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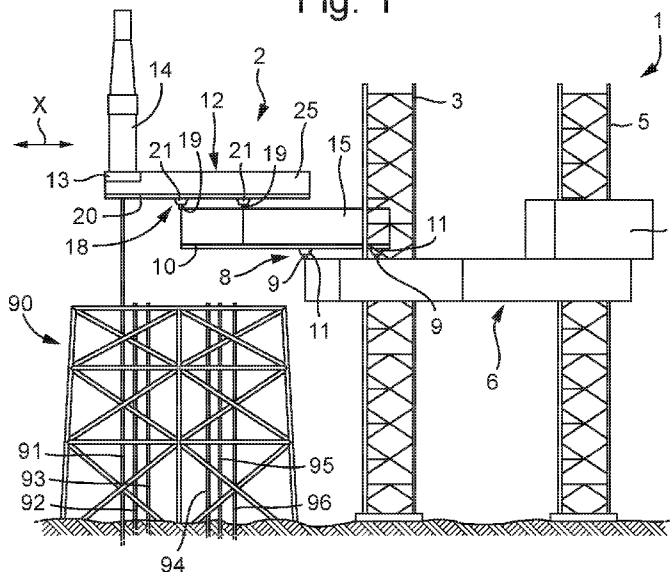
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(54) **Title:** CANTILEVER SYSTEM FOR AN OFFSHORE PLATFORM

Fig. 1



(57) **Abstract:** A cantilever system for an offshore platform, such as a jack-up platform, has a cantilever structure for carrying a well drilling or well intervention facility at a distal end of the cantilever structure and a primary cantilever guide for guiding movement of the cantilever structure relative to the platform between a distal position reaching outside the platform, such that said facility can be positioned outside the platform, and a retracted position. The cantilever structure has a primary cantilever guided by the primary cantilever guide, a secondary cantilever for carrying said facility at its distal end and a secondary cantilever guide guiding movement of the secondary cantilever relative to the primary cantilever, such that said facility can be positioned outside the primary cantilever.

TITLE: Cantilever system for an offshore platform

FIELD AND BACKGROUND OF THE INVENTION

The invention relates to a cantilever system for an offshore platform, such as a jack-up platform. A drill floor and drilling derrick of a mobile off-
5 shore platform, such as a jack-up platform, a drilling barge or a semi-submersible, are usually placed on the end of a cantilever structure such that when the cantilever structure is retracted, the drill floor and the derrick are substantially within the bounds of the floating platform (in the form of a buoyant hull). In this configuration the platform can be moved from one
10 drilling location to another, usually by towing.

Once on location, the platform is elevated above the sea level such that it is generally clear from the waves, for instance by lowering legs of the jack-up platform to the seabed and jacking up the platform along the legs which are supported by the seabed. Next, the cantilever is extended (skidded) out
15 (usually over the stern) of the platform, such that the drilling center is outside the platform and a well can be drilled and constructed in that position. This can be over open water or over a fixed structure positioned on the seabed.

U.S. patent 6 171 027 discloses a drilling rig in the form of a jack-up platform on which a cantilever system is mounted that has a cantilever
20 structure elongated in a longitudinal direction and a cantilever guide for guiding movement of the cantilever structure relative to the platform in the longitudinal direction between a distal position reaching outside the jack-up platform, such that a well drilling or well intervention facility can be positioned outside the jack-up platform, and in a retracted position. On the
25 cantilever structure a well drilling or intervention facility in the form of a drilling platform is present, at a distal end of the cantilever structure, such that the facility can be positioned outside the jack-up platform. The cantilever structure is guided for movement between a most proximal position and a most distal position. Thus, the facility for performing operations on a well can be

shifted over the side of the jack-up platform in the longitudinal direction of the cantilever into a position accurately matching the position of the well head on or through which an operation is to be performed. In this cantilever system, positioning of the drilling derrick or other equipment in horizontal directions transverse to the longitudinal direction of the cantilever system is performed by transversely shifting the cantilever in a direction perpendicular to the longitudinal direction. Other known solutions for this purpose are transversely shifting the drilling platform relative to the cantilever or pivoting the cantilever about a pivoting axis at its proximal end.

In particular when drilling over an existing fixed structure resting on the seabed, the requirement that all well positions can be reached, preferably without repositioning of the mobile platform is often difficult if not impossible to meet. Also during and at the end of the lifetime of wells additional work in or on the wells (well intervention) is required that may require the use of a jack-up or other mobile platform, such as work over during field life and plug and abandonment at the end of the field life. This type of work usually does not require the heavy duty drilling equipment and loads as required for drilling new wells. Wells on fixed production structures were usually drilled by drilling facilities placed on the fixed structure itself. In many cases it is now more efficient to perform the additional work on existing wells with modern equipment from a drilling jack-up platform. On some of these fixed structures, the arrangement of the well slots is such that one or more of the well slots cannot be reached using conventional cantilever drilling jack-up platforms.

Publication US 5407302 describes a method and device for moving the drilling derrick from the cantilever onto the fixed platform. Thereto, a skid base is provided that is movable from the cantilever onto the fixed platform. First, the cantilever is adjusted in height, by lowering or elevating the platform along the legs, until the cantilever is at the same height as the fixed platform. Then, the skid base is moved from the cantilever onto rails of the fixed platform. When the skid base is onto the fixed platform, the cantilever is

adjusted in height, by elevating the platform along the legs, until the cantilever is at the same height of the skid box. Then, the drilling derrick is transferred from the cantilever onto the skid box to perform drilling operations and/or other operations onto the wells of the fixed platform.

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SUMMARY OF THE INVENTION

It is an object of the present invention to provide a cantilever system that can be used for a wider range of operation and in particular that allows
10 performing operations on wells in a larger area.

According to the invention, this object is achieved by providing a cantilever system according to claim 1. The invention can also be embodied in an off-shore platform according to claim 17.

The secondary cantilever is guided relative to the primary cantilever by
15 the secondary cantilever guide for guided movement between a distal position reaching outside the primary cantilever, such that the well drilling or well intervention facility can be positioned outside the primary cantilever, and a retracted position. Thus, an increased reach is obtained when the secondary cantilever is in the distal position, while the cantilever system does not require
20 an accordingly increased free space on the platform when in retracted condition fully or partially within a top view contour of the primary cantilever. Such free space is typically limited due to the presence of legs, cranes and other equipment projecting upwardly from or arranged on top of the platform. During transit and installation, the primary cantilever and the secondary
25 cantilever are preferably retracted and sea-fastened. This retraction allows a minimal safety distance during the positioning of the platform adjacent to a fixed structure such as a production platform to be observed. The increased reach outside of the platform for positioning the well drilling or well intervention facility makes positioning of the platform less critical and allows

larger safety distances to be accepted, which is, in some situations, also necessary to avoid damaging subsea pipelines.

The increased reach provided by embodiments of a cantilever structure according to the invention may for instance be in longitudinal direction of the elongated first cantilever and/or in a direction transverse thereto. An increased reach in the longitudinal direction can be achieved because the combined length of the cantilever structure can be longer than would be allowed to be retracted in view of the free surface area available on the platform. An increased reach in transverse direction can be achieved, because transverse displacement of the secondary cantilever can be allowed over a wider range than would be allowed by the transverse spacing between for instance the legs or other obstacles of the platform. Since the secondary guide guiding the transverse displacement (which may be translatory and/or rotary) is arranged between the first cantilever and the second cantilever, the facilities guiding transverse displacement of the secondary cantilever do not have to be arranged at or near the distal end of the cantilever structure, but can nevertheless be shifted far enough outboard of the platform to keep the secondary cantilever clear of the legs or other obstacles on the platform when moved transversely.

Particular elaborations and embodiments of the invention are set forth in the dependent claims.

Further features, effects and details of the invention appear from the detailed description and the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a schematic side view of an off-shore platform with a first example of a cantilever system according to the invention;

Fig. 2 is a schematic top plan view of the platform shown in Fig. 1;

Fig. 3 is a schematic isometric view of the platform shown in Figs. 1 and 2;

Fig. 4 is a schematic top plan view of the platform shown in Figs. 1-3 in another operating condition

5 Fig. 5 is a schematic top plan view of the platform shown in Figs. 1-4 in a further operating condition

Fig. 6 is a schematic top plan view of the platform shown in Figs. 1-5 in yet another operating condition

10 Fig. 7 is a schematic side view of a cantilever structure of the platform in the condition as shown in Fig. 6;

Fig. 8 is a schematic top plan view of an off-shore platform with a second example of a cantilever system according to the invention;

Fig. 9 is a schematic isometric view of the platform shown in Fig. 8;

15 Fig. 10 is a schematic top plan view of an off-shore platform with a third example of a cantilever system according to the invention;

Fig. 11 is a schematic isometric view of the platform shown in Fig. 10; and

Fig. 12 is a schematic top plan view of an off-shore platform with a fourth example of a cantilever system according to the invention.

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DETAILED DESCRIPTION

The invention is first discussed with reference to the first example of an offshore platform in the form of a jack-up platform 1 with a cantilever system 2
25 according to the invention shown in Figs. 1-7 projecting substantially horizontally from a platform hull 6 of the jack-up platform 1. The jack-up platform 1 has three legs 3, 4, 5 carrying the platform hull 6, which is displaceable in vertical direction along the legs 3, 4, 5. Depending on various requirements, the number of legs may also be different e.g. one, two, four, five,
30 six or more legs. A cabin 7 for accommodating control facilities, machinery and

providing shelter or housing for a crew is arranged on the platform hull 6 at a side opposite of the side from which the cantilever system 2 projects.

The cantilever system 2 is composed of a primary cantilever guide 8 and a cantilever structure 12 guided thereby. The cantilever structure 12 is
5 composed of a primary cantilever 15, a secondary cantilever 25 and a secondary cantilever guide 18 for guiding movement of the secondary cantilever 25 relative to the primary cantilever 15.

The primary cantilever guide 8 is in the form of a skidding system having a fixed part in the form of transverse rails 9 fixedly mounted to the
10 platform hull 6 of the jack-up platform 1 and a movable part 10, guided for guided movement relative to the fixed part 9. The movable part 10 of the primary cantilever guide 8 is formed by longitudinal rails 10 that are part of an elongated primary cantilever 15 of an elongated cantilever structure 12. Instead of being an integral, e.g. load bearing, part of the primary cantilever,
15 the movable part may also be fixedly mounted to the primary cantilever. In the present example two rails are provided, but other numbers of rails and/or other longitudinal guides and/or traction providing structures are also conceivable.

Carts 11 are guided by the rails 9 for guided displacement along the
20 rails 9 so that the cantilever structure 12 is displaceable in substantially horizontal, transverse directions Y of the transverse rails 9, between extreme left and right positions while the primary cantilever 15 and its longitudinal rails 10 are held stationary relative to the carts 11. The cantilever structure 12 is guided to move over the carts 11 by its longitudinal rails 10 guided by the
25 carts 11, along a trajectory in substantially horizontal longitudinal X direction between a most proximal position and a most distal position while the carts 11 are held stationary relative to the transverse rails 9. Displacement in other selected directions can be achieved by combined (simultaneous or sequential) movement of the carts 11 along the transverse rails 9 and movement of the
30 primary cantilever 15 with its longitudinal rails 10 over the carts 11. For

examples of further details of carts and means for controlling displacements of the carts along the rails, reference is made to U.S. patent 6 171 027. The carts 11 may also be mutually connected forming a common intermediate member of the primary cantilever guide.

5 The cantilever structure 12 projects from the fixed part 9 of the primary cantilever guide 8 and has a drilling platform 13 carrying a drilling tower 14 at a distal end of the cantilever structure 12 for instance for performing drilling and other operations such as plugging on wells 91-96 performed over a fixed platform 90. Instead of a drilling platform with a drilling tower or other
10 rotary facilities, the cantilever structure may also carry a different well drilling or intervention facility, such as a crane or other equipment for performing operations such as well construction, maintenance, work over and/or plug and abandonment.

 In addition to the primary cantilever 15, the cantilever structure 12
15 includes a secondary cantilever guide 18 having a fixed part 19, also in the form of transverse rails 19. In this example, the transverse rails 19 are integral parts of the primary cantilever 15. A movable part 20 of the secondary cantilever guide 18 is provided in the form of rails 20 oriented in the longitudinal direction of the cantilever structure 12. The rails 20 are integral
20 parts of a secondary cantilever 25 for guiding movement of the secondary cantilever 25 in the longitudinal X direction relative to the primary cantilever 15, back and forth between a most proximal position and a most distal position of the secondary cantilever 25.

 The secondary cantilever 25 is elongated in the longitudinal X direction
25 and projects from the primary cantilever 15 in the longitudinal X direction, at least when the secondary cantilever 25 is in its most distal position. The drilling platform 13 is arranged at the distal end of the secondary cantilever 25.

 Carts 21 are guided by the rails 19 for guided displacement along the
30 rails 19, so that the secondary cantilever 25 is displaceable in transverse

directions Y between extreme left and right positions, in which the secondary cantilever is extended transversely relative to the primary cantilever 15, while the longitudinal rails 20 are held stationary relative to the carts 21. The secondary cantilever 25 is displaceable in longitudinal directions X of the
5 longitudinal rails 20 along a trajectory between a most proximal position and a most distal position while the carts 21 are held stationary relative to the transverse rails 19. Displacement in other selected directions can be achieved by combined (simultaneous or sequential) movement of the carts 21 along the longitudinal rails 20 and the transverse rails 19. For examples of further
10 details of carts and means for controlling displacements of the carts along the rails, reference is made to U.S. patent 6 171 027. Also the carts 21 may be mutually connected forming a common intermediate member of the secondary cantilever guide. Furthermore, instead of being provided in the form of integral, load bearing parts, of the primary cantilever 15 and, respectively, the
15 secondary cantilever 25, the fixed part 20 and the movable part 19 may also be fixedly mounted to the respective cantilevers. The cantilever system 2 projects substantially horizontally from the platform hull 6 at least when the secondary cantilever 25 is in its most distal position.

The secondary cantilever 25 is guided relative to the primary cantilever
20 15 for guided movement in the longitudinal X direction of the cantilevers 15, 25 and provides an increased reach in longitudinal direction when in extended condition while the cantilever system 2 does not require an accordingly increased free space on the platform hull 6 when in retracted condition (see e.g. retracted position of cantilever system 2' with cantilever structure 12' and
25 cantilevers 15', 25' indicated in dash-and-dot lines in Fig. 2). Such free space is limited due to the presence of jack-up platform legs 3-5 and other items 7 projecting upwardly from or arranged on top of the platform hull 6. Thus, the longitudinal reach of the drill tower is extended beyond the reach that can be obtained by a single cantilever and the area in which the well drilling or well
30 intervention facility can be positioned is considerably increased. For example,

this will enable the jack-up platform 1 to reach all wells 91-96 of a fixed platform 90 when performing 'work-over' or 'plug and abandonment' operations, without loading the fixed platform 90. This also avoids the need of skidding a drill tower onto the fixed platform 90.

5 The larger reach available for positioning of the rotary in longitudinal and/or transverse directions may be available only for working with smaller derrick loads, but this is nevertheless useful for performing operations such as work over and plugging & abandonment of wells over existing fixed platforms, while the larger derrick capacity is maintained for working within the reach of
10 the primary cantilever 15 only.

 During transit and installation, the primary cantilever and the secondary cantilever are preferably retracted further inboard than in the distal position and sea-fastened. In the retracted position, the cantilevers and any facilities mounted thereto are preferably completely inboard of the
15 platform, but a (preferably small) portion of one of the cantilevers or both cantilevers and/or of any facilities mounted thereto may still project outside of the platform. This retraction allows a minimal safety distance during the positioning of the jack-up platform 1 adjacent to a fixed platform to be observed. The increased reach of the rotary provided by the invention makes
20 positioning of the jack-up platform less critical and allows larger safety distances to be accepted, which may also be necessary to avoid damaging subsea pipelines. During jacking up and preloading of the jack-up platform, both cantilevers will remain retracted.

 A cantilever system according to the present embodiment may for
25 example be obtained by providing a secondary cantilever supporting a light duty drilling facility, mounted for guided movement on a primary cantilever originally designed for supporting a heavy duty drilling facility. In this manner, a cantilever system for performing one light duty operation at a time, but with a particularly large reach can be provided.

Since the primary cantilever guide 8 is arranged for guided movement of the primary cantilever 15 relative to the platform hull 6 in a direction transverse to the longitudinal X direction, the drilling platform 13 can also be displaced in directions transverse to the longitudinal X direction. In the present example, this has been achieved by providing the guide rails 9 in a substantially horizontal Y direction perpendicular to the longitudinal X direction by which the carts 11 are guided. However, other or additional solutions for providing horizontal transverse movability of the cantilever structure 12 as a whole in one or more directions are conceivable as well, such as pivotability about a vertical axis through the platform hull 6.

Movability of the drilling platform 13 in a horizontal direction transverse to the X direction may also or additionally be provided by arranging, as is known as such, the drilling platform, such that skidding of the drilling platform in that horizontal transverse direction relative to the cantilever to which the drilling platform is mounted is allowed.

That the guided movement of the primary cantilever 15 relative to the platform hull 6 in the further direction is a translatory movement in a direction transverse to the longitudinal X direction, is advantageous for obtaining a large longitudinal reach of the cantilever system 2 in the extreme left and right positions. This reach is not limited compared to the reach in the centered position if, as in the present example, the transverse translatory movability is in horizontal Y directions perpendicular to the longitudinal X directions.

Since the secondary cantilever guide 18 is arranged for guided movement of the secondary cantilever relative to the primary cantilever 15 in a further direction transverse to the longitudinal X direction, the secondary cantilever 25 is movable relative to the primary cantilever 15 in directions transverse to the X direction. This allows transverse displacement of the drilling platform 13 without transversely displacing the primary cantilever 15. Furthermore, if, as in the present example, the primary cantilever 15 is

displaceable transversely, the transverse displaceability of the secondary cantilever 25 relative to the primary cantilever 15 provides an enlarged range of transverse displaceability. This is particularly advantageous because transverse displacement of the primary cantilever 15 requires free space on the platform hull 6 to the side of the primary cantilever 15. Such free space, cleared from obstacles is not always available and typically limited by the presence of the legs 3, 4 of the jack-up platform 1 at the side of the cantilever system 2. Since the guide rails 19 and support structure allowing transverse displacement of the secondary cantilever 25 are located on the primary cantilever 15, the facilities guiding transverse displacement of the secondary cantilever 25 are arranged closer to the platform 6 than the distal end of the cantilever structure 12, but can nevertheless be shifted far enough outboard of the platform 6 to keep the secondary cantilever 25 clear of the legs 3, 4 or other obstacles on the platform 6 when moved transversely.

Also, the guided movement of the secondary cantilever guide 18 relative to the primary cantilever 15 in the further direction is preferably a translatory movement in a direction transverse and preferably perpendicular to the longitudinal X direction.

For obtaining a large range of transverse movability of the drilling platform 13 if both the primary cantilever guide and the secondary cantilever guide are arranged for guiding displacement transverse to the longitudinal direction, it is advantageous if, the secondary cantilever guide 18 is arranged for guiding translatory movement in a direction transverse to the longitudinal X direction over a distance larger than the width of a proximal portion of the primary cantilever 15. This allows the overall length of the transverse displacement trajectory over which the drilling platform 13 can be displaced to be larger than the distance in that direction between obstacles, such as the jack-up platform legs 3, 4, that limit transverse displacement of the primary cantilever 15. In the present example, the feature that the secondary cantilever guide 18 is arranged for guiding translatory movement in a

direction transverse to the longitudinal X direction over a distance larger than the width of a proximal portion of the primary cantilever 15, has been achieved by providing that the guide rails 19 of the secondary cantilever guide 18 are longer than the width of the proximal portion of the primary cantilever 15.

5 Also, a distal portion of the primary cantilever 15 supporting the rails 19 is wider than the proximal portion of the primary cantilever 15. It is however also possible to achieve the increased distance over which the secondary cantilever 25 can be guided relative to the primary cantilever 15 in other manners, for instance by providing a secondary cantilever guide with a first
10 set of transverse rails fixed to the primary cantilever, an intermediate body guided by and movable along the length of the first set of rails and a second set of transverse rails fixed to the secondary cantilever and guided by the intermediate body so as to be movable relative to the intermediate body in longitudinal direction of these rails.

15 As is illustrated by Fig. 4, the transverse reach of the cantilever structure 12 may additionally or alternatively be increased by providing that the secondary cantilever guide allows for pivoting movement of the secondary cantilever guide 25, 25" about a vertical axis 38 through the primary and secondary cantilevers 15, 25, 25", so that an angle α between longitudinal
20 center lines of the primary cantilever guide 15 and the secondary cantilever guide 25" can be varied. Since the pivoting axis 38 can be shifted outboard of the platform 6, pivoting of the secondary cantilever over a wide angle α while keeping clear of the legs 3, 4 is allowed. On the other hand, the axis 38 is located proximally of the distal end of the cantilever structure 12, so that the
25 construction providing pivotal support is less far outboard than the distal end of the cantilever structure 12 and exerts a smaller bending moment on the cantilever structure 12 than if it were provided at or near the distal end.

In the present example both the primary cantilever guide 8 and the secondary cantilever guide 18 are arranged for allowing transverse
30 displacement of the primary cantilever 15 and, respectively, the secondary

cantilever 25. It is however also possible to arrange only the primary cantilever guide or only the secondary cantilever guide for allowing transverse relative displacement of the parts guided thereby or not to allow transverse relative displacement at all, for instance if another mode of displacement is
5 provided for positioning in directions transverse to the longitudinal direction.

The secondary cantilever 25 can be used as a counter weight against the leverage of the primary cantilever 15 extending outboard of the platform 6. Thus, if the platform 6 can be positioned close enough to the well on which an operation is to be performed so that the additional reach provided by the
10 secondary cantilever 25 is not needed, the facility (not shown) can be arranged on the primary cantilever 15 and the secondary cantilever 25 can be either fully retracted or pivoted to a position in which it can be used as a counterweight for increasing the maximum load to which the primary cantilever 15 can be subjected without overloading the primary cantilever
15 guide 8.

As shown in Fig. 5 the load capacity of the facility now arranged on the primary cantilever 15 can be enlarged by pivoting the secondary cantilever 25 about a vertical axis 38 through the first and second cantilevers 15, 25 to a proximal position, so that the tower 14 or other load on the distal end of the
20 secondary cantilever 25 functions particularly effectively as a counter weight that is far inboard when the secondary cantilever 25 is pivoted to a position 25'" pointing proximally from the pivoting axis 38.

The secondary cantilever 25 can be fully retracted to a proximal position in which the guides 18 can still support the distal end of the secondary
25 cantilever, similar to the retracted position 25' of the secondary cantilever in relation to the primary cantilever 25 as shown in Fig. 2, but with the primary cantilever 15 in extended position. The proximal end of the secondary cantilever 25 now reaches inboard over the platform 6. In this position the moment exerted on the primary cantilever is reduced, thereby enlarging the
30 maximum load capacity available for the facility on the primary cantilever 15.

This effect can be further increased by applying additional load on the proximal end of the secondary cantilever. If the secondary cantilever is positioned aside of the primary cantilever, a temporary auxiliary support extending from the primary cantilever or from the deck of the platform can be
5 used to transfer the load.

As illustrated by Figs. 6 and 7, the secondary cantilever 25 is guided relative to the primary cantilever 15 for movement to a most proximal position 25''' in which a center of gravity 36 of the secondary cantilever 25''' is proximal of a most distal location (here at outer rail 9) where the primary
10 cantilever 15 is supported by the platform 6.

In the present example, the secondary cantilever 25 is guided for translatory movement in longitudinal direction of the primary cantilever 15 to the most proximal position 25'''. This allows the most retracted position to be reached in a simple manner with no a risk of hitting the legs 3, 4. For guiding
15 the secondary cantilever 25 to its most retracted position, the cantilever system has an auxiliary guide in the form of rails 37, in addition to the secondary cantilever guide 18, along which the secondary cantilever 25 can be skidded to its most retracted position 25'''. In the present example, when the auxiliary guide 37 guides the secondary cantilever 25, the secondary cantilever
20 25 is not movable in a translatory manner in directions transverse to the longitudinal direction of the primary cantilever 15.

In Figs. 8 and 9, a second example of a jack-up platform 101 with a cantilever system 102 according to the invention is shown. Features of the jack-up platform 101 according to the second example that are identical to the
25 jack-up platform 1 according to the first example are not described. In the jack-up platform 101 according to this example, the primary cantilever 115 has a further drilling platform 123, carrying a further drilling tower 124, at a distal end of the primary cantilever 115. This allows simultaneous operation of two towers 114, 124, for example, one for drilling a well and the other for
30 completing of another well, or both for performing light duty operations.

Similar to the first example, the load capacity of the derrick 124 mounted on the primary cantilever 115 can be enlarged by either fully retracting or pivoting the secondary cantilever 125 into a position in which it functions as a counter weight.

5 The secondary cantilever 125 can be retracted to a position 125' in which the proximal end of the secondary cantilever 125 reaches inboard over the platform, thereby enlarging the maximum load capacity available for the facility on the primary cantilever 115. This effect can be increased by applying an additional load 139 on the proximal end of the secondary cantilever. A
10 temporary support (not shown) extending from the side of primary cantilever 125 or from the deck of the platform adjacent its side facing in x-direction can be used to partially transfer the vertical load from the cantilever to the platform, so that leverage providing additional load capacity of the cantilever structure is provided in the form of a tilting moment about that temporary
15 support.

 The secondary cantilever 125 can also be pivoted about a vertical axis 138 through the first and second cantilevers 115, 125. When pivoted over smaller angles from a distally oriented position, such as for example to position 125', the pivotability about the vertical axis 138 provides an increased
20 reach in transverse direction to one side of the primary cantilever 115.

 The facility mounted to the secondary cantilever may be a crane, which typically has a much smaller weight than a drilling platform with a drilling derrick that may be mounted to the primary cantilever 115. The increased reach of the crane on the secondary cantilever, which is larger than the reach
25 of the facility on the primary cantilever, is of particular advantage in well abandonment operations. Well abandonment typically involves performing operations on the well that may include both rotary and vertical movement of tools, and hoisting operations on parts of the fixed platform structure to be dismantled that typically also need to be performed on parts of the fixed

platform structure that are distally (i.e. in the longitudinal direction) beyond the wells.

In Figs. 10 and 11, a third example of a jack-up platform 201 with a cantilever system 202 according to the invention is shown. Also regarding this third example, features of the jack-up platform 201 that are identical to the jack-up platforms 1, 101 according to the first and second examples are not described. The cantilever system 202 according to this third example has two of the secondary cantilever guides 218, 228 and two secondary cantilevers 225, 235, each guided for guided movement relative to the primary cantilever 215 by one of the secondary cantilever guides 225, 235.

In addition to the functionalities of the cantilever system 202 according to the second example, this allows simultaneous operation of two towers 214, 224 in a wider area, and retraction or pivoting of each of the secondary cantilevers 225, 235 for use as a counter weight for enlarging the load capacity of the derrick 224, 214 mounted on the other secondary cantilever 235, 225. To this end, as in the first example, an auxiliary cantilever guide, allowing one of the secondary cantilevers to be moved to a further retracted position than allowed by the associated secondary cantilever guide, may be provided. The jack-up platform according to the third example is particularly suitable for parallel drilling or other operations, e.g. over an array of wells in a fixed platform.

If the drilling tower 214, 224 on one of the secondary cantilevers 225, 235 is ready with one well, before the other tower 224, 214 is finished with its well, then that secondary cantilever 225, 235 can be moved by a certain distance Δx and/or Δy (depending on the well spacing), to start already operating on a next well.

A cantilever system according to this third embodiment may for example be obtained by providing two or more secondary cantilevers, each supporting a light duty well drilling or well intervention facility, mounted for guided movement on a primary cantilever originally designed for supporting a heavy

duty drilling facility. In this manner, a cantilever system is provided that allows performing two or more light duty operations simultaneously with very little restriction regarding the relative positions of the wells on which operations are performed simultaneously.

5 Within the framework of the invention, many other variants than the described embodiments and examples are conceivable. For instance, as illustrated in Fig.12, the option of transverse displacement of the primary and/or secondary cantilever may be provided in another manner, such as by guiding the secondary cantilever 325 along curved paths instead of along
10 straight paths, for instance by providing curved rails 319. Guiding along a curved path can for instance provide an increased transverse reach if the rails 319 for guiding the transverse movement have end portions that are curved away from the distal end of the cantilever structure 312, resulting in an additional outward swinging movement of the secondary cantilever about an
15 angle α when approaching a most extreme transverse position along the rails 319. In particular when pivoting over a relatively small angle α , the transverse reach is increased substantially, with relatively little sacrifice of distal reach. The width of a proximal portion of the primary cantilever may be equal to or larger than the distance over which the secondary cantilever guide can guide.
20 This principle can also be applied to the transverse guide tracks of the primary cantilever guide.

 Where parts are described as fixedly mounted, the mounting may be permanently fixed or removably or releasably fixed, the latter allowing dismounting or adjustment of the mounting position. In the retracted position,
25 the cantilever structure may be fully retracted within a top plan view contour of the jack-up platform or project horizontally outside of that contour, but less far than in the distal position. Similarly, in the retracted position, the secondary cantilever may be fully retracted in the longitudinal direction relative to the primary cantilever or project horizontally in longitudinal

direction beyond the primary cantilever, but less far than in the distal position.

Several features have been described as part of the same or separate embodiments. However, it will be appreciated that the scope of the invention
5 also includes embodiments having combinations of all or some of these features other than the specific combinations of features embodied in the examples.

Claims

1. A cantilever system for an offshore platform, such as a jack-up platform, comprising:

a cantilever structure for carrying a well drilling or well intervention facility at a distal end of the cantilever structure;

5 a primary cantilever guide for guiding movement of the cantilever structure relative to the platform between a distal position reaching outside the platform, such that said facility can be positioned outside the platform, and a retracted position;

wherein said cantilever structure comprises:

10 a primary elongated cantilever guided by the primary cantilever guide;
a secondary elongated cantilever for carrying said facility at its distal end; and

a secondary cantilever guide guiding movement of the secondary cantilever relative to the primary cantilever between a retracted position and
15 an extended position extending from the primary cantilever relative to the retracted position of the secondary cantilever, such that said facility can be positioned outside the primary cantilever.

2. A cantilever system according to claim 1, wherein, in the extended
20 position, the secondary cantilever extends from the primary cantilever with at least a directional component in a longitudinal direction of the secondary cantilever.

3. A cantilever system according to claim 1 or 2, wherein, in the or at
25 least one further extended position, the secondary cantilever extends from the primary cantilever with at least a directional component transverse to a longitudinal direction of the primary cantilever.

4. A cantilever system according to any of the preceding claims, wherein the primary cantilever guide is arranged for guided movement of the primary cantilever relative to the platform in longitudinal direction of the primary
5 cantilever and in at least one further direction transverse to said longitudinal direction.

5. A cantilever system according to claim 4, wherein said guided movement of the primary cantilever relative to the platform in said at least
10 one further direction is a translatory movement in a direction transverse and preferably perpendicular to said longitudinal direction of the primary cantilever.

6. A cantilever system according to any of the preceding claims, wherein
15 the secondary cantilever guide is arranged for guiding the secondary cantilever relative to the primary cantilever for guided movement in at least two directions transverse to each other.

7. A cantilever system according to any of the preceding claims, wherein
20 said guided movement of the secondary cantilever relative to the primary cantilever includes a translatory movement in a direction transverse and preferably perpendicular to a longitudinal direction of the primary cantilever.

8. A cantilever system according to claim 7, wherein the secondary
25 cantilever guide is arranged for guiding translatory movement of the secondary cantilever in a direction transverse to a longitudinal direction of the primary cantilever over a distance larger than the width of a proximal portion of the primary cantilever.

9. A cantilever system according to any of the preceding claims, wherein said guided movement of the secondary cantilever relative to the primary cantilever includes a pivoting movement about a vertical axis through said primary and secondary cantilevers.

5

10. A cantilever system according to any of the preceding claims, wherein the primary cantilever is arranged for carrying a further well drilling or well intervention facility at a distal end of said primary cantilever.

10

11. A cantilever system according to any of the preceding claims, comprising at least two of said secondary cantilever guides and at least two of said secondary cantilevers, each guided relative to the primary cantilever by one of said secondary cantilever guides.

15

12. A cantilever system according to any of the preceding claims, wherein at least the primary or secondary cantilever guide includes guide tracks oriented transversely to the first or second cantilever, end portions of the tracks being curved away from the distal end of the cantilever structure.

20

13. A cantilever system according to any of the preceding claims, wherein the secondary cantilever is guided relative to the primary cantilever for movement to a most proximal position in which a center of gravity of the secondary cantilever is proximal of a most distal location where the primary cantilever is supported by the platform.

25

14. A cantilever system according to claim 13, wherein the secondary cantilever is guided for translatory movement in longitudinal direction of the primary cantilever to said most proximal position.

15. A cantilever system according to claim 13, wherein the secondary cantilever is guided for pivoting movement about a vertical axis through said first and second cantilevers to said most proximal position.

5 16. A cantilever system according to any of the preceding claims, further comprising an auxiliary coupling member releasably coupling the secondary cantilever to at least the primary cantilever or the platform in addition to the secondary cantilever guide.

10 17. An off-shore platform with a cantilever system according to any of the preceding claims; wherein the primary cantilever guide is mounted to the platform, wherein said first and second cantilevers are oriented substantially horizontally and wherein the cantilever projects horizontally outside of the platform at least when said cantilever structure is in said distal position.

15 18. A platform according to claim 17, comprising a well drilling or well intervention facility mounted to the cantilever structure.

20 19. A platform according to claim 17 or 18, wherein the primary cantilever supports a well drilling or well intervention facility mounted to the primary cantilever and the secondary cantilever supports a well drilling or well intervention facility mounted to the secondary cantilever.

25 20. A platform according to claim 19, wherein the facility mounted to the secondary cantilever is a crane.

 21. A platform according to any of the claims 17-20 comprising at least two of said secondary cantilevers each supporting at least one of said facilities mounted to one of said secondary cantilevers.

Fig. 1

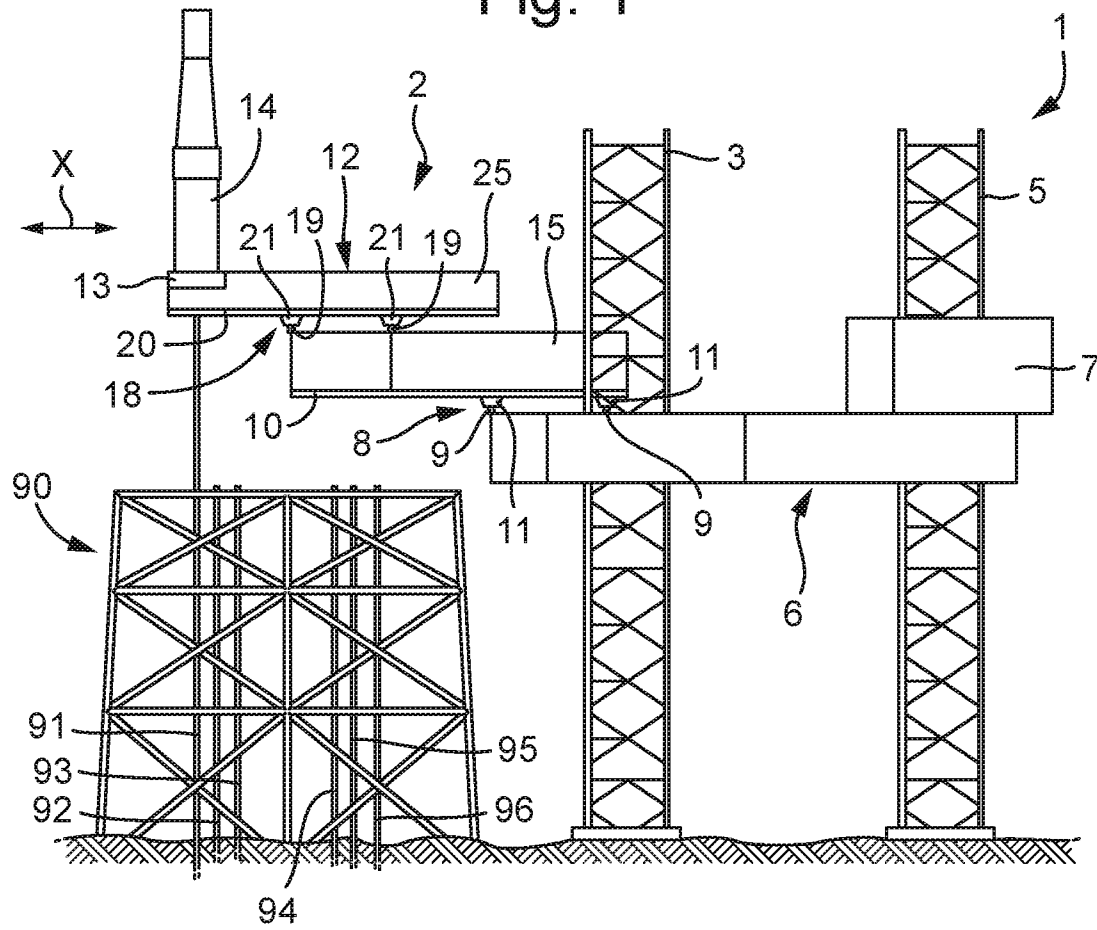


Fig. 2

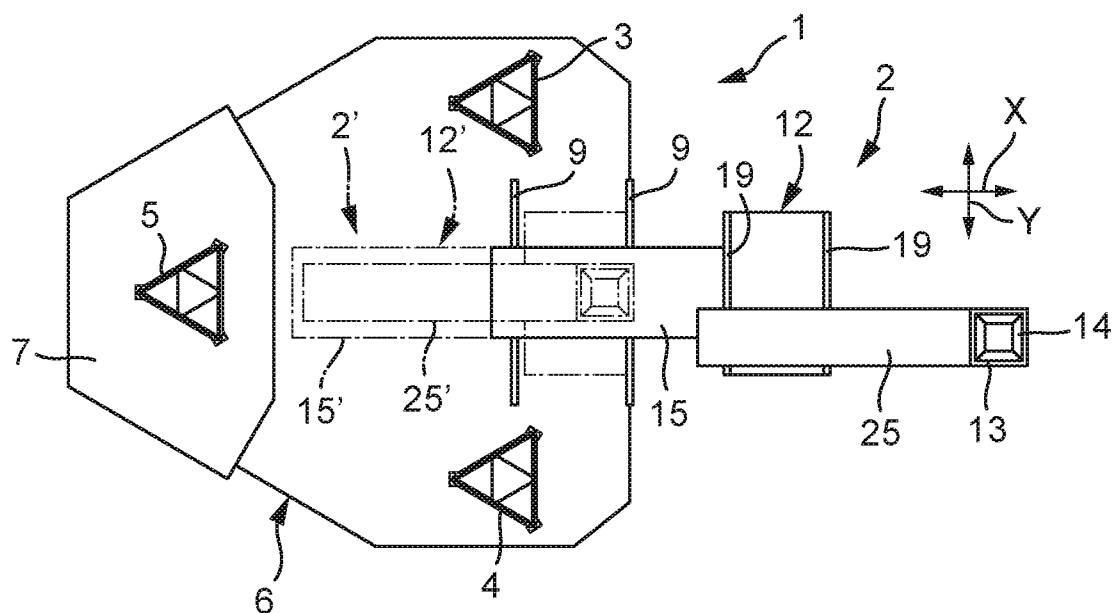


Fig. 3

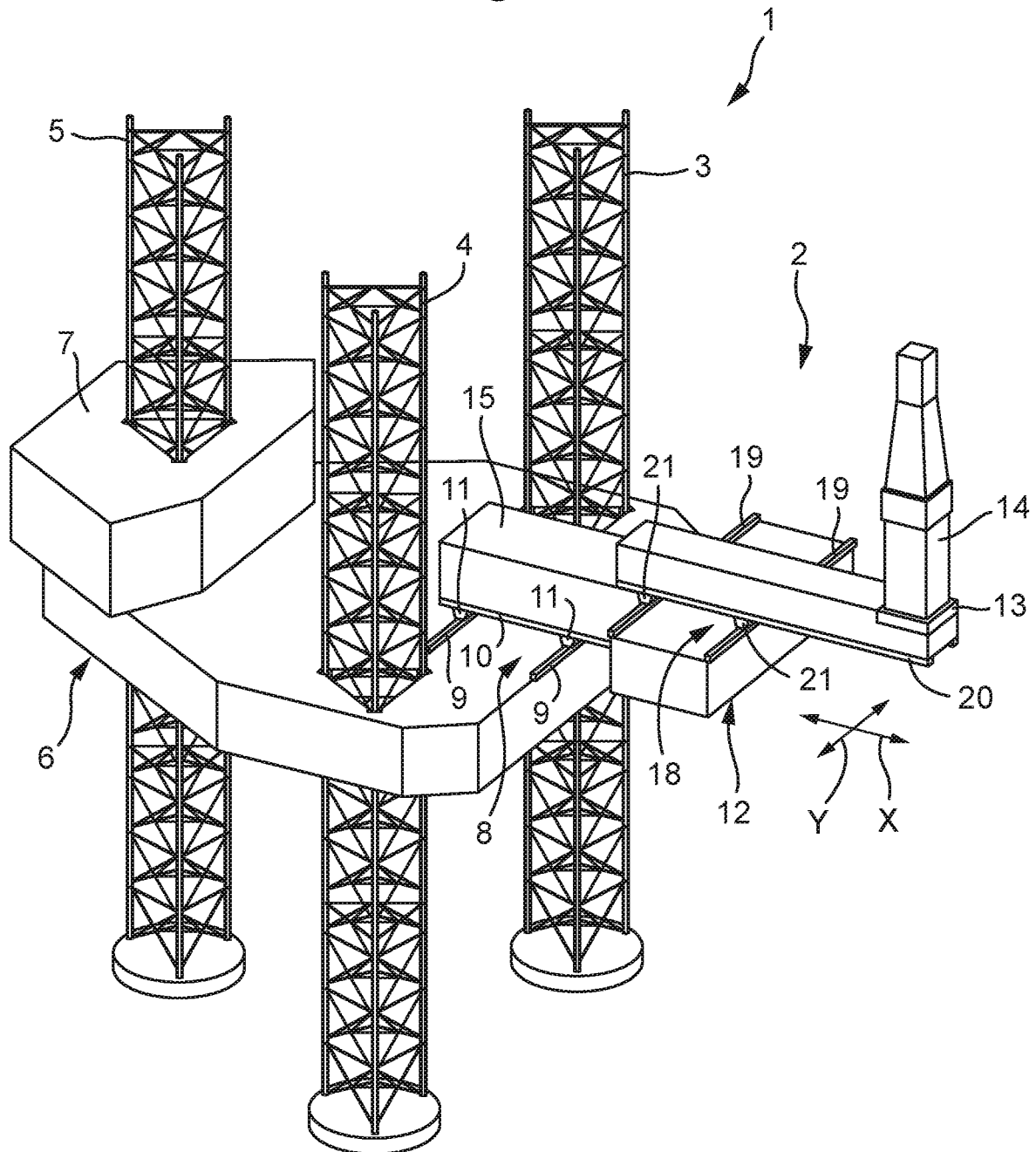


Fig. 4

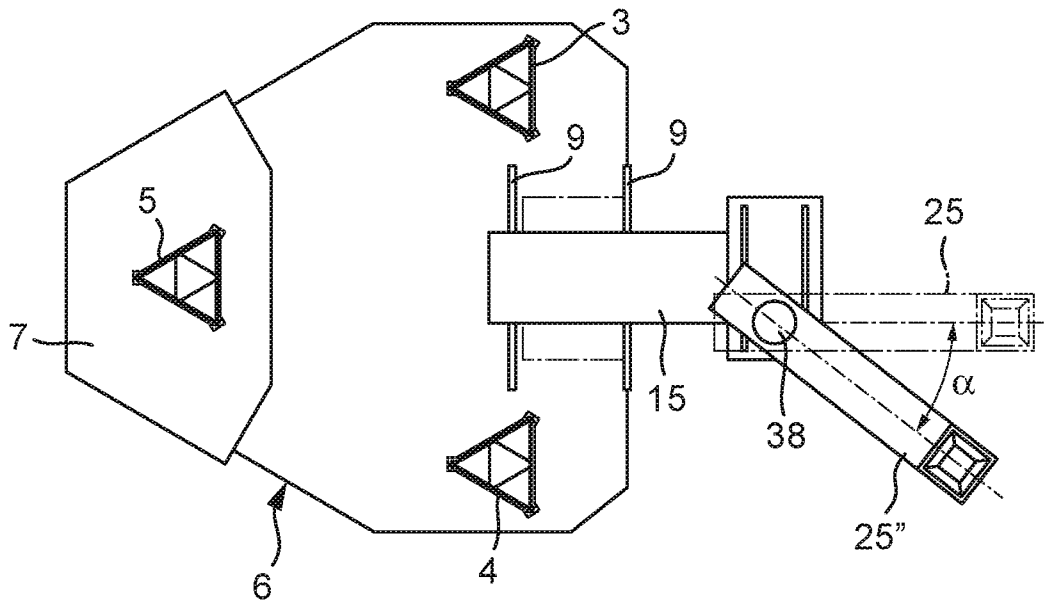


Fig. 5

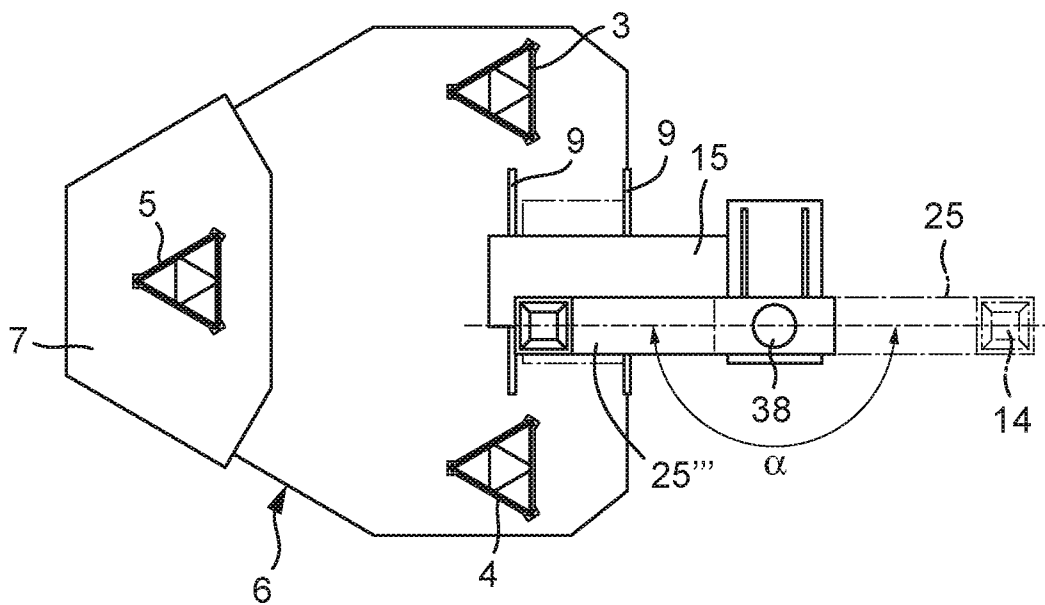


Fig. 6

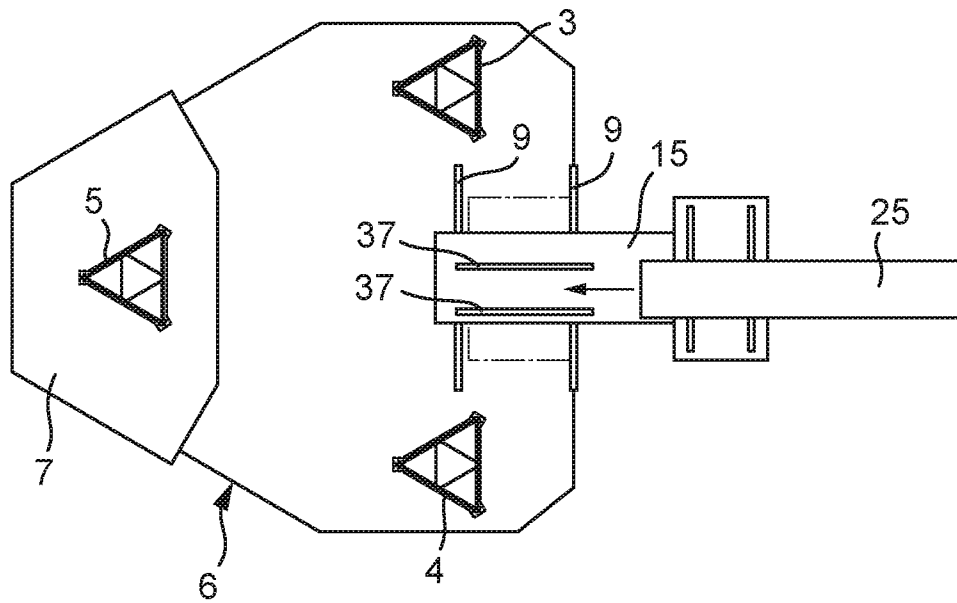


Fig. 7

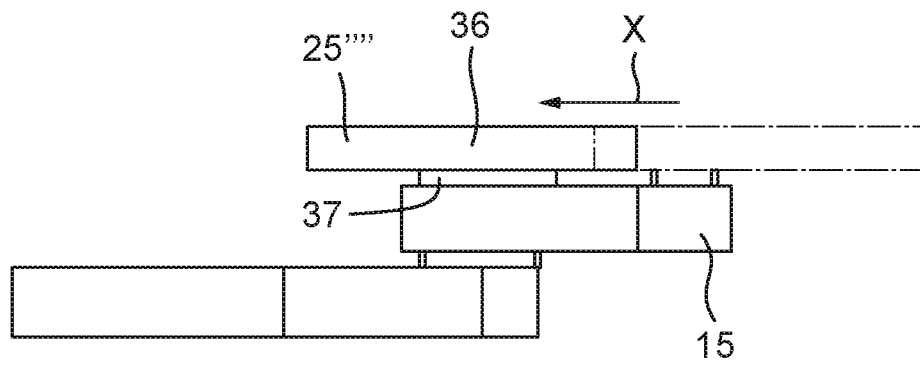


Fig. 8

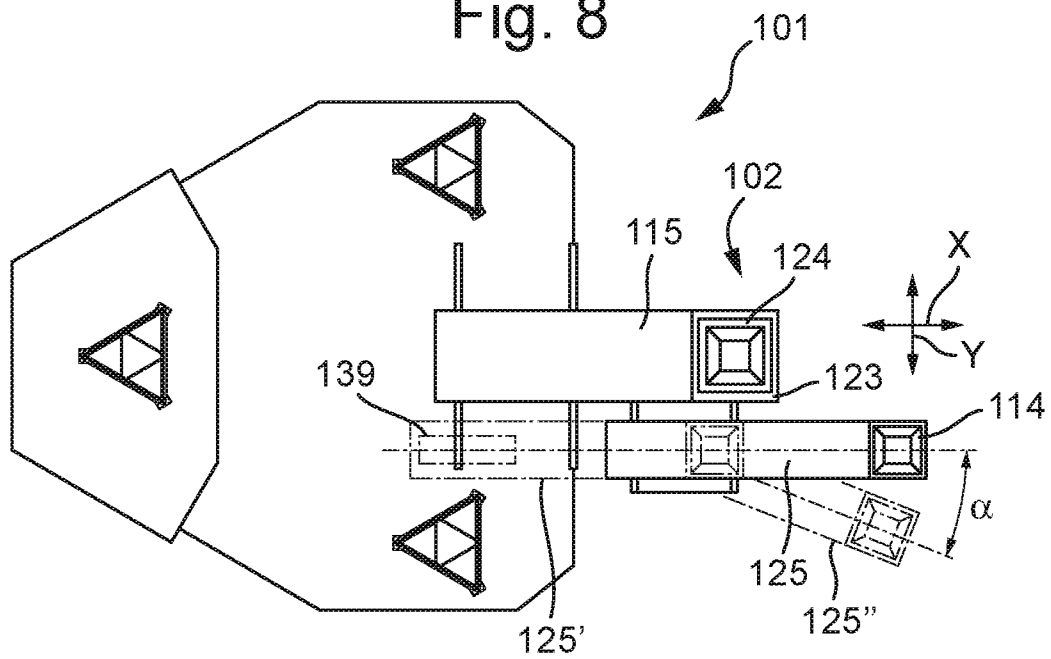


Fig. 9

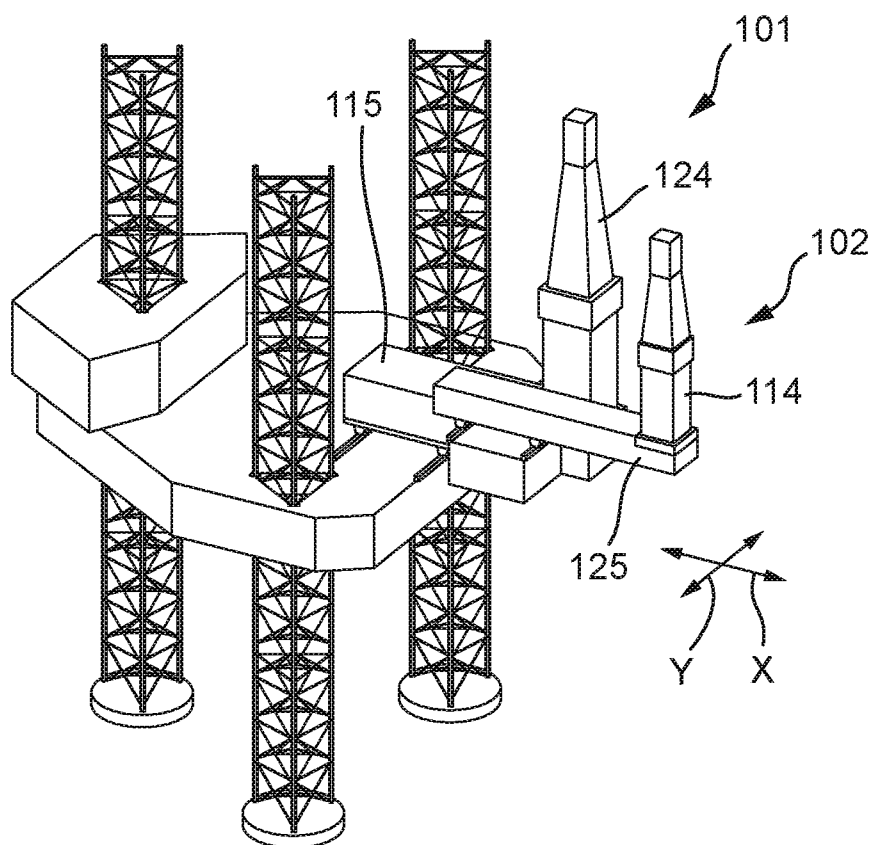


Fig. 10

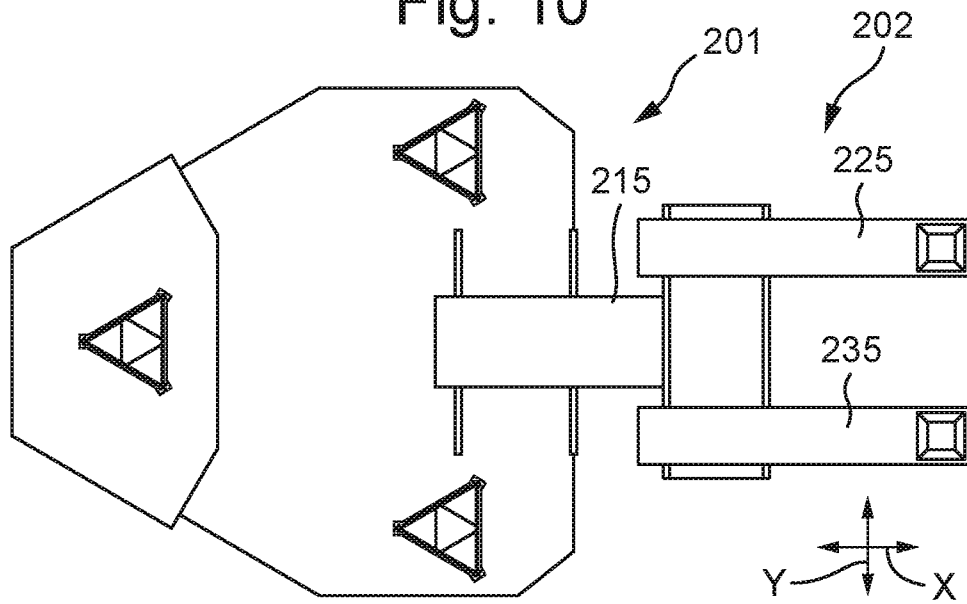


Fig. 11

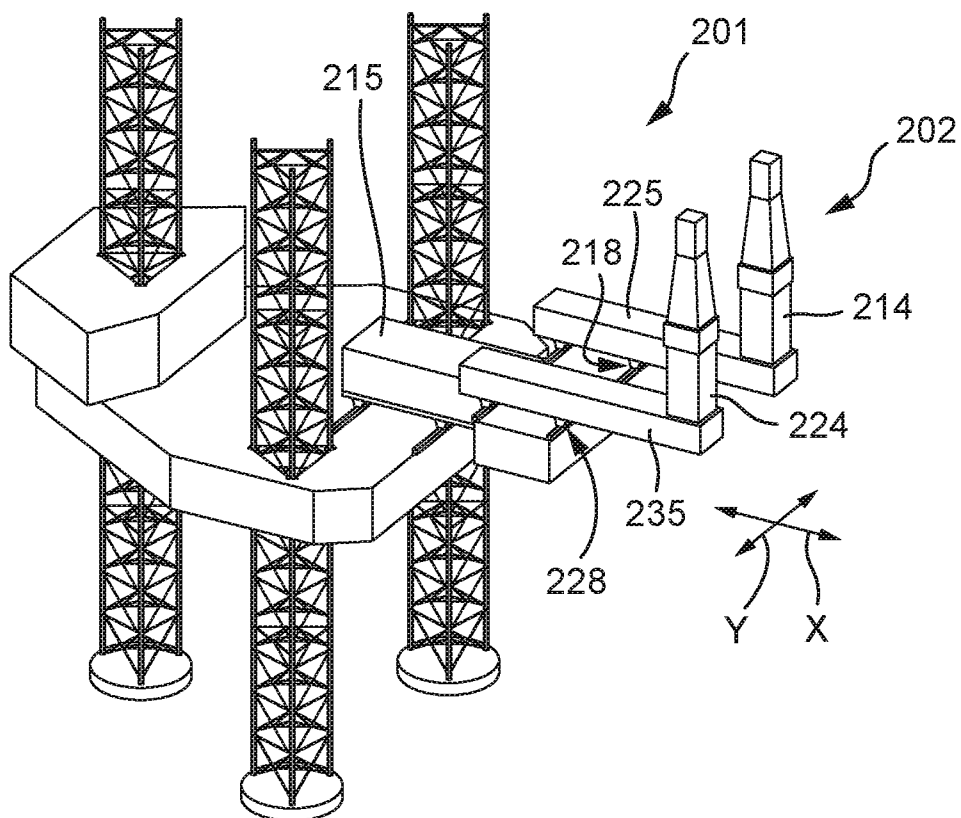
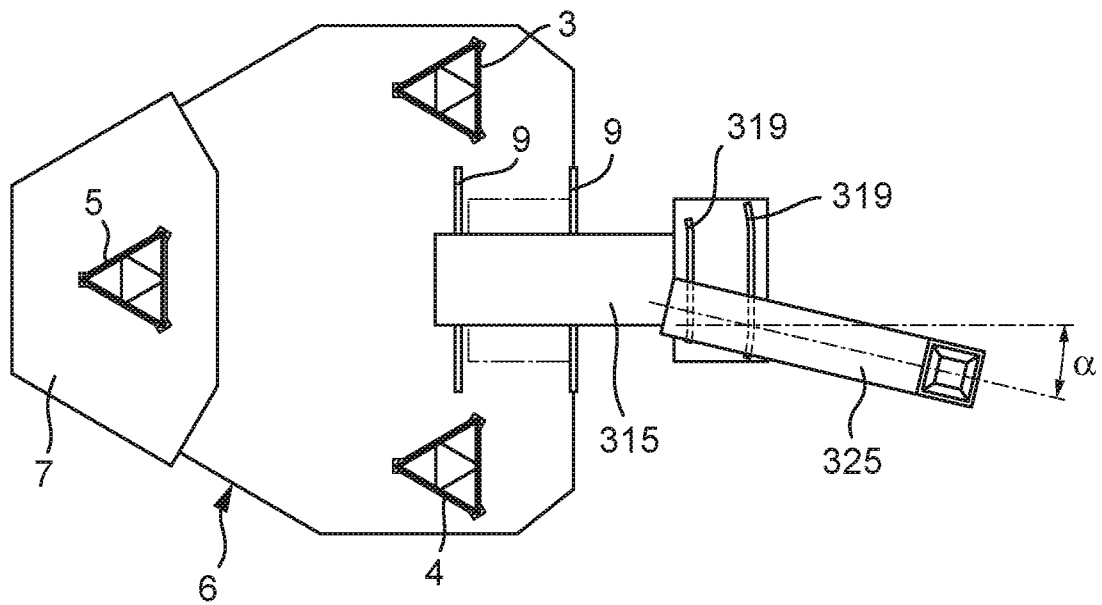


Fig. 12



INTERNATIONAL SEARCH REPORT

International application No
PCT/NL2016/050302

A. CLASSIFICATION OF SUBJECT MATTER

INV. E21B15/00 E21B15/02 E02B17/00
ADD.

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

E21B E02B

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

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

EP0-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 407 302 A (SPRINGETT CHARLES N [US] ET AL) 18 April 1995 (1995-04-18)	1,2,7, 9-21
Y	column 13, line 5 - column 18, line 2 figures 1a-1d,2a-2f	3-6,8
Y	----- WO 2014/120085 A1 (NG KHIM KIONG [SG]) 7 August 2014 (2014-08-07) figures 4a,4b	3-6,8
A	----- US 6 171 027 B1 (BLANKESTIJN ENRICO PEDRO [NL]) 9 January 2001 (2001-01-09) cited in the application the whole document	1-21



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

25 August 2016

Date of mailing of the international search report

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/NL2016/050302

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 5407302	A	18-04-1995	NONE	

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			GB 2328699 A	03-03-1999
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