OFFSHORE PLATFORM WITH MOVABLE CANTILEVER EXTENDING BEYOND THE DECK

The invention relates to an offshore system comprising a rig having a deck, and a cantilever, which is mounted on the deck and which is at least moveable in a longitudinal direction of the cantilever between a retracted position and an extended position, said cantilever having an operational end which extends beyond the deck in an extended position of the cantilever, said cantilever having an inner end opposite the operational end, said cantilever having one or more cantilever support rails in the longitudinal direction of the cantilever, the system further comprising support means comprising rail engagement members which allow longitudinal movement of the cantilever.

A prior art offshore system having a movable cantilever is disclosed in US 6,171,027. This cantilever is movable both in longitudinal direction (X-direction) and in transverse direction (Y-direction), basically along the side of the deck. An advantage of such a system is that the loads on the cantilever apply in the centre. Because the cantilever can be loaded efficiently its weight can be reduced and the capacity can be enhanced. Another advantage is that at the operational end a tower, and hence the drilling line, can be located in the middle of the cantilever giving the possibility to create an enclosed area with a moonpool in the centre.

A drawback of the known offshore systems having a cantilever with (borehole) equipment at the operational end is the limited size of the 'drilling envelope', i.e. the area that can be reached with (borehole) equipment by moving the cantilever in the longitudinal direction, and possibly also in a second (non-longitudinal) direction. In the extended position the cantilever projects partly beyond the deck of the rig. In the retracted position the cantilever is mainly situated on the deck of the rig. In general the size of the cantilever that can be used is determined by the space available on deck. In some cases, the available

space for movement and storage of the cantilever is limited, e.g. when the rig is a jack-up platform. Then one or more the legs of the jack-up from an obstacle. The same goes for any other "obstacle" on deck, such as accommodation for crew, machinery, cranes, etc.

The aim of the invention is to enlarge the 'envelope' of a cantilever type offshore system.

This aim is achieved according to the invention in that the system further comprises a support rail extension part for each cantilever support rail, that allows to extend the cantilever support rail at the inner end of the cantilever by being positioned in line with the cantilever support rail, for the purpose of increasing the length of the cantilever support rail and thereby the longitudinal reach of the cantilever.

When the position of the rig (e.g. the legs of a jack-up platform) with respect to the location where activities, e.g. borehole activities, are to be performed so require, the inventive system allows that the cantilever can be further extended in length by the support rail extension parts, thereby allowing a further movement in the longitudinal direction and enlarging the envelope in this dimension. In the retracted position of the cantilever, support rail extension parts are removed or moved to a storage position. For example, the support rail extension parts can be stored in the cantilever and move out of the cantilever telescopically when required, or the support rail extension parts can be slided in line with the cantilever support rail. It is also possible to rotate the support rail extension parts away from their active position, enabling the cantilever length to be reduced again. The support rail extension parts can for example be stored on the deck of the rig, in the cantilever or on another rig. The support rail extension parts can also be positioned in line with the cantilever support rail by the aid of a crane. Hence, with an offshore system according to the invention a large drilling envelope is obtainable while the required deck space is relatively limited.

Preferably, the cantilever is a box structure. Various equipment can be installed inside the cantilever. This facilitates the interface between the deck and the cantilever.

In a preferred embodiment, the support rail extension part is a separate part that is mountable on the cantilever. The support rail extension part can e.g. be stored on deck, in the cantilever, suspended or hung on a side of the cantilever or stored on another ship.

Alternatively, the support rail extension part is hingedly mounted on the cantilever or otherwise movably arranged on the cantilever, e.g. movable between a storage position and an active position. The support rail extension part could be arranged telescopically.

Possibly, the support rail extension part is designed as a flap, preferably a flap that is connected hingedly to the cantilever, e.g. about a vertical hinge axis, preferably near the inner end of the cantilever.

Preferably, bearing means are provided between the rail engagement members on the support means and the cantilever support rails on the cantilever. For example, the cantilever support rails comprise or form a longitudinal bearing surface or sliding surface or a rail surface-forming head.

In a preferred embodiment, the support means are mounted moveable on the deck, so that the cantilever is also moveable in a second (non-longitudinal) direction, while the cantilever is supported by the support means for movement in the longitudinal direction. It is possible to provide rails on the deck which allow for a movement of the support means. For example, the cantilever is also moveable in a translational direction perpendicular to the first longitudinal movement. In this case, a rectangular drilling envelope can be obtained.

In a second preferred embodiment, the second direction in which the cantilever can move is a rotational movement. For example, the support means is connectable or connected to the rig so that the cantilever is rotatable about a rotating axis, e.g. by a rotation pin. The rotating axis could be made positionable at multiple positions with respect to the rig, e.g. displaceable along a guide member. It is also possible to provide rails on the deck which allow for a movement of the support means, which rails could be made of an annular or circular shape which allows for a rotational movement of the support means. Preferably the cantilever is mounted so that it can be rotated at least between 0 and 90 degrees or is at least moveable in two directions or both.

In particular when the available space for movement of the cantilever with respect to the rig is limited, e.g. because the rig is a jack-up platform, and the space is limited by the legs of the jack-up, the cantilever with the tower can be arranged movable in two directions by extending the cantilever in its longitudinal direction and rotating the support means about a rotation axis on the rig. The shape of a thus-obtained drilling envelope is a segment of a ring. An advantage of a rotating cantilever over a transverse moving cantilever is that the piping and electrical interface between the rig and cantilever can be less complex. The rotating cantilever requires only a longitudinal drag chain between a swivel base and the cantilever. The transverse moving cantilever requires a longitudinal and a transverse drag chain.

When the support means move over the deck and / or the cantilever moves in the longitudinal direction over the support means considerable shearing forces occur. In order to at least partially relieve the parts sliding over each other in this regard friction reducing bearing means are provided at suitable locations. For instance at least two bearing members that are movable over the deck or a rail located closest to the edge of the rig are provided, which bearing members are operative in the longitudinal direction as well as in the transverse direction, to take up at least a part of the frictional forces between the support

means and the relevant deck area and between the bottom plate area of the cantilever and the support means.

In a practical embodiment, the friction-reducing bearing means are formed by hydrostatic bearings. It is contemplated that one or more mud pumps present on the rigs can be used to feed pressurized fluid, such as (sea) water to the hydrostatic bearings avoiding the need for separate power packs for this purpose. Alternatively, and even more practical, is the use of roller assemblies as bearing means.

In an alternative embodiment, the support means comprise a frame arranged between the deck and the cantilever, e.g. an essentially rectangular frame. In a possible embodiment the bearing means between one or more rails mounted on the deck and the frame of the support means are disposed at multiple positions, e.g. at all corners of said frame.

In a preferred embodiment, borehole equipment is provided at the operational end of the cantilever. The borehole equipment may comprise any suitable equipment for effecting activities related to a borehole or associated operations in the oil and gas industry. These include for instance drilling tools, maintenance tools or well intervention tools, lifting equipment for lowering or retrieving subsea equipment, such as wellhead equipment, etc.

More preferably, a tower or derrick and/ or crane is provided at the operational end of the cantilever. Preferably a multi-purpose tower is mounted on the cantilever. The multi-purpose tower e.g. can comprise drilling equipment, lifting equipment, etc. A drill floor can be provided on a top deck of the cantilever. In a particular embodiment, the length of the cantilever is between 30- 60 metres, wherein the rails can be extended with at least 5 metres, preferably at least 10m possibly up to 60m by the support rail extension parts. A particular preferred surface area of the drill floor on the cantilever is ~200m^2. By integrating the drill floor in the cantilever no hoses or dragchains

are required between the drill floor and the cantilever. A drill floor that is flush with the cantilever top deck makes the drill floor easy accessible and facilitates a pipe handling process. Additionally, a flush deck allow a gantry crane to be installed on the cantilever that can travel all the way to the tower.

The rig can be a member of the group: a Compliant Tower, a Deep Draft Caisson vessel, a SPAR, a Tension Leg Platform, Temporary Tension Leg Platform, a Semi Submersible rig, Jack-Up platform and Mono Hull Ship.

Further preferred embodiments are disclosed in the subclaims and the description which follows.

The present invention will be described further with reference to the appended drawings. In the drawings:

figs. 1-5 indicate subsequent stages of a method of installing drilling equipment on a sub-sea well using a preferred embodiment of a offshore system according to the invention;

figs. 6-10 show details of the flaps of the offshore system shown in figs. 1-5.

In figs. 1-5 part of a rig 1 is shown, having a deck 2. The rig 1 in this embodiment is a Jack-up platform comprising jack houses 3a, in which the legs 3b of the jack-up are moveable. A cantilever 4 is mounted on the deck of the rig 2. At an operational end 4a of the cantilever 4 a borehole equipment 5, in this embodiment a tower 5, is fixedly attached to the cantilever 4. A piperacker 8a is placed beside the tower 5, as well as a pipehandler 8b and pipe storage 8c. In this embodiment, a gantry crane 9 is placed on the cantilever 4. Cantilever 4 is mounted on deck 2 via support means 7. The cantilever 4 comprises cantilever support rails 10 in longitudinal direction L of the cantilever 4. Support rails 10 comprise a longitudinal bearing surface (not shown). Support means 7 comprise rail engagement members 7a, which

allow longitudinal movement of the cantilever 4. Bearing means (not shown) can be positioned between the longitudinal bearing surface of the support rails 10 and the rail engagement members 7a. A circular shaped rail 11 is mounted on deck 2 which allows for a rotational movement of the support means 7, so that the cantilever 4 is rotatable. Friction reducing bearing means (not shown) are provided between the rails 11 mounted on the deck 2 and the support means 7.

In the rest position shown in fig. 1, the cantilever 4 is in its retracted position, situated on the deck 2 of the drilling rig 1.

In fig. 2, cantilever 4 has partly moved in its longitudinal direction to an extended position. In this position, the tower 5 comprising borehole equipment extends beyond the deck 2 of the jack up platform 1, capable of performing operations in this area. At the inner end 4b of the cantilever 4, opposite to the operational end 4a, two hinges 6a are provided to which support rail extension parts 6b' are connected. In this embodiment, the support rail extension parts 6b' comprise two foldable flaps 6b. The hinges 6a extend perpendicular to the longitudinal direction 4a of the cantilever 4. A beam 6c is provided between flaps 6b for reasons of stability. In fig. 1, the flaps 6b were folded in to the end of the cantilever 4 remote from the tower 5, perpendicular to the longitudinal direction L of the cantilever 4.

In fig. 3, the cantilever 4 has moved further in the longitudinal direction to a further extended position than shown in fig. 2. The position of the cantilever is extended even further than the furthest position possible solely with the cantilever 4, by the aid of the support rail extension parts 6b.

In figs. 4 and 5, the cantilever 4 is also shown in its furthest extended position, in which the cantilever 4 has also rotated with respect to deck 2.

In fig. 6, a detail of deck 2 and cantilever 4 is shown, which cantilever 4 has moved into a longitudinal direction of the cantilever, indicated with the character 'L', to an almost fully extended position of the cantilever 4 itself. The operational end of the cantilever is not shown in this figure. Cantilever 4 is mounted on deck 2 via support means 7. The cantilever 4 comprises cantilever support rails 10 in the longitudinal direction L of the cantilever 4. Support rails 10 comprise a longitudinal bearing surface (not shown). Support means 7 comprise rail engagement members 7a, which allow longitudinal movement of the cantilever 4. Support rail extension parts 6b' are connected to the inner end 4b of the cantilever 4 by hinges 6a. Support rail extension parts 6b' comprise flaps 6b. Rail engagement members 7a on support means 7 allow longitudinal movement of the cantilever 4, but also of the extension parts 6b'. A circular shaped rail 11 is mounted on deck 2 which allows for a rotational movement of the support means 7, so that the cantilever 4 is rotatable. Friction reducing bearing means (not shown) are provided between the rails 11 mounted on the deck 2 and the support means 7. In figs. 6-10, the support rail extension parts 6b' are shown in subsequent positions, between the positions shown in fig. 2 and 3.

In fig. 7, the flaps 6b are partly folded out, being hinged about hinges 6a. In fig. 8, the flaps 6b are fully folded out, such that the rail extension parts 6b' are positioned in line with the cantilever support rail 10.

As shown in figs. 9 and 10, the rail extension parts 6b' can move across rail engagement members 7a of support means 7, allowing for a longitudinal movement of the rail extension parts 6b'. As a result, the length of the cantilever support rail 10 has increased by the length of the support rail extension parts 6b', thereby increasing the longitudinal reach to the cantilever 4. Therefore, it is possible for the cantilever 4 to move to a position extended further than the fully extended position of the cantilever solely.

C L A I M S

1. Offshore system comprising:

- a rig having a deck,
- a cantilever, which is mounted on the deck and which is at least moveable in a longitudinal direction of the cantilever between a retracted position and an extended position,
- said cantilever having an operational end which extends beyond the deck in an extended position of the cantilever,
- said cantilever having an inner end opposite the operational end,
- said cantilever having one or more cantilever support rails in the longitudinal direction of the cantilever,
- the system further comprising support means comprising rail engagement members which allow longitudinal movement of the cantilever,

characterized in that

the system further comprises a support rail extension part for each cantilever support rail, that allows to extend the cantilever support rail at the inner end of the cantilever by being positioned in line with the cantilever support rail, for the purpose of increasing the length of the cantilever support rail and thereby the longitudinal reach of the cantilever.

2. Offshore system according to claim 1, wherein the support rail extension part is mountable on the cantilever.

3. Offshore system according to claim 1 or 2, wherein the support rail extension part is hingedly mounted on the cantilever.

4. Offshore system according to any of the previous claims, wherein the support rail extension part is a flap.

5. Offshore system according to claim 4, wherein the flap comprises one or more hinges extending substantially perpendicular to the

longitudinal direction of the cantilever, which hinges are connected or connectable to the inner end of the cantilever.

6. Offshore system according to any of the previous claims, wherein bearing means are provided between the rail engagement members on the support means and the cantilever support rails on the cantilever.

7. Offshore system according to any of the previous claims, wherein the cantilever support rails comprise a longitudinal bearing surface.

8. Offshore system according to any of the previous claims, wherein the support means are mounted moveable on the deck, so that the cantilever is also moveable in a second direction.

9. Offshore system according to claim 8, wherein the cantilever is also moveable in a translational direction perpendicular to the first longitudinal movement.

10. Offshore system according to claim 8, wherein the support means is connectable or connected to the rig so that the cantilever is rotatable about a rotating axis, e.g. by a rotation pin.

11. Offshore system according to claim 10, wherein said rotating axis is positionable at multiple positions with respect to the rig, e.g. displaceable along a guide member.

12. Offshore system according to any of the previous claims, wherein rails are mounted on the deck which allow for a movement of the support means.

13. Offshore system according to claim 12, wherein an circular shaped rail is mounted on the deck, which allows for a rotational movement of the support means.

14. Offshore system according to claim 12 or 13, wherein friction reducing bearing means are provided between the rails mounted on the deck and the support means.

15. Offshore system according to claim 14, wherein said support means comprise a frame arranged between the deck and the cantilever, e.g. an essentially rectangular frame.

16. Offshore system according to claim 14, wherein said bearing means include one or more hydrostatic bearings.

17. Offshore system according to any of the previous claims, wherein at the operational end of the cantilever borehole equipment is provided, e.g. comprising drilling tools, maintenance tools or well intervention tools.

18. Offshore system according to any of the previous claims, wherein at the operational end of the cantilever a tower, a derrick and/or a crane is provided.

19. Offshore system according to any of the previous claims, wherein said rig is a drilling rig.

20. Offshore system according to any of the previous claims, wherein said rig is a member of the group: a Compliant Tower, a Deep Draft Caisson vessel, a SPAR, a Tension Leg Platform, Temporary Tension Leg Platform, a Semi Submersible rig, Jack-Up platform and Mono Hull Ship.