Ship for drilling and production in icy waters

The present invention relates to a ship which is adapted for drilling of oil and/or gas wells, as well as for production. In particular, the invention relates to such a ship adapted for use in arctic waters. Furthermore, the invention relates to a system and methods, as pointed out in the respective independent claims.

Ships with turrets for drilling of wells on the seabed are known, for instance from patent publication US 5,359,957. The turret makes an arbitrary orientation of the ship with respect to the well possible, as the ship can turn about the centre axis of the turret. Such a turning of the ship is often desirable in order to reduce the load on moorings or thrusters. For this purpose the ship is oriented in such a way that it is exposed to as small forces as possible coming from currents.

In arctic regions one will have an additional challenge due to ice in the sea. This may be ice structures (icebergs) which forces the ship to leave the well. It may also be packed floating ice. The floating ice will exert large forces on a big ship and must be dealt with in a good way in order to avoid excessive forces on moorings or thrusters.

The invention

In a first aspect of the invention there is provided a ship which is adapted for drilling of oil and/or gas wells. The ship is characterized in that it is adapted for drilling through a drill riser string extending from a well in the seabed up to a turret arranged with the ship. The drill riser string is adapted to be separated from connection with the ship in a position under the base line of the ship or the ship's bottom, in such a way that the ship can leave the drill riser string. This solution makes it possible for the ship to leave the well quickly. The drill riser string does not need to be pulled up into the ship, but can, however, remain standing.

Preferably the turret comprises a lower part which is adapted to be separated from the ship in such a way that it sinks downwards in the sea at separation and takes a position of equilibrium wherein it surrounds at least a part of the drill riser

string. The lower part of the turret has buoyancy, so that, in its position of equilibrium, it lifts at least parts of the mooring lines.

The lower part is preferably attached to mooring lines and has, as mentioned above, such a buoyancy that it, at separation from the ship, will sink down to a position of equilibrium where it keeps at least parts of the mooring lines up off the seabed. In this position it will advantageously simultaneously provide lateral support to the drill riser string. This is possible since the weight of the mooring lines will keep the lower part of the turret in a position above the well.

In an additional aspect of the invention there is provided a ship which is adapted for drilling of and/or production from an oil and/or gas well, which ship is adapted to have connection to at least one production riser which is connected to a turret connected to the ship, or to a drill riser string that extends through a turret connected to the ship. According to this aspect of the invention the lower part of the turret extends a distance below the basis line of the ship. This distance can advantageously be at least 3 meters.

In yet another aspect of the present invention there is provided a ship adapted for drilling of and/or production from an oil and/or gas well, which ship is adapted to have connection to at least one production riser attached to a turret connected to the ship, or to a drill riser string that extends through a turret attached to the ship, wherein the ship comprises an ice rejection structure that extends downwards from the ships bottom, and which partially surrounds said turret.

In another aspect of the present invention, there is provided a ship adapted for drilling of and/or production from an oil and/or gas well, which ship is adapted to have connection to at least one production riser connected to a turret connected to the ship, or to a drill riser string that extends through a turret connected to the ship. This ship is advantageously characterized in that

- the ship, between its bow and stern exhibits two long sides which along at least 50 % of their length are provided with an ice belt that exhibits an

angle α between the ship's hull and the horizontal, which angle α is between 45 and 80 degrees; and that

- the turret has a centre axis which is arranged in a position on the ship corresponding to 0,15 – 0,45 Lpp in front of the ship's half Lpp (length between perpendiculars).

This design of the ship makes a turning process of the ship possible when it is packed in with floating ice in the water surface, when the drifting direction of the ice has an angle in relation to the longitudinal axis of the ship. This is described closer in the example description. This ship is further preferably characterized in that if the ship has a parallel middle aisle, the centre axis of said turret is arranged in front of this.

The ship according to one of the above-mentioned aspects of the present invention preferably exhibits a length between the perpendiculars (Lpp) of more than 200 m, a width between 40 and 55 m, and has a draught of at least 10 m.

In another aspect of the present invention there is provided a connection system for releasable connection between a first part, in the form of turret arranged to a ship, and a second part in the form of a buoy, which buoy is adapted for receiving mooring lines and at least one riser. This system is adapted for removal of water above the buoy when the turret and the buoy is in a position connected to each other, for reduction of water pressure above the buoy. In this way the buoy will be forced up against the turret by the surrounding hydrostatic pressure, when the water above the buoy is removed.

One of the first and second parts can advantageously comprise a protruding guiding body, wherein the other of the parts comprises a recess adapted for oppositely correspondingly shaped reception of the guiding body in an engaged position. The one part can advantageously also comprise a locking arrangement for mechanical locking of the one part to the other, as the locking arrangement is adapted to engage with the other part. The system according to the invention will in this way be suited for handling large lateral forces from mooring. The guiding body and the recess will absorb lateral forces between them and in this way

protect the locking arrangement(s) from this. At disconnection of the buoy from the turret, the locking arrangement can be released first, so that this is not exposed to large lateral forces. Thereafter water can be supplied to the space above the buoy, so that the buoy will move downwards and out of contact with the turrets.

The protruding guiding body preferably has a cone shape and the recess has preferably an oppositely corresponding cone shape. This particularly advantageous design of guiding element and recess prevents excessive forces from arising between the surfaces of the guiding body and the recess, when the buoy moves downward under influence of lateral forces from mooring lines. The coning also contributes to correct and easier alignment of the buoy in respect of the turret when these are to be connected.

According to yet another aspect of the invention there is provided a method for disconnection of a buoy from a turret arranged in a ship, wherein the buoy is connected to mooring lines and at least one riser. The method comprises

(a) releasing locking arrangements from engaged position, which locking arrangements are adapted for mechanical locking of the buoy to the turret; and then

(b) supplying water above the buoy in order to increase the hydrostatic pressure above the buoy.

In this way the locking arrangements are protected from excessive forces at disconnection of the buoy from the turret.

According to another aspect of the present invention there is provided a method for connecting a buoy to a turret arranged in a ship, which buoy is connected to mooring lines and at least one riser. The method comprises

(p) pulling the buoy up the turret, and

(q) pumping water away from the area above the buoy, in order to reduce the hydrostatic pressure in this area.

The method comprises preferably locking the buoy mechanically to the turret by means of locking arrangements, after step (p). This can in principle be done before, during or after step (q). Preferably it is performed before.

As will appear from the example descriptions below, the various aspects according to the invention are particularly well suited for offshore operations in arctic waters where large amounts of ice may be present at the sea surface, including drifting ice and icebergs.

Description of examples of embodiments

In the following a plurality of examples of embodiments are described with reference to the figures, in which

Fig. 1a to 1c show the principle of disconnection of the riser from the ship;

Fig. 2a and 2b show a ship according to the invention, with a turret for drilling or production;

Fig. 3a and 3b show a ship according to the invention and an enlarged section view of a part of the ship's ice belt;

Fig. 4a to 4h show a method for dealing with drifting ice;

Fig. 5 shows the placing of a turret in a ship according to the invention;

Fig. 6 shows a connecting system for releasable connection between a buoy and a turret arranged in a ship; and

Fig. 7 shows a particular advantageous embodiment of the connection shown in Fig. 6.

Figs. 1a to 1c show the foremost part of the ship 1 according to the invention. The ship 1 is situated above an oil and/or gas well (not shown) arranged under a blowout preventer 3 (BOP). In the ship 1 there is arranged a turret 5, adapted in such way that the ship can turn freely about the centre axis of the turret 5 during operation. Between the blowout preventer 3 and the turret 5 one can see a rigid drill riser string 7. The drill riser string 7 has a buoyancy element 9 for drill riser string arranged to hold a part of the weight of the drill riser string 7. There may also be arranged more such buoyancy elements 9. A part of the weight of the drill riser string 7 is held by a tensioner on the ship 1, which compensates for the vertical movements of the ship in relation to the riser.

To the lower part of the turret 5 there are attached mooring lines 11 for mooring the ship 1 in a desired position above the well.

When the ship 1 is to leave the well, it may shut off the well with the blowout preventer 3 and pull up the drill riser string 7 after disconnection of this at the blowout preventer. However, the pulling of the drill riser string 7 takes long time. If a large ice structure approaches, such as an iceberg, the ship 1 must end the drilling and remove itself in order to avoid a possible collision with the ice structure. In order to avoid moving the ship 1 unnecessarily often, and loose valuable time above the well each time, the ship 1 is adapted in such way that it can disconnect from the drill riser string 7 in an upper part of this. It may, of course, also be other reasons for having to move the ship 1 quickly.

This is shown in Fig. 1b. In vertical distance below the basis line of the ship or the ships bottom, there is arranged a disconnection arrangement 13 for the drill riser string 7. The disconnection arrangement 13 is arranged below the tension ring. Here, the drill riser string 7 can be disconnected from the ship 1. The upper part of the disconnection arrangement 13 is pulled up towards the ship 1, so that it goes clear of the lower part, or the upper part of the drill riser string 7, respectively. However, the lower part of the turret 5 is still running about the upper part of the drill riser string 7, hence the ship 1 cannot move away.

In Fig. 1c it is shown how the turret 5 has an upper part 5a and a lower part 5b. When releasing the lower part 5b from the upper part 5a, the lower part 5b will sink downwards in the sea, still arranged about the drill riser string 7. The lower part 5b of the turret 5 has buoyancy which is adapted to carry at least a part of the mooring lines 11. The weight of the mooring lines 11 will thus pull the lower part 5b downwards in the sea, for instance 50 meters. As the lower part 5b of the turret 5 still is arranged about the drill riser string 7, it will provide lateral support to the drill riser string 7 and contribute to preventing it from tipping over. The mooring lines 11, which partially lie on the seabed, will with their weight contribute to maintaining the lower part 5b in position above the well, even if the drill riser string 7 lean against the lower part 5b of the turret 5. As shown in Fig.

1c, the lower part 5b is adapted to sink down past the buoyancy element(s) 9 for the drill riser string 7. The lower part 5b is advantageously adapted to take a position of equilibrium which is so far down that it will avoid colliding with ice.

The ship 1 is now disconnected from the drill riser string 7 and the lower part 5b of the turret 5, to which the mooring is attached, and can leave the well. These operations, as described above, will take considerably less time than if the entire drill riser string 7 would have to be pulled up into the ship 1. When an iceberg approaches, one may hence wait longer until a decision to move the ship 1 has to be made. This will save valuable time and unnecessary moving and interruptions of the operations.

The disconnection arrangement 13 is preferably arranged as described above, but it could also be arranged further down on the drill riser string 7. A possible positioning of the disconnection arrangement 13 is between an upper position within the lower part 5b, when this is connected to the upper part 5a, and a lower part directly above the position of equilibrium of the lower part 5b.

A particular advantageous feature with the lower part 5b of the turret 5 is that it extends a distance below the bottom or basis line of the ship 1. In use in waters with drifting ice the lower part 5b will thus provide a protection of the drill riser string 7 against ice which possibly moves below the hull of the ship 1. The lower part can for instance extend 3 meters further down into the sea than the basis line of the ship. It may also extend even further down, for instance 5 meters or more.

The Figs. 2a and 2b show a principle sketch of the design of the hull of a ship 1 according to the invention. In these figures the ship 1 is adapted for production and has a plurality of flexible risers 15 which extend from a turret 105 to the seabed. In a manner known for production ships, a lower part 105b of the turret 105 can be released from the ship 1 and sink down to a position of equilibrium in the sea, still connected to mooring lines 11 and the flexible risers 15. The lower part 105b preferably sinks so deep that it avoids contact with ice that floats at the surface, for instance 50 meters. This turret 105 can, as explained above in

relation to the turret 5 for drilling, likewise extend a distance below the basis line of the ship 1 in order to provide protection against ice.

In Figs. 2a and 2b one can further see an ice rejection structure 17 which extends about the turret 105. The ice rejection structure 17 forms a skirt about the turret 105, extending somewhat downwards from the ship's bottom. The ice rejection structure 17 exhibits an oval shape with its longest axis parallel to the longitudinal axis of the ship 1. If ice should find its way as deep as the ice rejection structure 17, the ice rejection structure 17 will contribute in leading the ice past the turret 105 and splitting ice masses. In this way it will contribute to protection of the flexible risers 15 and the mooring lines 11. The ice rejection structure 17 is advantageously also arranged with the same function when the ship 1 is used for drilling, as described above.

The ice rejection structure 17 can also have other shapes, for instance with a sharp edge in the front and back. The ice rejection structure 17 can preferably extend 1,5-2 meters below the basis line of the ship 1, but can also extend downwards a shorter or longer distance.

Furthermore, the figures show an ice knife 19 arranged in the bow of the ship, arranged for cutting to pieces meeting ice which finds its way down to the ice knife 19, as well as leading it towards the sides. The bow of the ship is thus characterized in that it prevents that ice finds its way down to below the keel of the ship. Ice that meets the bow will first be broken because of the bow's angle with respect to the water line, then it will be lead away by the longitudinal centre axis of the ship.

The ship 1 according to the present invention has advantageously a large draught. This will contribute in preventing ice coming in contact with production or drilling equipment that extends downward from the bottom of the ship. The ship's draught is at least 10 meters. Preferably it is at least 12 meters, and most preferred it is at least 15 meters.

The lower part 5b, 105b of the turret 5, 105 in the ship 1 is preferably connected to the ship 1 by means of a hydraulic locking and releasing mechanism (not shown). The locking and releasing mechanism must be dimensioned to bear a full ice load on the longitudinal sides of the ship, typically 3000 – 10 000 metric tonnes. The deplacement of the lower part of the turret 5b, 105b should be sufficient to carry at least parts of mooring lines and risers (if arranged to the turret/buoy 105b). This can typically be 2000 to 5000 metric tonnes.

Additional shaping of the hull

In the following, a particularly advantageous design of the hull of a ship 1 according to the invention will be described. As will be described later, the hull of the ship 1 is designed particularly advantageous for execution of a process for turning the ship 1 when it is influenced by densely packed drifting ice with a drifting direction with an angle in relation to the longitudinal axis of the ship.

The Figs. 3a and 3b show a ship 1 for drilling of an oil and/or gas well according to the invention. Far ahead on the ship 1 there is arranged a turret 5, 105. As described above the ship 1 is moored here. Fig. 3b shows a section view of a cross section of the ship's side, crosswise to the longitudinal direction of the ship 1. The ship hull exhibits a lower part 1a, a middle part or ice belt 1b and an upper part 1c. The ice belt 1b is an area of the hull which extends around the ship along the water line, in the area where ice floating in the sea will impinge against the ship 1. Thus, the ice belt has a certain vertical extension, as floating ice may have different dimensions and shape, and the ship 1 may have different draught. As appears from Fig. 3b, the ice belt 1b exhibits an angle α with respect to the water line. The angle α is preferably between 45 and 80 degrees.

The ship 1 has a bow and a stern. Between the bow and the stern the ship 1 has two longitudinal sides. The ship exhibits an ice belt with such an angle α along at least 50 % of the length of the longitudinal sides. However, preferably the ship 1 exhibits an ice belt with such an α along the whole of both longitudinal sides.

A longitudinal side with such a designed ice belt will result in that ice which abuts against the ship 1 with an angle to the longitudinal axis of the ship 1 will be

pushed down by the ice belt 1b so that the ice brakes. As will appear from the description below, such a ship 1 will exhibit considerable advantages when used in arctic regions, where large amounts of ice can accumulate about the ship.

In the following, it is referred to the Figs. 4a to 4h. These figures illustrate a ship 1 according to the present invention, which has been packed in by ice on the sea surface. As described above, the ship is moored in the turret 5, 105. In order to explain the functional principle which is made possible by the advantageous design of the ship's ice belt 1b, it is assumed that ice is drifting in the direction shown with the arrow U, perpendicular onto one of the longitudinal sides of the ship, as shown in Fig. 4a. The ice will operate on the ship 1 with large forces, which are countered by the forces F of the mooring. Gradually the ice that meets the longitudinal side of the ship will be broken due to the inclined angle α, as described above. The ice will still drift towards the ship 1, and thus a slit of open water is created on the opposite side of the ship 1. This is shown in Fig. 4b.

Since the turret 5, 105 with which the ship is moored, is arranged at the bow of the ship 1, a turning of the ship 1 will arise as the accumulated forces from the ice (U) and the mooring (F) create a rotational force on the ship 1. As appears from Fig. 4c the ship 1 will turn its stern as far as is possible into the slit of open water, in the direction of the drifting ice (U). In Fig. 4d this process has continued an additional distance, and here one can see how the ice breaking bow of the ship is being forced against the drifting direction (U) of the ice, and breaks the ice. The entire ship 1 functions as a lever bar, turning about the turret 5, 105. The Figs. 4e – 4h show the rest of the process, where the ship 1 in the end has aligned itself with its longitudinal axis parallel to the drifting direction of the ice. When the ice drifts further the icebreaking bow of the ship will break the ice continuously and there will be considerably less forces operating on the moorings.

This process shows how the ship 1 according to the invention, comprising longitudinal sides with the ice belt described above, is suited for operations in waters with the possibility of ice formation or accumulation of ice around the ship 1. Ships for operations as described herein typically have large length-to-with

relationships. This results in large forces in the mooring lines. A normal drilling vessel with vertical longitudinal sides would lead to significantly larger forces on the mooring, since the ice would not be broken when meeting the longitudinal sides. The ice would instead have to be crushed by compression forces, which requires significantly larger forces.

It shall be noticed that the ship 1 according to the invention not is meant to alter its draught or vertical position significantly by contact with the ice. This is different from known ships, such as the polar ship *Fram*, which with its inclined longitudinal sides was adapted to be forced up by the ice, by sufficiently large forces onto the ship broadsides.

It is of course not compulsory that the entire longitudinal sides of the ship 1 exhibit an ice belt 1b with the described angle α. For example, a ship 1 with only 50 % of the longitudinal sides provided with such an angle will also work. However, this will result in unnecessary and undesired large forces on ship and mooring.

For the process described under reference to the Figs. 4a – 4h to operate appropriately, the turret 5, 105 must be arranged on a suitable location in the ship 1. For indication of such a desired location it is referred to Fig. 5. The ship 1 is characterized by its *length between perpendiculars*, or LPP (or LBP). According to the invention the location of the turret 5, 105 in the ship 1 is preferably characterized in that its centre axis is arranged 0,15 – 0,45 Lpp in front of the half Lpp. Furthermore, if the ship has a parallel middle isle, the centre axis of the turret 5, 105 shall preferably be arranged in front of this.

The design of the hull of the ship 1 and the location of the turret 5, 105 is hence such that the resultants of the ice forces at any time will turn the ship 1 optimally, so that the ship's longitudinal axis is parallel to the drifting direction of the ice. The ship 1 will thus be suitable for use in waters with possibility of packaging with one or multi-year ice.

As described, the ship 1 has preferably an ice-breaking design of the bow. The ship 1 has also preferably an ice-breaking stern. This will be useful if the drift of the ice should change direction, for instance to the opposite direction.

Furthermore, the ship 1 preferably has thrusters that can be turned in order to assist the orientation of the ship 1, as well as to reduce the tension in the mooring lines 11.

Fig. 6 shows a principle drawing of an advantageous embodiment of a connection system according to the invention. In a, for that matter known way, a turret 205a is arranged in a ship 201 in such a way that the ship 201 can turn about the centre axis of the turret 205a. To the lower part of the turret 205a there is connected a buoy 205b. To the buoy 205b there is connected mooring lines 211. The ship 201 is thus moored with mooring lines 211 through the buoy 205b.

Through the buoy 205b risers 215 are led, which over their each own connection means 221 are connected to the turret 205a.

In order to connect the buoy 205b to the turret 205a there is arranged locking devices 223. The locking devices 223 are here only schematically indicated. The locking devices 223 are preferably hydraulically activated hooks arranged in the turret 205a, which for connection between the turret 205a and the buoy 205b engage with appropriate locking bolts in the buoy 205b.

When mooring the ship 201 in arctic regions, influence from ice masses in the ships hull may result in large forces between the buoy 205b and the turret 205a. In order to spare the locking devices 225 from such forces there is preferably, according to the invention, arranged a guiding protrusion 225 in the lower part of the turret 205a. When the buoy 205b and the turret 205a are connected to each other, the guiding protrusion 225 extends into a correspondingly oppositely formed recess 227 in the buoy 205b. The walls in the recess 227 abut against the guiding protrusion 225 and absorb large parts of the lateral forces operating between the buoy 205b and the turret 205a. At extreme loads from the mooring lines 211 the contact between the guiding protrusion 225 and the recess 227 will

hence spare the locking devices 223 from excessive lateral forces. The guiding protrusion 225 is preferably concentrically shaped and can advantageously have a diameter of 5 – 10 m. However, one can also imagine other shapes, for instance a polygon-shaped guiding protrusion. In principle the invention will also be possible to practise with a plurality of smaller guiding protrusions or guiding elements, adapted to absorb lateral forces between the turret 205a and the buoy 205b.

The buoy 205b is preferably provided with buoyancy, so that it carries at least part of the weight of mooring lines 211 and risers 215. At disconnection of the buoy 205b from the turret 205a, the buoy 205b will advantageously sink a distance down into the sea until it takes a position of equilibrium. In a position directly beneath the ship 201, the buoy 205b can have an effective weight of for instance 500 – 2000 tonnes. This means that when the buoy 205b shall be pulled up to the ship for connection to the turret 205a, winch(es) in the ship 201 will have to lift 500 – 2000 tonnes when the buoy 205b is close to the bottom of the ship 201.

A seal 229 is arranged in such way that it seals around a space 231 between the turret 205a and the buoy 205b when the buoy 205b is connected to the turret 205a. The seal 229 preferably has a circular shape and is preferably arranged on the outside of the connection means 221 for the risers 215 and the locking devices 223.

When connecting the buoy 205b to the turret 205a, the buoy 205b is pulled up towards and against the turret 205a, in such way that the seal 229 seals around the space 231. In a connecting situation there will be no or only small lateral forces which operate between the buoy 205b and the turret 205a. When the buoy 205b has been pulled in against the turret 205b, so that the seal 229 seals around the space 231, water in the space 231 is pumped out through an admission channel (not shown). The water in the space 231 is thus replaced with air. The pressure in the space 231 will then preferably be approximately atmospheric. The buoy 205b is preferably mechanically connected to the turret 205a by means of the locking devices 223 before the water is pumped out.

The hydrostatic pressure below the buoy 205b will then be much larger than the pressure in the space 231 above the buoy 205b. The buoy 205b can for instance be arranged approximately 20 m below the sea surface. It will then be a pressure of 2 atmospheres below the buoy 205b, with respect to the sea surface. This pressure forces the buoy 205b up against the turret 205a with a force equal to the area within the seal 229 multiplied by the pressure. With a circular shaped seal 229 that for instance has a diameter of 20 m, this upwardly directed force will then be about 6300 tonnes. Thus, with a connection system according to the invention, and as illustrated with the embodiment shown in Fig. 6, both the locking devices 223 and the hydrostatic pressure will contribute to the connection between the buoy 205b and the turret 205a.

As mentioned above, when ice masses push against the hull of the ship 201, large lateral forces between the buoy 205b and the turret 205a will arise. If the locking devices 223, for instance in the form of hooks engaging with bolts (not shown), should absorb such forces, these would have to be unsuitably large. It would also be problematic to release the connection, for instance by pulling the hooks out of engagement with the bolts, while large lateral forces were operating on them. When releasing the buoy 205b from the turret 205a, it is with the solution according to the present invention possible to release the locking devices 223 before the connection between the buoy 205b and the turret 205a is released. As explained above, the hydrostatic pressure will contribute to connection between the buoy 205b and the turret 205a even if the locking devices 223 are released. After releasing the locking devices 223, the space 231 between the buoy 205b, turret 205a, and the seal 229 is filled with water. This makes the buoy 205b start to sink, wherein the guiding protrusion 225 moves out of engagement with the recess 227.

If the lateral forces between the buoy 205b and the turret 205a are large when the buoy 205b is released, large forces between the surfaces of the guiding protrusion 225 and the recess 227 may arise when the buoy 205b sinks downwards. Fig. 7 shows a particularly advantageous embodiment of the invention which accounts for this. Here, the guiding protrusion 225 is shaped with

a coned form. The recess 227 is correspondingly shaped with an oppositely shaped coned form. When the buoy 205b is connected to the turret 205a the guiding protrusion 225 and the recess 227 will be in engagement with each other as in the example of embodiment described under reference to Fig. 6. In this position they will in the same manner absorb lateral forces. When the connection between the buoy 205b and the turret 205a is released under large laterally operating forces, the buoy 205b will sink downwards simultaneously as the moorings 211 pulls it sideways. The conicity of the guiding protrusion 225 and the recess 227 will then guarantee that no excessively large forces will operate between their respective surfaces. The conicity is preferably determined according to wanted threshold value for allowed lateral forces from mooring and allowed forces between the surfaces of the guiding protrusion 225 and the recess 227. A possible range for the conicity can be an angle φ of between 45° and 70° between the horizontal plane and a surface of the guiding protrusion 225 or recess 227, as indicated in Fig. 7. The conicity can for instance be arranged in such way that the surfaces of the guiding protrusion 225 and the recess 227 will not touch each other during release, or that they may touch each other with a determined largest force value.

Furthermore, the conicity can be advantageous when attaching the buoy 205b to the turret 205a, as the guiding protrusion 225 and the recess 227 then function as guiding means for correct alignment of the buoy 205b.

With the described configuration of buoy 205b and turret 205a, the buoy 205b is advantageously arranged to be releasable from the turret 205a even with loads of up to 6000 tonnes in the lateral direction and up to 4000 tonnes in the vertical direction. However, the invention is not limited to these values, as they naturally depend on the dimensioning of the connection system.

The connection system described above, as arranged in connection with the ship 201, may also be used in connection with a turret 5, 105 as described in connection with a ship as described in other examples of embodiments above.

Claims

1. Ship adapted for drilling of oil and/or gas wells, **characterized in** that it is adapted for drilling through a drill riser string that extends from a well in the seabed to a turret arranged in the ship, wherein the drill riser string is adapted to be separated from connection to the ship in a position beneath the ship's base line, so that the ship can leave the drill riser string.

2. Ship according to claim 1, **characterized in** that the turret comprises a lower part adapted to be separated from the ship, in such a way that when separated it sinks downwards in the sea and takes a position of equilibrium where it surrounds at least a part of the drill riser string.

3. Ship according to claim 2, **characterized in** that the lower part is connected to mooring lines and has such buoyancy that when separated from the ship it will sink down to a position of equilibrium where it keeps at least parts of the mooring lines up from the seabed, wherein it simultaneously provides lateral support to the drill riser string.

4. Ship adapted for drilling of and/or production from an oil and/or gas well, which ship is adapted to have a connection to at least one production riser which is connected to a turret connected to the ship or a drill riser string that extends through a turret connected to the ship, **characterized in** that the lower part of the turret extends a distance below the base line of the ship.

5. Ship according to claim 4, **characterized in** that said distance is at least 3 meters.

6. Ship adapted for drilling and/or production from an oil and/or gas well, which ship is adapted to have a connection to at least one production riser which is connected to a turret connected to the ship or a drill riser string that extends through a turret connected to the ship, **characterized in** that the ship comprises an ice rejecting structure that extends down from the bottom of the ship and which at least partially surrounds said turret.

7. Ship adapted for drilling and/or production from an oil and/or gas well, which ship is adapted to have connection to at least one production riser that is connected to a turret connected to the ship or a drill riser string that extends through a turret connected to the ship, **characterized in** that

- the ship between its bow and stern exhibit two longitudinal sides which along at least 50 % of their length are provided with an ice belt that exhibit an angle α between the hull of the ship and the horizontal, which angle α is between 45 and 80 degrees; and that
- the turret has a centre axis which is arranged in a position on the ship corresponding to 0,15 – 0,45 Lpp in front of the ship's half Lpp (length between perpendiculars).

8. Ship according to claim 7, **characterized in** that the ship has a parallel middle aisle, wherein the centre axis of said turret is arranged in front of it.

9. Ship according to one of the preceding claims, **characterized in** that it exhibits a length between perpendiculars (Lpp) of more than 200 m, a with between 40 and 55 m, and has a draught of at least 10 m.

10. Connection system for releasable connection between a first part in the form of a turret arranged in a ship and a second part in the form of a buoy, which buoy is adapted for receiving mooring lines and at least one riser, **characterized in** that
- the system is adapted for removal of water above the buoy when the turret and the buoy are in a position connected to each other, for reduction of the water pressure above the buoy.

11. Connection system according to claim 10, **characterized in** that
- one of the parts comprises a protruding guiding body;
- the other of the parts comprises an oppositely correspondingly shaped recess adapted for receiving the guiding body in an engaged position; and that
- one of the parts comprises a locking device for mechanically locking of the one part to the other, as the locking device is adapted to engage with the other part.

12. Connection system according to claim 11, **characterized in** that the protruding guiding body has a coned shape and that the recess has a correspondingly opposite shaped coned shape.

13. Method for disconnection of a buoy (205b) from a turret (205a) arranged in a ship (201), which buoy (205b) is attached to mooring lines (211) and at least one riser (215), **characterized in**

(a) releasing locking devices (223) from engaged position, which locking devices (223) are adapted for mechanical locking of the buoy (205b) to the turret (205a); and then

(b) supplying water above the buoy (205b) in order to increase the hydrostatic pressure above the buoy (205b).

14. Method for connecting a buoy (205b) to a turret (205a) arranged in a ship (201), which buoy (205b) is connected to mooring lines (211) and at least one riser (215), **characterized in**

(p) pulling the buoy (205b) up to the turret (205a); and

(q) pumping water away from the area above the buoy (205b) in order to reduce the hydrostatic pressure in this area.

15. Method according to claim 14, **characterized in** after step (p), locking the buoy (205b) mechanically to the turret (205a) by means of locking devices (223).