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OFFSHORE WORK EQUIPMENT AND METHOD FOR CONSTRUCTING THEREOF

Technical Field

[0001]

The present invention relates to an offshore work facility which can be used for constructing an offshore equipment such as an offshore wind power generation, and a method for constructing thereof.

Background Art

[0002]

From the viewpoint of effective utilization of natural energy, offshore wind power generation is attracting attention.

[0003]

For constructing offshore wind power generation, offshore work facility such as a self-elevating platform (SEP) are often used. A self-elevating platform usually has a plurality of legs and a hull supported by these legs so as to be vertically movable (Patent Literatures 1 and 2). A crane for working is mounted on the hull, and the offshore wind power generation is assembled using this crane. The hull can also be used as a cargo handling space for various parts of offshore wind power generation.

Citation List

Patent Literature

[0004]

Patent Literature 1: Japanese Patent Laid-Open No. 2015-37925

Patent Literature 2: Japanese Patent Laid-Open No. 2016-215937

Summary of Invention

Technical Problem

[0005]

In recent years, as an offshore wind power generation, a large output offshore wind power generation of, for example, 6 MW or more has been developed. Along with this, the size of the offshore wind power generation

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itself has become larger, and in addition to the landing type, the floating type equipment is being developed and put into practical use. As mentioned above, the hull of the offshore work facility is equipped with a crane for working and is also used as a cargo handling space for various parts.

Therefore, in order to construct a large offshore wind power generation, an offshore work facility having a larger hull is required. Further, in order to construct a floating type wind power equipment, it is necessary to have an offshore work facility that can stably work even in a sea area where the water depth exceeds 90 m.

[0006]

There is no existing self-elevating platform that can be used for offshore construction in waters with a depth of more than 90 m. Therefore, a large floating crane is normally used, but it is easily affected by waves and a work standby period is likely to occur, resulting in a decrease in work efficiency. On the other hand, an offshore work facility having a large hull causes a decrease in towing speed from a port to the sea area where the offshore equipment is constructed. The decrease in towing speed causes a longer construction period for offshore equipment.

[0007]

Therefore, one of the objects of the present invention is to provide an offshore work facility capable of performing stable work even in a deep sea area and improving work efficiency, and a method for constructing the same.

Solution to Problem

[0008]

An offshore work facility according to the present invention is an offshore work facility comprising,
three or more legs,
a hull constructed as a floating structure and supported so as to be able to move up and down with respect to the legs, and
a crane mounted on the hull,
wherein the hull comprises a main hull portion in which the legs are arranged and an overhanging portion formed by overhanging from the main hull portion,

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the offshore work facility is configured by adding the overhanging portion and the crane to an existing jack-up drilling rig having the main hull portion and the legs,

the overhanging portion is added to the main hull portion by using a support structure for a cantilever for an onboard drilling equipment mounted on the existing jack-up drilling rig, and

the crane is mounted on the overhanging portion.

[0009]

A method for constructing an offshore work facility comprises, preparing a jack-up drilling rig comprising three or more legs, main hull portion in which the legs are arranged and is supported so as to be able to move up and down with respect to the legs, a cantilever supported to the main hull portion via a support structure, and a drilling equipment arranged on the cantilever,

removing the cantilever and the drilling equipment from the jack-up drilling rig,

adding an overhanging portion, which is formed by overhanging from the main hull portion, to the main hull portion using the support structure, and

mounting a crane on the overhanging portion.

Advantageous Effects of Invention

[0010]

According to the present invention, it is possible to provide an offshore work facility that can work stably and efficiently even in a deep sea area. Further, according to the method for constructing an offshore work facility of the present invention, the above-mentioned offshore work facility can be constructed in a short period of time and at low cost.

Brief Description of Drawings

[0011]

[Fig. 1] Fig. 1 is a schematic side view of an offshore work facility according to an embodiment of the present invention.

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[Fig. 2] Fig. 2 is a schematic plan view of the offshore work facility shown in Fig. 1.

[Fig. 2A] Fig. 2A is a diagram showing an internal structure of a hull in the offshore work facility shown in Fig. 2.

[Fig. 3] Fig. 3 is a diagram illustrating a working range of a crane when the crane is arranged in a region surrounded by legs.

[Fig. 4] Fig. 4 is a schematic side view of an offshore work facility according to another embodiment of the present invention in which the hull has a multi-layer structure.

[Fig. 5] Fig. 5 is a diagram illustrating an example of a utilization form of the offshore work facility shown in Fig. 1.

Description of Embodiments

[0012]

Referring to Figs. 1-3, an offshore work facility 1 according to one embodiment of the present invention is shown having legs 10, a hull 20 supported by the legs 10, and a crane 30 mounted on the hull 20. The offshore work facility 1 can be used for construction of offshore equipment such as offshore wind power generation. The hull 20 is configured as a floating structure, and when constructing offshore equipment using the offshore work facility 1, the offshore work facility 1 is towed by a towing vessel such as a tugboat to the sea area where the offshore equipment is constructed.

[0013]

The legs 10 supports the hull 20 above the sea level during offshore work by the offshore work facility 1. Therefore, the legs 10 have a length capable of supporting the hull 20 above the sea surface in a state where the lower end portion of the legs 10 are set on a bottom of the sea. The offshore work facility 1 has three or more legs 10 in order to stably support the hull 20. The structure of the legs 10 may be arbitrary as long as the legs 10 can perform the above-mentioned functions, and a known structure, for example, a structure of legs used for a self-elevating platform which is a kind of offshore work facility 1 or a jack-up drilling rig can be adopted. Although the length of the legs 10 is not particularly limited, it is preferable that the

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length of the legs 10 is long enough to allow the legs 10 to reach the bottom even when the construction is performed in a sea area exceeding 90 m and to stably perform the construction without being affected by waves. The cross-sectional shape of the legs 10 is not particularly limited, and may be any shape such as a circle or a polygon.

[0014]

The hull 20 is supported by elevating mechanisms (not shown) so as to be vertically movable with respect to the legs 10. As the elevating mechanism, any mechanism such as a rack and pinion mechanism can be used. When the offshore work facility 1 is towed, the elevating mechanisms are operated to raise the legs 10 with respect to the hull 20 so that the legs 10 do not reach the bottom of the sea. Since the hull 20 is configured as a floating structure, the offshore work facility 1 floats above the sea surface by raising the legs 10, and the offshore work facility 1 can be towed in this state.

[0015]

The hull 20 has a deck 20a, a bottom 20b, and an outer side shell 20c, whereby the hull 20 is configured as a floating body structure in which a closed internal space is formed. As shown in Fig. 2A, the internal space of the hull 20 is divided into a plurality of sections by at least one bulkhead 20d, which is a strength member, whereby sufficient mechanical strength is ensured so that the upper surface of the hull 20 can be used as a work space and a component storage space for offshore equipment to be constructed.

[0016]

As shown in Fig. 2, the hull 20 has a main hull portion 21, a first overhanging portion 22, and a second overhanging portion 23. In the illustrated embodiment, the hull 20 has one first overhanging portion 22 and two second overhanging portions 23, but the number of the first overhang portions 22 and the number of the second overhanging portions 23 may be arbitrary. Among the main hull portion 21, the first overhanging portion 22, and the second overhanging portion 23, the main hull portion 21 is the portion having the largest area when viewed from above, and the legs 10 are arranged at the outer edge portion of the main hull portion 21. Therefore, most of the upper surface of the main hull portion 21 can be used as a work space and a component storage space for offshore equipment to be

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constructed. When the offshore equipment is an offshore wind power generation, it is preferable that the hull 20 has a space in which components for one offshore wind power generation can be placed, for example. The planar shape of the main hull portion 21 may be arbitrary.

[0017]

The first overhanging portion 22 may have a shape overhanging in a convex shape from the main hull portion 21 with respect to the side connecting the two adjacent legs 10 when viewed from above. Moreover, it is preferable that the upper surface of the first overhanging portion 22 is in the same plane with the upper surface of the main hull portion 21. As a result, the working space on the upper surface of the hull 20 and the component storing space can be substantially expanded.

[0018]

The crane 30 is mounted on the first overhanging portion 22. The crane 30 may be a fixed type or a crawler type. However, since the work is often performed on the first overhanging portion 22 without moving, the crane 30 of the fixed type is substantially sufficient. Further, the fixed-type crane 30 is also advantageous in that it occupies less area on the hull 20 and a larger space can be ensured on the hull 20 as compared with the crawler-type crane.

[0019]

By mounting the crane 30 on the first overhanging portion 22, the crane 30 is located outside the region surrounded by all the legs 10 (three legs 10 in this embodiment) that support the hull 20.

[0020]

Thus, by mounting the crane 30 on the first overhanging portion 22 and positioning it outside the region surrounded by the legs 10, as shown in Fig. 2, the working range $\theta 1$ of the crane 30 (rotation range around the turning center O of the crane 30) can be expanded to a range exceeding 180° . On the other hand, when the crane 30 is mounted on the main hull portion 21 as shown in Fig. 3, since the legs 10 are usually arranged at the corner portions of the main hull portion 21, the crane 30 will be located in the area between the two legs 10. Therefore, the working range $\theta 2$ of the crane 30 is less than

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180°. By expanding the working range of the crane 30, it is possible to improve the degree of freedom of work by the crane 30.

[0021]

Also long as the hull 20 is configured as a floating structure as a whole, the first overhanging portion 22 itself may be configured as a floating structure or may not be configured as a floating structure. When the first overhanging portion 22 is configured as a floating structure, the first overhanging portion 22 can have a deck, a bottom, and an outer side shell that form an internal space in the first overhanging portion 22, like the main hull 21. The first overhanging portion 22 may further have a bulkhead if necessary.

[0022]

The second overhanging portion 23 is formed at a position different from the first overhanging portion 22 so as to overhang from the main hull 21 in a shape that does not exceed the width of the main hull portion 21. Similar to the first overhanging portion 22, the second overhanging portion 22 can also have a convex shape overhanging from the main hull portion 21 with respect to the side connecting the two adjacent legs 10 when viewed from above. The second overhanging portion 23 is configured as a floating structure. Therefore, like the main hull portion 21, the second overhanging portion 23 can have a deck, a bottom, and an outer side shell that form an internal space in the second overhanging portion 23. The second overhanging portion 23 may further have a bulkhead if necessary.

[0023]

By adding the second overhanging portion 23 to the main hull portion 21, the space on the hull 20 is expanded, and at the same time, the stability of the offshore work facility 1 during towing can be improved. Further, since the second overhanging portion 23 has a shape that does not exceed the width of the main hull portion 21, it is possible to suppress an increase in resistance during towing. As a result, it is possible to efficiently tow the offshore work facility 1 by suppressing a decrease in towing speed. In order to further suppress the resistance during towing, when the offshore work facility 1 is configured to be towed in the direction of the white arrow shown in Fig. 2A, it is preferable that the second overhanging portion 23 is formed

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in such a shape that the shape, in which the main hull portion 21 and the second overhanging portion 23 are combined, is a boat shape in which the width is widened in a direction from the bow side toward the stern side.

[0024]

Although the case where the hull 20 has a single-layer has been described above, the hull 20 may have a multi-layer structure. Fig. 4 shows a schematic side view of an offshore work facility having a multi-layer hull. In the following description of the offshore work facility shown in Fig. 4, the same components as those of the offshore work facility described above are denoted by the same reference numerals as those in Fig. 1 and the like, and the description thereof will be omitted.

[0025]

In the offshore work facility 1 shown in Fig. 4, the hull 20 comprises a second deck 120a arranged above the deck 20a with a space from the deck 20a, and a second outer side shell 120c and a second bulkhead (not shown) that support the second deck 120a with a space from the deck 20a. As a result, the hull 20 has a two-layer structure. By the deck 20a, the second deck 120a, the second outer side shell 120c and the second bulkhead, the structure arranged above the deck 20a is configured as a floating structure in which an internal space divided into a plurality of sections is formed. Therefore, even if structures such as the second deck 120a, the second outer side shell 120c, and the second bulkhead are added to the deck 20a, the hull 20 ensures the buoyancy required to allow the offshore work facility to be towed.

[0026]

The second deck 120a and the second outer side shell 120c can be arranged at a position corresponding to at least the main hull portion 21 among the main hull portion 21 (see Fig. 2), the first overhanging portion 22 (see Fig. 2), and the second overhanging portion (see Fig. 2). That is, all regions of the hull 20 does not need to have a two-layer structure. However, in order to effectively use the upper surface of the hull 20, it is preferable to arrange the second deck 120a and the second outer side shell 120c so that all regions of the main hull portion 21, the first overhanging portion 22, and the second overhanging portion 23 have a two-layer structure.

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[0027]

Since the hull 20 has a two-layer structure, the mechanical strength of the hull 20 can be improved, and a heavier object can be mounted on the hull 20. As a result, the offshore work facility can be used to transport more or heavier components when transporting the components from the construction yard for offshore equipment construction to the sea area at the construction site. Although the case where the hull 20 has a two-layer structure has been described here, the hull 20 can also be configured with three or more layers.

[0028]

Next, a method for constructing an offshore equipment using the offshore work facility 1 of the present embodiment will be described by taking an example where the offshore equipment is an offshore wind power generation.

[0029]

First, various components such as a wind turbine member of an offshore wind power generation and the offshore work facility 1 are moved from a construction yard for construction to a sea area which is a construction site. The offshore work facility 1 is moved by towing the offshore work facility 1 with a towing vessel in a state that the legs 10 are raised with respect to the hull 20 and the hull 20 is floating above the sea surface. At this time, the components of the offshore wind power generation are mounted on the hull 20. If the hull 20 has a space and mechanical strength for mounting the components for one offshore wind power generation, a vessel for transporting the components is not required to move the components of the offshore wind power generation.

[0030]

When the movement of the components of the offshore wind power generation and the offshore work facility 1 is completed, the legs 10 of the offshore work facility 1 are lowered with respect to the hull 20 and the legs 10 are set to the bottom of the sea. At this time, as shown in Fig. 1, the legs 10 are lowered until the hull 20 is positioned above the surface of the sea. As a result, it is possible to construct an offshore wind power generation without being affected by sea condition.

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[0031]

After setting the legs 10 on the bottom of the sea, the components on the hull 20 are suspended by the crane 30 and the offshore wind power generation is assembled by the crane 30. Since the crane 30 is mounted on the first overhanging portion 22 and the working range of the crane 30 is further expanded, the assembling can be smoothly performed.

[0032]

After assembling the offshore wind power generation, the legs 10 are raised again with respect to the hull 20, and the offshore work facility 1 is returned to the construction yard by the towing vessel.

[0033]

It is also possible to connect a plurality of offshore work facility 1 and use them as a construction yard for constructing offshore equipment for loading and assembling components of the offshore equipment. Fig. 5 shows a plan view of a construction yard using a plurality of offshore work facility 1.

[0034]

The construction yard shown in Fig. 5 is configured by connecting three offshore work f equipment 1 so that the components of the offshore equipment can be loaded and assembled on the hull 20. Since the crane 30 is mounted on the first overhanging portion 22, a wider hull space can be ensured. Further, by arranging the offshore work facility 1 so that the cranes 30 are alternately positioned, it is possible to suppress interference with each other even when a plurality of cranes 30 are simultaneously operated.

[0035]

Construction yard can be installed for each project. By using the offshore work facility 1 as a construction yard, when the yard work is completed, the offshore work facility 1 can be moved to the construction area for offshore equipment as it is to construct the offshore equipment. The construction yard can also be used as permanent equipment. Thus, by using the offshore work facility 1 as a construction yard, the offshore work facility can be used as a substitute for the port equipment for the offshore equipment, and the construction yard can be installed at low cost and in a short period of time.

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[0036]

The present invention has been described above by taking the typical embodiment as an example. The offshore work facility 1 according to the present invention can be configured by adding the first overhanging portion 22 and the crane 30, and further adding the second overhanging portion 23 as necessary, to an existing offshore work facility such as a self-elevating platform or a jack-up drilling rig having a main hull portion 21 and legs 10. The “existing offshore work facility” means an offshore work facility that is already assembled and has the intended function of the offshore work facility, and the offshore work facility 1 according to the present embodiment can be constructed by modifying such an offshore work facility.

[0037]

In general, conventional offshore work facility such as a self-elevating platform and a jack-up drilling rig comprises self-elevating legs and a platform (corresponding to the main hull portion 21 in the above-mentioned offshore work facility 1 of the present embodiment) supported so as to be able to move up and down with respect to the legs.

[0038]

Therefore, by using (modifying) the existing offshore work facility to construct the offshore work facility according to the present invention, the legs 10 and the main hull portion 21 can be configured by using the legs and the platform of the existing offshore work facility respectively. Therefore, the offshore work facility can be obtained more easily and in a shorter construction period, and as a result, a significant cost reduction of the offshore work facility can be achieved. In particular, by constructing the offshore work facility 1 using the existing jack-up drilling rig, an offshore work facility, which can perform stable construction without being affected by waves by setting the legs on the bottom of the sea during offshore construction in a water depth of more than 90 m, can be obtained more easily and in a shorter construction period.

[0039]

Further, the jack-up drilling rig has an onboard drilling equipment so that drilling work for oil and natural gas can be performed in a state of setting on the bottom of the sea. The onboard drilling equipment is

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mounted on a cantilever installed on the platform. However, the cantilever is moved on the platform by a driving mechanism and performs drilling work at a position overhanging from the platform. In order to support the load of the entire cantilever including the driving mechanism and the shipboard drilling equipment, the platform internally has a strength member such as a bulkhead having a necessary strength as a support structure.

[0040]

The present embodiment focuses on this point, and utilizes the support structure for the cantilever of the existing jack-up drilling rig when forming the first overhanging portion 22. That is, the first projecting portion 22 is supported by the support structure for the cantilever and overhangs from the main hull portion 21. Here, the “support structure for the cantilever” is a support structure provided on the platform in order to support the load of the entire cantilever including the driving mechanism and the onboard drilling equipment described above, and specifically, the support structure for the cantilever is a strength member having a strength necessary to support the entire cantilever, for example, a bulkhead. As described above, by utilizing the support structure originally provided in the existing jack-up drilling rig, the first overhanging portion 22 having a mechanical strength sufficient to mount the crane 30 which can hoist a heavy structure such as a nacelle of an offshore wind power generation can be easily added in accordance with the originally provided strength member without newly adding a strength member. As a result, a significant cost reduction of offshore work facility is achieved.

[0041]

When the first projecting portion 22 is configured by using the support structure for the cantilever of the jack-up drilling rig as described above, the cantilever of the jack-up drilling rig and the onboard drilling equipment are removed, the first projecting portion 22 is formed on the support structure for the cantilever, and the crane 30 is mounted thereon. Therefore, the offshore work facility 1 no longer functions as a drilling rig.

[0042]

Further, when the hull 20 has a multi-layer structure in order to improve the mechanical strength of the hull 20, it is generally considered to

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replace the originally provided deck with a deck having higher mechanical strength. However, various structures such as electric wiring and water supply/drainage pipes are usually attached to the lower surface of the deck. Therefore, when replacing the deck, these structures also need to be replaced together. Thus, as shown in Fig. 4, by leaving the deck 20a as it is and arranging the second deck 120a above the deck 20a, originally provided electric wiring and water supply/drainage pipes can be utilized. As a result, it is possible to shorten the construction period of the offshore work facility 1 and suppress an increase in construction cost.

Explanation of Symbols

[0043]

- 1 Offshore work facility
- 10 Leg
- 20 Hull
- 20a Deck
- 20b Bottom
- 20c Outer side shell
- 20d Bulkhead
- 21 Main hull portion
- 22 First overhanging portion
- 23 Second overhanging portion
- 30 Crane
- 120a Second deck
- 120c Outer side shell

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CLAIMS

1. An offshore work facility comprising:
three or more legs,
a hull constructed as a floating structure and supported so as to be able to move up and down with respect to the legs, and
a crane mounted on the hull,
wherein the hull comprises a main hull portion in which the legs are arranged and an overhanging portion formed by overhanging from the main hull portion,
the offshore work facility is configured by adding the overhanging portion and the crane to an existing jack-up drilling rig having the main hull portion and the legs,
the overhanging portion is added to the main hull portion by using a support structure for a cantilever for an onboard drilling equipment mounted on the existing jack-up drilling rig, and
the crane is mounted on the overhanging portion.
2. The offshore work facility according to claim 1, wherein the hull further comprises a second overhanging portion configured as a floating structure.
3. The offshore work facility according to claim 2, wherein the second overhanging portion is formed so as to overhang from the main hull portion in a shape that does not exceed a width of the main hull portion.
4. The offshore work facility according to claim 2 or 3, wherein the second overhanging portion is formed by overhanging from the overhanging portion in such a shape that the shape combined with the main hull portion becomes a boat shape in which a width is widened in a direction from a bow side to a stern side,
5. The offshore work facility according to anyone of claims 1 to 4, the hull has a deck, a bottom, an outer side shell and a bulkhead, an internal space is

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formed in the hull by the deck, the bottom and the outer side shell, and the internal space is divided into a plurality of sections by the bulkhead.

6. The offshore work facility according to claim 5, further comprising a second deck arranged above the deck, and a second outer side shell and a second bulkhead that support the second deck with a space from the deck.

7. A method for constructing an offshore work facility comprising the steps of:

preparing a jack-up drilling rig comprising three or more legs, main hull portion in which the legs are arranged and is supported so as to be able to move up and down with respect to the legs, a cantilever supported to the main hull portion via a support structure, and a drilling equipment arranged on the cantilever,

removing the cantilever and the drilling equipment from the jack-up drilling rig,

adding an overhanging portion, which is formed by overhanging from the main hull portion, to the main hull portion using the support structure, and

mounting a crane on the overhanging portion.