along the longitudinal direction of the floating installation 10. FIG. 1 is a cross-sectional view of the riser-support structure 14 and the shell plate 12 of the floating installation 10 at the same position.

[0015] The riser-support structure 14 includes an upper riser-support structure 14A that supports and fixes the riser pipe R on the upper side of the side shell plate 12; and a lower riser-support structure 14B that supports the riser pipe R, which for example hangs down into the sea from an area close to a bilge beneath the draft, on the lower side of the side shell plate 12. The upper riser-support structure 14A includes a riser-pipe support portion 16 through which the riser pipe R is inserted and in turn supported and fixed, attachment structures 18 and 19, and a bracket member 20. The bracket members 20 may be provided as a plate-like structure having an inverted right-angled triangle shape, and are attached to the outside of the shell plate 12 at a predetermined interval along the longitudinal direction of the floating installation 10. The riser-pipe support portion 16 is bridged over the bracket members 20 between the tops of

the bracket members 20. Further, the lower riser-support structure 14B is mainly composed of, for example, a guide tube that restricts horizontal movement of the riser pipe R.

[0016] In the first embodiment, the riser-pipe support portion 16, the attached structures 18, 19, and the bracket member 20 of the upper riser-support structure 14A are preassembled in units of a predetermined length, and after the modules of the floating installation 10 are assembled, the upper riser-support structures 14A are attached thereto.

10 The upper riser-support structures 14A, which are integrated as shown in FIG. 2, are attached to the outside of the shell plate 12 of the floating installation 10 using welding or the like. The lower riser-support structures 14B, which are preassembled as shown in FIG. 2, are also attached to the

15 outside of the shell plate 12 of the floating installation 10 by using welding or the like, after the modules of the floating installation 10 are assembled.

[0017] In the present embodiment, each of the upper riser-support structure 14A and the lower riser-support structure

20 14B is attached to the floating installation 10 via each of mounting-base structures 22A and 22B. That is, the mounting-base structures 22A and 22B are elongated members (for example, T-shaped structures) having lengths corresponding to the vertical length of the upper riser-support structure 14A

25 and the lower riser-support structure 14B, respectively.

During construction of each of the modules, the mounting-base structures 22A and 22B are attached along the vertical direction on the outside of the shell plate 12, at positions corresponding to each mounting position of the bracket member 20 and each mounting position of the lower riser-support structure 14B. The riser-support structure 14 is fixed to the floating installation 10 by means of welding the bracket member 20 of the upper riser-support structure 14A to the mounting-base structure 22A and welding the lower riser-support structure 14B to the mounting-base structure 22B.

[0018] Next, with reference to FIG. 3 and FIG. 4, the reinforcing structure of a web frame in the present embodiment will be described. Note that FIG. 3 and FIG. 4 are enlarged views of a portion surrounded by a frame "A" in FIG. 1. FIG. 3 illustrates an embodiment where an opening, such as a manhole, is not provided on the web frame, and FIG. 4 illustrates an embodiment where an opening, such as a manhole, is provided on the web frame.

[0019] As shown in FIG. 3 and FIG. 4, a plurality of longitudinal stiffeners 24 are provided inside the shell plate 12 of the floating installation 10, and at the position where the riser-support structure 14 is attached, a web frame 26 extending along the section is provided. In the present embodiment, a predetermined area (e.g., the vertical and horizontal dimensions in a range from 0.5 to 1.5 times the

installation interval of the longitudinal stiffener 24) of the web frame 26 in an area corresponding to the top of a section to which the riser-support structure 14 (the mounting-base structure 22A and/or the mounting-base structure 22B) is attached, is replaced beforehand with a reinforcing member having a plate thickness greater (e.g., +5 mm to + 15 mm thicker) than the thickness of the other areas. For example, in FIG. 3 and FIG. 4, the top end of the mounting-base structure 22A coincides with the positions of the longitudinal stiffeners 24A and 24B. The web frame 26 about the longitudinal stiffeners 24A and 24B are replaced by the reinforcing members 28A and 28B and are attached to the surrounding web frame 26 by welding. Further, in order to assemble a plate member of the web frame 26 to a normal longitudinal stiffener 24, a gap 12A may be provided between one side (the lower side in FIG. 3 and FIG. 4) of the longitudinal stiffener 24 and the web frame 26. In the present embodiment, the reinforcing member 30A or 30B (substantially the same material and thickness as the reinforcing members 28A and 28B) is fitted into the gap 12A and is welded to the normal longitudinal stiffener 24 and the web frame 26, respectively. As shown in FIG. 4, when the web width of the longitudinal stiffener or the width of the gap 12A is substantially equal to or larger than the above-mentioned predetermined area of the reinforcing member, the

reinforcing member may be divided into upper and lower portions. In some cases, a side stringer may be provided in place of the longitudinal stiffener. Note that the structural reinforcement achieved by the reinforcing members 5 28A, 28B, 30A and 30B is designed to correspond to the anticipated heaviest upper riser-support structure 14A (or lower riser-support structure 14B). Further, in FIG. 4, an opening 32 is a manhole and the longitudinal stiffener 24B also serves as a floor.

10 [0020] As described above, according to the first embodiment, the riser-support structures may also be constructed after the floating installation has been completed, since welding for attaching the riser support-structure, for example, can be carried out after painting the inside of the shell plate 15 by configuring the mounting-base structure to extend outward from the shell plate. Further, in the present embodiment, by adopting a reinforcing structure assuming the maximum load at the mounting position of the riser support structure of the floating installation, the construction period can be 20 shortened and labor and construction costs can be reduced, because there is no need to reconfigure the periphery of the mounting position of the riser-support structures again, even though the type and arrangement of the risers is not determined in advance and the type and arrangement of the 25 risers is determined after the assembly of the modules.

[0021] Next, first and second variations of the first embodiment will be described with reference to FIG. 5 and FIG 6. The first and second variations are dissimilar from the first embodiment in the manner of unitizing the riser support structure. The other configurations are the same as those of the first embodiment, the same reference numerals are used for the same configurations, and the descriptions thereof have been omitted.

[0022] In the first embodiment, as shown in FIG. 2, the upper riser-support structure was attached to the outside of the shell plate 12 of the floating installation 10 after all the components were assembled. However, the structure that may vary depending on the type and arrangement of the risers is part of the riser-support structure. Therefore, in the first and second variations, configurations other than the configurations that may vary depending on the type and arrangement of the risers are standardized, and for example, they are attached beforehand to the floating installation 10 while it is still in the module state, but members other than the above-mentioned configurations can be attached after the modules are assembled. In the first variation illustrated in FIG. 5, for example, the bracket member 20 is standardized and attached to the outside of the shell plate 12 beforehand, in the module construction stage, and the riser-pipe support portions 16 and the attached structures 18 and 19 are

attached to the bracket member 20A after the modules are assembled (i.e., after the types and arrangement of the risers are determined). On the other hand, in the second variation illustrated in FIG. 6, for example, the bracket members 20A and the attached structures 19 are standardized; and only these components are attached beforehand to the outside of the shell plate 12 in the construction stage for each module. The riser-pipe support portion 16 and the attached structures 18 are attached to the bracket member 20A after the modules are assembled (i.e., after the types and arrangement of the risers are determined).

[0023] As described above, the same effects as those of the first embodiment can also be obtained in the first and second variations. Further, in the variations, the floating installation can be more efficiently constructed because the components that do not depend on the type and arrangement of the risers can be attached beforehand via the standardization thereof.

[0024] Next, with reference to FIG. 7 and FIG. 8, the configuration of the riser-support structure applied to a floating installation of a second embodiment will be described. The difference of the second embodiment from the first embodiment exists only in configurations related to the riser-pipe support portion. The other configurations are the same as in the first embodiment, the first and second

variations. Therefore, the same reference numerals are used for the same components, and descriptions thereof have been omitted.

[0025] The second embodiment is an embodiment applied when it is obvious that only two types of riser pipes having different diameters are used. In such a case, if a riser-pipe support portion is unitized by two risers, the permutations and combinations of large diameter and small diameter result in only four types. Therefore, in the second embodiment, the riser-pipe support portion is configured as a riser-pipe support portion unit 160 with two risers as a unit.

[0026] FIG. 7 is a perspective view showing the configuration of one type of riser-pipe support portion unit 160A among the units. As shown in FIG. 7, the riser-pipe support portion unit 160A includes two cylindrical members 161 and 162 of different diameters, which are provided with riser-pipe insertion holes through which the riser pipes are respectively inserted; a pair of top plates 163 and 164 for supporting the upper ends and lower ends of the cylindrical members 161 and 162, and a plate member 165 for supporting the side surfaces of the cylindrical members 161 and 162 from the four directions and for maintaining the strength of the entire unit.

[0027] In the example of FIG. 7, the cylindrical members 161 and 162 with different diameters are paired. Also provided,

as other units, is a riser-pipe support portion unit 160B with a pair of cylindrical members 161 having the large diameters; a riser-pipe support portion unit 160C in which the arrangement of the cylindrical members 161 and 162 of the riser-pipe support portion unit 160A are reversed; and a riser-pipe support portion unit 160D with a pair of cylindrical members 162 having the small diameters (see FIG. 8).

[0028] FIG. 8 is a plan view of the riser-pipe support unit 160 and attached structure assemblies 180 and 190, which are the assemblies of the attached structures 18 and 19. FIG. 8(a) illustrates the appearance after the assembly, and FIG. 8(b) illustrates the appearance before the assembly.

[0029] As described above, effects similar to those of the first embodiment can also be obtained by the second embodiment. In the second embodiment, since the types of the riser pipes are restricted, the assembly efficiency can be further enhanced by preparing several types of riser-pipe support portion units corresponding to the combinations; such that after determining the arrangement of the riser pipes, the riser-pipe support portion units are attached (welded) according to the determined arrangement of the riser pipes.

[0030] Next, with reference to FIG. 9 and FIG. 10, the configuration of the riser support structure applied to the floating installation of the third embodiment will be

described. The only difference in the third embodiment from the first and second embodiments is the configuration of the riser-pipe support portion, ~~and~~ the other configurations are the same as in the first and second embodiments and the first and second variations. Therefore, the same reference numerals are used for the same components, and the descriptions thereof have been omitted.

[0031] In the third embodiment, the riser-pipe support portion is configured as a unit having one riser in a unit.

FIG. 9 and FIG. 10 illustrate riser-pipe support portion units 170 and 171 that use, for example, two types of riser pipes with a large diameter and a small diameter. The riser-pipe support portion unit 170 is mainly composed of a large-diameter cylindrical member 172 and the riser-pipe support portion unit 171 is mainly composed of a small-diameter cylindrical member 173. Flange portions 174 and 175 extending outward are provided at the upper and lower open ends of each riser-pipe support portion unit 170 and 171.

The arc-shaped flange portions 174 and 175 reflect the half-circumferential portions of the cylindrical members 172 and 173. The lower flange portion is configured with width slightly narrower than that of the upper flange portion so that attached structure assemblies 180 and 190 can be attached from the top side after being assembled. Three

plate members 176 extending along the generating line of the

cylindrical member 172 are provided between the upper and lower flange portions 174 at equal intervals along the circumference to reinforce the structure of the cylindrical member 172 and the flange portions 174. Similarly, between
5 the upper and lower flange portions 175, three plate members 177 extending along the generating line of the cylindrical member 173 are provided at equal intervals along the circumference to reinforce the structure of the cylindrical member 173 and the flange portions 175. The upper and lower
10 widths of the plate members 176 and 177 are formed to be substantially equal to the upper and lower widths of the flange portions.

[0032] FIG. 10 is a plan view of the riser-pipe support portion units 170, 171 and the attached structure assemblies
15 180 and 190, which are the assemblies of the attached structures 18 and 19. FIG. 10(a) illustrates the appearance after assembly and FIG. 8(b) illustrates the appearance before assembly.

[0033] In the third embodiment, a pair of upper and lower top
20 plates 200 for attaching the riser-pipe support portion units 170 and 171 are provided between the attached structure assemblies 180 and 190. The top plate 200 is provided with a large number of substantially oval openings 202 having major axes in the longitudinal direction of the floating
25 installation 10. For example, one opening 202 is provided

between a pair of bracket members 20. The sizes of the flange portions 174 and 175 of the riser-pipe support portion units 170 and 171 are adapted to the diameters of the arcuate portions at both ends of each opening 202. The flange portions 174 and 175 of the riser-pipe support portion units 170 and 171 are respectively welded to arcuate portions at both ends of each opening 202 according to the determined arrangement of the riser pipes. At this time, the plate members 176 and 177 are also welded to the plate member provided between the upper and lower top plates 200.

[0034] As described above, substantially the same effect as in the second embodiment can also be obtained in the third embodiment. Further, in the configuration of the third embodiment, wasteful occurrence of units is further suppressed and costs can be further reduced.

[0035] FIG. 11 is a transverse sectional view showing the configuration of a riser support structure of a fourth embodiment. In the riser support structure of the first to third embodiments, the riser pipe is held and fixed to the upper riser-support structure 14A, however, in the riser support structure of the fourth embodiment, the lower riser support structure 15 holds and fixes the riser pipe onto the floating installation. As shown in FIG. 11, the lower riser support structure 15 of the fourth embodiment includes a riser-pipe support portion 15A that restricts the movement of

the riser pipe R in the horizontal direction and the vertical direction. The lower riser support structure 15 is welded to the mounting-base structure 22B as in the first to third embodiments. Note that another riser pipe (not shown) that
5 is inserted through the upper riser support structure 14A is connected to the riser pipe R, which is mounted on the riser-pipe support portion 15A. Other configurations are the same as those of the first to third embodiments. As for the structure reinforcement features, for example, the web frame
10 (26) located at the position corresponding to the top of the mounting-base structure 22B may be reinforced by the same method as described in the first embodiment. Further, the riser-pipe support portion 15A provided on the lower riser-support structure 15 may be composed of a plurality of
15 divided units that is unitized for a predetermined number of riser pipes, similar to the riser-pipe support portion 16 of the second and third embodiments.

[0036] As described above, substantially the same effects as those of the first to third embodiments can also be obtained
20 in the fourth embodiment.

[0037] Further, as a variation of the first to fourth embodiments, the bracket member 20 may be directly attached to the shell plate 12 before the module construction stage, and the riser-pipe support portion 16, and the attached
25 structure portions 18 and 19 may be attached to the bracket

member 20 after the modules are connected. In this case, the bracket member 20 is configured as a mounting-base structure and is not included in the upper riser-support structure.

[0038] Note that the structural reinforcements in the present
5 embodiments may include configurations other than replacing a web frame with a reinforcing material.

[Explanation of sign]

[0039]

10 floating installation

10 12 shell plate

14 riser support structure

14A Upper riser-support structure

14B, 15 lower riser-support structures

15A, 16 riser-pipe support portions

15 18, 19 attached structures

20 bracket member

22A, 22B mounting-base structures

26 web frame

28A, 28B, 30A, 30B reinforcing members

20 160, 160A-160D riser-pipe support portion units

161, 162 cylindrical members

170, 171 riser-pipe support portion units

172, 173 cylindrical member

174, 175 flange portions

25 200 top plate

202 opening

R riser pipe

CLAIMS

1. A floating installation comprising:

a shell plate; and

5 a riser support structure that is mounted on the outside of the shell plate;

a mounting-base structure for mounting the riser support structure being provided on the shell plate.

2. The floating installation according to claim 1,
10 comprising a web frame provided vertically along an inner side of the shell plate, wherein the web frame is structurally reinforced at a position where the riser support structure is attached.

3. The floating installation according to one of claims 1-2,
15 wherein the riser support structure comprises a riser-pipe support portion through which the riser is inserted for retaining and fixing the riser, and the mounting-base structure is configured as a structure supporting the riser-pipe support portion.

20 4. The floating installation according to one of claims 1-2, wherein the configuration of the riser support is divided into a riser-pipe support portion through which the riser is inserted for retaining and fixing the riser and a structure attached to the shell plate via the mounting-base structure
25 for supporting the riser-pipe support portion.

5. The floating installation according to one of claims 3 and 4, wherein the structure supporting the riser-pipe support portion is configured as a bracket member.

6. The floating installation according to one of claims 3-5,
5 wherein the riser-pipe support portion is attached to a structure supporting the riser-pipe support portion after the structure supporting the riser pipe support portion is attached to the shell plate of the floating installation.

7. The floating installation according to one of claims 3
10 to 6, wherein the riser-pipe support portion has a unit structure comprising two risers in a unit.

8. The floating installation according to one of claims 3 to 6, wherein the riser-pipe support portion has a unit structure comprising one riser in a unit.

15 9. The floating installation according to claim 8, wherein the riser-pipe support portion comprises a top plate and two of the unit structures can be attached to the top plate; the top plate is provided with an opening in which both ends in the longitudinal direction are arc shaped, and the unit
20 structure is attached to each of the arc-shaped ends.

10. The floating installation according to claim 9, wherein the unit structure comprises a half-circumferential flange portion adapted to the arcuate shape.

11. The floating installation according to one of claims 3
25 to 10, wherein the riser-pipe support portion is disposed

above the draft.

12. The floating installation according to one of claims 3 to 10, wherein the riser-pipe support portion is disposed below the draft.

5 13. A method of constructing a floating installation that includes a shell plate and a riser support structure attached to the outside of the shell plate, the method comprising:

providing a mounting-base structure for attaching the riser support portion to the shell plate;

10 configuring the riser support portion by dividing it into a riser-pipe support portion through which a riser is inserted for retaining and fixing the riser and a structure attached to the shell plate via the mounting-base structure for supporting the riser-pipe support portion; and

15 attaching the riser-pipe support portion to a structure supporting the riser-pipe support portion after attaching the structure supporting the riser-pipe support portion to the shell plate.