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(54) A HANG-OFF SYSTEM AND A HANG-OFF STRUCTURE

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Description

TECHNICAL FIELD

[0001] The present invention relates to hang-off system comprising a floating weathervaning vessel comprising a hang-off structure and one or more flexible transporting units hanging from said hang-off structure. The invention also relates to a turret comprising a hang-off structure.

BACKGROUND ART

[0002] Hang-off systems comprising a floating weathervaning vessel with a hang-off structure and one or more flexible transporting units hanging from the hang-off structure are well known in the art and are generally used in the offshore transportation of fluids, electricity, electromagnetic waves and other media to or from a floating weathervaning vessel.

[0003] A floating weathervaning vessel from which one or more flexible transporting units are leading to a subsea connection point usually comprises an external turret system or an internal turret system. The internal turret system leads the flexible transporting units through the hull bottom whereas the external turret system leads the flexible transporting unit from a topside hang-off structure extending beyond the hull and the rail of the vessel.

[0004] The weathervaning vessel is usually moored to the seabed such that it can weathervane around the centre axis of its turret.

[0005] The documents GB 2 354 219, US 5,893,334, US 6,126,501 and US 5,480,264 describes mooring systems for floating vessels.

[0006] The hang-off structure is usually mounted to the turret via a bearing and swivel system of the turret such that when the weathervaning vessel is weathervaning, the hang-off structure will be rotated with respect to the weathervaning vessel, but it will substantially not rotate with respect to the flexible transporting units.

[0007] In many situations only limited horizontal and/or vertical space is available for the weathervaning vessel and/or the flexible transporting units. In this text "horizontal space" means horizontal space at the sea surface and/or at the seabed and/or any horizontal plane there between. "Vertical space" means depth of water from sea surface to seabed and/or from the keel of the weathervaning vessel to seabed. In such situations with limited space there is a high risk that the flexible transporting unit is subjected to high wear and even to bending with damaging curvature and/or an over stretching of the flexible transporting unit.

[0008] The object of the invention is to provide a hang-off system which results in a reduced risk of subjecting the flexible transporting unit(s) to high wear, to bending with damaging curvature and/or to over stretching of the flexible transporting unit.

DISCLOSURE OF INVENTION

[0009] The object of the invention is solved by the hang-off system as defined in the claims. Additional beneficial solutions which may have additional advantages are defined in the sub claims and are described in the following.

[0010] The term 'seabed' is generally used to denote the subsea floor.

[0011] In the prior art hang-off systems, the hang-off structure normally has been provided with an essential circular plate structure often integrated with a mooring chaintable for mooring the weathervaning vessel by lines to the seabed. Circular openings in the circular plate structure arranged around the centre axis (normally also the centre axis for a bearing and swivel system) form hang-off connecting points for one or more flexible transporting units extending to a subsea connecting point. Generally, in prior art hang-off systems one or more flexible transporting units were arranged to hang-off from a hang-off connecting point which was as close to the subsea connection point as possible.

[0012] The inventor of the present invention has found that large and unpredictable benefits can be obtained by increasing the horizontal distance between the hang-off connecting point and the subsea connecting point and furthermore the inventor has provided a hang-off system which allows such an increase of horizontal distance. Even though such an increase in horizontal distance requires the flexible transporting unit to be longer than in corresponding prior art systems, the benefits obtained with respect to reduced risk of subjecting the flexible transporting unit(s) to high wear, to bending with damaging curvature and/or to over stretching of the flexible transporting unit, far exceed the drawbacks of using a slightly longer flexible transporting unit.

[0013] The hang-off structure is in particular useful in highly shallow waters or areas with limited horizontal space for the weathervaning vessel, but it may also be beneficial in other offshore areas. The hang-off system of the invention is highly applicable in shallow waters with a depth of up to about 200 m, such as preferably with a depth of up to about 100 m, such as with a depth of up to about 80 m.

[0014] Further scope of applicability of the present invention will become apparent from the description given hereinafter. However, it should be understood that the detailed description and specific examples, while indicating preferred embodiments of the invention, are given by way of illustration only, since various changes and modifications within the scope of the invention will become apparent to those skilled in the art from this detailed description. The hang-off system of the invention comprises a floating, moored weathervaning vessel with a turret.

[0015] The weathervaning vessel may be any kind of weathervaning vessel with an external turret system or an internal turret system. Examples of weathervaning vessels include FPSO (Floating Production, Storage,

and Offloading systems), FSO (Floating Storage and Offloading systems) and FSRU (Floating Storage and Regasification Unit systems).

[0016] Weathervaning vessels with turrets are well known in the art, e.g. as described above. The turret may be as the prior art turret with the modification(s) specified in the claims and described below.

[0017] The turret system of the hang-off system of the invention comprises a hang-off structure and at least one flexible transporting unit hanging from the hang-off structure.

[0018] A hang-off structure is a structure to which the flexible transporting unit or units are connected and hang-off from. The hang-off structure is the part of the turret from where the flexible transporting unit exits the weathervaning vessel and passes on to connection with another structure, in the present hang-off system a subsea structure.

[0019] The flexible transporting unit may be any kind of flexible transporting units which are usable in such a hang-off system. The flexible transporting unit may for example be a flexible riser or an umbilical. Preferably the hang-off system comprises a plurality of flexible transporting units e.g. comprising a plurality of risers, such as a plurality of risers and optionally at least one umbilical. Flexible transporting units - sometimes also called jumpers - such as risers and umbilicals are well known in the art. Risers are usually applied for transportation of petrochemical products from the seabed to a sea surface installation such as a weathervaning vessel. Umbilicals are often used for transporting fluids, electricity, signals and other to and/or from installations at or beyond the seabed.

[0020] The turret comprises a bearing and swivel system connected to or integrated with the hang-off structure.

[0021] The term "connected to" indicates that the parts connected to each other are two parts with distinguished functions. The term "integrated with" indicates that the integrated parts at least have some common structures or common functional part(s).

[0022] Bearing and swivel systems of weathervaning vessels are well known in the art and may for example be as described in US 5,517,937. The bearing and swivel system of the turret is the part of the turret that ensures that the weathervaning vessel can weathervane around the turret, usually around a centre axis of the bearing and swivel system.

[0023] In one embodiment the bearing and swivel system comprises two parts which are rotatably connected to each other. A first part of the bearing and swivel system is connected in a substantially stiff connection to a hull of the weathervaning vessel and a second part connected to the hang-off structure and preferably a mooring system such as a mooring chainable through which the weathervaning vessel is moored by lines.

[0024] In the hang-off system of the invention, the bearing and swivel system comprises a centre axis, which

herein is defined as an axis of rotation of the bearing and swivel system. The flexible transporting unit hangs-off from a hang-off connecting point to a subsea connection point.

[0025] The hang-off connecting point is defined as the point closer to the centre axis provided by the bearing and swivel system of the hang-off structure from where the flexible transporting unit hangs-off (the in length direction last point of connection). Normally the flexible transporting unit will hang-off from a hang-off aperture provided in the hang-off structure and the final area of connection is the periphery of this hang-off aperture. Accordingly, the hang-off connecting point is the point along the periphery of the hang-off aperture which is closer to the centre axis provided by the bearing and swivel system.

[0026] The subsea connection point is the connection point between the flexible transporting unit and a subsea structure, which in length direction of the pipe is closer to the hang-off connecting point. If several points are equally close, the subsea connection point is the midpoint of the two more distinct of such several equally close points.

[0027] In the hang-off system of the invention the hang-off structure and the flexible transporting unit are arranged such that risk of damaging the flexible transporting unit is reduced. A vector extending from the subsea connecting point to the hang-off connection point has a vertical and a horizontal component, the horizontal component is perpendicular to a hang-off vertical plane extending through the centre axis of the bearing and swivel system, the hang-off vertical plane separates the hang-off structure in a flexible transporting unit heading part and an opposite part. The flexible transporting unit heading part is horizontally closer to the subsea connection point than the opposite part. In the present invention the hang-off connecting point is arranged in the opposite part of the hang-off structure, thereby reducing the risk of damaging the flexible transporting unit.

[0028] As mentioned above the hang-off system of the invention may comprise any kind of turret system providing one or more hang-off connecting points as described herein.

[0029] In one embodiment the weathervaning vessel has a hull and comprises an external turret system where the hang-off structure is a topside hang-off structure fixed at a position beyond the hull of the weathervaning vessel.

[0030] External turret systems as such are well known in the art, and are often used in vessels which have temporarily or permanently been rebuilt to become a weathervaning vessel. External turret systems are often relatively small compared with internal turret systems and are in particular used in shallow water applications, but they may also be used at deeper water.

[0031] In one embodiment the weathervaning vessel has a hull and comprises an internal turret arranged inside and/or below the hull of the weathervaning vessel. Such internal turret can in principle have any size.

[0032] The weathervaning is preferably moored by lines to the seabed and/or to one or more fixed structures such that it can rotate fully or partly around the centre axis of the bearing and swivel system. Generally it is preferred to moor the weathervaning vessel directly by lines to the seabed for providing a safe mooring.

[0033] The moored weathervaning vessel generally has a large freedom to move to adapt to the forces applied to the weathervaning vessel e.g. by wind, water current and waves, and even though the weathervaning vessel is moored the movements of the weathervaning vessel may become quite considerable.

[0034] The weathervaning vessel may for example be able to rotate such that it can have an optimal position with respect to wind, water current and/or waves to be as stable on the water as possible. In one embodiment the weathervaning vessel and the mooring thereof is arranged such that the weathervaning vessel is always facing the wind.

[0035] In one embodiment the turret system comprises a mooring chaintable, the weathervaning vessel is moored by lines connected to the mooring chaintable such that it can rotate fully or partly around the centre axis of the bearing and swivel system, the mooring chaintable preferably is connected to or integrated with the bearing and swivel system, such that the weathervaning vessel in moored condition can weathervane around the centre axis of the bearing and swivel system while keeping the mooring chaintable substantially non-rotating with respect to the mooring to the seabed and/or subsea structure(s).

[0036] In one embodiment the mooring chaintable and the hang-off structure are connected to each other. Both the mooring chaintable and the hang-off structure are substantially non-rotating with respect to the mooring to the seabed and/or subsea structure(s), while the weathervaning vessel may or may not weathervane. The connection between the mooring chaintable and the hang-off structure may be any kind of connection e.g. mechanical, chemical and/or physical, preferably a relatively stiff connection. The connection between the mooring chaintable and the hang-off structure may be a direct connection or a connection via another element such as an axis shaft of the turret.

[0037] In one embodiment the mooring chaintable and the hang-off structure are integrated with each other and comprise for example a totally or partly common structure comprising one or more apertures for the flexible transporting unit to provide hang-off connecting points and totally or partly carrying the chaintable for mooring the weathervaning vessel.

[0038] In one embodiment the bearing and the swivel system, the mooring chaintable and the hang-off structure are integrated with each other and comprise for example a bearing and swivel system comprising a first and a second part rotatable with respect to each other and a totally or partly common structure comprising at least a part of the second part of the bearing and swivel system

and comprising one or more apertures for the flexible transporting unit to provide hang-off connecting points and totally or partly carrying the chaintable for mooring the weathervaning vessel.

[0039] In one embodiment where the hang-off structure is at least partly integrated with the mooring chaintable, the hang-off structure comprises a first part and a second part where the first part is at least partly provided by the mooring chaintable - i.e. the first part is totally or partly provided by a common structure. The second part of the hang-off structure is an extension of the first part and/or a part connected to the first part in a stiff connection. The second part thereby preferably provides a major part of the opposite part of the hang-off structure.

[0040] In a preferred embodiment the second part extends in a direction away from the hang-off vertical plane. Thereby the at least one hang-off connecting point is arranged in the second part of the hang-off structure and an even further reduction of the risk of damaging the one or more flexible transporting units will be obtained. By providing the second part to extend in a direction away from the hang-off vertical plane large freedom in designing the hang-off system is obtained, and any limitation with respect to available horizontal and/or vertical space provides much less difficulties and further the risk that the flexible transporting unit will be subjected to high wear, damaging curvature and/or an over stretching is highly reduced.

[0041] In one embodiment the hang-off structure has a larger opposite part than the flexible transporting unit heading part.

[0042] The flexible transporting unit heading part has a heading part length from the hang-off vertical plane and the opposite part has an opposite part length from the hang-off vertical plane. In one embodiment the opposite part length is substantially longer than the heading part length, more preferably the opposite part length is at least about 10 % longer, such as at least about 20 % longer, such as at least about 30 % longer, such as at least about 50 % longer, such as at least about 75 % longer, such as at least about 100 % longer, such as at least about 125 % longer, such as at least about 150 % longer, such as at least about 200 % longer, such as up to about least about 1000 % longer than the heading part length.

[0043] All lengths from the hang-off vertical plane are measured as lengths perpendicular to the hang-off vertical plane.

[0044] In one embodiment the opposite part length is at least about 0.5 m longer, such as at least about 1 m longer, such as at least about 2 m longer, such as at least about 4 m longer, such as at least about 6 m longer, such as at least about 8 m longer, such as at least about 10 m longer, such as at least about 12 m longer, such as at least about 14 m longer, such as at least about 16 m longer, such as up to about least about 18 m longer than the heading part length.

[0045] The at least one hang-off connecting point has a hang-off distance to the hang-off vertical plane. In one

embodiment the hang-off distance is at least about 1 m, such as at least about 2 m, such as at least about 4 m, such as at least about 6 m, such as at least about 8 m, such as at least about 10 m, such as at least about 12 m, such as at least about 14 m, such as at least about 16 m, such as at least about 18 m, such as at least about 20 m, such as at least about 22 m, such as at least about 24 m, such as at least about 26 m, such as at least about 28 m, such as at least about 30 m.

[0046] All distances from the hang-off vertical plane are measured as distances perpendicular to the hang-off vertical plane.

[0047] The subsea connection point may in principle be any kind of connection point to any kind of subsea structure e.g. a connection point connecting the flexible transporting unit to a subsea structure or directly to the seabed. The subsea connection point may be a fixed connection or a non-fixed connection. Generally it is desired that the subsea structure has a mechanical influence on the flexible transporting unit, i.e. it provides some forces to the flexible transporting unit e.g. by providing the flexible transporting unit with a curvature.

[0048] In one embodiment the subsea connection point is a connection to a subsea structure in the form of a fixed structure, preferably fixed directly to the seabed, such as a riser tower and a subsea anchoring device for anchoring the one or more flexible transporting units. Examples of such fixed subsea structures are for example described in US 4,182,584 and US 7,040,841.

[0049] In one embodiment the subsea connection point is a connection to a subsea structure in the form of a subsea structure moored to a fixed structure, the subsea structure preferably comprises a buoyancy system, more preferably the subsea structure is a moored mid water arch. Such mid water arch is well known in the art.

[0050] In one embodiment the subsea connection point is a connection to a subsea structure held in position by the one or more flexible transporting units. The subsea structure may preferably comprise a buoyancy system, more preferably the subsea structure is a moored mid water arch or a mid water jacket.

[0051] As indicated above buoyancy systems are well known in the art and include in practice any systems that can hold a part of the flexible transporting unit at a position above the seabed by means of having a lower density than the sea water. Buoyancy systems usually employ one or more elements comprising low density materials or elements with enveloped air.

[0052] In one embodiment the at least one flexible transporting unit comprises or is supported by a buoyancy system arranging the at least one flexible transporting unit in a wave configuration.

[0053] In one embodiment the at least one flexible transporting unit is supported by a buoyancy system in hog bend.

[0054] In one embodiment the hang-off system comprises a moored buoy; the weathervaning vessel is arranged to weathervane around the moored buoy.

[0055] In one embodiment the at least one flexible transporting unit comprises one or more of a flexible riser and an umbilical. The hang-off system may preferably comprise a plurality of flexible transporting units, such as a plurality of risers and optionally at least one umbilical.

[0056] In principle there is no upper limit to the number of flexible transporting units provided that the hang-off system can carry the weight and is designed sufficiently large to the number of flexible transporting units.

[0057] In one embodiment the hang-off system comprises at least 2, such as at least 3, such as at least 4, such as at least 5, such as at least 6, such as at least 7, such as at least 8, such as at least 9, such as at least 10, such as at least 15 flexible transporting units. Not all of the flexible transporting units need to have hang-off connecting points arranged in the opposite part of the hang-off structure. In one embodiment it is desired that at least about half, such as at least about 60 %, such as at least about 70 %, such as at least about 80 %, such as about 90 %, such as preferably all of the flexible transporting units, each hangs-off from a hang-off connecting point to a subsea connection point, providing a hang-off vertical plane extending through the centre axis of the bearing and swivel system, and the hang-off connecting point(s) is/are arranged in the opposite part of the hang-off structure.

[0058] All percentages of flexible transporting units are rounded up to whole flexible transporting units.

[0059] Some flexible transporting units are more sensible to being damaged when subjected to high wear, bending with low curvature and/or stretching, whereas other flexible transporting units have a higher resistance. In general risers are more sensitive to high wear, bending with low curvature and/or stretching than umbilicals, and large flexible transporting units are more sensitive to high wear, bending with low curvature and/or stretching than small flexible transporting units (large/small relates to the inner diameter of the flexible transporting units).

[0060] In one embodiment the hang-off system comprises a plurality of flexible transporting units in the form of risers or in the form of risers and umbilicals, at least about half, such as at least about 60 %, such as at least about 70 %, such as at least about 80 %, such as about 90 %, such as preferably all of the flexible transporting units in the form of risers, each hangs-off from a hang-off connecting point to a subsea connection point, providing a hang-off vertical plane extending through the centre axis of the bearing and swivel system, and the hang-off connecting point is arranged in the opposite part of the hang-off structure.

[0061] In one embodiment the hang-off system comprises a plurality of flexible transporting units in the form of risers or in the form of risers and umbilicals, at least about half, such as at least about 60 %, such as at least about 70 %, such as at least about 80 %, such as about 90 %, such as preferably all of the flexible transporting units in the form of risers having an inner diameter of at least about 3", such as at least about 4", such as at least

about 5", such as at least about 6", such as at least about 8", such as at least about 10", such as at least about 12", such as at least about 14", such as at least about 16", such as at least about 18", such as at least about 20", such as at least about 22", such as at least about 24", such as at least about 26", such as at least about 28", such as at least about 30", each hang-off from a hang-off connecting point to a subsea connection point, providing a hang-off vertical plane extending through the centre axis of the bearing and swivel system, and the hang-off connecting point is arranged in the opposite part of the hang-off structure.

[0062] In one embodiment the hang-off system comprises at most 1 flexible transporting unit hanging-off from the flexible transporting unit heading part, preferably the hang-off system comprises at most 2, such as at most 3, such as at most 4, such as at most 5, such as at most 6, such as at most 7, such as at most 8 flexible transporting units hanging-off from the flexible transporting unit heading part. Any flexible transporting unit(s) hanging-off from the flexible transporting unit heading part is preferably less sensitive to being damaged when subjected to high wear, bending with low curvature and/or stretching, than a flexible transporting unit hanging-off from the opposite part of the hang-off structure.

[0063] In one embodiment the hang-off system comprises at most 1 flexible transporting unit hanging-off from the flexible transporting unit heading part, preferably the hang-off system comprises at most 2, such as at most 3, such as at most 4, such as at most 5, such as at most 6, such as at most 7, such as at most 8 of the flexible transporting units hanging-off from the flexible transporting unit heading part, preferably the one or more flexible transporting units hanging-off from the flexible transporting unit heading part comprise at least one umbilical and/or at least the flexible transporting units with a small inner diameter.

[0064] In one embodiment where the hang-off system comprises a plurality of flexible transporting units each hanging-off from a hang-off connecting point to a subsea connection point, providing a hang-off vertical plane extending through the centre axis of the bearing and swivel system, the hang-off connecting point is arranged in the opposite part of the hang-off structure, it is desired that the hang-off vertical planes for the respective flexible transporting units differ from each other. Thereby the flexible transporting units will not have an entirely uniform curvature, but they may for example be closer to each other at some length sections than in other length sections. It may also be possible to provide relatively sensitive flexible transporting units with additional length for an extra protection.

[0065] In one embodiment where the hang-off system comprises a plurality of flexible transporting units each hanging-off from a hang-off connecting point to a subsea connection point, providing a hang-off vertical plane extending through the centre axis of the bearing and swivel system, the hang-off connecting point is arranged in the

opposite part of the hang-off structure, it is desired that the hang-off vertical planes for at least 2 or more of the flexible transporting units are substantially identical. In one embodiment the hang-off vertical planes for all of the flexible transporting units are substantially identical.

[0066] In this embodiment the flexible transporting units may be arranged in a substantially parallel structure and have a substantially identical curvature. Alternatively the flexible transporting units may be arranged to be closer to each other at some length sections than in other length sections. It may also be possible to provide relatively sensitive flexible transporting units with additional length for an extra protection.

[0067] In one embodiment at least 2, preferably all of the hang-off connecting points are arranged in the opposite part of the hang-off structure.

[0068] The turret system may be provided at any position inside or external to the weathervaning vessel. Depending on the application and the available space as well as the number and size of the flexible transporting units some positions of the turret system may be more preferable than other positions.

[0069] In one embodiment the turret system is an external turret system, the bearing and swivel system is positioned forward of the weathervaning vessel, the bearing and swivel system preferably being positioned substantially in a vertical plane of a straight forward sailing direction of the weathervaning vessel.

[0070] In one embodiment the weathervaning vessel has a hull with a keel and the turret system is an external turret system, the bearing and swivel system positioned backward of the weathervaning vessel, the bearing and swivel system preferably being positioned substantially in a vertical plane comprising the keel.

[0071] The keel is the spine of the vessel, which runs along the bottom thereof and usually constitutes the lowermost part of the weathervaning vessel.

[0072] In one embodiment the weathervaning vessel comprises a hull, a bow and a stern, and a length of the hull determined as the maximal length in a plane perpendicular to the water line, the turret system is an internal turret system, positioned at a distance from the stern of up to about 95 %, such as at a distance from the stern up to about 5 % of the hull length, such as from about 5 % to about 10 % of the hull length, such as from about 10 % to about 15 % of the hull length, such as from about 15 % to about 20 % of the hull length, such as from about 20 % to about 25 % of the hull length, such as from about 25 % to about 30 % of the hull length, such as from about 30 % to about 35 % of the hull length, such as from about 35 % to about 40 % of the hull length, such as from about 40 % to about 45 % of the hull length, such as from about 45 % to about 50 % of the hull length, such as from about 50 % to about 55 % of the hull length, such as from about 55 % to about 60 % of the hull length, such as from about 60 % to about 65 % of the hull length, such as from about 65 % to about 70 % of the hull length, such as from about 70 % to about 75 % of the hull length, such as from about

75 % to about 80 % of the hull length, such as from about 80 % to about 85 % of the hull length, such as from about 85 % to about 90 % of the hull length, such as from about 90 % to about 95 % of the hull length from the stern.

[0073] When determining the length of the hull bowsprit and other fittings should be excluded.

[0074] In one embodiment the turret system is an internal turret system, positioned at a distance from the stern of up to about 550 m, such as up to about 525 m, such as up to about 500 m, such as up to about 475 m, such as up to about 450 m, such as up to about 425 m, such as up to about 400 m, such as up to about 375 m, such as up to about 350 m, such as up to about 325 m, such as up to about 300 m, such as up to about 275 m, such as up to about 250 m, such as up to about 225 m, such as up to about 200 m, such as up to about 175 m, such as up to about 150 m, such as up to about 125 m, such as up to about 100 m, such as up to about 75 m, such as up to about 50 m, such as up to about 25 m from the stern.

[0075] In one embodiment the turret system is applied in the aft of the vessel.

[0076] The difference of aft and stern is that the aft is the inside (onboard) rearmost part of the vessel, while the stern refers to outside (off board) rearmost part of the vessel.

[0077] In situations where the hang-off system comprises at least 2 flexible transporting units with the hang-off connecting points arranged in opposite parts of the hang-off structure, the hang-off connecting points may be arranged in any pattern and with any mechanically possible distance. Generally it is desired that such 2 or more hang-off connecting points are arranged with a distance which is at least the average outer diameter of the flexible transporting units. In one embodiment the hang-off connecting points are arranged in a pattern such that the hang-off vertical planes for the flexible transporting units are substantially identical. In one embodiment the hang-off connecting points are arranged in a side by side relation with a substantially equal distance to the substantially identical hang-off vertical planes. In one embodiment the substantially identical distance to the substantially identical hang-off vertical planes is preferably at least about 2 m, such as at least about 4 m, such as at least about 6 m, such as at least about 8 m, such as at least about 10 m, such as at least about 12 m, such as at least about 14 m, such as at least about 16 m, such as at least about 18 m, such as at least about 20 m, such as at least about 22 m, such as at least about 24 m, such as at least about 26 m, such as at least about 28 m, such as at least about 30 m.

[0078] The invention also relates to a turret for a floating, moored weathervaning vessel. The turret comprises a hang-off structure and a bearing and swivel system connected to or integrated with the hang-off structure. The bearing and swivel system comprises a centre axis.

[0079] The hang-off structure of the turret has a hang-off body with a hang-off extent in a plane perpendicular

to the centre axis, and an outer periphery of the hang-off body comprising an asymmetrical shape.

[0080] The hang-off body may preferably comprise a first and a second part, the periphery of the first part comprises a distance to the centre axis which is substantially uniform and the periphery of the second part comprises one or more distances to the centre axis which are longer than the substantially uniform distance to the centre axis of the periphery of the first part.

[0081] In one embodiment the turret comprises a mooring chaintable connected to or integrated with the bearing and swivel system.

[0082] In one embodiment of the turret, the mooring chaintable and the hang-off structure are connected to each other. The connection between the mooring chaintable and the hang-off structure may be any kind of connection e.g. mechanical, chemical and/or physical, preferably a relatively stiff connection. The connection between the mooring chaintable and the hang-off structure may be a direct connection or a connection via another element such as an axis shaft of the turret.

[0083] In one embodiment of the turret the mooring chaintable and the hang-off structure are integrated with each other and comprise for example a totally or partly common structure comprising one or more apertures for the flexible transporting unit to provide hang-off connecting points and totally or partly carrying the chaintable for mooring the weathervaning vessel.

[0084] In one embodiment of the turret the bearing and the swivel system, the mooring chaintable and the hang-off structure are integrated with each other and comprise for example a bearing and swivel system comprising a first and a second part rotatable with respect to each other [where] and a totally or partly common structure comprising at least a part of the second part of the bearing and swivel system and comprising one or more apertures for the flexible transporting unit to provide hang-off connecting points and totally or partly carrying the chaintable for mooring the weathervaning vessel.

[0085] In one embodiment of the turret where the hang-off structure is at least partly integrated with the mooring chaintable, the hang-off structure comprises a first part and a second part where the first part is at least partly provided by the mooring chaintable - i.e. the first part is totally or partly provided by a common structure. The second part of the hang-off structure is an extension of the first part and/or a part connected to the first part in a stiff connection. The second part thereby provides the opposite part of the hang-off structure.

[0086] In a preferred embodiment of the turret the second part extends in a direction away from the hang-off vertical plane. Thereby the at least one hang-off connecting point is arranged in the second part of the hang-off structure

[0087] In one embodiment of the turret the hang-off body comprises a first and a second part, the periphery of the first part comprises a first short distance to the centre axis and the periphery of the second part com-

prises a second long distance to the centre axis which is longer than the first short distance to the centre axis of the periphery of the first part, preferably the second long distance is at least about 0.5 m longer, such as at least about 1 m longer, such as at least about 2 m longer, such as at least about 4 m longer, such as at least about 6 m longer, such as at least about 8 m longer, such as at least about 10 m longer, such as at least about 12 m longer, such as at least about 14 m longer, such as at least about 16 m longer, such as up to about least about 18 m longer than the first short distance to the centre axis of the periphery of the first part.

[0088] In one embodiment of the turret the hang-off structure comprises at least one hang-off point for hanging off a flexible transporting unit, the at least one hang-off point is arranged in the second part of the hang-off body, preferably in a distance from the centre axis of at least about 2 m, such as at least about 4 m, such as at least about 6 m, such as at least about 8 m, such as at least about 10 m, such as at least about 12 m, such as at least about 14 m, such as at least about 16 m, such as at least about 18 m, such as at least about 20 m, such as at least about 22 m, such as at least about 24 m, such as at least about 26 m, such as at least about 28 m, such as at least about 30 m.

BRIEF DESCRIPTION OF DRAWINGS

[0089] The invention will be explained more fully below in connection with a preferred embodiment and with reference to the drawings in which:

FIG. 1 shows a schematical side view of a hang-off system of the invention.

FIG. 2 shows the hang-off system of FIG. 1 in a schematic, partly transparent, perspective view.

FIG. 3 shows the hang-off system of FIG. 1 in a slightly perspective view.

FIG. 4 shows a turret of a hang-off system seen in a schematic view from below.

[0090] The figures are schematic and may be simplified for clarity. Throughout, the same reference numerals are used for identical or corresponding parts.

[0091] The hang-off system of FIG 1 comprises a floating, moored weathervaning vessel 3 comprising a turret 11. The turret comprises a bearing and swivel system 5, 9, a mooring chaintable 9 and a hang-off structure 9, 8. The bearing and swivel system 5, 9, a mooring chaintable 9 and a hang-off structure 9, 8 are integrated with each other in that they have the mooring chaintable 9 as a common structure. The bearing and swivel system comprises a centre axis 4 which in FIG. 1 also provides a side view of a hang-off vertical plane as explained in the following. The hang-off structure 9, 8 comprises a first

part 9 in common with the swivel system 5, 9, and the mooring chaintable 9, and further the hang-off structure 9, 8 comprises a second part 8 applied as an extension of the first part 9 but the second part 8 could as well have been connected to the first part.

[0092] The second part 8 of the hang-off structure 9, 8 extends in a direction away from the hang-off vertical plane 4.

[0093] The weathervaning vessel 3 is moored by lines 6 from the mooring chaintable 9 to the seabed. The hang-off system comprises 2 flexible transporting units 2. As explained above the hang-off system could comprise only one or it could comprise more than two. The flexible transporting units 2 hang from the second part of the hang-off structure 8. Each of the flexible transporting units 2 hang-off from a hang-off connecting point 7 to a subsea connection point 12 of a sub sea structure 1. A hang-off vertical plane 4 is defined for each flexible transporting unit 2, and in the example of FIG. 1 the hang-off vertical planes 4 for the two flexible transporting units are substantially identical and therefore only one can be seen. The hang-off vertical plane for a flexible transporting unit is found as follows: A vector extending from the subsea connecting point 12 to the hang-off connection 7 point has a vertical and a horizontal component, the horizontal component is perpendicular to a hang-off vertical plane extending through the centre axis of the bearing and swivel system.

[0094] The hang-off vertical plane 4 separates the hang-off structure 9, 8 in a flexible transporting unit heading part on the side of the hang-off vertical plane 4 horizontally closer to the subsea connecting point 12 (left side of the hang-off vertical plane 4) and an opposite part horizontally closer to the hang-off connecting point 7 (right side of the hang-off vertical plane 4).

[0095] The hang-off connecting point 7 is arranged in the second part of the hang-off structure which constitutes the major part of the opposite part of hang-off structure.

[0096] FIG. 2 shows the same hang-off system as FIG. 1 but in a schematic, partly transparent, perspective view. The turret system is an external turret system with the external turret 11 connected near the bow 10 of the weathervaning vessel 3.

[0097] FIG. 3 shows the same hang-off system as FIG. 1 but in a slightly perspective view. The shape of the subsea structure 1 is more visible and it can be seen that the flexible transporting units 2 follow a substantially parallel pattern.

[0098] FIG. 4 shows a turret of a hang-off system seen in a schematic view from below. The turret shown in FIG. 4 could be similar to the turret 11 of FIG. 1.

[0099] The turret comprises a bearing and swivel where only an axis shaft 5 of the bearing and swivel system is visible, a mooring chaintable 9 and a hang-off structure 9, 8 integrated with the mooring chaintable 9 in that they have the mooring chaintable 9 as a common structure. The hang-off structure 9, 8 comprises a first

part 9 in common with the mooring chaintable 9, and further the hang-off structure 9, 8 comprises a second part 8 connected to the first part 9 or applied as an extension to the first part 9.

[0100] In non-mounted condition apertures for mounting of the flexible transporting units are applied in the second part 8 of the hang-off structure 9, 8.

[0101] In mounted condition, i.e. as applied in a hang-off system as it is shown in FIG. 4, the turret is moored by mooring lines 6 and two flexible transporting units 2 are arranged to hang-off from hang-off connecting points 7 which are points along the periphery of the apertures closest to the centre axis 4 of the bearing and swivel system. In the example shown in FIG. 4 the flexible transporting units have identical hang-off vertical planes 4 and the flexible transporting units pass with a right angle through the hang-off vertical planes 4 as indicated with reference 10.

[0102] Some preferred embodiments have been shown in the foregoing, but it should be stressed that the invention is not limited to these, but may be embodied in other ways within the subject-matter defined in the following claims.

Claims

1. A hang-off system comprising a floating, moored weathervaning vessel (3) comprising a turret (11) with a hang-off structure (8, 9) and at least one flexible transporting unit (2) hanging from the hang-off structure (8, 9), wherein the turret (11) comprises a bearing and swivel system connected to or integrated with the hang-off structure (8, 9), the bearing and swivel system comprises a centre axis (4), the flexible transporting unit (2) hangs-off from a hang-off connecting point (7) to a subsea connection point (12), a vector extending from the subsea connection point to the hang-off connection point (7) has a vertical and a horizontal component, the horizontal component is perpendicular to a hang-off vertical plane extending through the centre axis (4) of the bearing and swivel system, the hang-off vertical plane separates the hang-off structure (8, 9) in a flexible transporting unit heading part and an opposite part, the flexible transporting unit heading part is horizontally closer to the subsea connection point (12) than the opposite part, the hang-off connecting point is arranged in the opposite part of the hang-off structure, preferably the weathervaning vessel (3) has a hull and comprises an external turret system where the hang-off structure is a topside hang-off structure fixed at a position beyond the hull of the weathervaning vessel (3).
2. A hang-off system as claimed in claim 1, wherein the weathervaning (3) is moored by lines (6) to the seabed and/or to one or more fixed structures such that

it can rotate fully or partly around the centre axis of the bearing and swivel system, preferably the weathervaning comprises a mooring chaintable (9), the weathervaning vessel (3) is moored by lines (6) connected to the mooring chaintable (9) such that it can rotate fully or partly around the centre axis of the bearing and swivel system, the mooring chaintable preferably is connected to or integrated with the bearing and swivel system, more preferably the bearing and swivel system, the mooring chaintable (9) and the hang-off structure (8, 9) are connected to or integrated with each other.

3. A hang-off system as claimed in claim 2, wherein the hang-off structure (8, 9) is at least partly integrated with the mooring chaintable (9), the hang-off structure (8, 9) preferably comprises a first part and a second part, the first part being at least partly provided by the mooring chaintable (9), the second part being an extension of the first part and/or a part connected to the first part in a stiff connection, preferably the second part extends in a direction away from the hang-off vertical plane, preferably the at least one hang-off connecting point (7) is arranged in the second part of the hang-off structure (8, 9), more preferably the at least one hang-off connecting point has a hang-off distance to the hang-off vertical plane, the hang-off distance is at least about 1 m.
4. A hang-off system as claimed in any one of claims 1 to 3, wherein the hang-off structure (8, 9) has a larger opposite part than the flexible transporting unit heading part, preferably the flexible transporting unit heading part has a heading part length from the hang-off vertical plane and the opposite part has an opposite part length from the hang-off vertical plane, the opposite part length is substantially longer than the heading part length, more preferably the opposite part length is at least about 10 % longer, such as at least about 20 % longer, such as at least about 30 % longer, such as at least about 50 % longer, such as at least about 75 % longer, such as at least about 100 % longer, such as at least about 125 % longer, such as at least about 150 % longer, such as at least about 200 % longer, such as up to about least about 1000 % longer than the heading part length.
5. A hang-off system as claimed in any one of claims 1 to 4, wherein the subsea connection point (12) is connecting the flexible transporting unit (2) to a subsea structure (1) or directly to the seabed, preferably the subsea connection point (13) is a connection to a subsea structure in the form of a fixed structure (1).
6. A hang-off system as claimed in any one of claims 1 to 5, wherein the hang-off system comprises a moored buoy, the weathervaning vessel (3) is arranged to weathervane around the moored buoy.

7. A hang-off system as claimed in any one of claims 1 to 6, wherein the hang-off system comprises a plurality of flexible transporting units (2), each hanging-off from a hang-off connecting point (7) to a subsea connection point (12), providing a hang-off vertical plane extending through the centre axis (4) of the bearing and swivel system, the hang-off connecting point (7) is arranged in the opposite part of the hang-off structure (8, 9), and the hang-off vertical planes for the respective flexible transporting units (2) differ from each other. 5
8. A hang-off system as claimed in any one of claims 1 to 6, wherein the hang-off system comprises a plurality of flexible transporting units (2), each hanging-off from a hang-off connecting point (7) to a subsea connection point (12), providing a hang-off vertical plane extending through the centre axis (4) of the bearing and swivel system, the hang-off connecting point (7) is arranged in the opposite part of the hang-off structure (8, 9), and the hang-off vertical planes for at least 2 of the flexible transporting units are substantially identical, preferably the hang-off vertical planes for all of the flexible transporting units are substantially identical. 10 15 20 25
9. A hang-off system as claimed in claim 8, wherein at least two, preferably all of the hang-off connecting points (7) are arranged in the opposite part of the hang-off structure. 30
10. A hang-off system as claimed in any one of claims 1 to 9, wherein the turret system is an external turret system, the bearing and swivel system is positioned forward of the weathervaning vessel (3), the bearing and swivel system preferably being positioned substantially in a vertical plane of a straight forward sailing direction of the weathervaning vessel (3). 35
11. A hang-off system as claimed in any one of claims 1 to 9, wherein the weathervaning vessel (3) comprises a hull with a keel and the turret system is an external turret system, the bearing and swivel system positioned backward of the weathervaning vessel (3), the bearing and swivel system preferably being positioned substantially in a vertical plane comprising the keel. 40 45
12. A hang-off system as claimed in any one of claims 1 to 9, wherein the weathervaning vessel (3) comprises a hull, a bow and a stern, and a length of the hull determined as the maximal length in a plane perpendicular to the water line, the turret system is an internal turret system positioned at a distance from the stern of up to about 95 %, such as at a distance from the stern up to about 5 % of the hull length, such as from about 5 % to about 10 % of the hull length, such as from about 10 % to about 15 % of the hull length, such as from about 15 % to about 20 % of the hull length, such as from about 20 % to about 25 % of the hull length, such as from about 25 % to about 30 % of the hull length, such as from about 30 % to about 35 % of the hull length, such as from about 35 % to about 40 % of the hull length, such as from about 40 % to about 45 % of the hull length, such as from about 45 % to about 50 % of the hull length, such as from about 50 % to about 55 % of the hull length, such as from about 55 % to about 60 % of the hull length, such as from about 60 % to about 65 % of the hull length, such as from about 65 % to about 70 % of the hull length, such as from about 70 % to about 75 % of the hull length, such as from about 75 % to about 80 % of the hull length, such as from about 80 % to about 85 % of the hull length, such as from about 85 % to about 90 % of the hull length, such as from about 90 % to about 95 % of the hull length from the stern. 50 55
13. A hang-off system as claimed in any one of claims 1 to 12, wherein the hang-off system comprises at least 2 flexible transporting units (2), the hang-off connecting points (7) of the bearing and swivel system being arranged in a pattern such that the hang-off vertical planes for the flexible transporting units (2) are substantially identical, the hang-off connecting points (7) preferably being arranged in a side by side relation with a substantially equal distance to the substantially identical hang-off vertical planes, the substantially identical distance to the substantially identical hang-off vertical planes preferably being at least about 2 m, such as at least about 4 m, such as at least about 6 m, such as at least about 8 m, such as at least about 10 m, such as at least about 12 m, such as at least about 14 m, such as at least about 16 m, such as at least about 18 m, such as at least about 20 m, such as at least about 22 m, such as at least about 24 m, such as at least about 26 m, such as at least about 28 m, such as at least about 30 m.
14. A hang-off system as claimed in any one of the preceding claims, wherein the turret (11) comprising a hang-off and a bearing and swivel system connected to or integrated with the hang-off structure (8, 9), the bearing and swivel system comprises a centre axis (4), the hang-off structure (8, 9) has a hang-off body with a hang-off extent in a plane perpendicular to the centre axis (4), and an outer periphery of the hang-off body comprising an asymmetrical shape, preferably the hang-off body comprises a first and a second part, the periphery of the first part comprises a distance to the centre axis (4) which is substantially uniform and the periphery of the second part comprises one or more distances to the centre axis which are longer than the substantially uniform distance to the centre axis of the periphery of the first part.

15. A hang-off system as claimed in claim 14, wherein the hang-off structure comprises at least one the hang-off point (7) for hanging off a flexible transporting unit (2), the at least one hang-off point (7) is arranged in the second part of the hang-off body, preferably in a distance from the centre axis of at least about 2 m, such as at least about 4 m, such as at least about 6 m, such as at least about 8 m, such as at least about 10 m, such as at least about 12 m, such as at least about 14 m, such as at least about 16 m, such as at least about 18 m, such as at least about 20 m, such as at least about 22 m, such as at least about 24 m, such as at least about 26 m, such as at least about 28 m, such as at least about 30 m.

Patentansprüche

1. Hang-off-System, das ein schwimmendes, verankertes, sich in den Wind stellendes Schiff (3) aufweist, das einen Turm (11) mit einer Hang-off-Struktur (8, 9) und mindestens eine flexiblen Transporteinheit (2) aufweist, die von der Hang-off-Struktur (8, 9) herabhängt, wobei der Turm (11) ein mit der Hang-off-Struktur (8, 9) verbundenes oder in diese integriertes Lager- und Schwenksystem aufweist, wobei das Lager- und Schwenksystem eine Mittelachse (4) aufweist, die flexible Transporteinheit (2) von einem Hang-off-Verbindungspunkt (7) zu einem Unterwasser-Verbindungspunkt (12) herabhängt, wobei ein Vektor, der sich vom Unterwasser-Verbindungspunkt zum Hang-off-Verbindungspunkt (7) erstreckt, eine vertikale und eine horizontale Komponente hat, wobei die horizontale Komponente senkrecht zu einer durch die Mittelachse (4) des Lager- und Schwenksystems verlaufenden Hang-off-Vertikalebene steht, wobei die Hang-off-Vertikalebene die Hang-off-Struktur (8, 9) in einen flexiblen Transporteinheits-Kopfteil und einen gegenüberliegenden Teil trennt, wobei der flexible Transporteinheits-Kopfteil horizontal näher zum Unterwasser-Verbindungspunkt (12) als der gegenüberliegende Teil ist, wobei der Hang-Off-Verbindungspunkt in dem gegenüberliegenden Teil der Hang-off-Struktur angeordnet ist, wobei vorzugsweise das sich in den Wind stellende Schiff (3) einen Rumpf hat und ein äußeres Turmsystem aufweist, wobei die Hang-off-Struktur eine Topside-Hang-off-Struktur ist, die an einer Position außerhalb des Rumpfes des sich in den Wind stellenden Schiffs (3) befestigt ist.
2. Hang-Off-System nach Anspruch 1, wobei das sich in den Wind stellende Schiff (3) durch Leinen (6) am Meeresboden und/oder an einer oder mehreren festen Strukturen derart verankert ist, dass es sich ganz oder teilweise um die Mittelachse des Lager- und Schwenksystems drehen kann, wobei vorzugsweise das sich in den Wind stellende Schiff einen Veran-

kerungstisch (9) aufweist, wobei das sich in den Wind stellende Schiff (3) durch mit dem Verankerungstisch (9) verbundene Leinen (6) derart verankert ist, dass es sich ganz oder teilweise um die Mittelachse des Lager- und Schwenksystems drehen kann, wobei vorzugsweise der Verankerungstisch mit dem Lager- und Schwenksystem verbunden oder in dieses integriert ist, wobei besonders bevorzugt das Lager- und Schwenksystem, der Verankerungstisch (9) und die Hang-off-Struktur (8, 9) miteinander verbunden oder ineinander integriert sind.

3. Hang-Off-System nach Anspruch 2, wobei die Hang-off-Struktur (8, 9) mindestens teilweise in den Verankerungstisch (9) integriert ist, wobei die Hang-off-Struktur (8, 9) vorzugsweise einen ersten Teil und einen zweiten Teil aufweist, wobei der erste Teil mindestens teilweise durch den Verankerungstisch (9) bereitgestellt ist, wobei der zweite Teil eine Verlängerung des ersten Teils und/oder ein mit dem ersten Teil in einer steifen Verbindung verbundener Teil ist, wobei sich vorzugsweise der zweite Teil in einer Richtung von der Hang-off-Vertikalebene weg erstreckt, wobei vorzugsweise der mindestens eine Hang-off-Verbindungspunkt (7) im zweiten Teil der Hang-off-Struktur (8, 9) angeordnet ist, wobei besonders bevorzugt der mindestens eine Hang-off-Verbindungspunkt einen Hang-off-Abstand zur Hang-off-Vertikalebene hat, wobei der Hang-off-Abstand mindestens etwa 1 m beträgt.
4. Hang-Off-System nach einem der Ansprüche 1 bis 3, wobei die Hang-off-Struktur (8, 9) einen gegenüberliegenden Teil hat, der größer ist als der flexible Transporteinheits-Kopfteil, wobei vorzugsweise der flexible Transporteinheits-Kopfteil eine Kopfteil-Länge von der Hang-off-Vertikalebene aus hat, und der gegenüberliegende Teil eine gegenüberliegende Teil-Länge von der Hang-off-Vertikalebene aus hat, wobei die gegenüberliegende Teil-Länge wesentlich länger ist als die Kopfteil-Länge, wobei besonders bevorzugt die gegenüberliegende Teil-Länge etwa 10% länger, wie etwa mindestens etwa 20% länger, wie etwa mindestens etwa 30% länger, wie etwa mindestens etwa 50% länger, wie etwa mindestens etwa 75% länger, wie etwa mindestens etwa 100% länger, wie etwa mindestens etwa 125% länger, wie etwa mindestens etwa 150% länger, wie etwa mindestens etwa 200% länger, wie etwa bis zu mindestens etwa 1000% länger als die Kopfteil-Länge ist.
5. Hang-Off-System nach einem der Ansprüche 1 bis 4, wobei der Unterwasser-Verbindungspunkt (12) die flexible Transporteinheit (2) mit einer Unterwasserstruktur (1) oder direkt mit dem Meeresboden verbindet, wobei vorzugsweise der Unterwasser-Verbindungspunkt (13) eine Verbindung mit einer Unterwasserstruktur in Form einer befestigten Struktur

- (1) ist.
6. Hang-Off-System nach einem der Ansprüche 1 bis 5, wobei das Hang-Off-System eine verankerte Boje aufweist, wobei das sich in den Wind stellende Schiff (3) so angeordnet ist, dass es sich um die verankerte Boje herum in den Wind stellt.
 7. Hang-Off-System nach einem der Ansprüche 1 bis 6, wobei das Hang-Off-System eine Vielzahl von flexiblen Transporteinheiten (2) aufweist, die jeweils von einem Hang-Off-Verbindungspunkt (7) zu einem Unterwasser-Verbindungspunkt (12) herabhängen, was eine Hang-off-Vertikalebene bereitstellt, die sich durch die Mittelachse (4) des Lager- und Schwenksystems erstreckt, wobei der Hang-Off-Verbindungspunkt (7) im gegenüberliegenden Teil der Hang-off-Struktur (8, 9) angeordnet ist, und wobei sich die Hang-off-Vertikalebenen für die jeweiligen flexiblen Transporteinheiten (2) voneinander unterscheiden.
 8. Hang-Off-System nach einem der Ansprüche 1 bis 6, wobei das Hang-Off-System eine Vielzahl von flexiblen Transporteinheiten (2) aufweist, die jeweils von einem Hang-Off-Verbindungspunkt (7) zu einem Unterwasser-Verbindungspunkt (12) herabhängen, was eine Hang-off-Vertikalebene bereitstellt, die sich durch die Mittelachse (4) des Lager- und Schwenksystems erstreckt, wobei der Hang-Off-Verbindungspunkt (7) in dem gegenüberliegenden Teil der Hang-off-Struktur (8, 9) angeordnet ist, und die Hang-off-Vertikalebenen für mindestens zwei der flexiblen Transporteinheiten im Wesentlichen identisch sind, wobei vorzugsweise die Hang-off-Vertikalebenen für alle flexiblen Transporteinheiten im Wesentlichen identisch sind.
 9. Hang-Off-System nach Anspruch 8, wobei mindestens zwei, vorzugsweise alle Hang-Off-Verbindungspunkte (7) im gegenüberliegenden Teil der Hang-off-Struktur angeordnet sind.
 10. Hang-Off-System nach einem der Ansprüche 1 bis 9, wobei das Turmsystem ein äußeres Turmsystem ist, wobei das Lager- und Schwenksystem vor dem sich in den Wind stellenden Schiff (3) positioniert ist, wobei vorzugsweise das Lager- und Schwenksystem im Wesentlichen in einer vertikalen Ebene einer geraden Vorwärtsfahrtrichtung des sich in den Wind stellenden Schiffs (3) positioniert ist.
 11. Hang-Off-System nach einem der Ansprüche 1 bis 9, wobei das sich in den Wind stellende Schiff (3) einen Rumpf mit einem Kiel aufweist und das Turmsystem ein äußeres Turmsystem ist, wobei das Lager- und Schwenksystem hinter dem sich in den Wind stellenden Schiff (3) positioniert ist, wobei das

Lager- und Schwenksystem vorzugsweise im Wesentlichen in einer vertikalen Ebene angeordnet ist, die den Kiel aufweist.

12. Hang-Off-System nach einem der Ansprüche 1 bis 9, wobei das sich in den Wind stellende Schiff (3) einen Rumpf, einen Bug und ein Heck und eine Länge des Rumpfes aufweist, die als die maximale Länge in einer Ebene senkrecht zur Wasserlinie bestimmt ist, wobei das Turmsystem ein inneres Turmsystem ist, das in einem Abstand vom Heck von bis zu etwa 95% positioniert ist, wie etwa in einem Abstand vom Heck bis etwa 5% der Rumpflänge, wie etwa von etwa 5% bis etwa 10% der Rumpflänge, wie etwa von etwa 10% bis etwa 15% der Rumpflänge, wie etwa von etwa 15% bis etwa 20% der Rumpflänge, wie etwa von etwa 20% bis etwa 25% der Rumpflänge, wie etwa von etwa 25% bis etwa 30% der Rumpflänge, wie etwa von etwa 30% bis etwa 35% der Rumpflänge, wie etwa von etwa 35% bis etwa 40% der Rumpflänge, wie etwa von etwa 40% bis etwa 45% der Rumpflänge, wie etwa von etwa 45% bis etwa 50% der Rumpflänge, wie etwa von etwa 50% bis etwa 55% der Rumpflänge, wie etwa von etwa 55% bis etwa 60% der Rumpflänge, wie etwa von etwa 60% bis etwa 65% der Rumpflänge, wie etwa von etwa 65% bis etwa 70% der Rumpflänge, wie etwa von etwa 70% bis etwa 75% der Rumpflänge, wie etwa von etwa 75% bis etwa 80% der Rumpflänge, wie etwa von etwa 80% bis etwa 85% der Rumpflänge, wie etwa von etwa 85% bis etwa 90% der Rumpflänge, wie etwa von etwa 90% bis etwa 95% der Rumpflänge vom Heck.
13. Hang-Off-System nach einem der Ansprüche 1 bis 12, wobei das Hang-off-System mindestens 2 flexible Transporteinheiten (2) aufweist, wobei die Hang-Off-Verbindungspunkte (7) des Lager- und Schwenksystems derart in einem Muster angeordnet sind, dass die Hang-off-Vertikalebenen für die flexiblen Transporteinheiten (2) im Wesentlichen identisch sind, wobei die Hang-Off-Verbindungspunkte (7) vorzugsweise in einer Seite-an-Seite-Beziehung mit einem im Wesentlichen gleichen Abstand zu den im Wesentlichen identischen Hang-off-Vertikalebenen angeordnet sind, wobei der im Wesentlichen identische Abstand zu den im Wesentlichen identischen Hang-off-Vertikalebenen vorzugsweise mindestens etwa 2 m beträgt, wie etwa mindestens etwa 4 m, wie etwa mindestens etwa 6 m, wie etwa mindestens etwa 8 m, wie etwa mindestens etwa 10 m, wie etwa mindestens etwa 12 m, wie etwa mindestens etwa 14 m, wie etwa mindestens etwa 16 m, wie etwa mindestens etwa 18 m, wie etwa mindestens etwa 20 m, wie etwa mindestens etwa 22 m, wie etwa mindestens etwa 24 m, wie etwa mindestens etwa 26 m, wie etwa mindestens etwa 28 m, wie etwa mindestens etwa 30 m.

14. Hang-Off-System nach einem der vorhergehenden Ansprüche, wobei der Turm (11) eine Hang-off-Struktur und ein Lager- und Schwenksystem aufweist, das mit der Hang-off-Struktur (8, 9) verbunden oder in diese integriert ist, wobei das Lager- und Schwenksystem eine Mittelachse (4) aufweist, wobei die Hang-off-Struktur (8, 9) einen Hang-off-Körper mit einer Hang-off-Ausdehnung in einer Ebene senkrecht zur Mittelachse (4) aufweist, und wobei ein äußerer Umfang des Hang-off-Körpers eine asymmetrische Form aufweist, wobei vorzugsweise der Hang-off-Körper einen ersten und einen zweiten Teil aufweist, wobei der Umfang des ersten Teils einen Abstand zur Mittelachse (4) aufweist, der im Wesentlichen gleichmäßig ist, und der Umfang des zweiten Teils einen oder mehrere Abstände zur Mittelachse aufweist, die länger sind als der im Wesentlichen einheitliche Abstand zur Mittelachse des Umfangs des ersten Teils.

15. Hang-Off-System nach Anspruch 14, wobei die Hang-off-Struktur mindestens einen Hang-Off-Verbindungspunkt (7) zum Abhängen einer flexiblen Transporteinheit (2) aufweist, wobei der mindestens eine Hang-Off-Verbindungspunkt (7) im zweiten Teil des Hang-off-Körpers angeordnet ist, vorzugsweise in einem Abstand zur Mittelachse von mindestens etwa 2 m, wie etwa mindestens etwa 4 m, wie etwa mindestens etwa 6 m, wie etwa mindestens etwa 8 m, wie etwa mindestens etwa 10 m, wie etwa mindestens etwa 12 m, wie etwa mindestens etwa 14 m, wie etwa mindestens etwa 16 m, wie etwa mindestens etwa 18 m, wie etwa mindestens etwa 20 m, wie etwa mindestens etwa 22 m, wie etwa mindestens etwa 24 m, wie etwa mindestens etwa 26 m, wie etwa mindestens etwa 28 m, wie etwa mindestens etwa 30 m.

Revendications

1. Système de mise en pendant comprenant un navire flottant amarré réalisant un changement de cap ou évitage par pivotement en fonction des conditions météorologiques (3) qui comprend une tourelle (11) qui est munie d'une structure de mise en pendant (8, 9) et au moins une unité de transport flexible (2) qui est suspendue à la structure de mise en pendant (8, 9), dans lequel la tourelle (11) comprend un système de palier et de tourillon qui est connecté ou intégré à la structure de mise en pendant (8, 9), le système de palier et de tourillon comprend un axe central (4), l'unité de transport flexible (2) est mise en pendant depuis un point de connexion de mise en pendant (7) jusqu'à un point de connexion sous-marin (12), un vecteur qui s'étend depuis le point de connexion sous-marin jusqu'au point de connexion de mise en pendant (7) comporte une composante

verticale et une composante horizontale, la composante horizontale est perpendiculaire à un plan vertical de mise en pendant qui s'étend au travers de l'axe central (4) du système de palier et de tourillon, le plan vertical de mise en pendant sépare la structure de mise en pendant (8, 9) selon une partie de tête d'unité de transport flexible et une partie opposée, la partie de tête d'unité de transport flexible est horizontalement plus proche du point de connexion sous-marin (12) que ne l'est la partie opposée, le point de connexion de mise en pendant est agencé dans la partie opposée de la structure de mise en pendant, de préférence le navire réalisant un évitage (3) comporte une coque et comprend un système de tourelle externe, dans lequel la structure de mise en pendant est une structure de mise en pendant de côté supérieur qui est fixée au niveau d'une position au-dessus de la coque du navire réalisant un évitage (3).

2. Système de mise en pendant tel que revendiqué selon la revendication 1, dans lequel le navire réalisant un évitage (3) est amarré au moyen de lignes (6) au niveau du fond de la mer et/ou à une ou plusieurs structure(s) fixe(s) de telle sorte qu'il puisse réaliser une rotation complète ou partielle autour de l'axe central du système de palier et de tourillon, de préférence le navire réalisant un évitage comprend une plaque à chaîne d'amarrage (9), le navire réalisant un évitage (3) est amarré au moyen de lignes (6) qui sont connectées à la plaque à chaîne d'amarrage (9) de telle sorte qu'il puisse réaliser une rotation complète ou partielle autour de l'axe central du système de palier et de tourillon, la plaque à chaîne d'amarrage est de préférence connectée ou intégrée au système de palier et de tourillon, de façon davantage préférable, le système de palier et de tourillon, la plaque à chaîne d'amarrage (9) et la structure de mise en pendant (8, 9), sont connectés ou intégrés les uns aux autres.

3. Système de mise en pendant tel que revendiqué selon la revendication 2, dans lequel la structure de mise en pendant (8, 9) est au moins partiellement intégrée à la plaque à chaîne d'amarrage (9), la structure de mise en pendant (8, 9) comprend de préférence une première partie et une seconde partie, la première partie étant au moins partiellement constituée par la plaque à chaîne d'amarrage (9), la seconde partie étant une extension de la première partie et/ou une partie qui est connectée à la première partie selon une connexion rigide, de préférence la seconde partie s'étend dans une direction d'éloignement par rapport au plan vertical de mise en pendant, de préférence l'au moins un point de connexion de mise en pendant (7) est agencé dans la seconde partie de la structure de mise en pendant (8, 9), de façon davantage préférable, l'au moins un

point de connexion de mise en pendant présente une distance de mise en pendant par rapport au plan vertical de mise en pendant, la distance de mise en pendant est d'au moins environ 1 m.

4. Système de mise en pendant tel que revendiqué selon l'une quelconque des revendications 1 à 3, dans lequel la structure de mise en pendant (8, 9) comporte une partie opposée plus grande que la partie de tête d'unité de transport flexible, de préférence la partie de tête d'unité de transport flexible présente une longueur de partie de tête depuis le plan vertical de mise en pendant et la partie opposée présente une longueur de partie opposée depuis le plan vertical de mise en pendant, la longueur de partie opposée est sensiblement plus longue que la longueur de partie de tête, de façon davantage préférable, la longueur de partie opposée est plus longue d'au moins environ 10 %, tel que plus longue d'au moins environ 20 %, tel que plus longue d'au moins environ 30 %, tel que plus longue d'au moins environ 50 %, tel que plus longue d'au moins environ 75 %, tel que plus longue d'au moins environ 100 %, tel que plus longue d'au moins environ 125 %, tel que plus longue d'au moins environ 150 %, tel que plus longue d'au moins environ 200 %, tel que plus longue jusqu'à au moins environ 1000 % que la longueur de partie de tête.
5. Système de mise en pendant tel que revendiqué selon l'une quelconque des revendications 1 à 4, dans lequel le point de connexion sous-marin (12) connecte l'unité de transport flexible (2) à une structure sous-marine (1) ou directement au niveau du fond de la mer, de préférence le point de connexion sous-marin (13) est une connexion sur une structure sous-marine sous la forme d'une structure fixe (1).
6. Système de mise en pendant tel que revendiqué selon l'une quelconque des revendications 1 à 5, dans lequel le système de mise en pendant comprend une bouée amarrée, le navire réalisant un évitage (3) est agencé de manière à ce qu'il réalise un évitage par pivotement autour de la bouée amarrée.
7. Système de mise en pendant tel que revendiqué selon l'une quelconque des revendications 1 à 6, dans lequel le système de mise en pendant comprend une pluralité d'unités de transport flexibles (2), chacune étant mise en pendant depuis un point de connexion de mise en pendant (7) jusqu'à un point de connexion sous-marin (12), d'où la constitution d'un plan vertical de mise en pendant qui s'étend au travers de l'axe central (4) du système de palier et de tourillon, le point de connexion de mise en pendant (7) est agencé dans la partie opposée de la structure de mise en pendant (8, 9), et les plans verticaux de mise en pendant pour les unités de transport flexibles res-

pectives (2) diffèrent les uns des autres.

8. Système de mise en pendant tel que revendiqué selon l'une quelconque des revendications 1 à 6, dans lequel le système de mise en pendant comprend une pluralité d'unités de transport flexibles (2), chacune étant mise en pendant depuis un point de connexion de mise en pendant (7) jusqu'à un point de connexion sous-marin (12), d'où la constitution d'un plan vertical de mise en pendant qui s'étend au travers de l'axe central (4) du système de palier et de tourillon, le point de connexion de mise en pendant (7) est agencé dans la partie opposée de la structure de mise en pendant (8, 9), et les plans verticaux de mise en pendant pour au moins deux des unités de transport flexibles sont sensiblement identiques, de préférence les plans verticaux de mise en pendant pour toutes les unités de transport flexibles sont sensiblement identiques.
9. Système de mise en pendant tel que revendiqué selon la revendication 8, dans lequel au moins deux, de préférence tous les points de connexion de mise en pendant (7), sont agencés dans la partie opposée de la structure de mise en pendant.
10. Système de mise en pendant tel que revendiqué selon l'une quelconque des revendications 1 à 9, dans lequel le système de tourelle est un système de tourelle externe, le système de palier et de tourillon est positionné à l'avant du navire réalisant un évitage (3), le système de palier et de tourillon étant de préférence positionné sensiblement dans un plan vertical d'un sens de navigation droit devant du navire réalisant un évitage (3).
11. Système de mise en pendant tel que revendiqué selon l'une quelconque des revendications 1 à 9, dans lequel le navire réalisant un évitage (3) comprend une coque qui est munie d'une quille et le système de tourelle est un système de tourelle externe, le système de palier et de tourillon étant positionné à l'arrière du navire réalisant un évitage (3), le système de palier et de tourillon étant de préférence positionné sensiblement dans un plan vertical qui comprend la quille.
12. Système de mise en pendant tel que revendiqué selon l'une quelconque des revendications 1 à 9, dans lequel le navire réalisant un évitage (3) comprend une coque, une proue et une poupe, et une longueur de la coque est déterminée en tant que longueur maximale dans un plan qui est perpendiculaire à la ligne d'eau, le système de tourelle est un système de tourelle interne qui est positionné à une distance de la poupe qui va jusqu'à environ 95 %, tel qu'à une distance de la poupe qui va jusqu'à environ 5 % de la longueur de la coque, tel que d'environ 5 % à en-

viron 10 % de la longueur de la coque, tel que d'environ 10 % à environ 15 % de la longueur de la coque, tel que d'environ 15 % à environ 20 % de la longueur de la coque, tel que d'environ 20 % à environ 25 % de la longueur de la coque, tel que d'environ 25 % à environ 30 % de la longueur de la coque, tel que d'environ 30 % à environ 35 % de la longueur de la coque, tel que d'environ 35 % à environ 40 % de la longueur de la coque, tel que d'environ 40 % à environ 45 % de la longueur de la coque, tel que d'environ 45 % à environ 50 % de la longueur de la coque, tel que d'environ 50 % à environ 55 % de la longueur de la coque, tel que d'environ 55 % à environ 60 % de la longueur de la coque, tel que d'environ 60 % à environ 65 % de la longueur de la coque, tel que d'environ 65 % à environ 70 % de la longueur de la coque, tel que d'environ 70 % à environ 75 % de la longueur de la coque, tel que d'environ 75 % à environ 80 % de la longueur de la coque, tel que d'environ 80 % à environ 85 % de la longueur de la coque, tel que d'environ 85 % à environ 90 % de la longueur de la coque, tel que d'environ 90 % à environ 95 % de la longueur de la coque, par rapport à la poupe.

13. Système de mise en pendant tel que revendiqué selon l'une quelconque des revendications 1 à 12, dans lequel le système de mise en pendant comprend au moins deux unités de transport flexibles (2), les points de connexion de mise en pendant (7) du système de palier et de tourillon étant agencés selon un motif qui est tel que les plans verticaux de mise en pendant pour les unités de transport flexibles (2) sont sensiblement identiques, les points de connexion de mise en pendant (7) étant de préférence agencés selon une relation de côte à côte selon une distance sensiblement égale par rapport aux plans verticaux de mise en pendant sensiblement identiques, la distance sensiblement identique par rapport aux plans verticaux de mise en pendant sensiblement identiques étant de préférence d'au moins environ 2 m, tel que d'au moins environ 4 m, tel que d'au moins environ 6 m, tel que d'au moins environ 8 m, tel que d'au moins environ 10 m, tel que d'au moins environ 12 m, tel que d'au moins environ 14 m, tel que d'au moins environ 16 m, tel que d'au moins environ 18 m, tel que d'au moins environ 20 m, tel que d'au moins environ 22 m, tel que d'au moins environ 24 m, tel que d'au moins environ 26 m, tel que d'au moins environ 28 m, tel que d'au moins environ 30 m.

14. Système de mise en pendant tel que revendiqué selon l'une quelconque des revendications qui précèdent, dans lequel la tourelle (11) comprend un moyen de mise en pendant et un système de palier et de tourillon qui est connecté ou intégré à la structure de mise en pendant (8, 9), le système de palier et de tourillon comprend un axe central (4), la structure de mise en pendant (8, 9) comporte un corps

de mise en pendant qui est muni d'une extension de mise en pendant dans un plan qui est perpendiculaire à l'axe central (4), et une périphérie externe du corps de mise en pendant présentant une forme asymétrique, de préférence le corps de mise en pendant comprend une première partie et une seconde partie, la périphérie de la première partie comprend une distance par rapport à l'axe central (4) qui est sensiblement uniforme et la périphérie de la seconde partie comprend une ou plusieurs distance(s) par rapport à l'axe central qui est/sont plus longue(s) que la distance sensiblement uniforme par rapport à l'axe central de la périphérie de la première partie.

15. Système de mise en pendant tel que revendiqué selon la revendication 14, dans lequel la structure de mise en pendant comprend au moins un point de mise en pendant (7) pour mettre en pendant une unité de transport flexible (2), l'au moins un point de mise en pendant (7) est agencé dans la seconde partie du corps de mise en pendant, de préférence à une distance de l'axe central d'au moins environ 2 m, tel que d'au moins environ 4 m, tel que d'au moins environ 6 m, tel que d'au moins environ 8 m, tel que d'au moins environ 10 m, tel que d'au moins environ 12 m, tel que d'au moins environ 14 m, tel que d'au moins environ 16 m, tel que d'au moins environ 18 m, tel que d'au moins environ 20 m, tel que d'au moins environ 22 m, tel que d'au moins environ 24 m, tel que d'au moins environ 26 m, tel que d'au moins environ 28 m, tel que d'au moins environ 30 m.

FIG.1

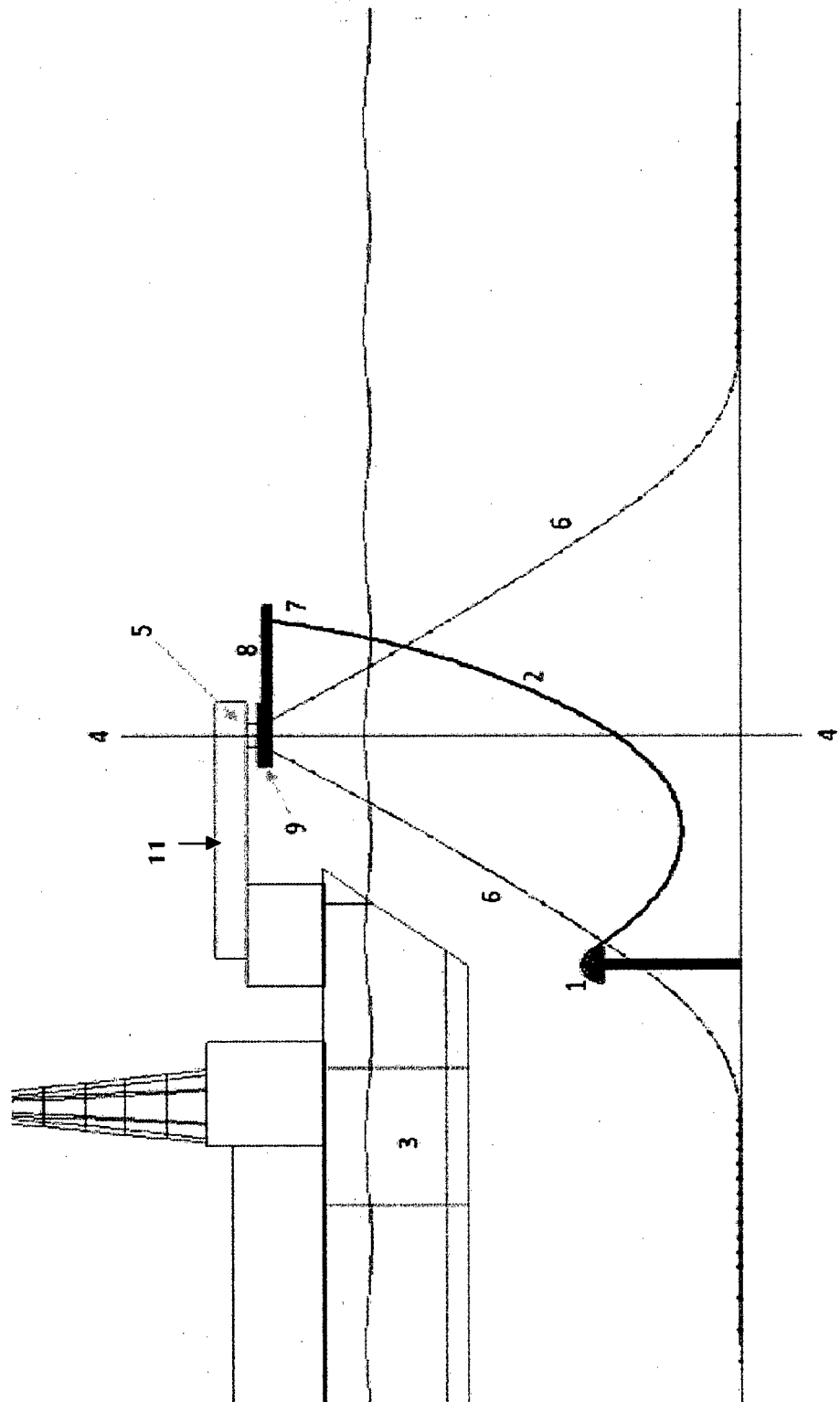


FIG.2

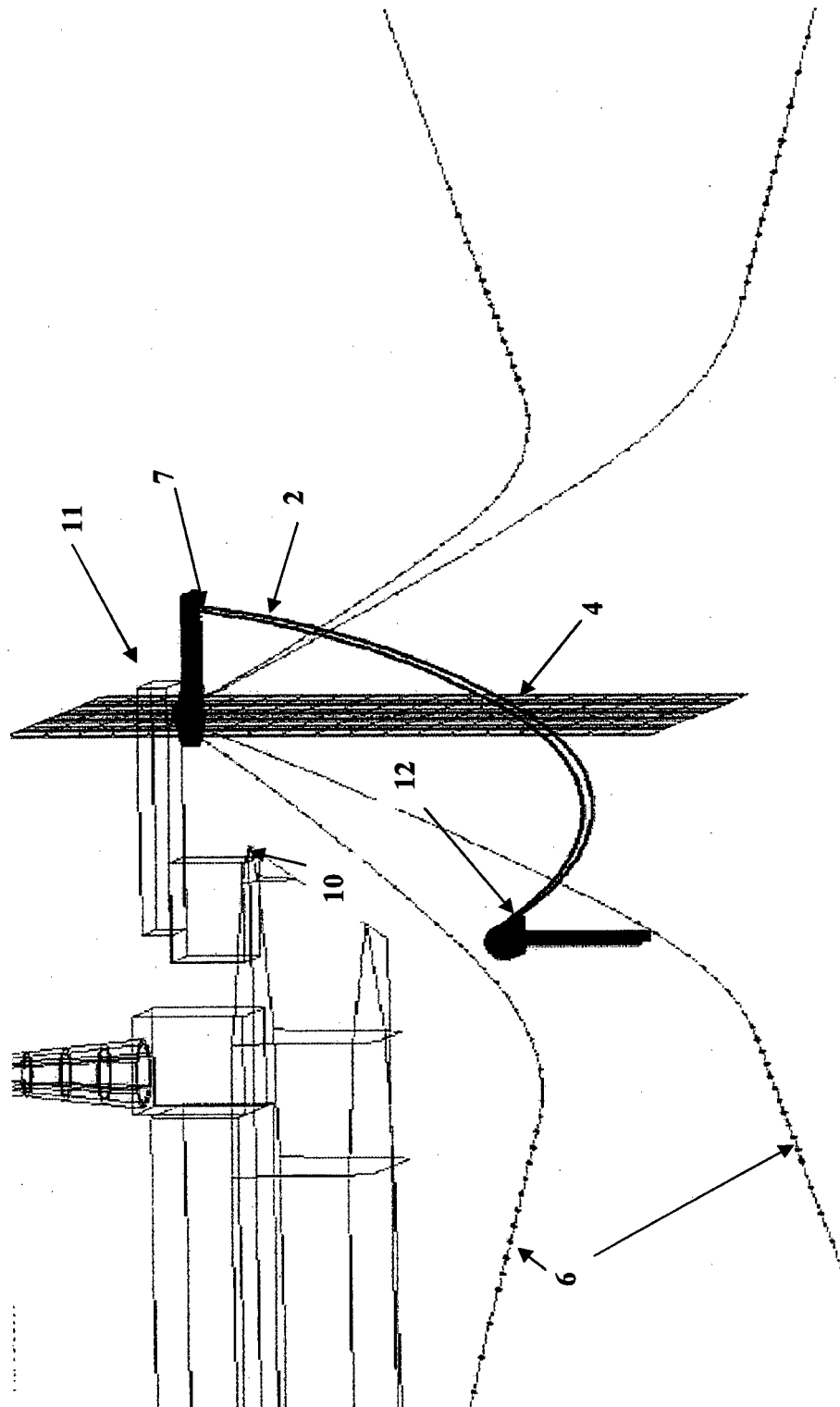


FIG.3

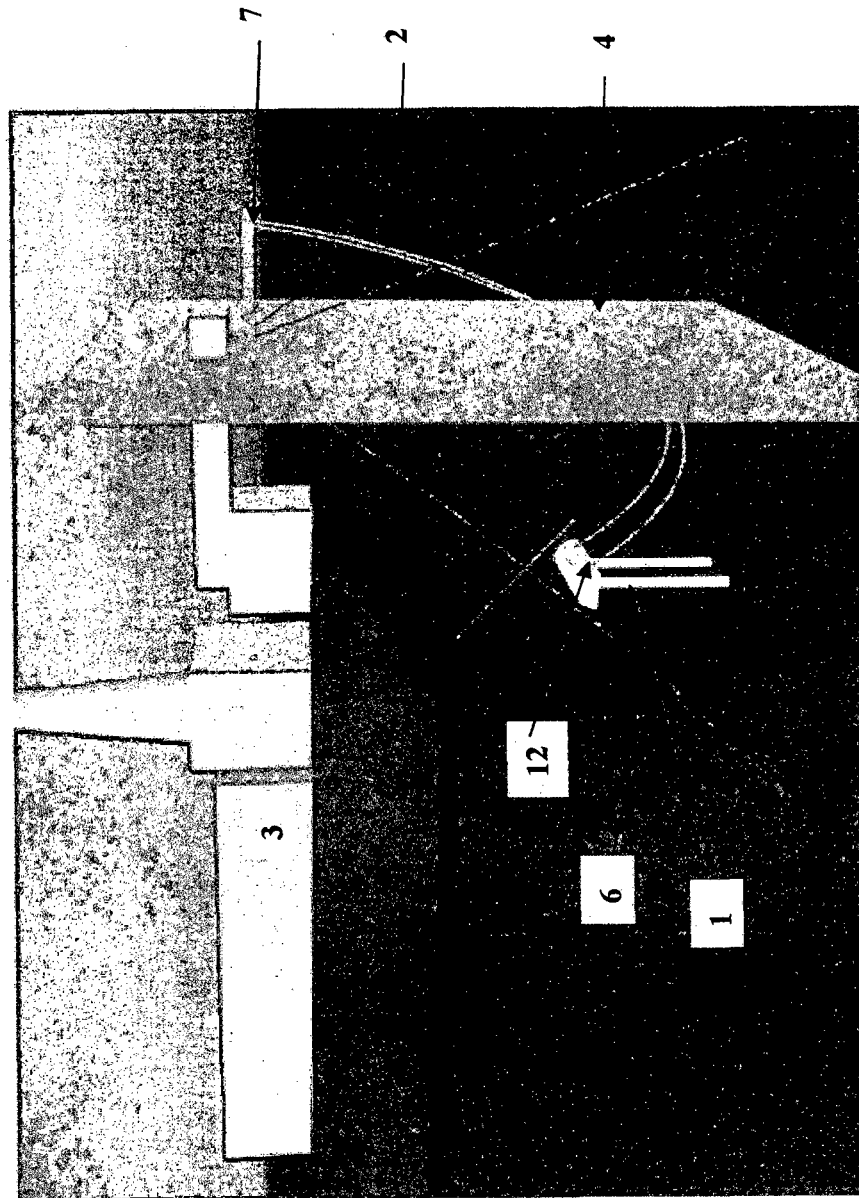
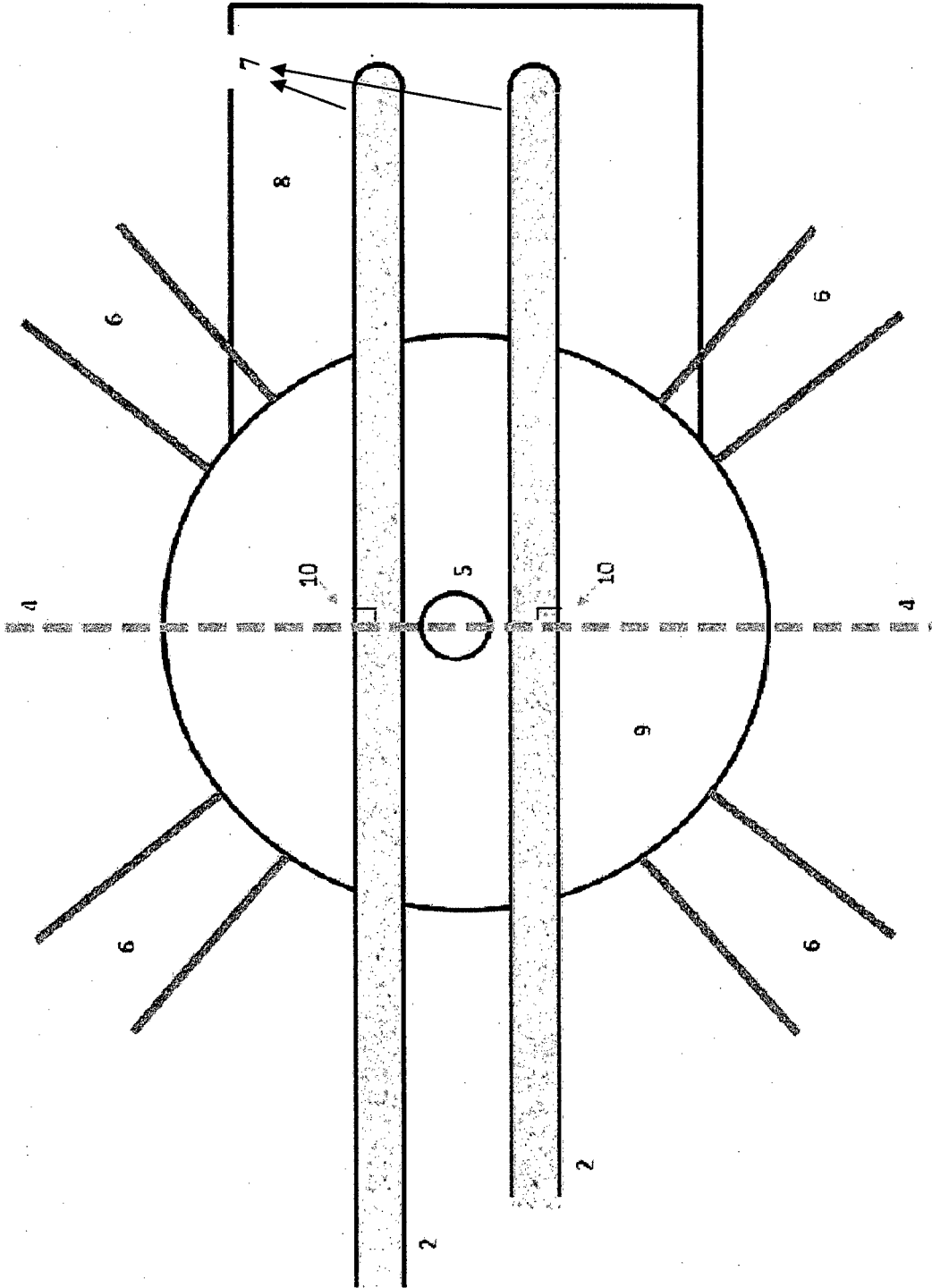


FIG.4



REFERENCES CITED IN THE DESCRIPTION

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