

RISER RACK STRUCTURE

CROSS-REFERENCE TO RELATED APPLICATION

The present application claims priority to Korean patent application number 10-2013-0137792 filed on November 13, 2013, in the Korean Intellectual Property Office, the entire disclosure of which is incorporated by reference herein.

BACKGROUND

1. Field

[0001] An embodiment relates generally to a riser rack structure.

2. Related Art

[0002] With the rapid global industrialization and industrial development, the use of the Earth's resources, such as oil, has been rising. Accordingly, the stable production and supply of oil is becoming a significant global issue.

[0003] Thus, the development of marginal fields or deepwater oil fields which have been ignored due to reasons of economics has become more economic. Therefore, along with development of offshore drilling techniques, drillships equipped with drilling facilities appropriate for the development of such oil fields are constantly under development.

[0004] According to conventional offshore drilling methods, rig ships or fixed platforms designed for use in offshore drilling

which are towed by tugboats and anchored at one point at sea by moorings were in widespread use. Recently, however, a drillship having a ship-shaped design has been developed and used for offshore drilling. This drillship has technically advanced drilling equipment and sails under its own propulsion.

[0005] Offshore drilling facilities such as drillships or Floating Production Storage & Offloading (FPSO) used for collecting deep sea resources have moonpools at the central portions thereof, and drilling equipment including drill pipes. Risers or drill pipes provided to drill for oil or gas below the seafloor move vertically through the moonpools. The drill pipes are extended to a well through the risers, and the risers guide the drill pipes to the inlet of the well.

[0006] Mud provided as fluids in the excavation process and rock, or ocean sediments generated in the excavation process are moved toward offshore drilling facilities through the risers, and then provided through the drill pipes to a target to be excavated at a pressure appropriate for the excavation depth. The drilling equipment including the drill pipes and the risers realizes a system capable of performing excavation while circulating a working fluid (mud).

[0007] Therefore, in general, a drillship has a pipe structure to protect drill pipes and includes a riser deck and riser racks fixed in the shape of cantilever columns in a vertical direction to

the riser deck in order to load risers for moving drilling mud. The riser deck provides space in which the risers are loaded. The riser racks are formed to load the risers and perform a restraining function.

[0008] When the drillship is leaning to one side according to the marine environment, the horizontal component of the weight of the risers may be applied. The riser racks are designed to have enough strength and rigidity to withstand the horizontal component. Therefore, a plurality of riser racks in the shape of cantilever columns are to be installed on the riser deck, which may increase the weight of the drill ship and impair the stability thereof.

[0009] Accordingly, considerable research and efforts have been put into a riser rack structure.

SUMMARY OF THE INVENTION

[0010] Various embodiments relate to a riser rack structure in which a riser rack reinforcement part having a comb shape, such as a U shape, an E shape, or a combination thereof, is additionally connected to a conventional riser rack structure so that a riser rack may withstand more horizontal component applied thereto with respect to the weight of a riser when a ship leans to one side according to the marine environment, and an additional riser rack may not be formed.

[0011] A riser rack structure according to an aspect of the

present invention may include riser racks having a cantilever shape and supporting and fixing a riser, and a riser rack reinforcement part coupled to at least two of the riser racks and reinforcing the riser racks, wherein the riser rack reinforcement part comprises: rack connection units connecting the riser racks, and a reinforcement connection unit connected to the rack connection units and separated from the riser racks, wherein the reinforcement connection unit is connected perpendicularly to at least two of the rack connection units.

[0012] The riser rack reinforcement part may be connected to upper portions or central portions of the riser racks.

[0013] The riser rack reinforcement part may have a comb shape such as a U shape, an E shape, or a combination thereof.

[0014] The riser rack reinforcement part may have a beam shape or an H-beam shape.

[0015] The riser rack reinforcement part may have a structure of continuously stacked cuboids.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] FIG. 1 is a perspective view of a conventional riser rack structure;

[0017] FIG. 2(A) is a perspective view of a riser rack reinforcement part according to a first embodiment of the present invention;

[0018] FIG. 2(B) is a perspective view of a riser rack structure according to the first embodiment of the present invention;

[0019] FIG. 3(A) is a perspective view of a riser rack structure according to a second embodiment of the present invention;

[0020] FIG. 3(B) is a perspective view of a riser rack structure according to a third embodiment of the present invention;

[0021] FIG. 4(A) is a perspective view of a riser rack structure according to a fourth embodiment of the present invention;

[0022] FIG. 4(B) is a perspective view of a riser rack structure according to a fifth embodiment of the present invention; and

[0023] FIG. 4(C) is a perspective view of a riser rack structure according to a sixth embodiment of the present invention.

DETAILED DESCRIPTION

[0024] The object, specific advantages and novel features of the present invention will be clarified through the Detailed Description of the Invention and preferred embodiments with reference to the accompanying drawings. Like reference numerals refer to like elements throughout. Moreover, detailed

descriptions related to well-known functions or configurations will be ruled out in order not to unnecessarily obscure subject matters of the present invention.

[0025] Hereinafter, various embodiments will be described in detail with reference to the accompanying drawings.

[0026] FIG. 1 is a perspective view of a conventional riser rack structure.

[0027] As illustrated in FIG. 1, a conventional riser rack structure 1 includes riser racks 10 and a riser 11.

[0028] In the conventional riser rack structure 1, the riser racks 10 in the shape of cantilevers are installed in a vertical direction to a riser deck (not illustrated), and load and fix the riser 11. However, when movements of a drillship (not illustrated) are caused by the horizontal component applied to the riser racks 10 by the loaded riser 11 and an external force according to the marine environment, these movements may increase the horizontal component applied to the riser racks 10 by the riser 11.

[0029] Therefore, when the riser racks 10 are installed on the riser deck of the drillship, the riser racks 10 are designed to have enough strength and rigidity to withstand the horizontal component at the time of initial design.

[0030] As more risers 11 are loaded on the drillship or the external force is increased due to harsh marine environments,

the horizontal component may be increased. In order to withstand the increased horizontal component, a plurality of the riser racks 10 are installed at the time of initial design. As a result, the weight of the drillship may be increased, and stability of the drillship may be impaired. On the other hand, when a small number of the riser racks 10 are installed to reduce the weight of the drillship and ensure stability, the number of risers 11 to be loaded is reduced to lower the efficiency of a drilling operation.

[0031] FIG. 2(A) is a perspective view of a riser rack reinforcement part according to a first embodiment of the present invention. FIG. 2(B) is a perspective view of a riser rack structure according to the first embodiment of the present invention

[0032] As shown in FIGs. 2(A) and 2(B), a riser rack structure 2 according to the first embodiment of the present invention includes the riser racks 10 and an E-shaped first riser rack reinforcement part 20. Although the riser racks of FIGs. 2(A) and 2(B) are denoted by the same reference numerals in the riser rack structure 1 as shown in FIG. 1 for convenience of description, they do not necessarily refer to the same configuration.

[0033] Each of the riser racks 10 is provided in a cantilever shape, and supports and fixes the riser 11. The riser racks 10

may be installed in the shape of cantilever columns in a vertical direction to a riser deck. One or more riser racks 10 may be installed on the riser deck to withstand the horizontal component of the riser 11.

[0034] The riser rack 10 may have an H-beam shape. Preferably, the riser rack 10 may have a structure of continuously stacked cuboids.

[0035] The E-shaped first riser rack reinforcement part 20 is connected to at least two riser racks 10 and reinforces the riser racks 10.

[0036] The E-shaped first riser rack reinforcement part 20 includes rack connection units 201 and a reinforcement connection unit 202. Each of the rack connection units 201 connects two riser racks 10. The reinforcement connection unit 202 is connected to and separated from the riser racks 10, and connected in the vertical direction to three rack connection units 201. More specifically, with reference to FIG. 2(A), the three rack connection units 201 having a columnar shape are arranged next to each other in a horizontal direction, and the reinforcement connection unit 202 is connected perpendicularly to the three rack connection units 201 arranged next to each other. Connecting portions of the rack connection unit 201 to the riser racks 10 may have a columnar shape with an octagonal cross section and be formed on the rack connection unit 201.

[0037] The E-shaped first riser rack reinforcement part 20 may be coupled to the outermost riser racks 10 of the riser rack structure 2 according to the first embodiment of the present invention. Since the reinforcement connection unit 202 of the E-shaped first riser rack reinforcement part 20 is connected to and separated from the riser racks 10, the riser 11 may be loaded smoothly without a yoke (not illustrated) for moving and loading the riser 11 on the riser deck being caught, and the strength and rigidity of the riser racks 10 may be increased.

[0038] In addition, the E-shaped first riser rack reinforcement part 20 may be connected to an upper portion or a central portion of the riser rack 10. However, the present invention is not limited thereto, and the position at which the first riser rack reinforcement part 20 is connected to the riser rack 10 may be changed according to design requirements. Preferably, when the risers 11 are loaded on the riser rack 10, the E-shaped first riser rack reinforcement part 20 may be installed at a position corresponding to one or two risers 11 down from the top riser 11.

[0039] Referring to FIG. 2(B), the E-shaped first riser rack reinforcement part 20 may be located at and firmly fixed to the upper portions of the riser racks 10. Specifically, two riser racks 10 may be connected to each other with the rack connection unit 201 interposed therebetween. Connecting portions of the rack

connection unit 201 to the two riser racks 10 have a columnar shape with an octagonal cross section to provide a secure and tight coupling therebetween. The reinforcement connection unit 202 may be connected to the riser racks 10 at a predetermined distance therebetween. As described above, by installing the E-shaped first riser rack reinforcement part 20, the riser racks 10 may withstand more horizontal component applied thereto, so that the strength and rigidity of the riser rack structure 2 according to the first embodiment may be increased, and the number of riser racks 10 to be installed may be reduced as compared with that in the conventional riser rack structure 1. Since the number of riser racks 10 to be installed is reduced, the weight of the drillship may be reduced, the stability thereof may be increased, and the number of risers 11 loaded may be significantly increased.

[0040] In addition, the first riser rack reinforcement part 20 may have an E-shape. However, the present invention is not limited thereto. The E-shape of the first riser rack reinforcement part 20 may be slightly modified according to design requirements. The first riser rack reinforcement part 20 may include a beam shape or an H-beam shape. Preferably, the first riser rack reinforcement part 20 may have a structure of continuously stacked cuboids.

[0041] FIG. 3(A) is a perspective view of a riser rack structure according to a second embodiment of the present invention.

[0042] As illustrated in FIG. 3(A), a riser rack structure 3 according to the second embodiment of the present invention includes the riser racks 10 and an E-shaped second riser rack reinforcement part 30. Although the riser racks of FIG. 3(A) are denoted by the same reference numerals in the riser rack structure 1 as shown in FIG. 1 for convenience of description, they do not necessarily refer to the same configuration.

[0043] The E-shaped second riser rack reinforcement part 30 is coupled to at least two riser racks 10 and reinforces the riser racks 10.

[0044] The E-shaped second riser rack reinforcement part 30 includes rack connection units 301 and a reinforcement connection unit 302. Each of the rack connection units 301 is coupled to each of the riser racks 10. The rack connection units 301 connect the reinforcement connection unit 302 to the riser racks 10 at a predetermined distance therebetween. The reinforcement connection unit 302 is connected perpendicularly to three rack connection units 301. Since the E-shaped second riser rack reinforcement part 30 is not connected through the riser rack 10, a columnar shape having an octagonal cross section is not present in the rack connection unit 301 of the E-

shaped second riser rack reinforcement part 30. Connecting portions of the E-shaped second riser rack reinforcement part 30 to the riser racks may have a columnar structure with a trapezoidal cross section to secure the connection therebetween.

[0045] The E-shaped second riser rack reinforcement part 30 may be connected to the outermost riser racks 10 of the riser rack structure 3 according to the second embodiment of the present invention. Since the reinforcement connection unit 302 of the E-shaped second riser rack reinforcement part 30 is connected to and separated from the riser racks 10, the risers 11 may be loaded smoothly without a yoke for moving and loading the risers 11 on the riser deck being caught, and the strength and rigidity of the riser rack 10 may be increased.

[0046] In addition, the E-shaped second riser rack reinforcement part 30 may be connected to the upper portion or the central portion of the riser rack 10. However, the present invention is not limited thereto. The position at which the E-shaped second riser rack reinforcement part 30 is connected to the riser rack 10 may be changed according to design requirements. Preferably, when the riser racks 10 are loaded with the risers 11, the E-shaped second riser rack reinforcement part 30 may be installed at a position corresponding to one or two risers 11 down from the top riser 11. Referring to FIG. 3(A), the E-shaped second riser rack reinforcement part 30 is located

at and firmly fixed to the upper portion of the riser rack 10. Specifically, the riser rack 10 is connected to one side of the rack connection unit 301, and the reinforcement connection unit 302 is connected to the other side thereof, so that the reinforcement connection unit 302 is separated from the riser racks 10 by a predetermined distance. A connecting portion of the rack connection unit 301 to the riser rack 10 may have a columnar structure with a trapezoidal cross section in order to secure the connection therebetween.

[0047] Therefore, as described above, by forming the E-shaped second riser rack reinforcement part 30, the riser racks 10 may withstand more horizontal component applied thereto, so that the strength and rigidity of the riser rack structure 3 according to the second embodiment of the present invention may be increased to reduce the number of riser racks 10 as compared with the conventional riser rack structure 1. Since the number of riser racks 10 is reduced, the weight of the drillship may be reduced, the stability thereof may be increased, and the number of risers 11 loaded may be significantly increased.

[0048] In addition, the second riser rack reinforcement part 30 may have an E shape. However, the present invention is not limited thereto. The E-shape of the second riser rack reinforcement part 30 may be slightly modified according to design requirements. The first riser rack reinforcement part 20

may include a beam shape or an H-beam shape. Preferably, the second riser rack reinforcement part 30 may have a structure of continuously stacked cuboids.

[0049] FIG. 3(B) is a perspective view of a riser rack structure according to a third embodiment of the present invention.

[0050] As illustrated in FIG. 3(B), a riser rack structure 4 according to the third embodiment of the present invention includes the riser racks 10, the E-shaped first riser rack reinforcement part 20 and the E-shaped second riser rack reinforcement part 30. Although the riser rack 10, the E-shaped first riser rack reinforcement part 20 and the E-shaped second riser rack reinforcement part 30 of the riser rack structure 4 are denoted by the same reference numerals in the conventional riser rack structure 1 and the riser rack structures 2 and 3 according to the first and second embodiments for convenience of description, they do not necessarily refer to the same configurations.

[0051] In the riser rack structure 4 according to the third embodiment of the present invention, the E-shaped first riser rack reinforcement part 20 of the riser rack structure 2 according to the first embodiment of the present invention and the E-shaped second riser rack reinforcement part 30 of the riser rack structure 3 according to the second embodiment of the

present invention are coupled to the riser racks 10 to increase the strength and rigidity of the riser racks 10.

[0052] The E-shaped first riser rack reinforcement part 20 may be installed at upper portions of the riser racks 10, and the E-shaped second riser rack reinforcement part 30 may be installed at lower portions of the riser racks 10. On the other hand, the E-shaped first riser rack reinforcement part 20 may be installed at the lower portions of the riser racks 10, and the E-shaped second riser rack reinforcement part 30 may be installed at the upper portions of the riser racks 10. The installation positions of the E-shaped first and second riser rack reinforcement parts 20 and 30 may be changed according to initial design to withstand the horizontal component applied to the riser racks 10.

[0053] FIG. 4(A) is a perspective view of a riser rack structure according to a fourth embodiment of the present invention.

[0054] Referring to FIG. 4(A), a riser rack structure 5 according to the fourth embodiment of the present invention includes the riser racks 10 and connecting reinforcement riser racks 40. Although the riser racks of the riser rack structure 5 are denoted by the same reference numerals in the riser rack structure 1 as shown in FIG. 1 for convenience of description, they do not necessarily refer to the same configuration.

[0055] Each of the connecting reinforcement riser racks 40 may include five rack connection units 401 and a reinforcement connection unit 402 connected perpendicularly to the five rack connection units 401. The number of rack connection units 401 is not limited to the number shown in this embodiment and may be changed according to initial design. The rack connection units 401 and the reinforcement connection unit 402 of the connecting reinforcement riser rack 40 may have similar configuration and structure as described above in connection with the first, second and third embodiments.

[0056] In addition, the connecting reinforcement riser rack 40 may be connected to the upper portion or the central portion of the riser racks 10. However, the present invention is not limited thereto. The position at which the connecting reinforcement riser rack 40 is connected to the riser racks 10 may be changed according to design requirements as described above in connection with the first, second and third embodiments.

[0057] FIG. 4(B) is a perspective view of a riser rack structure according to a fifth embodiment of the present invention.

[0058] As illustrated in FIG. 4(B), a riser rack structure 6 according to the fifth embodiment of the present invention includes the riser racks 10, the E-shaped first riser rack

reinforcement parts 20, and U-shaped first riser rack reinforcement parts 50. Although the riser racks 10 and the E-shaped first riser rack reinforcement parts 20 of the riser rack structure 6 are denoted by the same reference numerals in the conventional riser rack structure 1 and the riser rack structures 2 and 4 according to the first and third embodiments of the present invention, they do necessarily refer to the same configurations.

[0059] Each of the U-shaped first riser rack reinforcement parts 50 is connected to at least two riser racks 10 and reinforces the riser racks 10.

[0060] The U-shaped first riser rack reinforcement part 50 includes rack connection units 501 and a reinforcement connection unit 502. Each of the rack connection units 501 connects two riser racks 10. The reinforcement connection unit 502 is connected to and separated from the riser racks 10, and is connected perpendicularly to the two rack connection units 501. A connecting structure, an internal structure and an external shape of each of the rack connection unit 501 and the reinforcement connection unit 502 of the U-shaped first riser rack reinforcement part 50 are similar to those of the E-shaped first riser rack reinforcement part 20. Thus, a detailed description thereof is omitted.

[0061] In the riser rack structure 6 according to the fifth embodiment of the present invention, the E-shaped first riser rack reinforcement part 20 of the riser rack structure 2 according to the first embodiment of the present invention and the U-shaped first riser rack reinforcement part 50 of the riser rack structure 6 according to the fifth embodiment of the present invention are coupled to the riser racks 10 to increase the intensity and rigidity of the riser racks 10. The E-shaped first riser rack reinforcement part 20 and the U-shaped first riser rack reinforcement part 50 are separately coupled to the riser racks 10. In this case, the connection between the E-shaped and U-shaped first riser rack reinforcement parts 20 and 50 and the riser racks 10 may be changed according to initial design. For example, the E-shaped first riser rack reinforcement part 20 and the U-shaped first riser rack reinforcement part 50 may be connected to upper portions or lower portions of the riser racks 10. The E-shaped first riser rack reinforcement part 20 and the U-shaped first riser rack reinforcement part 50 may be formed in the same plane, like the above-described connecting reinforcement riser rack 40.

[0062] FIG. 4(C) is a perspective view of a riser rack structure according to a sixth embodiment according to the present invention.

[0063] As illustrated in FIG. 4(C), a riser rack structure 7 according to the sixth embodiment of the present invention includes the riser racks 10, the E-shaped second riser rack reinforcement parts 30 and U-shaped second riser rack reinforcement parts 60. Although the riser rack 10 and the E-shaped second riser rack reinforcement part 30 are denoted by the same reference numerals in the conventional riser rack structure 1 and the riser rack structures 2, 3, and 4 according to the first, second and third embodiments of the present invention, they do not necessarily refer to the same configurations.

[0064] The U-shaped second riser rack reinforcement part 60 is connected to at least two riser racks 10 and reinforces the riser rack 10.

[0065] The U-shaped second riser rack reinforcement part 60 includes rack connection units 601 and a reinforcement connection unit 602. Each of the rack connection units 601 is coupled to each of the riser racks 10. The rack connection units 601 connect the reinforcement connection unit 602 to the riser racks 10 at a predetermined distance therebetween. The reinforcement connection unit 602 is connected to and separated from the riser racks 10, and is connected perpendicularly to two rack connection units 601. A connection structure, an internal structure and an external shape of each of the rack connection unit 601 and the reinforcement connection unit 602 of the U-

shaped second riser rack reinforcement part 60 are similar to those of the E-shaped second riser rack reinforcement part 30. Thus, a detailed description thereof is omitted.

[0066] In the riser rack structure 7 according to the sixth embodiment, the E-shaped second riser rack reinforcement part 30 of the riser rack structure 3 according to the second embodiment of the present invention and the U-shaped second riser rack reinforcement part 60 of the riser rack structure 7 according to the sixth embodiment of the present invention are coupled to the riser rack 10 to increase the strength and rigidity of the riser rack 10. The E-shaped second riser rack reinforcement part 30 and the U-shaped second riser rack reinforcement part 60 are separately connected to the riser racks 10. The connection between the E-shaped and U-shaped second riser rack reinforcement parts 30 and 60 and the riser racks 10 may be changed according to initial design.

[0067] As described above, according to the first to sixth embodiments, the strength and rigidity of the conventional riser rack structure 1 is increased by additionally connecting the U-shaped riser rack reinforcement parts (50 and 60) or the E-shaped riser rack reinforcement parts (20 and 30) to the conventional riser rack structure 1. Thus, when the drillship leans to one side according to the marine environment, the riser racks 10 may withstand more horizontal component applied

thereto with respect to the weight of the riser 11. Therefore, the riser rack 10 may not be added to significantly reduce the number of riser racks 10. The decrease in number of riser racks 10 may reduce the weight of the drillship, increase stability and significantly increase the number of risers 11 loaded.

[0068] However, the present invention is not limited to the above-described embodiments. The riser rack reinforcement parts (20, 30, 40, 50, and 60) may be installed on the riser racks 10 in various ways according to initial design to load and fix the risers 11.

[0069] In a riser rack structure according to the present invention, the strength and rigidity of a conventional riser rack structure is increased by additionally connecting a riser rack reinforcement part having a comb shape, such as a U-shape, an E-shape, or a combination thereof, to the conventional riser rack structure. Therefore, when a ship leans to one side according to the marine environment, riser racks may withstand more horizontal component applied thereto with respect to the weight of risers. Thus, the riser racks may not be added to significantly reduce the number of riser racks. The decrease in number of riser racks may reduce the weight of the ship, increase stability and significantly increase the number of risers loaded.

WHAT IS CLAIMED IS:

1. A riser rack structure, comprising:
 - riser racks having a cantilever shape and supporting and fixing a riser; and
 - a riser rack reinforcement part coupled to at least two of the riser racks and reinforcing the riser racks,wherein the riser rack reinforcement part comprises:
 - rack connection units connecting the riser racks; and
 - a reinforcement connection unit separated from the riser racks and connected to the rack connection units to prevent a yoke for moving the riser from being caught, and connected perpendicularly to at least two of the rack connection units,wherein the reinforcement connection unit has a comb shape such as a U shape, an E shape, or a combination thereof.
2. The riser rack structure of claim 1, wherein the riser rack reinforcement part is connected to upper portions or central portions of the riser racks.
3. The riser rack structure of claim 1, wherein the riser rack reinforcement part has a beam shape or an H-beam shape.
4. The riser rack structure of claim 1, wherein the riser rack reinforcement part has a structure of continuously stacked cuboids.