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(71) Applicant: ITREC B.V. [NL/NL]; 2, Admiraal Trompstraat, 3115 HH SCHIEDAM (NL).

(72) Inventors: DONKERS, Jeroen Adrianus Joseph; c/o 2, Admiraal Trompstraat, 3115 HH SCHIEDAM (NL).
VEHMEIJER, Terence Willem August; c/o 2, Admi-

raal Trompstraat, 3115 HH SCHIEDAM (NL). **ROOD-ENBURG, Joop**; c/o 2, Admiraal Trompstraat, 3115 HH SCHIEDAM (NL).

(74) Agent: **HOLLANDER, M.W.**; EP&C P.O. Box 3241, 2280 GE Rijswijk (NL).

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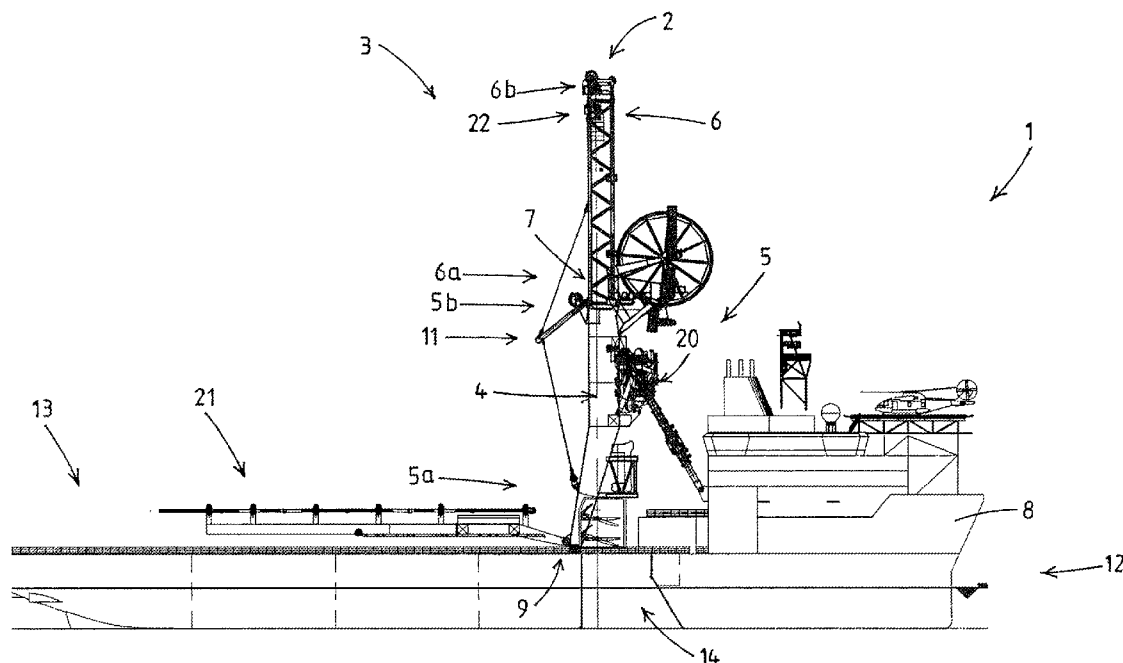


Fig.1

(57) Abstract: The invention relates to a pipe laying vessel for laying an offshore pipeline on the seafloor by way of a J-lay method and a reel lay method. The vessel is provided with a pipeline launch tower, the pipeline launch tower comprising a base tower section and a top tower section, which are connected to each other via a hinge mechanism, such that the top towers section can be pivoted relative to the base tower section between a J-lay position, in which the top tower section is in line with the base tower section and both the top tower section and the base tower section extend along the firing line, and a reel lay position, in which the top tower section is in a folded position relative to the base tower section and only the base tower section extends along the firing line.





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A pipe-laying vessel

5 FIELD AND BACKGROUND OF THE INVENTION

This invention relates to a pipe-laying vessel and a method for laying an offshore pipeline on the seafloor.

10 Such a vessel and such a method are known from WO2007108673. The known pipe-laying vessel is provided with a marine pipeline installation system for laying an offshore pipeline on the seafloor by way of the reel lay method and by way of the J-lay method. The pipe-laying vessel comprises a pipeline launch tower provided with reel lay pipeline guide that can be moved between a pipe laying position and a retracted, non-operable position wherein
15 the entire pipeline guide is positioned away from the firing line and at a side of the pipeline launch tower opposite a side of the pipeline launch tower with the firing line. When the pipeline guide is removed from the firing line, the firing line is cleared to allow for J-lay pipe laying. When laying an offshore pipeline with the J-lay method, there is no need for a pipeline guide as used in reel pipe laying.

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Even though the prior art allows for a reel lay tower to be used for J-lay pipe laying as well, in the J-lay configuration the pipe laying capacity is limited. It is therefore an object of the invention to provide an improved marine pipeline laying vessel, more in particular to provide a pipe laying vessel with an improved pipeline installation system and an associated
25 method.

In order to meet the abovementioned object, the invention provides a pipe-laying vessel for laying an offshore pipeline on the seafloor by way of a J-lay method and a reel lay method according to claim 1.

30

According to the claimed invention, the pipe-laying vessel is provided with a marine pipeline installation system, the marine pipeline installation system comprising:

a pipeline launch tower, defining a firing line and adapted to launch pipeline along
35 the firing line into the sea by way of the J-lay method in a J-lay configuration and by way of the reel lay method in a reel lay configuration and, wherein the pipeline launch tower comprises:

a base tower section that extends between a base end and a hinge end, and that is at the base end connected to the hull of the vessel via a pivot axis,

a top tower section that extends between a hinge end and a top end, and

5

a hinge mechanism, that connects the hinge end of the base tower section with the hinge end of the top tower section, and that comprises a top tower section pivot axis such that the top tower section can be pivoted relative to the base tower section between;

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a J-lay position, in which the top tower section is in line with the base tower section and both the top tower section and the base tower section extend along the firing line, and

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a reel lay position, in which the top tower section is in a folded position relative to the base tower section and only the base tower section extends along the firing line,

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a top tower section pivot device, for switching between the J-lay configuration and the reel lay configuration by pivoting the top tower section of the pipeline launch tower into the J-lay position and the reel lay position respectively;

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a pipeline launch tower inclination adjuster, for supporting the base tower section in various pipe laying positions, including an upright, preferably vertical, pipe laying position; and

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a reel lay pipeline guide for guiding pipeline, provided from a reel or carousel, into the firing line,

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a reel lay tensioner, adapted to be moveable and/or removable supported in a reel lay tensioner position by the tower, the reel lay tensioner comprising multiple tracks adapted for engaging the pipeline in the firing line and for supporting at least part of the weight of the launched pipeline,

a J-lay pipe loader, comprising a boom structure that can be pivoted between a horizontal loading position and a raised unload position, for transporting a pipe section, preferably for transporting a stand comprising multiple pipe sections, into the firing line;

5 a J-lay travelling head clamp, moveably supported by the tower for movement along the firing line, for supporting pipeline at a top end of the firing line and for lowering pipeline along the firing line, wherein, when the tower is in the J-lay configuration, the travelling J-lay head clamp can travel along the firing line between a position above the tensioner position and a position below the tensioner position; and

10 a J-lay hang off clamp, for supporting the pipeline at a bottom end of the firing line.

Thus, the pipe-laying vessel has a pipeline launch tower comprising a base tower section and a top tower section, connected by way of a hinge mechanism.

15 In the J-lay configuration, the top tower section is in line with the base tower section and both the top tower section and the base tower section extend along the firing line.

In the reel lay configuration, the top tower section is in a folded position relative to the base tower section and only the base tower section extends along the firing line. Thus, the

20 pipeline launch tower allows for only using the base tower section of the pipeline launch tower during reel lay, and for both the base tower section and the top tower section during J-lay. In the J-lay configuration, the top tower section provides an extended firing line, compared to the firing line of prior art reel lay towers, and thus for an increased J-lay capacity compared to the prior art.

25 Furthermore, due to the top tower section and the base tower section being connected via a hinge mechanism, the top tower section can be pivoted towards the hull of the vessel during reel lay as well as between pipe laying activities. Thus, the improved J-lay capacity is achieved without substantially impairing the behaviour of the pipe laying vessel. By pivoting

30 the top tower section out of the J-lay position, the centre of gravity of the pipeline launch tower, and thus the centre of gravity of the pipe laying vessel, is lowered, thus providing the vessel with increased stability.

Thus, the invention not only provides an improved pipeline launch tower for both reel lay and

35 J-lay, but also allows for this tower to be used on small vessels. The prior art J-lay towers, due to their height, are typically used in combination with large vessel to provide enough

stability. Smaller vessels are cheaper to run. Combination of the tower with a comparatively small size vessel thus allows for a reduction in daily costs of operation.

In an embodiment, the pipe-laying vessel is a monohull vessel, wherein the monohull vessel is provided with a moonpool, and wherein preferably the pipeline launch tower is mounted
5 on the hull of the vessel such that it straddles the moonpool, and preferably such that side of the pipeline launch tower at which the J-lay pipe loader is, or is to be, mounted faces a stern of the vessel.

In an embodiment, the J-lay tower is a pivotably mounted on the pipe-laying vessel, such
10 that it can pivot about a substantially horizontal axis relative to the vertical between a pivoted forward position, i.e. towards the moonpool, and backward, i.e. away from the moonpool. In a further embodiment, the substantially horizontal pivot axis at the base of the pipeline launch tower extends in a direction perpendicular to a longitudinal axis of the pipe-laying vessel.

15 In an embodiment, the J-lay tower is a pivotably mounted onto the pipe-laying vessel such that it can pivot about a substantially horizontal axis relative to the vertical between a pivoted forward position, i.e. towards the moon pool, and pivoted rearward position, i.e. away from the moon pool, wherein in the pivoted forward position the J-lay tower is pivoted towards the
20 bow of the pipe laying vessel, and in the pivoted rearward position the J-lay tower is pivoted towards the stern of the pipe-laying vessel.

In an embodiment, the pipe-laying vessel comprises a main deck at the stern side of the moonpool and a superstructure, e.g. living quarters, bridge, etc., at the bow side of the
25 moonpool. In a further embodiment, the pipeline launch tower is located adjacent the moonpool, preferably straddles the moonpool, preferably such that the side of the pipeline launch tower at which the J-lay pipe loader is, or is to be, mounted faces the stern of the vessel, and thus faces a the main deck of the vessel. Thus the main deck can be used for supporting a reel from which pipeline is guided into the firing line of the pipeline launch
30 tower.

The pipeline launch tower is provided with a pipeline launch tower inclination adjuster, for adjusting the position of the pivotably supported pipeline launch tower and position the tower in various pipe laying positions, including an upright, preferably vertical, pipe laying position.
35 To enable the position to be adjusted during reel lay as well as during J-lay, the inclination adjuster is configured for supporting and adjusting the inclination of the base tower section.

In an embodiment, the pipeline launch tower inclination adjuster is configured to not only support the pipeline launch tower in various pipe-laying positions, but also support the base tower section in one or more top tower section folding positions, which folding positions allow gravity to act as a counter balance during the pivoting of the top tower section and/or enable the top tower section to be pivoted past obstacles, for example a superstructure mounted on the deck adjacent the pipeline launch tower.

In an embodiment, the pipeline launch tower is located adjacent a moonpool, preferably straddles the moonpool, the hinge mechanism is configured to pivot the top tower section away from a main deck located at the stern side of the moonpool, and the pipe line launch tower inclination adjuster is provided with an extended reach, to pivot the base tower section beyond a pipe laying position and into a top tower section folding position, to prevent movement of the top tower section to be blocked by an obstacle, e.g. a super structure such as a reel or crew living quarters, stored on the deck or mounted on the hull of the vessel respectively.

In an embodiment, the tower support structure is configured, e.g. comprises hydraulic cylinders, for pivoting the tower between the upright, preferably vertical, pipe laying position and a tilted folding position.

In an embodiment, the base tower section of the pipeline launch tower comprises an A-frame, preferably a box type A-frame, providing the tower with a rigid and hollow base tower section, comprising two legs that flank the firing line, i.e. are located on opposite sides of the firing line. And one or more cross sections connecting the legs. In an embodiment, the pipeline launch tower straddles a moonpool and the firing line is located between the two legs of the tower. Such a configuration is known in the prior art and allows for optimal support of items, e.g. pipeline, in the firing line.

In an embodiment, the length of the base tower section is such that, when the top tower section is in the reel lay configuration, the height of the folded pipeline tower allows for the vessel to pass below certain bridges, e.g. allows for the pie-laying vessel to negotiate the Panama Canal or pass below the Bosphorus bridge.

In a further embodiment, the tower furthermore has a travel configuration, in which the top tower section is folded adjacent the base tower section such that the tower sections have a minimum height above the deck of the vessel, and further components, e.g. a reel lay pipeline guide and/or components of the top tower section pivot device, are in a passive configuration to provide the vessel with a reduced travelling height. In an embodiment,

components are removed from the tower, for example the reel lay pipeline guide can be craned onto a deck of the vessel, when the tower is in the travel configuration. In an alternative embodiment, components are moveably supported by the pipeline launch tower, such that they can be moved between an active position and a travel position. For example, the reel lay pipeline guide can be pivotably supported by the pipeline launch tower, such that it can be lowered from a reel lay position into a travel position, or the top tower section pivot device comprises one or more lever arms that are pivotably supported by the pipeline launch tower such that they can be pivoted between an active position, for pivoting the top tower section, and a travel position, to provide the vessel with a minimum travel height.

To enable J-lay, the marine pipeline installation system comprises a J-lay pipe loader, a J-lay travelling head clamp and a J-lay hang off clamp. As such, these components are known from the prior art. These components are permanently or temporarily supported by the J-lay tower to handle pipeline during J-lay operations. The pipeline launch tower allows for them to be utilized as known in the prior art.

The J-lay pipe loader is at one end pivotably supported adjacent the base tower section, preferably is pivotably connected to the base tower section at the base end thereof, such that it can pivot from a substantially horizontal position into a substantially vertical position, to transfer pipe stands into the firing line.

In an embodiment, the pipe loader is releasably supported, such that it can be removed during the reel lay.

In an embodiment, the pipeline launch tower is provided with a plet loader, for transferring accessories into the firing line. In an embodiment, the pipe loader is configured to also function as a plet loader. For example, the pipe loader may comprise a second boom, configured for supporting an accessory and for pivoting that accessory into the firing line, which boom is pivotably connected to the base tower section of the pipeline launch tower, preferably shares its pivot axis with the pipe loader.

The J-lay travelling head clamp is supported by the pipeline launch tower such that it can be lifted and lowered along the firing line. The head clamp is configured to receive an end of the pipe stand brought into the firing line by the pipe loader, support the pipe stand in the firing line, and lower the pipe stand along the firing line.

The pipeline launch tower is provided with a track for guiding the travelling head clamp along the firing line, which track preferably extends along both the base tower section and the top tower section.

- 5 In an alternative embodiment, the pipeline launch tower is provided with two travelling head clamps, one that travels along the top tower section and one that travels along the bottom tower section.

10 In an embodiment, the tower top section is provided with a travelling head clamp parking position, in which parking position the head clamp can be secured such that it can be pivoted in combination with the tower top section between the J-lay position and the reel lay position. In addition, or as an alternative, the travelling head clamp, or part thereof, is configured to be lifted out of the tower, to thus be removed when the top tower section is to be pivoted into the reel lay position.

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The J-lay hang off clamp is configured to support the top end of launched pipeline at the lower end of the firing line. The J-lay hang off clamp is located at the lower region of the base tower section of the pipeline launch tower, preferably is supported by the base tower section at the base end thereof.

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In an embodiment, the J-lay hang off clamp is configured to be removed from the firing line during reel lay activities. In an embodiment, the hang off clamp is configured as a retractable hang off clamp, i.e. a clamp that can be moved into and out off the firing line. In addition, or as an alternative, the pipeline launch tower is provided with a hang off clamp support and
25 the hang off clamp can be connected with and disconnected from the hang off clamp support, for example can be lifted from the hang off clamp support using a crane.

To enable reel lay, the marine pipeline installation system comprises a reel lay pipeline guide, and at least one reel lay tensioner. In an embodiment, the system comprises a
30 straightener to enable rigid reel lay. As such, these components are known from the prior art. These components are permanently or temporarily supported by the J-lay tower to handle pipeline during reel lay operations. The pipeline launch tower allows for them to be utilized as known in the prior art.

35 The reel lay pipeline guide is configured for guiding pipeline, provided from a reel or a carousel, into the firing line. A reel lay pipe line guide typically has a circular, e.g. an aligner wheel, or semi circular guide surface, and with a pipeline launch tower according to the

invention is located at the top end of the base tower section, at least during reel lay activities.

5 The pipeline guide is adapted to - in a primary pipe laying position thereof relative to the tower - guide a pipeline from a storage reel or carousel over the pipeline guide into the firing line, wherein said pipeline contacts the pipeline guide surface at a first contact point outside of the firing line and departs said surface at a first departure point into the firing line.

10 In an embodiment, the reel lay pipe line guide is configured to be removed from the pipeline launch tower during J-lay activities. In an embodiment, the pipe line guide is configured as a retractable pipe line guide, i.e. a pipe line guide that can be moved into and out off position, for example can be pivoted away from the firing line to free up space to facilitate J-lay activities. In addition, or as an alternative, the pipeline launch tower is provided with a pipeline guide support at the top end of the base tower section, and the pipeline guide can
15 be connected with and disconnected from the support, for example can be lifted from the support using a crane.

In a further embodiment, the pipeline guide is moveably supported, preferably by the base tower section of the pipe line launch tower, such that it can be moved between a lifted
20 position, that allows it to be used for reel lay activities, and a lowered position, to reduce the height of the pipeline launch tower when in the reel lay configuration during travel, i.e. between pipe laying activities.

In an embodiment a pipeline guide displacement drive is provided which is adapted to
25 displace the pipeline guide with respect to the tower between a primary pipe laying position, to guide a pipeline from a first storage reel over the pipeline guide into the firing line, and a secondary pipe laying position, to guide a pipeline from a second storage reel over the pipeline guide into the firing line.

30 The reel lay tensioner is adapted to be moveable and/or removable supported in a reel lay tensioner position by the tower, preferably by the base section of the tower, the reel lay tensioner comprising multiple tracks adapted for engaging the pipeline in the firing line and for supporting at least part of the weight of the launched pipeline.

35 In an embodiment the reel lay tensioner is configured to be removed from the firing line during J-lay activities. In an embodiment, the reel lay tensioner is configured as a retractable tensioner, i.e. a tensioner that can be moved into and out off the firing line. In addition, or as

an alternative, the pipeline launch tower is provided with a reel lay tensioner support and the reel lay tensioner can be connected with and disconnected from the support, for example can be lifted from the support using a crane.

- 5 In an embodiment, the top tower section can be pivoted in the reel lay position, and can be pivoted beyond the reel lay position into a fully folded position, in which the top tower section is adjacent and substantially parallel to the base section of the tower. In such an embodiment, when in the reel lay position, the top tower section extends parallel to the deck surface. Thus, the pipeline launch tower can already be used for reel lay without the top
- 10 tower section being lowered adjacent the base tower section. This is particularly beneficial when the pipeline launch tower is mounted on the deck adjacent a superstructure, e.g. living quarters, bridge, etc., that would require a lengthy folding process to fold the top tower section in-between the base tower section and the superstructure. In such an embodiment, the top tower section, when in the reel lay position, extends over the superstructure.
- 15 In an embodiment, when the tower is in the reel lay configuration the top tower section is adjacent and substantially parallel to the base section of the tower. Such a position of the top tower section provides the pipeline launch tower with a compact configuration having a comparatively low centre of gravity.
- 20 In a further embodiment, the base section of the tower is provided with a securing device, preferably at the base end of the base tower section, configured to, when the tower is in the reel lay configuration, secure the top tower section in the reel lay position. In the embodiment, the securing device is coupled with the top tower section near or at the top end thereof.
- 25 In an embodiment, the base section of the tower is provided with a support, preferably at the base end of the base tower section, configured to, when the tower is in the reel lay configuration, support the top tower section. Thus, when the tower is in the reel lay configuration, which preferably is also configuration for travelling between pipe laying
- 30 operations, the weight of the tower is not supported, or not supported only, by the hinge mechanism. Thus, wear and/or deformation of the hinge mechanism is prevented and/or a less robust design of the hinge mechanism is possible, which may reduce weight and/or costs.
- 35 In an embodiment, the hinge mechanism is adapted to pivot the top tower section towards the side of the base tower section that faces away from the side of the pipeline launch tower at which the J-lay pipe loader is, or is to be, mounted. Thus, the side of the pipeline launch

tower at which the J-lay pipe loader feeds pipeline sections into the firing line, is kept free from the top tower section. Thus, that side of the pipeline launch tower also is free for mounting for example a reel lay pipeline guide and/or for feeding pipeline from a reel located on a deck of the vessel at the stern side of the vessel. Such a pivot direction thus facilitates reel lay pipe laying operations, more in particular provides space for mounting reel lay equipment onto the base tower section that faces a deck that is used for j-lay operations and thus can also be used for reel lay operations, and utilizing that equipment.

In an embodiment, the top tower section pivot device comprises:

a pivot winch and an associated pivot wire, wherein the pivot winch is located near the base end of the base tower section, and the pivot wire extends between the winch and a lift point, which lift point is fixed to the top tower section, away from the hinge end of the top tower section; and

a pivot wire spacer member, which spacer member is attached to the top tower section near the respective hinge end thereof, for supporting the pivot wire at a support point spaced in a radial direction relative to the top tower section pivot axis;

a pivot wire guide member, which guide member is attached to the base tower section, or to the top tower section, near the respective hinge end thereof, for guiding the pivot wire along the hinge end of the base tower section when the top tower section is in the reel lay position;

wherein the pivot winch allows to vary the length of the pivot wire and thus to pivot the top tower section relative to the base tower section.

Thus, the invention provides a compact and flexible system for pivoting the top tower section relative to the base tower section. In an alternative embodiment, cylinders or drives can be used, to pivot the top tower section.

In a further embodiment, the pivot wire spacer member is a lever arm, extending between a base end, pivotably attached to the base tower section or the top tower section near the respective hinge end thereof, and a support end for supporting the pivot wire, wherein the spacer member can be pivoted relative to the top tower section between an active position for pivoting the top tower section and an inactive position.

In an embodiment, for example when the bottom tower section and/or the top tower section are A-frames, i.e. frames comprising two legs, one on each side of the firing line, the hinge mechanism is doubled, i.e. is provided with double pivot winch, wire spacer member and pivot wire guide member, each being associated with one side, preferably with one leg, of the A-frame or A-frames.

In an embodiment, the hinge mechanism comprises an intermediate tower section, which separates the bottom tower section from the top tower section when the tower is in the J-lay position, and comprises a pivot axis at one end, connecting the base tower section with the intermediate tower section, and a pivot axis at an opposite end, connecting the top tower section with the intermediate tower section.

Such an embodiment allows for the hinge axis to be provided within the confines, i.e. within the perimeter or cross sectional circumference, of the tower, while still pivoting the top tower section in a compact reel lay position. In such an embodiment, the intermediate tower section is configured such that in the reel lay position, the base tower section and the top tower section extend parallel to each other, preferably are located adjacent to each other.

In an embodiment, the top tower section and the base tower section are of similar length, i.e. when in the reel lay position the top end of the top section is located adjacent the base end of the base section. Thus, the top end of the top tower section can be supported and/or secured at the base end of the base tower section.

The invention furthermore provides a marine pipeline installation system for providing a pipe-laying vessel according to the invention, and a pipeline launch tower for providing such a system.

The invention furthermore provides a method for folding a pipeline launch tower of a pipe-laying vessel, preferably of a pipe-laying vessel according to the invention, wherein the pipeline launch tower defines a firing line and is adapted to launch pipeline along the firing line into the sea by way of the J-lay method and by way of the reel lay method, the pipeline launch tower comprising

a base tower section that extends between a base end and a hinge end, and that is at the base end connected to a hull of a vessel via a pivot axis,

a top tower section that extends between a hinge end and a top end, and

a hinge mechanism, that connects the hinge end of the base tower section with the hinge end of the top tower section, and that comprises a top tower section pivot axis such that the top tower section can be pivoted relative to the base tower section between:

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a J-lay position, in which J-lay position the top tower section is in line with the base tower section and both the top tower section and the base tower section extend along the firing line, and

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a reel lay position, which reel lay position preferably is also a reel lay position that enables the pipeline launch tower to be utilized for reel lay activities, in which the top tower section is in a folded position relative to the base tower section, preferably is adjacent to the base tower section,

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a top tower section pivot device, for pivoting the top tower section relative to the base tower section between the J-lay position and the reel lay position, the method comprising the steps:

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support the base tower section of the pipeline launch tower, with the top tower section in the J-lay position, in a substantially upright pipe-laying position,

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prior to folding the top tower section out of the J-lay position, pivot the base tower section into an inclined top tower section folding position, and support the base tower section in that position, such that the top tower section is to be held in the extended position against the force of gravity, by the top tower section pivot device;

pivoting the top tower section relative to the bottom tower section in a downward direction using the top tower section pivot device;

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pivot the base tower section into an upright position, and, at the same time or subsequently, pivot the top tower section into the reel lay position, in which it is located adjacent to, and preferably is parallel to, the base tower section;

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optionally: supporting and/or securing the top end of the top tower section using a support and/or securing device mounted on the base tower section at a base end thereof.

The invention furthermore provides a pipe-laying vessel for laying an offshore pipeline on the seafloor by way of a J-lay method, wherein the vessel is provided with a marine pipeline installation system, the marine pipeline installation system comprising:

5 a pipeline launch tower, defining a firing line and adapted to launch pipeline along the firing line into the sea by way of the J-lay method in a J-lay configuration and, wherein the pipeline launch tower comprises:

10 a base tower section that extends between a base end and a hinge end, and that is at the base end connected to the hull of the pipe-laying vessel via a pivot axis,

a top tower section that extends between a hinge end and a top end, and

15 a hinge mechanism, that connects the hinge end of the base tower section with the hinge end of the top tower section, and that comprises a top tower section pivot axis such that the top tower section can be pivoted relative to the base tower section between

a J-lay position, in which the top tower section is in line with the base tower section and both the top tower section and the base tower section extend along the firing line, and

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a travel position, in which the top tower section is in a folded position relative to the base tower section and only the base tower section extends along the firing line,

25 a top tower section pivot device, for switching between the J-lay configuration and a travel configuration by pivoting the top tower section of the pipeline launch tower into the J-lay position and the travel position respectively;

a top tower section locking device, e.g. comprising locking pins, for securing the top tower section relative to the base tower section in the J-lay position;

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a pipeline launch tower inclination adjuster, for supporting the base tower section in various pipe laying positions, including an upright, preferably vertical, pipe laying position;

35 a J-lay pipe loader, comprising a boom structure that can be pivoted between a horizontal loading position and a raised unload position, for transporting a pipe section, preferably for transporting a stand comprising multiple pipe sections, into the firing line;

a J-lay travelling head clamp, moveably supported by the tower for movement along the firing line, for supporting pipeline at a top end of the firing line and for lowering pipeline along the firing line, wherein, when the pipeline launch tower is in the J-lay configuration, the J-lay travelling head clamp can travel along the firing line; and

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a J-lay hang off clamp, for supporting the pipeline at a bottom end of the firing line.

The invention furthermore provides a method for folding a pipeline launch tower of a pipe-laying vessel, preferably of a pipe-laying vessel according to the invention, wherein the pipeline launch tower defines a firing line and is adapted to launch pipeline along the firing line into the sea by way of the J-lay method and by way of the reel lay method, the pipeline launch tower comprising

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a base tower section that extends between a base end and a hinge end, and that is at the base end connected to a hull of a vessel via a pivot axis,

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a top tower section that extends between a hinge end and a top end, and

a hinge mechanism, that connects the hinge end of the base tower section with the hinge end of the top tower section, and that comprises a top tower section pivot axis such that the top tower section can be pivoted relative to the base tower section between:

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an extended position, in which the top tower section is in line with the base tower section and both the top tower section and the base tower section extend along the firing line, and

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a travel position, which travel position preferably is also a reel lay position that enables the pipeline launch tower to be utilized for reel lay activities, in which the top tower section is in a folded position relative to the base tower section, preferably is adjacent to the base tower section,

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a top tower section pivot device, for pivoting the top tower section relative to the base tower section between the extended position and the travel position, the method comprising the steps:

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support the base tower section of the pipeline launch tower, with the top tower section in the extended position, in a substantially upright pipe-laying position,

prior to folding the top tower section out of the extended position, pivot the base tower section into an inclined top tower section folding position, and support the base tower section in that position, such that the top tower section is to be held in the extended position against the force of gravity, by the top tower section pivot device;

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pivoting the top tower section relative to the bottom tower section in a downward direction using the top tower section pivot device;

pivot the base tower section into an upright position, and, at the same time or subsequently,

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pivot the top tower section into the travel position, in which it is located adjacent to, and preferably is parallel to, the base tower section;

optionally: supporting and/or securing the top end of the top tower section using a support and/or securing device mounted on the base tower section at a base end thereof.

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Thus, the invention provides a method that allows for folding a pipeline launch tower, more in particular pivoting the top tower section relative to the base tower section, utilizing gravity to provide a smooth folding process and furthermore enabling the pipeline launch tower inclination adjuster to comprise a pivot winch and wires using the gravity to act as a counter balance during the pivoting of the top tower section.

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The invention furthermore provides a method for folding a pipeline launch tower of a pipe-laying vessel, preferably of a pipe-laying vessel according to the invention, wherein the pipeline launch tower defines a firing line and is adapted to launch pipeline along the firing line into the sea by way of the J-lay method and by way of the reel lay method, the pipeline launch tower comprising

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a base tower section that extends between a base end and a hinge end, and that is at the base end connected to a hull of a vessel via a pivot axis,

30

a top tower section that extends between a hinge end and a top end, and

a hinge mechanism, that connects the hinge end of the base tower section with the hinge end of the top tower section, and that comprises a top tower section pivot axis such that the top tower section can be pivoted relative to the base tower section between:

an extended position, in which the top tower section is in line with the base tower section and both the top tower section and the base tower section extend along the firing line, and

35

a travel position, which travel position preferably is also a reel lay position that enables the pipeline launch tower to be utilized for reel lay activities, in which the top tower section is in a folded position relative to the base tower section, preferably is adjacent to the base tower section,

5 a top tower section pivot device, for pivoting the top tower section relative to the base tower section between the extended position and the travel position, the method comprising the steps:

support the base tower section of the pipeline launch tower, with the top tower section in the extended position, in a substantially upright pipe-laying position,

10 prior to folding the top tower section out of the extended position, pivot the base tower section into an inclined top tower section folding position, preferably thus pivoting the base tower section towards an object mounted on the hull of the vessel or located on the deck of the vessel, and support the base tower section in that position, such that the top tower section is to be held in the extended position against the force of gravity, by the top
15 tower section pivot device;

pivoting the top tower section relative to the bottom tower section into an inclined intermediate position, for negotiating an obstacle,

pivoting the base tower section out of the inclined top tower section folding position and into an auxiliary inclined top tower section folding position, in which auxiliary top tower
20 section folding position the base tower section is located on an opposite side of the base tower section held in the substantially upright pipe laying position, and preferably extends over the object;

pivoting the top tower section relative to the bottom tower section in a downward direction using the top tower section pivot device;

25 pivot the top tower section into the travel position, in which it is located adjacent to, and preferably is parallel to, the base tower section, and at the same time or subsequently pivot the base tower section into an upright position;

optionally: supporting and/or securing the top end of the top tower section using a support and/or securing device mounted on the base tower section at a base end thereof.

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Thus, the invention provides a method that, as was already mentioned above with respect to the first method, allows for folding a pipeline launch tower, more in particular pivoting the top tower section relative to the base tower section, utilizing gravity and furthermore enabling the use of winches and wires using in the pivot process. In addition, this method allows for
35 the top tower section to be pivoted past an obstacle, e.g. a super structure such as a reel or crew living quarters, stored on the deck or mounted on the hull of the vessel respectively. Thus, the foot print required for proper use of the pipeline launch tower is reduced, which

allows for the pipeline launch tower to be set up in restricted spaces, for example adjacent living quarters, which living quarters typically are located on the bow side of a vessel and close to the moonpool,

5 According to a second aspect the invention provides:

a pipe-laying vessel for laying an offshore pipeline on the seafloor by way of a J-lay method and a reel lay method, wherein the vessel is provided with a marine pipeline installation system, the system comprising:

10

a pipeline launch tower, defining a firing line and adapted to launch pipeline along the firing line into the sea by way of the J-lay method in a J-lay configuration and by way of the reel lay method in a reel lay configuration and, wherein the pipeline launch tower comprises:

a base tower section that extends between a base end and a hinge end, and that is

15 at the base end connected to the hull of the vessel via a pivot axis;

a top tower section that extends between a hinge end and a top end; and

a hinge mechanism, that connects the hinge end of the base tower section with the hinge end of the top tower section, and that comprises a top tower section pivot axis such that the top tower section can be pivoted relative to the base tower section between:

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a pipe laying position, in which the pipeline launch tower can be utilised for pipe laying by way of the J-lay method, and the reel lay method, in which the top tower section is in line with the base tower section and both the top tower section and the base tower section extend along the firing line, and

a travel position, in which the top tower section is in a folded position relative to the

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base tower section, such that the top tower section is adjacent to the base tower section, and preferably extends parallel to the base tower section, to provide the pipe-laying vessel with a reduced height and lowered centre of gravity;

a top tower section pivot device, for switching the pipeline launch tower between the pipe
30 laying configuration and the travel configuration by pivoting the top tower section of the pipeline launch tower into the pipe laying position and the travel position respectively;

a top tower section locking device, e.g. comprising locking pins, for securing the top tower section relative to the base tower section in the extended position;

35

a pipeline launch tower inclination adjuster, for supporting the base tower section in various pipe laying positions, including an upright, preferably vertical, pipe laying position; and

a reel lay pipeline guide for guiding pipeline, provided from a reel or carousel, into the firing line,

5 a reel lay tensioner, adapted to be moveable and/or removable supported in a reel lay tensioner position by the pipeline launch tower, the reel lay tensioner comprising multiple tracks adapted for engaging the pipeline in the firing line and for supporting at least part of the weight of the launched pipeline,

10 a J-lay pipe loader, comprising a boom structure that can be pivoted between a horizontal loading position and a raised unload position, for transporting a pipe section, preferably for transporting a stand comprising multiple pipe sections, into the firing line;

a J-lay travelling head clamp, moveably supported by the tower for movement along the firing line, for supporting pipeline at a top end of the firing line and for lowering pipeline along the firing line, wherein, when the tower is in the J-lay configuration, the travelling J-lay head clamp can travel along the firing line between a position above the reel lay tensioner position and a position below the tensioner position; and

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20 a J-lay hang off clamp, for supporting the pipeline at a bottom end of the firing line.

Similar to a pipe-laying vessel and pipeline launch tower according to the first aspect of the invention, a pipeline launch tower of a vessel according to a second aspect of the invention comprises a base tower section and a top tower section which are connected by way of a hinge mechanism. According to the second aspect of the invention, the top tower section can be pivoted between an extended position, in which the pipeline launch tower can be used for J-lay and for reel lay activities, and a travel position, in which the top tower section is folded adjacent and substantially parallel to the base section of the tower.

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The pipeline launch tower according to the second aspect of the invention thus differs from the pipeline launch tower according to the first aspect of the invention in that the J-lay configuration of the pipeline launch tower is also used for reel lay.

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According to the second aspect, the tower is switched between the J-lay configuration and the reel lay configuration by moving the J-lay components and/or reel lay components between an active position, in which they enable the pipeline launch tower to be utilized for J-lay and reel lay respectively, and a passive position, in which they enable the pipeline launch tower to be utilized for reel lay and J-lay respectively.

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In an embodiment, the reel lay pipeline guide is pivotably supported by the base tower section at a hinge end thereof, such that it can be pivoted about a vertical axis between an active position, adjacent the firing line of the pipeline launch tower and a passive position, in which it is located at the side of the pipeline launch tower, away from the firing line.

In an alternative embodiment the reel lay pipeline guide is pivotably supported by the base tower section at a hinge end thereof, such that it can be pivoted about a horizontal axis, and through an opening in the top tower section, between an active position, adjacent the firing line of the pipeline launch tower and a passive position, in which it is located at the backside of the pipeline launch tower, away from the firing line.

In yet another embodiment, the reel lay pipeline guide is a retractable guide, configured to be retracted into, or through, an opening in the pipeline launch tower to free up the firing line and enable J-lay activities.

It is submitted that the other reel lay components, e.g. the reel lay tensioner, can be configured in a similar way, i.e. to be pivoted or retracted out of the firing line to enable J-lay activities. Also, the J-lay components can thus be configured to enable reel lay activities, for example the J-lay hang off clamp can be configured as a retractable clamp.

In addition, or as an alternative, to movably mounting J-lay components and/or reel lay components, the components can be configured to be removed, preferably by a crane, from the tower, temporarily stored on for example the deck, and again set up in the tower when required.

The pipeline launch tower according to the second aspect of the invention does provide a pipeline launch tower that can be used for both J-lay and reel lay, and that has an increased J-lay capacity compared to prior art pipeline launch towers. Furthermore, the pipeline launch tower according to the second aspect achieves the increased J-lay capacity without substantially impairing the behaviour of the vessel, by providing a travel configuration in which the centre of gravity of the pipeline launch tower, and thus of the vessel, is lowered.

In a preferred embodiment according to the first aspect of the invention, the top tower section is pivoted in a direction away from the side of the pipeline launch tower at which the J-lay pipe loader is, or is to be, mounted, to thus create space for the components required for reel lay operations, e.g. the reel lay pipeline guide and the reel lay tensioner, at the side of the pipeline launch tower that is also used for J-lay operation. In case such a pipeline

launch tower is located adjacent a super structure, e.g. living quarters, bridge, etc., the pipeline launch tower inclination adjuster is configured to not only support the pipeline launch tower in various pipe-laying positions, but also support the base tower section in one or more top tower section folding positions. These folding positions allow gravity to act as a counter balance during the pivoting of the top tower section and enable the top tower section to be pivoted past the obstacle, for example a superstructure mounted on the deck adjacent the pipeline launch tower.

In an alternative embodiment according to the first aspect of the invention, the top tower section is pivoted towards the side of the pipeline launch tower at which the J-lay pipe loader is, or is to be, mounted, and the pipeline launch tower, more in particular the top tower section of the pipeline launch tower is configured for, in a position in which it is folded adjacent to the bottom tower section, supporting the reel lay pipeline guide and/or other reel lay components, and or is configured to allow reel lay components access to the firing line while the top tower section is in the reel lay position. For example, the top tower section can be configured as an A-frame of which the space between the legs is adapted to receive the reel lay pipeline guide and/or the reel lay tensioner. Thus the side of the pipeline launch tower used for J-lay operations can also be used for reel lay operations, i.e. a deck used for J-lay operations can also be used for reel lay operations

Advantageous embodiments of the pipe-laying vessel according to the invention and the method according to the invention are disclosed in the sub claims and in the description, in which the invention is further illustrated and elucidated on the basis of a number of exemplary embodiments, of which some are shown in the schematic drawing. In the figures, components corresponding in terms of construction and/or function are provided with the same last two digits of the reference numbers.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings

Fig. 1 shows a side view a first embodiment of a pipe-laying vessel with a pipeline launch tower according to the invention in a J-lay configuration;

Fig. 2 shows the vessel of figure 1 with the pipeline launch tower in the reel lay configuration;

Fig. 3 shows the vessel of Fig. 1 with the pipeline launch tower in a travel configuration;

Fig. 4 shows a frontal view of the pipeline launch tower of figure 1;

Fig. 5 show a side view of the pipeline launch tower of figure 1 with a reel lay pipeline guide depicted in a travel position, a reel lay position and a J-lay position;

Fig. 6 shows the pipeline launch tower in a J-lay position, having a top tower section in an extended position relative to a base tower section;

5 Fig. 7 shows the pipeline launch tower of figure 1 in a first top tower folding position, with the top tower section in an extended position;

Fig. 8 shows the pipeline launch tower of figure 7 in a first top tower folding position, with the top tower section still in the intermediate folding position;

10 Fig. 9 shows the pipeline launch tower of figure 7 in a second top tower folding position, with the top tower section still in the intermediate folding position;

Fig. 10 shows the pipeline launch tower of figure 7 in the second top tower folding position, with the top tower section in a folded position;

Fig. 11 shows the pipeline launch tower of figure 7 in a reel lay position;

Fig. 12 shows the pipeline launch tower of figure 7 in a travel configuration;

15 Fig. 13 shows a perspective view of an embodiment of a pipe-laying vessel with a pipeline launch tower according to a second aspect of the invention in a J-lay configuration;

Fig. 14 shows a frontal view of the pipeline launch tower of figure 13;

Fig. 15 shows the pipeline launch tower of figure 13 in a J-lay position, having a top tower section in an extended position relative to a base tower section;

20 Fig. 16 shows the pipeline launch tower of figure 13 with the top tower section in an intermediate folding position;

Fig. 17 shows the pipeline launch tower of figure 13 with the top tower section in a folded position;

25 DETAILED DESCRIPTION

The invention will be further elucidated on the basis of an exemplary embodiment of a pipe laying vessel 1 comprising a pipeline launch tower 2 according to a first aspect of the invention, shown in Figs. 1-12, and an exemplary embodiment of a pipe laying vessel 101 comprising a pipeline launch tower 102 according to a second aspect of the invention,

30 shown in Figs. 13-16.

Figures 1-3 show the first pipe-laying vessel 1 in three different modes, a J-lay mode, shown in figure 1 a reel lay mode, shown in figure 2, and a travel mode, shown in figure 3. Figures 6-12 show the in subsequent steps how the pipeline launch tower 2 is folded from a J-lay configuration

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, shown in figure 6, into a reel lay configuration, shown in figure 11, and finally into a travel configuration, shown in figure 12.

Figure show 13 shows a perspective view of a pipe-laying vessel 101. Similar to the pipe-laying vessel 1 and pipeline launch tower 2 shown in the preceding figures, the pipeline launch tower can be folded between a J-lay configuration, shown in figures 13 and 15, and

5 travel configuration, shown in figure 17. The pipeline launch tower 102 differs from the pipeline launch tower 2 shown in the figures 1-12 in that the J-lay configuration of the pipeline launch tower is also used for reel lay. The pipeline launch tower according to the second aspect of the invention does provide a pipeline launch tower that can be used for both J-lay and reel lay, and that has an increased J-lay capacity compared to prior art
10 pipeline launch towers. Furthermore, the pipeline launch tower according to the second aspect achieves this without substantially impairing the behaviour of the vessel, by providing a travel configuration, in which the centre of gravity of the pipeline launch tower, and thus of the vessel is lowered.

15 Figure 1-12 show pipe-laying vessel for laying an offshore pipeline on the seafloor by way of a J-lay method and a reel lay method. The vessel 1 is provided with a marine pipeline installation system 3. The marine pipeline installation system comprises a pipeline launch tower 2.

20 The pipeline launch tower 2 defines a firing line 4 and is adapted to launch pipeline along that firing line into the sea by way of the J-lay method in a J-lay configuration, shown in figure 1 and by way of the reel lay method in a reel lay configuration, shown in figure 2.

According to the invention, the pipeline launch tower 2 comprises a base tower section 5
25 and a top tower section 6, which are connected to each other via a hinge mechanism 7. The base tower section 5 extends between a base end 5a and a hinge end 5b. the base tower section 5 is at the base end 5a connected to the hull 8 of the vessel 1 via a pivot axis 9.

30 The top tower section 6 extends between a hinge end 6a and a top end 6b. The hinge mechanism 7 connects the hinge end 5a of the base tower section 5 with the hinge end 6a of the top tower section 6. The hinge mechanism comprises a top tower section pivot axis 10 such that the top tower section 6 can be pivoted relative to the base tower section 5 between a J-lay position and a reel lay position.

Figure 1 shows the top tower section 6 in the J-lay position, in which the top tower section 6 is in line with the base tower section 5 and both the top tower section and the base tower section extend along the firing line 4.

- 5 Figure 2 shows the top tower section 6 in the reel lay position, in which the top tower section 6 is in a folded position relative to the base tower section 5 and only the base tower section extends along the firing line 4.

10 In the preferred embodiment shown, the top tower section, when in the reel lay position, is located adjacent to the base tower section 5 and is parallel to the base tower section 5. This allows for a compact configuration, having a small footprint, and a low centre of gravity.

15 In an alternative embodiment, when in the reel lay position, the top tower section is inclined relative to the base tower section. For example, the pipeline launch tower may be configured to allow for reel lay with the top tower section extending in a direction parallel to the deck of the vessel, for example similar to the position shown in figure 8. It is submitted that in such a configuration, the pipeline launch tower is furthermore provided to allow for the top tower section to be pivoted in a travel position in which it is located adjacent to and preferably is parallel to the base tower section, similar to the position shown in figure 2

20

According to the invention, the pipeline launch tower 2 is provided with a top tower section pivot device 11, for switching between the J-lay configuration and the reel lay configuration by pivoting the top tower section of the pipeline launch tower into the J-lay position and the reel lay position respectively.

25

Subsequent steps of such a pivoting process are shown in the figures 6-12, which show the top tower section 6 of the pipeline launch tower 2 being pivoted from the J-lay position into the reel lay position, which process will be discussed in more detail below. It is submitted that, the top tower section can be pivoted from the reel lay position into the J-lay position by performing the steps shown in reverse order.

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35 In the embodiment shown, the top tower section pivot axis 10 of the top tower section pivot device 11 is located at the side of the pipeline launch tower facing the bow 12 of the vessel 1, i.e. the side of the pipeline launch tower facing away from the side of the pipeline launch tower which is to be used for J-lay activities. Thus, in the embodiment shown, the side of the pipeline launch tower that is to be used for J-lay operations can also be used for reel lay

operations, i.e. can also be used when the top tower section 6 is in the reel lay position. furthermore, the side of the base tower section that faces a deck of the vessel.

According to the invention, the pipeline launch tower 2 is furthermore provided with a top tower section locking device 12, in the embodiment shown a locking device comprising
5 locking pins, for securing the top tower section 6 relative to the base tower section 5 in the extended position.

According to the invention, the pipeline launch tower 2 is furthermore provided with a pipeline launch tower inclination adjuster 16, for supporting the base tower section 5 in
10 various pipe laying positions, including an upright, substantially vertical pipe laying position shown in figure 1. In the embodiment shown the pipeline launch tower inclination adjuster 16 comprises two arms 17 of adjustable length, each extending between a super structure 18 mounted on the hull of the vessel and the base tower section 5. In the embodiment shown the super structure 18 comprises living quarters and the bridge of the vessel 1.

15 According to the invention, the pipeline launch tower 2 is furthermore provided with a reel lay pipeline guide 19 and a reel lay tensioner 20 to enable reel lay operations.

The reel lay pipeline guide 19, for guiding pipeline provided from a reel as shown in figure 2 into the firing line, is in the embodiment shown configured as a circular guide, i.e. an aligner
20 wheel.

The reel lay tensioner 20 comprises multiple tracks adapted for engaging the pipeline in the firing line 4 and for supporting at least part of the weight of the launched pipeline. According to the invention, the reel lay tensioner 20 is moveable supported in a reel lay tensioner
25 position by the pipeline launch tower 2, such that the tensioner can be moved out of the firing line to enable J-lay activities.

According to the invention, the pipeline launch tower 2 is furthermore provided with J-lay pipe loader 21 , a J-lay travelling head clamp 22 and a J-lay hang off clamp 23 to enable J-lay activities.

30 The J-lay pipe loader 21 comprises a boom structure 24 that can be pivoted between a horizontal loading position and a raised unload position, for transporting a pipe section, preferably for transporting a stand comprising multiple pipe sections, into the firing line.

35 The J-lay travelling head clamp 22 is moveably supported by the tower for movement along the firing line 4. Thus the head clamp 22 can be used for supporting pipeline at a top end of the firing line and for lowering pipeline along the firing line. When the tower is in the J-lay

configuration, the travelling J-lay head clamp 22 can travel along the firing line between a position above the tensioner position 25 and a position below the tensioner position.

5 The J-lay hang off clamp 23 is provided in the lower region of the pipeline launch tower for supporting the pipeline at a bottom end of the firing line.

In the preferred embodiment shown the top tower section pivot device 11 comprises a pivot winch 26 with an associated pivot wire 27, a pivot wire spacer member 28, and a pivot wire guide member 29.

10

The pivot winch 26 is located near the base end 5b of the base tower section 5, and the pivot wire 27 extends between the pivot winch 26 and a lift point 30, which lift point is fixed to the top tower section 6, away from the hinge end 6a thereof.

15 The pivot wire spacer member 28 is attached to the top tower section 6 near the respective hinge end 6a thereof, for supporting the pivot wire 27 at a support point spaced in a radial direction relative to the top tower section pivot axis 10

20 The pivot wire guide member 29 is attached to the base tower section 5 near the respective hinge end 5b thereof, for guiding the pivot wire along the hinge end 5b of the base tower section 5 when the top tower section is in the reel lay position, see for example figures 10-12.

25 The pivot winch 26 allows to vary the length of the pivot wire 27 and thus to pivot the top tower section 6 relative to the base tower section 5, which process is shown in the figures 6-12.

30 In the preferred embodiment shown, the pivot wire spacer member 28 is a lever arm, extending between a base end 28a, at which it is pivotably attached to the hinge end 6a of the top tower section 6, and a support end 28b for supporting the pivot wire 27. The spacer member 28 can be pivoted relative to the top tower section between an active position depicted in figures 1 and 2, for pivoting the top tower section, and an inactive position, depicted in figure 3.

35 Also, in the preferred embodiment shown, the reel lay pipeline guide is pivotably supported by the pipeline launch tower, such that it can be lowered from a reel lay position, depicted in figure 2, into a travel position, depicted in figure 3, such that it can be pivoted between an

active position, for performing reel lay activities, and a travel position, to provide the vessel with a minimum travel height.

The pipe-laying vessel depicted in figures 1-12 thus allows for a method for folding a

5 pipeline launch tower of a pipe-laying vessel, preferably of a pipe-laying vessel according to the invention, wherein the pipeline launch tower defines a firing line and is adapted to launch pipeline along the firing line into the sea by way of the J-lay method and by way of the reel lay method, the pipeline launch tower comprising:

10 a base tower section that extends between a base end and a hinge end, and that is at the base end connected to a hull of a vessel via a pivot axis,

a top tower section that extends between a hinge end and a top end, and

a hinge mechanism, that connects the hinge end of the base tower section with the hinge end of the top tower section, and that comprises a top tower section pivot axis such that the top tower section can be pivoted relative to the base tower section between:

15 an extended position, in which the top tower section is in line with the base tower section and both the top tower section and the base tower section extend along the firing line, and

a travel position, which travel position preferably is also a reel lay position that enables the pipeline launch tower to be utilized for reel lay activities, in which the top tower section is in a folded position relative to the base tower section, preferably is adjacent to the base tower section,

a top tower section pivot device, for pivoting the top tower section relative to the base tower section between the extended position and the travel position, the method comprising the steps:

25 support the base tower section of the pipeline launch tower, with the top tower section in the extended position, in a substantially upright pipe-laying position,

prior to folding the top tower section out of the extended position, pivot the base tower section into an inclined top tower section folding position, preferably thus pivoting the base tower section towards an object mounted on the hull of the vessel or located on the deck of the vessel, and support the base tower section in that position, such that the top tower section is to be held in the extended position against the force of gravity, by the top tower section pivot device;

pivoting the top tower section relative to the bottom tower section into an inclined intermediate position, for negotiating an obstacle,

35 pivoting the base tower section out of the inclined top tower section folding position and into an auxiliary inclined top tower section folding position, in which auxiliary top tower section folding position the base tower section is located on an opposite side of the base

tower section held in the substantially upright pipe laying position, and preferably extends over the object;

pivoting the top tower section relative to the bottom tower section in a downward direction using the top tower section pivot device;

5 pivot the top tower section into the travel position, in which it is located adjacent to, and preferably is parallel to, the base tower section, and at the same time or subsequently pivot the base tower section into an upright position;

optionally: supporting and/or securing the top end of the top tower section using a support and/or securing device mounted on the base tower section at a base end thereof.

10

As was already indicated above, figures 13-17 show a pipe laying vessel 101 according to a second aspect of the invention, which differs from the vessel 1 shown in figures 1-12 in that the J-lay configuration of the pipeline launch tower is also used for reel lay. The pipe-laying vessel depicted in figures 13-17 thus allows for a method for folding a pipeline launch tower

15 102 of a pipe-laying vessel 101, preferably of a pipe-laying vessel according to the invention, wherein the pipeline launch tower 102 defines a firing line 104 and is adapted to launch pipeline along the firing line into the sea by way of the J-lay method and by way of the reel lay method, the pipeline launch tower 102 comprising:

20 a base tower section 105 that extends between a base end 105a and a hinge end 105b, and that is at the base end connected to a hull of a vessel via a pivot axis,

a top tower section 106 that extends between a hinge end 106a and a top end 106b, and

25 a hinge mechanism 107, that connects the hinge end 105b of the base tower section 105 with the hinge end 106a of the top tower section 106, and that comprises a top tower section pivot axis 110 such that the top tower section can be pivoted relative to the base tower section between:

30 an extended position, in which the top tower section 106 is in line with the base tower section 105 and both the top tower section and the base tower section extend along the firing line 104, and

a travel position, which travel position preferably is also a reel lay position that enables the pipeline launch tower 102 to be utilized for reel lay activities, in which the top tower section 106 is in a folded position relative to the base tower section, preferably is adjacent to the base tower section,

35

a top tower section pivot device 111, for pivoting the top tower section 106 relative to the base tower section 105 between the extended position and the travel position, the method comprising the steps:

5

support the base tower section of the pipeline launch tower, with the top tower section in the extended position, in a substantially upright pipe-laying position,

10

prior to folding the top tower section out of the extended position, pivot the base tower section into an inclined top tower section folding position, and support the base tower section in that position, such that the top tower section is to be held in the extended position against the force of gravity, by the top tower section pivot device;

15

pivoting the top tower section relative to the bottom tower section in a downward direction using the top tower section pivot device;

pivot the base tower section into an upright position, and, at the same time or subsequently,

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pivot the top tower section into the travel position, in which it is located adjacent to, and preferably is parallel to, the base tower section;

optionally: supporting and/or securing the top end of the top tower section using a support and/or securing device mounted on the base tower section at a base end thereof.

25

It is submitted that components and features disclosed herein with respect to the pipeline installation system, in particular the pipe line launch tower, can be used with a pipeline launch tower according to the second aspect of the invention as well. Furthermore, the methods according to the invention, i.e. a method for folding the pipeline launch tower and the method for folding a pipeline launch tower and passing the top tower section along an object, can in principle also be used with both the pipeline launch tower depicted in figures 1-12 and the pipeline launch tower disclosed in figures 13-17.

30

Reference signs

- 01 pipe-laying vessel
- 02 pipeline launch tower
- 5 03 pipeline installation system
- 04 firing line
- 05 base tower section
- 05a base end
- 05b hinge end
- 10 06 top tower section
- 06a hinge end
- 06b top end
- 07 hinge mechanism
- 08 hull
- 15 09 pivot axis base end pipeline launch tower
- 10 top tower section pivot axis
- 11 top tower section pivot device
- 12 bow vessel
- 13 stern vessel
- 20 14 moonpool
- 15 top tower section locking device
- 16 pipeline launch tower inclination adjuster
- 17 arms of adjustable length
- 18 super structure
- 25 19 reel lay pipeline guide
- 20 reel lay tensioner
- 21 J-lay pipe loader
- 22 J-lay travelling head clamp
- 23 J-lay hang off clamp
- 30 24 boom structure j-lay pipe loader
- 25 reel lay tensioner position
- 26 pivot winch
- 27 pivot wire
- 28 pivot wire spacer member
- 35 28a base end
- 28b support end
- 29 pivot wire guide member

- 30 lift point
- 101 pipe-laying vessel
- 102 pipeline launch tower
- 103 pipeline installation system
- 5 104 firing line
- 105 base tower section
- 105a base end
- 105 b hinge end
- 106 top tower section
- 10 106a hinge end
- 106b top end
- 107 hinge mechanism
- 108 hull
- 109 pivot axis base end pipeline launch tower
- 15 110 top tower section pivot axis
- 111 top tower section pivot device
- 112 bow vessel
- 113 stern vessel
- 114 moonpool
- 20 115 top tower section locking device
- 116 pipeline launch tower inclination adjuster
- 117 arms of adjustable length
- 118 super structure
- 119 reel lay pipeline guide
- 25 120 reel lay tensioner
- 121 J-lay pie loader
- 122 J-lay travelling head clamp
- 123 J-lay hang off clamp
- 124 boom structure j-lay pipe loader
- 30 125 reel lay tensioner position
- 126 pivot winch
- 127 pivot wire
- 128 pivot wire spacer member
- 128a base end
- 35 128b support end
- 129 pivot wire guide member
- 130 lift point

C L A I M S

1. A pipe-laying vessel (1) for laying an offshore pipeline on the seafloor by way of a J-lay method and a reel lay method, wherein the vessel (1) is provided with a marine pipeline
5 installation system (3), the marine pipeline installation system (3) comprising:

a pipeline launch tower (2), defining a firing line (4) and adapted to launch pipeline along the firing line into the sea by way of the J-lay method in a J-lay configuration and by way of the reel lay method in a reel lay configuration and, wherein the pipeline launch tower
10 (2) comprises:

a base tower section (5) that extends between a base end (5a) and a hinge end (5b), and that is at the base end (5a) connected to a hull (8) of the pipe-laying vessel (1) via a pivot axis (9),
15

a top tower section (6) that extends between a hinge end (6a) and a top end (6b), and

a hinge mechanism (7), that connects the hinge end (6a) of the base tower section (5) with the hinge end (6a) of the top tower section (6), and that comprises a top tower section pivot axis (10) such that the top tower section (6) can be pivoted relative to the base tower section (5) between:
20

a J-lay position, in which the top tower section (6) is in line with the base tower section (5) and both the top tower section (6) and the base tower section (5) extend along the firing line (4), and
25

a reel lay position, in which the top tower section (6) is in a folded position relative to the base tower section (5) and only the base tower section (5) extends along the firing line (4),
30

a top tower section pivot device (11), for switching between the J-lay configuration and the reel lay configuration by pivoting the top tower section (6) of the pipeline launch tower (2) into the J-lay position and the reel lay position respectively;
35

a top tower section locking device (15), e.g. comprising locking pins, for securing the top tower section (6) relative to the base tower section (5) in the J-lay position;

a pipeline launch tower inclination adjuster (16), for supporting the base tower section (5) in various pipe laying positions, including an upright, preferably vertical, pipe laying position; and

5

a reel lay pipeline guide (19) for guiding pipeline, provided from a reel or carousel, into the firing line (4),

a reel lay tensioner (20), adapted to be moveable and/or removable supported in a reel lay tensioner position by the pipeline launch tower (2), the reel lay tensioner (20) comprising multiple tracks adapted for engaging the pipeline in the firing line (4) and for supporting at least part of the weight of the launched pipeline,

10

a J-lay pipe loader (21), comprising a boom structure (24) that can be pivoted between a horizontal loading position and a raised unload position, for transporting a pipe section, preferably for transporting a stand comprising multiple pipe sections, into the firing line (4);

15

a J-lay travelling head clamp (22), moveably supported by the pipeline launch tower (2) for movement along the firing line (4), for supporting pipeline at a top end of the firing line (4) and for lowering pipeline along the firing line (4), wherein, when the pipeline launch tower (2) is in the J-lay configuration, the J-lay travelling head clamp (22) can travel along the firing line (4) between a position above the reel lay tensioner position and a position below the tensioner position; and

20

25

a J-lay hang off clamp (23), for supporting the pipeline at a bottom end of the firing line (4).

30

2. A pipe-laying vessel according to claim 1, wherein, when the tower is in the reel lay configuration the top tower section is adjacent and substantially parallel to the base section of the tower.

35

3. A pipe-laying vessel according to claim 1 or 2, wherein the base section of the tower is provided with a securing device, preferably at the base end of the base tower section, configured to, when the tower is in the reel lay configuration, secure the top tower section in the reel lay position.

4. A pipe-laying vessel according to one or more of the preceding claims, wherein the base section of the tower is provided with a support, preferably at the base end of the base tower section, configured to, when the tower is in the reel lay configuration, support the top tower section.

5

5. A pipe-laying vessel according to one or more of the preceding claims, wherein the hinge mechanism is adapted to pivot the top tower section towards the side of the base tower section that faces away from a side of the pipeline launch tower at which the J-lay pipe loader is, or is to be, mounted.

10

6. A pipe-laying vessel according to one or more of the preceding claims, wherein the top tower section pivot device comprises:

a pivot winch and an associated pivot wire, wherein the pivot winch is located near the base end of the base tower section, and the pivot wire extends between the winch and a lift point, which lift point is fixed to the top tower section, away from the hinge end of the top tower section; and

15

a pivot wire spacer member, which spacer member is attached to the top tower section near the respective hinge end thereof, for supporting the pivot wire at a support point spaced in a radial direction relative to the top tower section pivot axis;

20

a pivot wire guide member, which guide member is attached to the base tower section near the respective hinge end thereof, for guiding the pivot wire along the hinge end of the base tower section when the top tower section is in the reel lay position;

25

wherein the pivot winch allows to vary the length of the pivot wire and thus to pivot the top tower section relative to the base tower section.

7. A pipe-laying vessel according to claim 6, wherein the pivot wire spacer member is a lever arm, extending between a base end, pivotably attached to the base tower section or the top tower section near the respective hinge end thereof, and a support end for supporting the pivot wire, wherein the spacer member can be pivoted relative to the top tower section between an active position for pivoting the top tower section and an inactive position.

30

35

8. A pipe-laying vessel according to one or more of the preceding claims, wherein the hinge mechanism comprises an intermediate tower section, which separates the base tower section from the top tower section when the tower is in the J-lay position, and comprises a pivot axis at one end, connecting the base tower section with the intermediate tower section,
5 and a pivot axis at an opposite end, connecting the top tower section with the intermediate tower section.

9. A pipe-laying vessel according to claim 8, wherein the intermediate tower section is configured such that when the top tower section (6) is in the reel lay position, the base tower section (5) and the top tower section (6) extend parallel to each other, preferably are located adjacent to each other.
10

10. A pipe-laying vessel according to one or more of the preceding claims, wherein the top tower section (6) and the base tower section (5) are of similar length, i.e. when in the reel lay position the top end (6a) of the top tower section (6) is located adjacent the base end (5a) of the base tower section (5).
15

11. A pipe-laying vessel according to one or more of the preceding claims, wherein the tower support structure is configured, e.g. comprises hydraulic cylinders, for pivoting the tower between the upright, preferably vertical, pipe laying position and a tilted folding position.
20

12. Method for folding a pipeline launch tower (2) of a pipe-laying vessel (1), preferably of a pipe-laying vessel according to the invention as claimed in one or more of the claims 1-11, wherein the pipeline launch tower (2) defines a firing line (4) and is adapted to launch pipeline along the firing line (4) into the sea by way of the J-lay method and by way of the reel lay method, the pipeline launch tower (2) comprising:
25

a base tower section (5) that extends between a base end (5a) and a hinge end (5b),
30 and that is at the base end (5a) connected to a hull (8) of a vessel (1) via a pivot axis (9),

a top tower section (6) that extends between a hinge end (6a) and a top end (6b),
and

a hinge mechanism (7), that connects the hinge end (5b) of the base tower section (5) with the hinge end (6a) of the top tower section (6), and that comprises a top tower
35

section pivot axis (10) such that the top tower section (6) can be pivoted relative to the base tower section (5) between:

5 an extended position, in which the top tower section (6) is in line with the base tower section (5) and both the top tower section (6) and the base tower section (5) extend along the firing line (4), and

10 a travel position, which travel position preferably is also a reel lay position that enables the pipeline launch tower to be utilized for reel lay activities, in which travel position the top tower section (6) is in a folded position relative to the base tower section (5), preferably is adjacent to the base tower section (5),

15 a top tower section pivot device (11), for pivoting the top tower section (6) relative to the base tower section (5) between the extended position and the travel position, the method comprising the steps:

support the base tower section (5) of the pipeline launch tower (2), with the top tower section 6 in the extended position, in a substantially upright pipe-laying position,

20 prior to folding the top tower section (6) out of the extended position, pivot the base tower section (5) into an inclined top tower section folding position, and support the base tower section (5) in that position, such that the top tower section (6) is to be held in the extended position against the force of gravity, by the top tower section pivot device (11);

25 pivoting the top tower section (6) relative to the bottom tower section (5) in a downward direction using the top tower section pivot device (11);

pivot the base tower section (5) into an upright position, and, at the same time or subsequently,

30 pivot the top tower section (6) into the travel position, in which it is located adjacent to, and preferably is parallel to, the base tower section (5);

35 optionally: supporting and/or securing the top end (6b) of the top tower section (6) using a support and/or securing device mounted on the base tower section (5) at a base end (5a) thereof.

13. Method for folding a pipeline launch tower (2) of a pipe-laying vessel (1), preferably of a pipe-laying vessel according to the invention as claimed in one or more of the claims 1-11, wherein the pipeline launch tower (2) defines a firing line (4) and is adapted to launch pipeline along the firing line (4) into the sea by way of the J-lay method and by way of the reel lay method, the pipeline launch tower (2) comprising:

a base tower section (5) that extends between a base end (5a) and a hinge end (5b), and that is at the base end (5a) connected to a hull (8) of the pipe-laying vessel (1) via a pivot axis (9),

a top tower section (6) that extends between a hinge end (6a) and a top end (6b), and

a hinge mechanism (7), that connects the hinge end (5b) of the base tower section (5) with the hinge end (6a) of the top tower section (6), and that comprises a top tower section pivot axis (10) such that the top tower section (6) can be pivoted relative to the base tower section (5) between:

an extended position, in which the top tower section (6) is in line with the base tower section (5) and both the top tower section (6) and the base tower section (5) extend along the firing line (4), and

a travel position, which travel position preferably is also a reel lay position that enables the pipeline launch tower (2) to be utilized for reel lay activities, in which the top tower section (6) is in a folded position relative to the base tower section (5), preferably is adjacent to the base tower section (5),

a top tower section pivot device (11), for pivoting the top tower section (6) relative to the base tower section (5) between the extended position and the travel position, the method comprising the steps:

support the base tower section (5) of the pipeline launch tower (2), with the top tower section (6) in the extended position, in a substantially upright pipe-laying position,

prior to folding the top tower section (6) out of the extended position, pivot the base tower section (5) into an inclined top tower section folding position, preferably thus pivoting the base tower section (5) towards an object mounted on the hull (8) of the pipe-laying vessel (1) or located on the deck of the pipe-laying vessel (1), and support the base tower

section (5) in that position, such that the top tower section (6) is to be held in the extended position against the force of gravity, by the top tower section pivot device (11);

5 pivoting the top tower section (6) relative to the base tower section (5) into an inclined intermediate position, for negotiating an obstacle,

10 pivoting the base tower section (5) out of the inclined top tower section folding position and into an auxiliary inclined top tower section folding position, in which auxiliary top tower section folding position the base tower section (5) is located on an opposite side of the base tower section (5) held in the substantially upright pipe laying position, and wherein, with the base tower section in the auxiliary top tower section folding position the top tower section preferably extends over the object;

15 pivoting the top tower section (6) relative to the bottom tower section (5) in a downward direction using the top tower section pivot device (11);

20 pivot the top tower section (6) into the travel position, in which it is located adjacent to, and preferably is parallel to, the base tower section (5), and at the same time or subsequently pivot the base tower section (5) into an upright position;

optionally: supporting and/or securing the top end (6b) of the top tower section (6) using a support and/or securing device mounted on the base tower section (5) at a base end thereof.

25 14. A pipe-laying vessel according to one or more of the claims 1-11, wherein the pipe-laying vessel is a monohull vessel, wherein the monohull vessel is provided with a moonpool (14), and wherein preferably the pipeline launch tower (2) is mounted such that a side of the pipeline launch tower (2) at which the J-lay pipe loader (21) is, or is to be, mounted faces a stern (13) of the pipe-laying vessel (1).

30 15. A marine pipeline installation system (3) for providing a pipe-laying vessel (1) according to one or more of the claims 1-11.

35 16. Pipeline launch tower (2) for providing a marine pipeline installation system (3) according to claim 15.

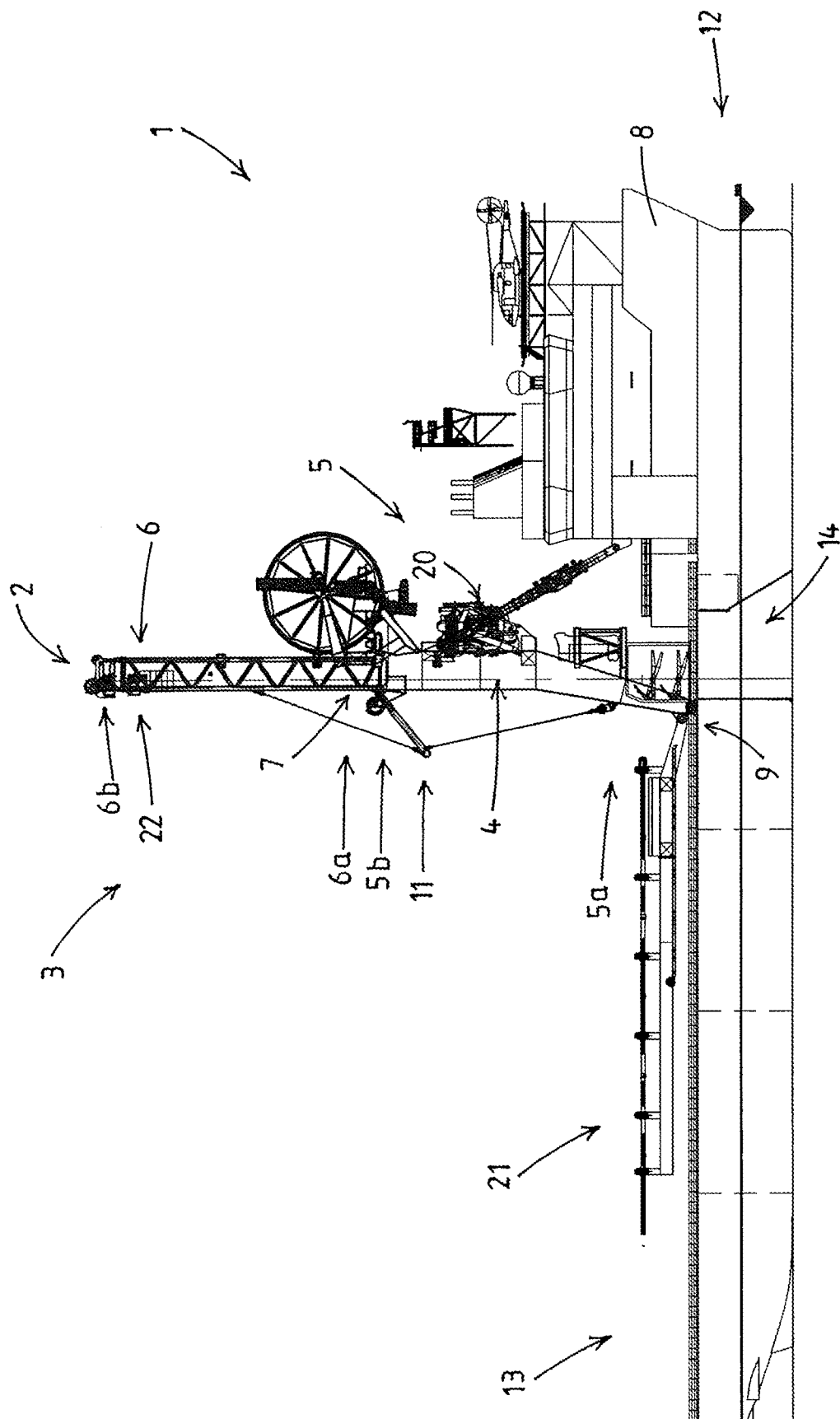


Fig. 1

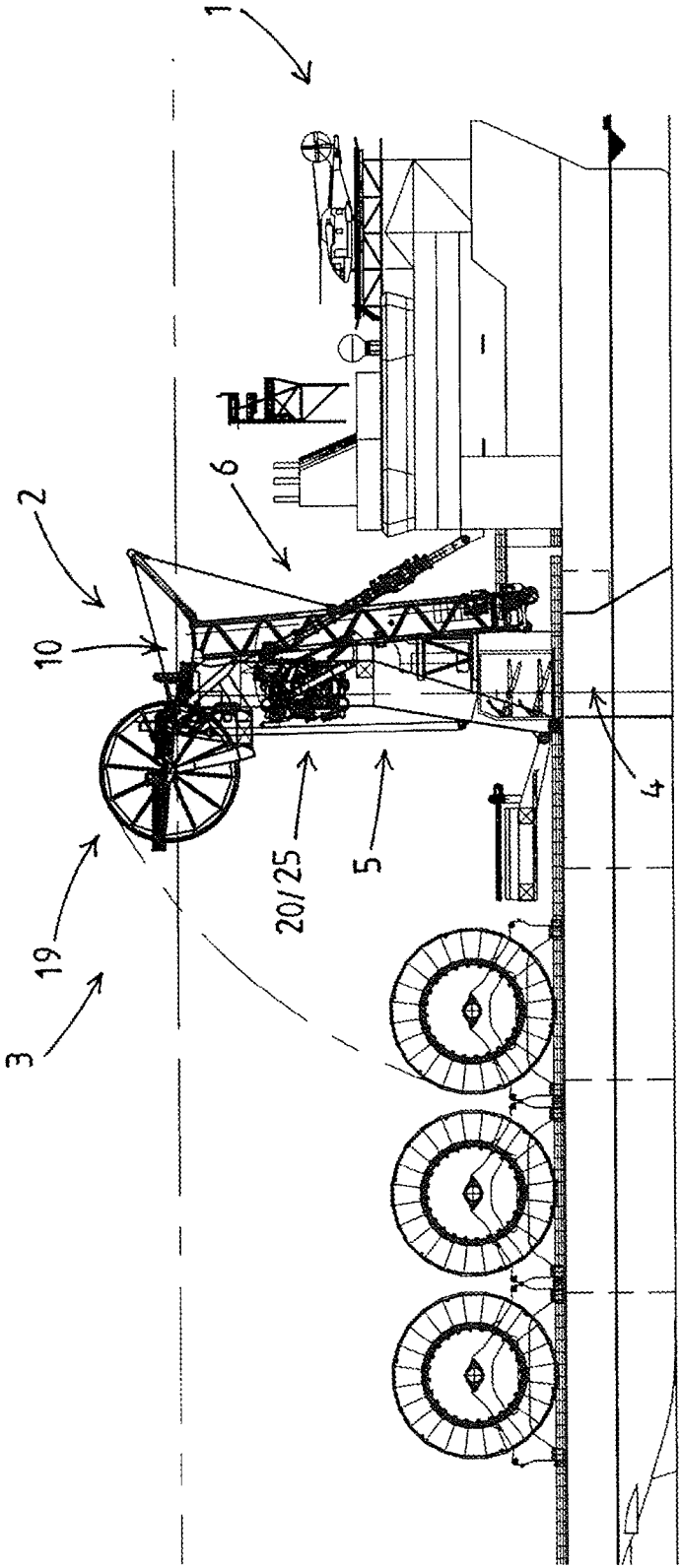


Fig.2

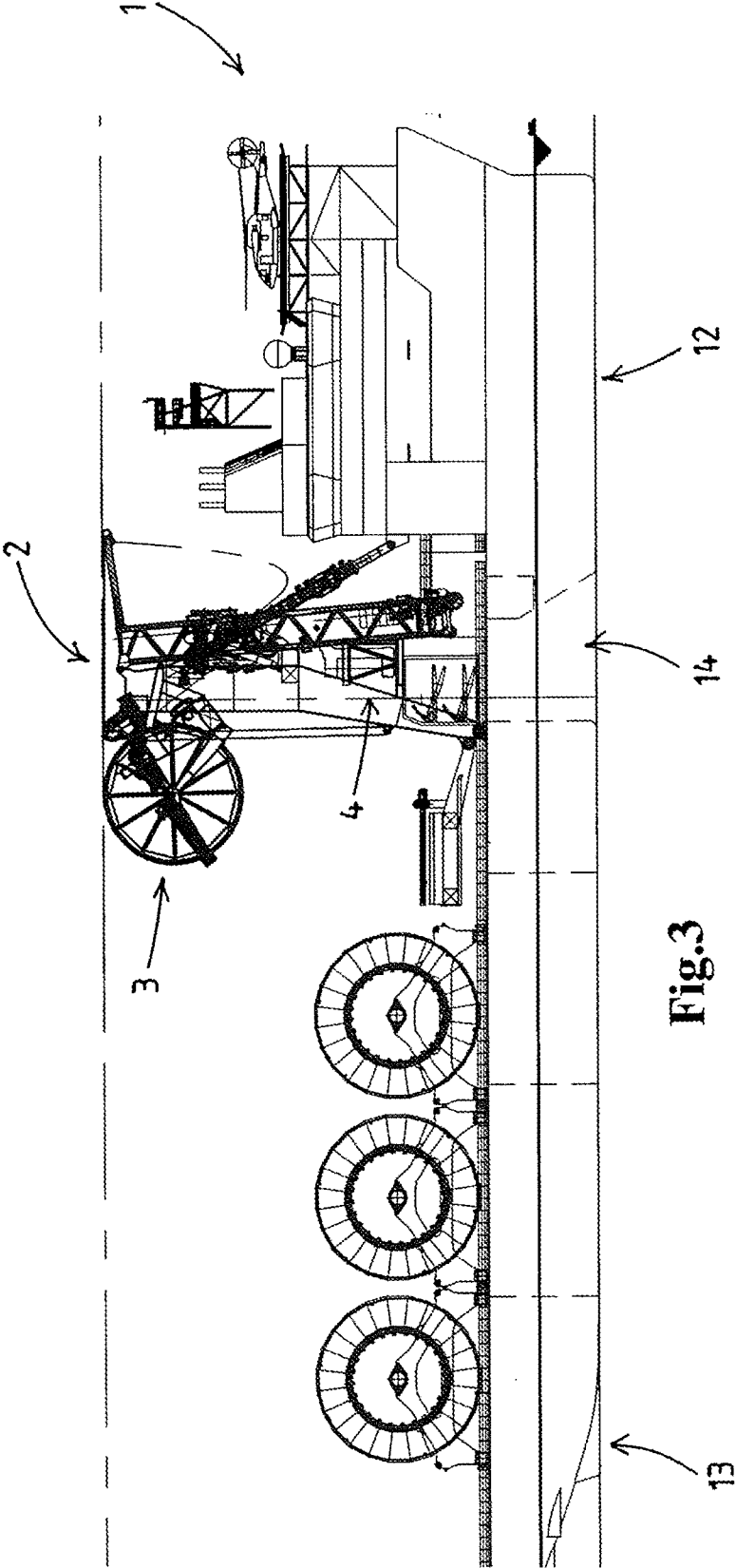


Fig.3

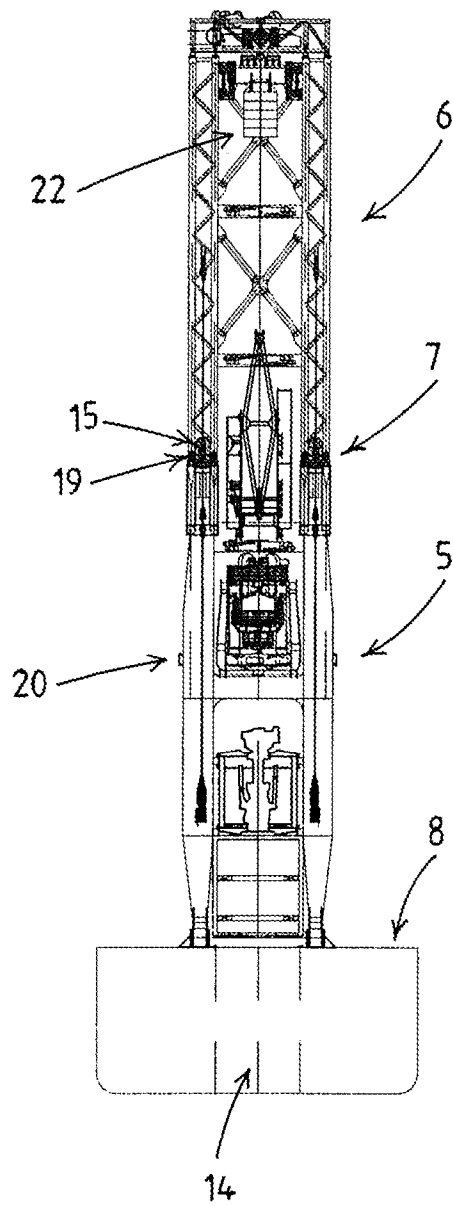


Fig.4

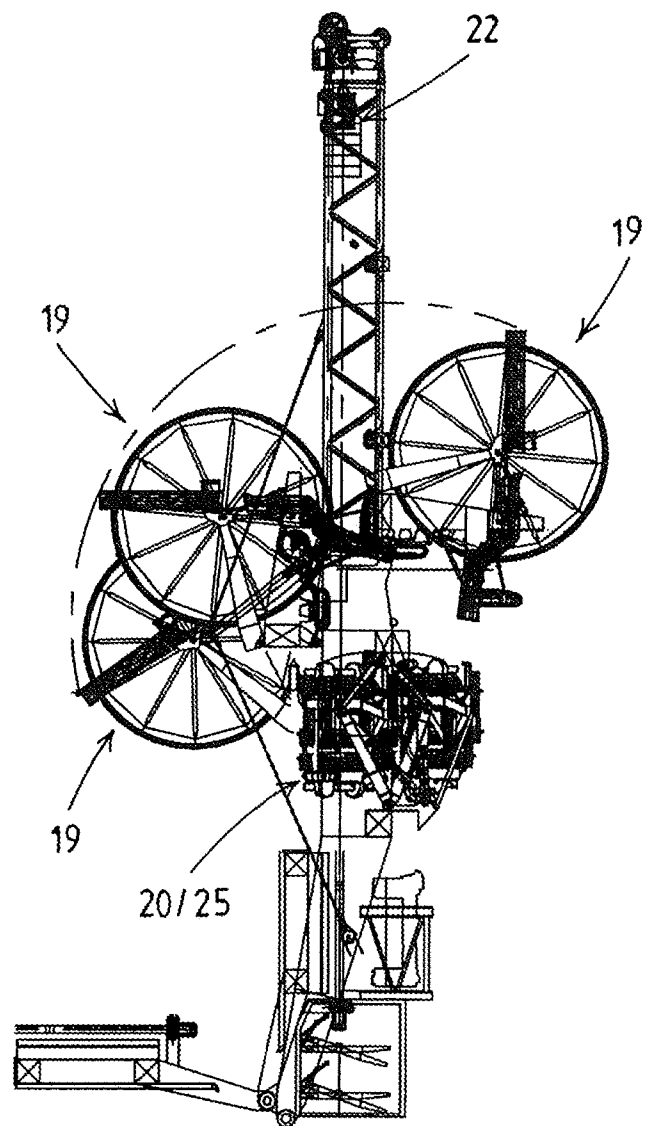


Fig.5

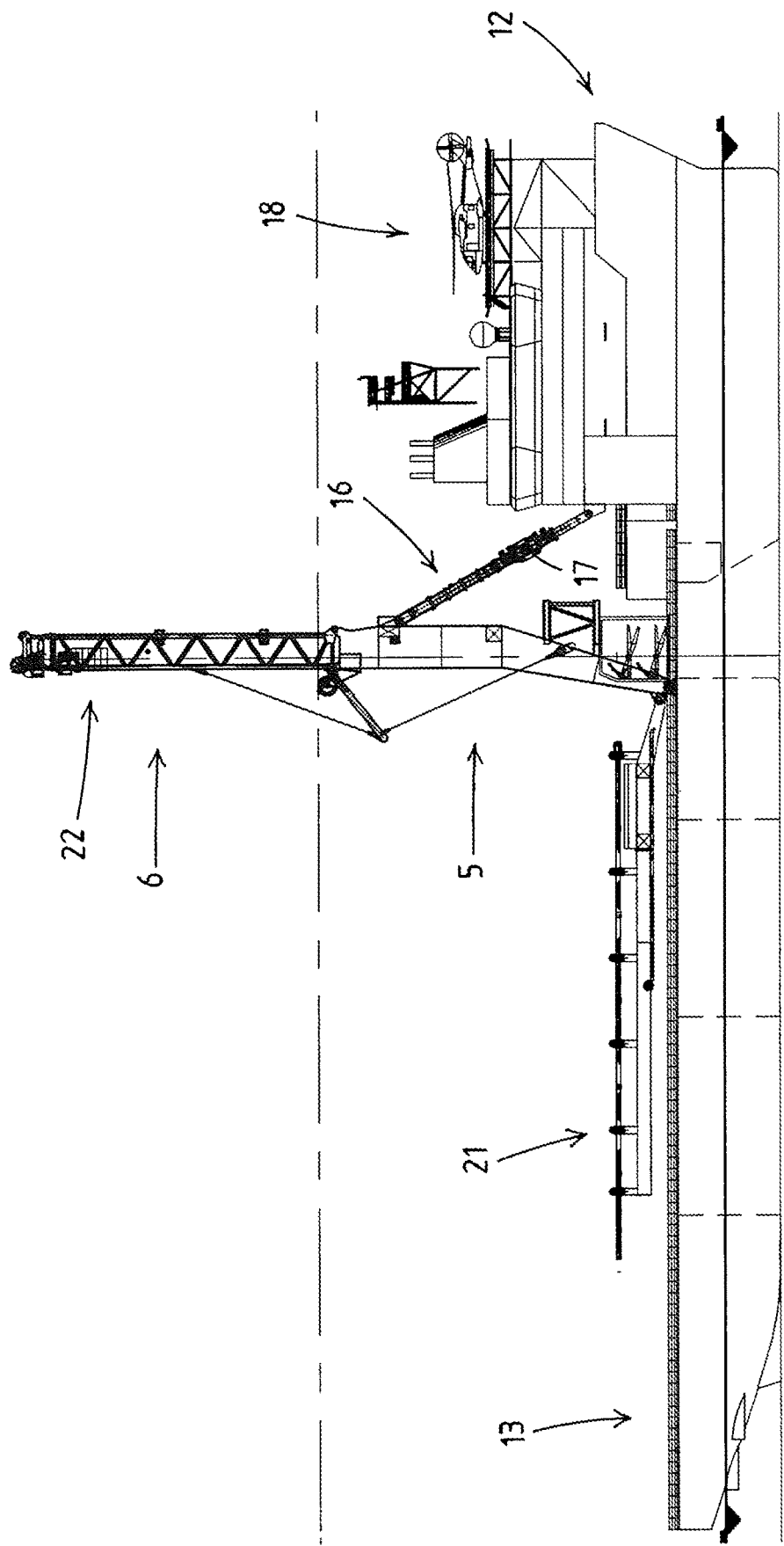


Fig.6

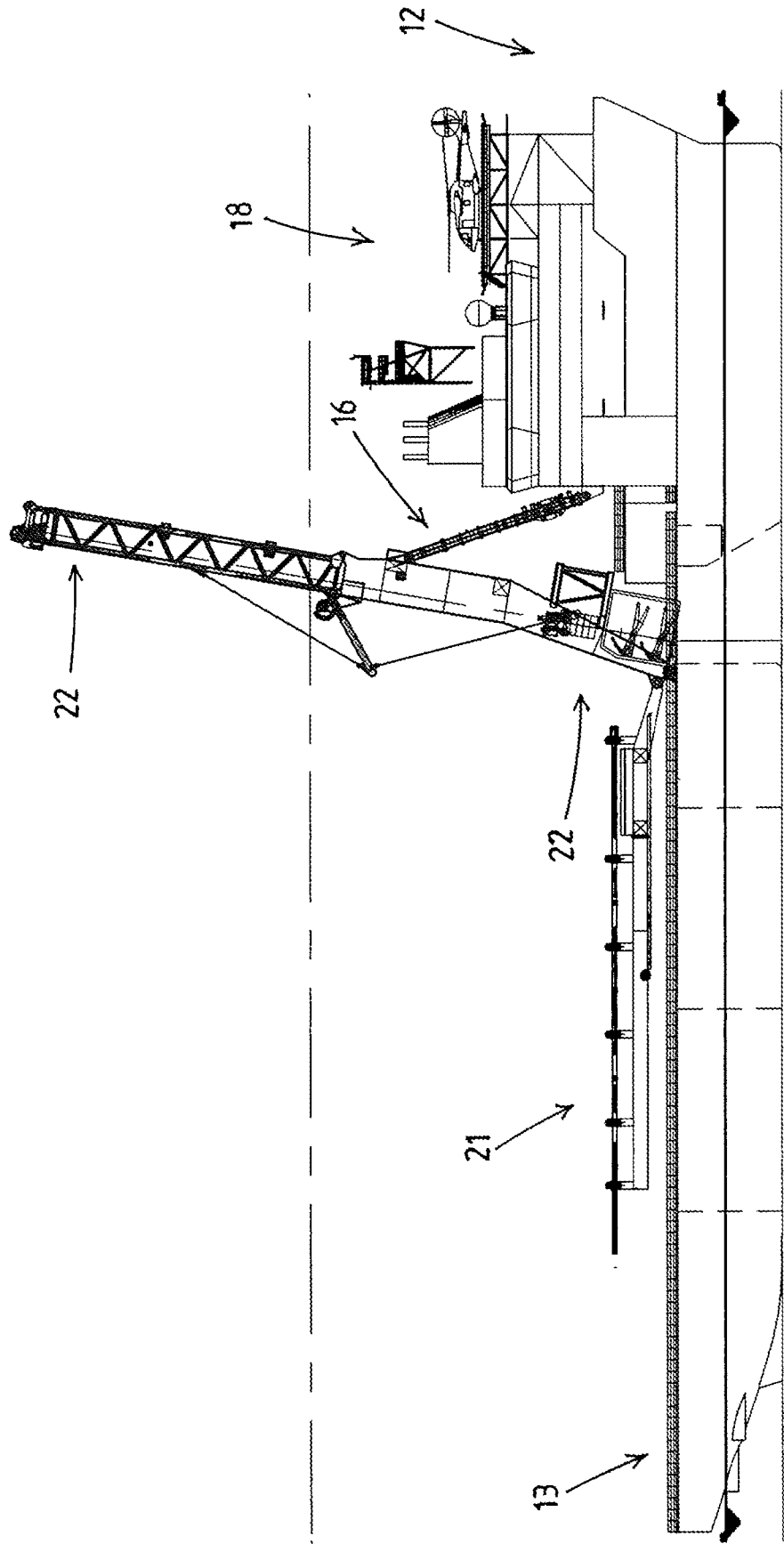


Fig.7

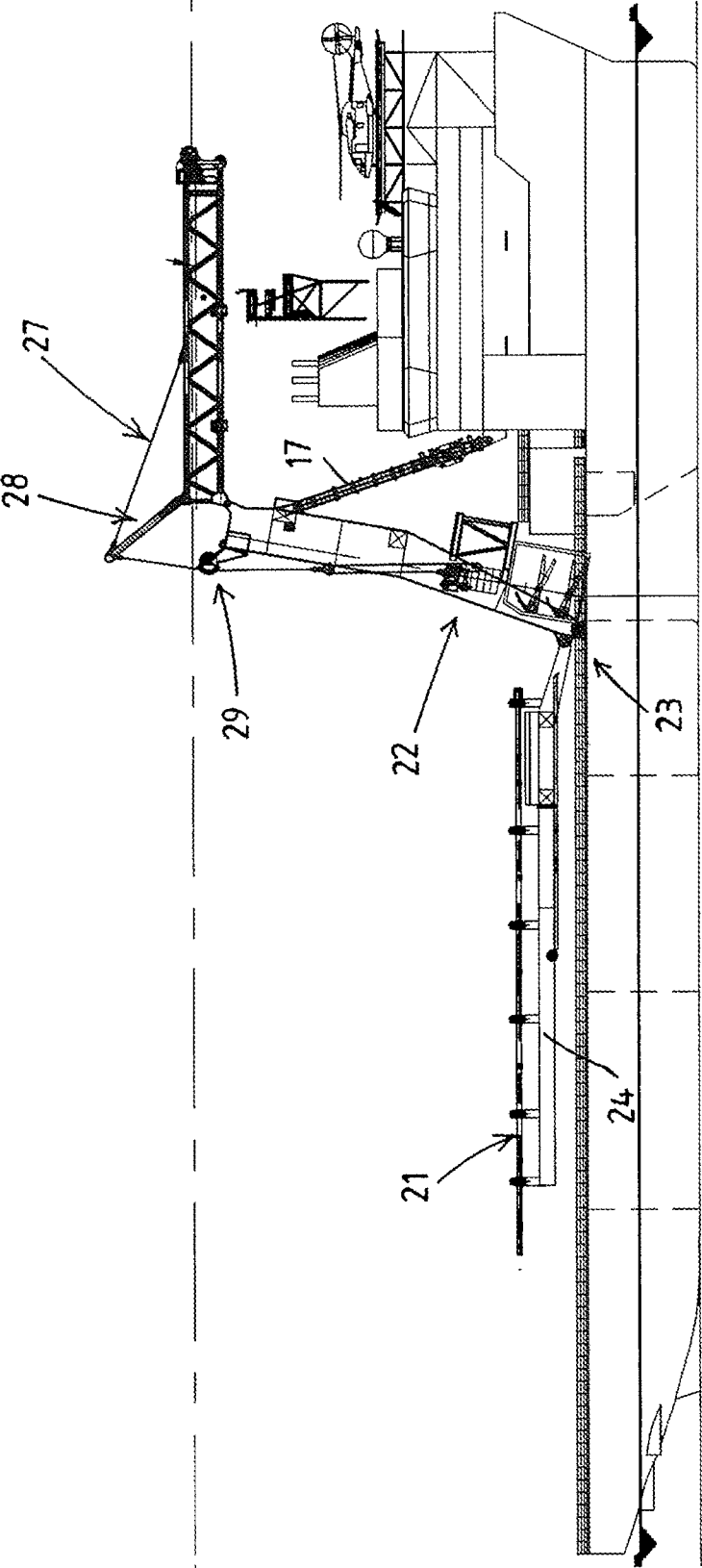


Fig.8

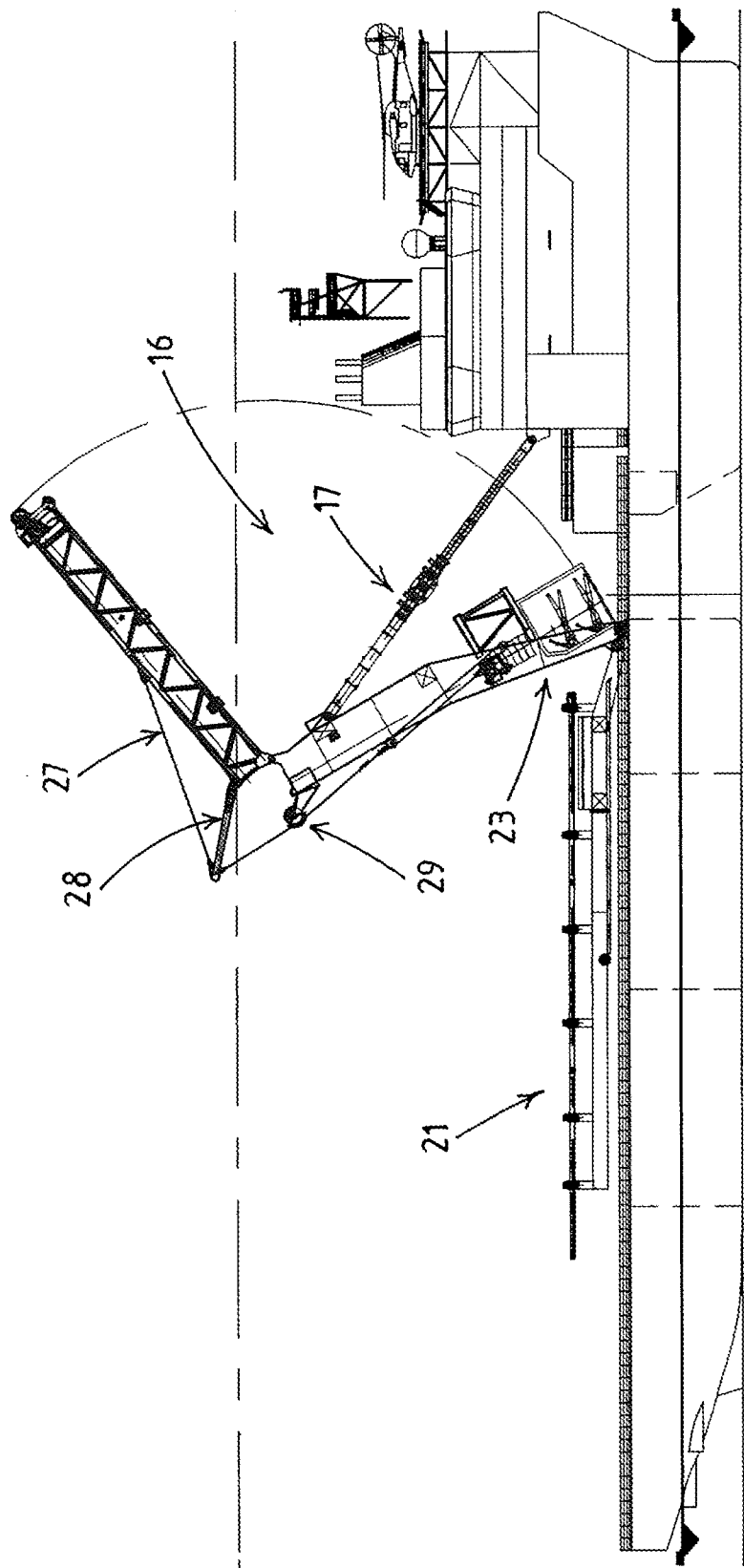


Fig.9

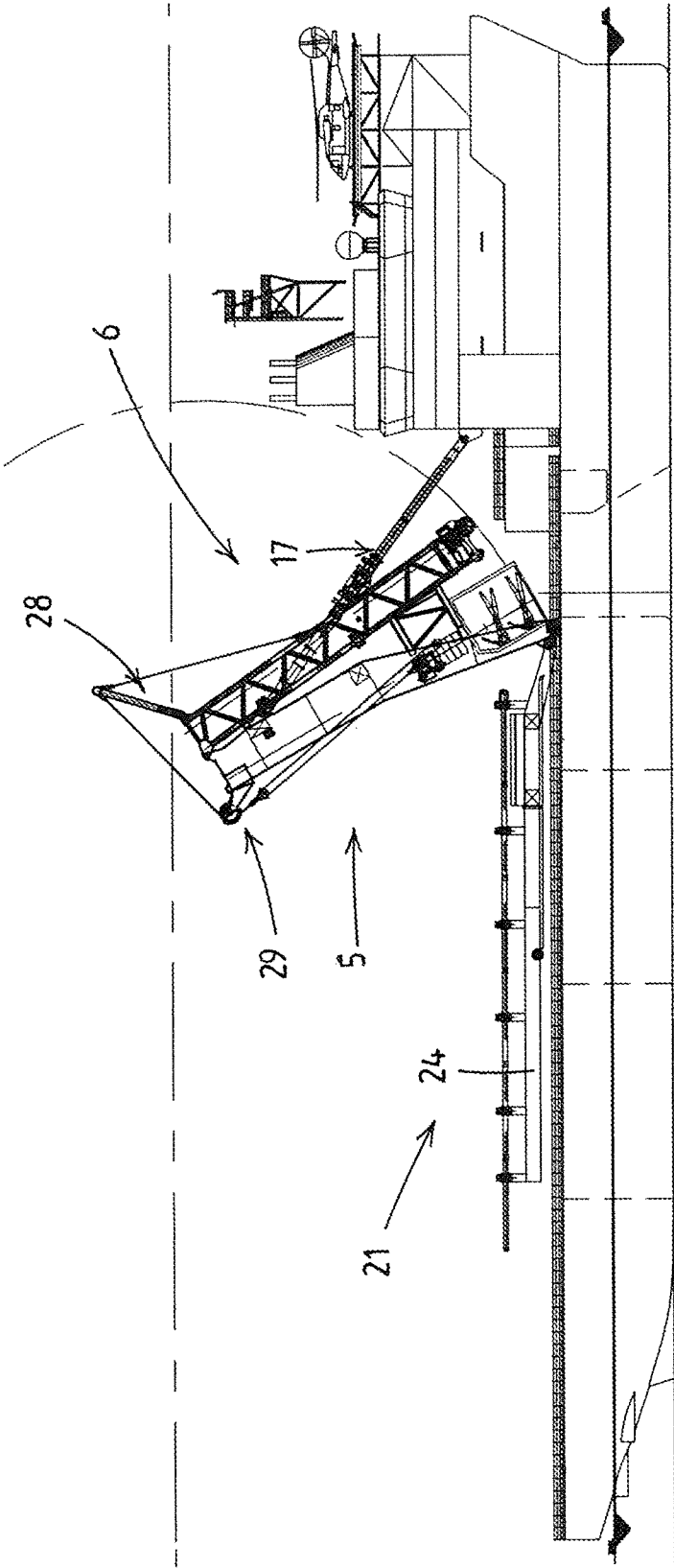


Fig.10

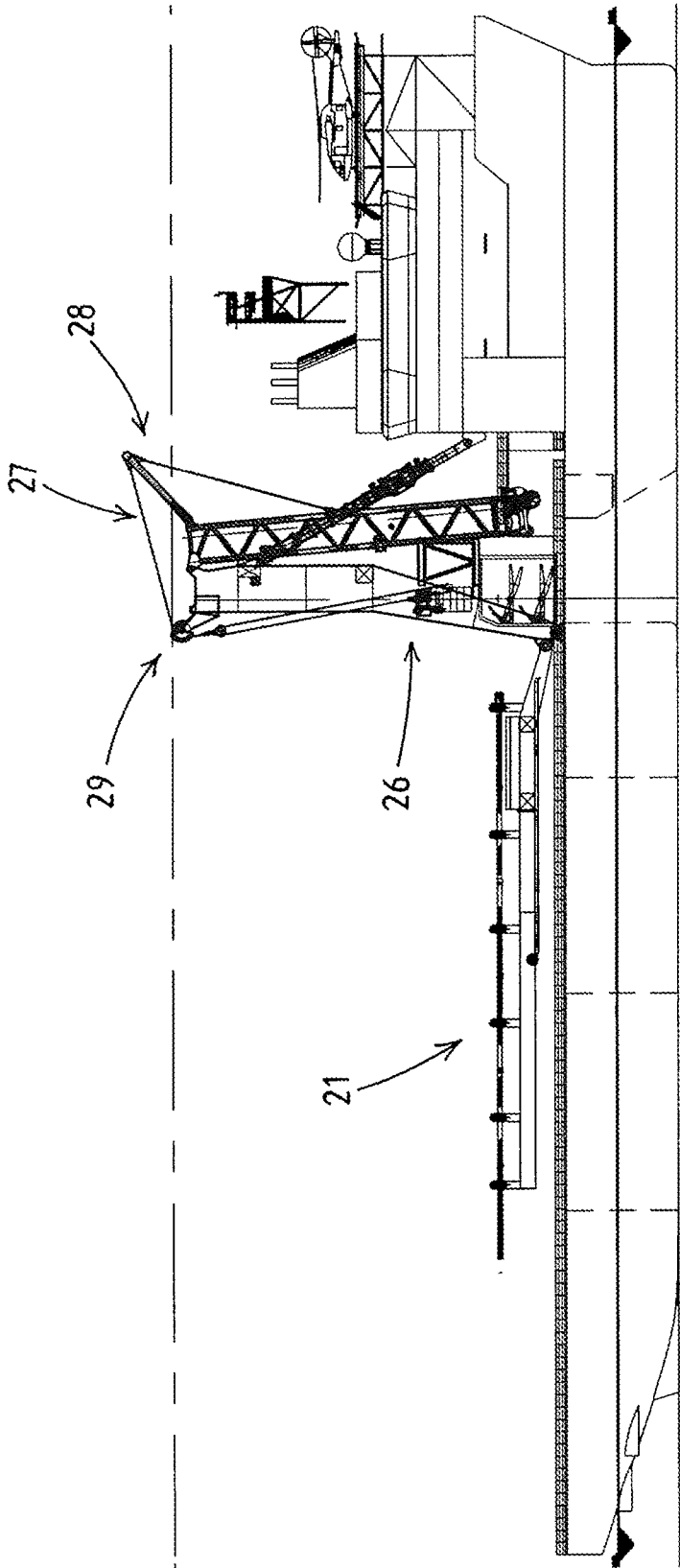


Fig.11

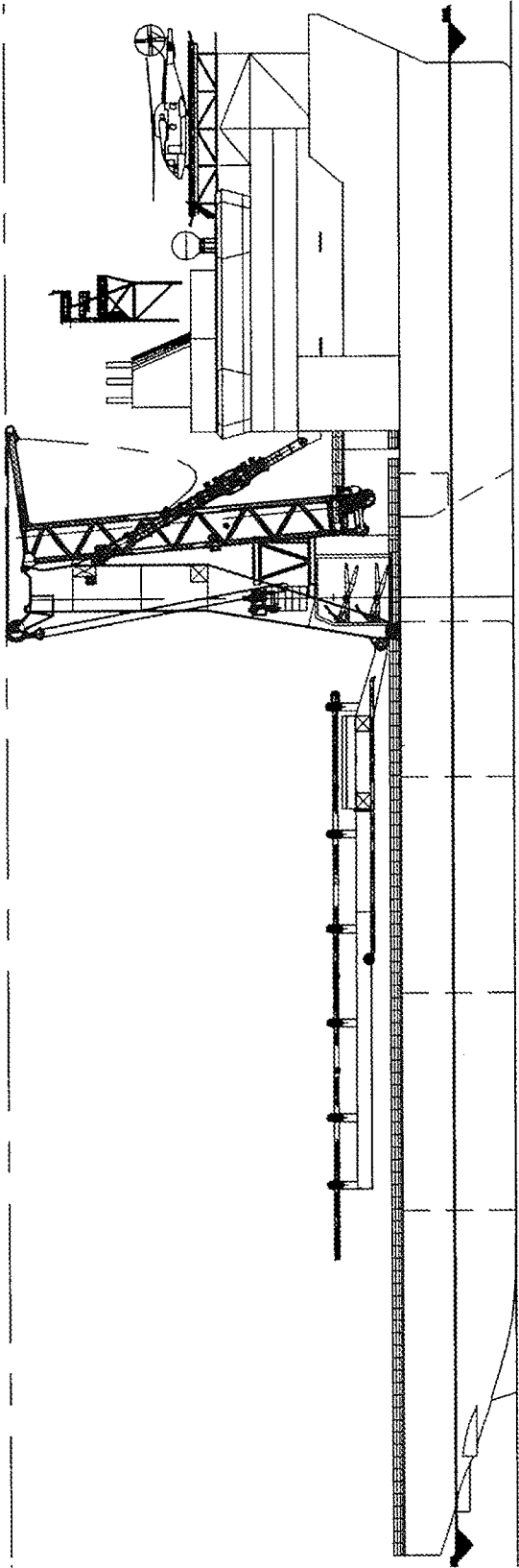


Fig.12

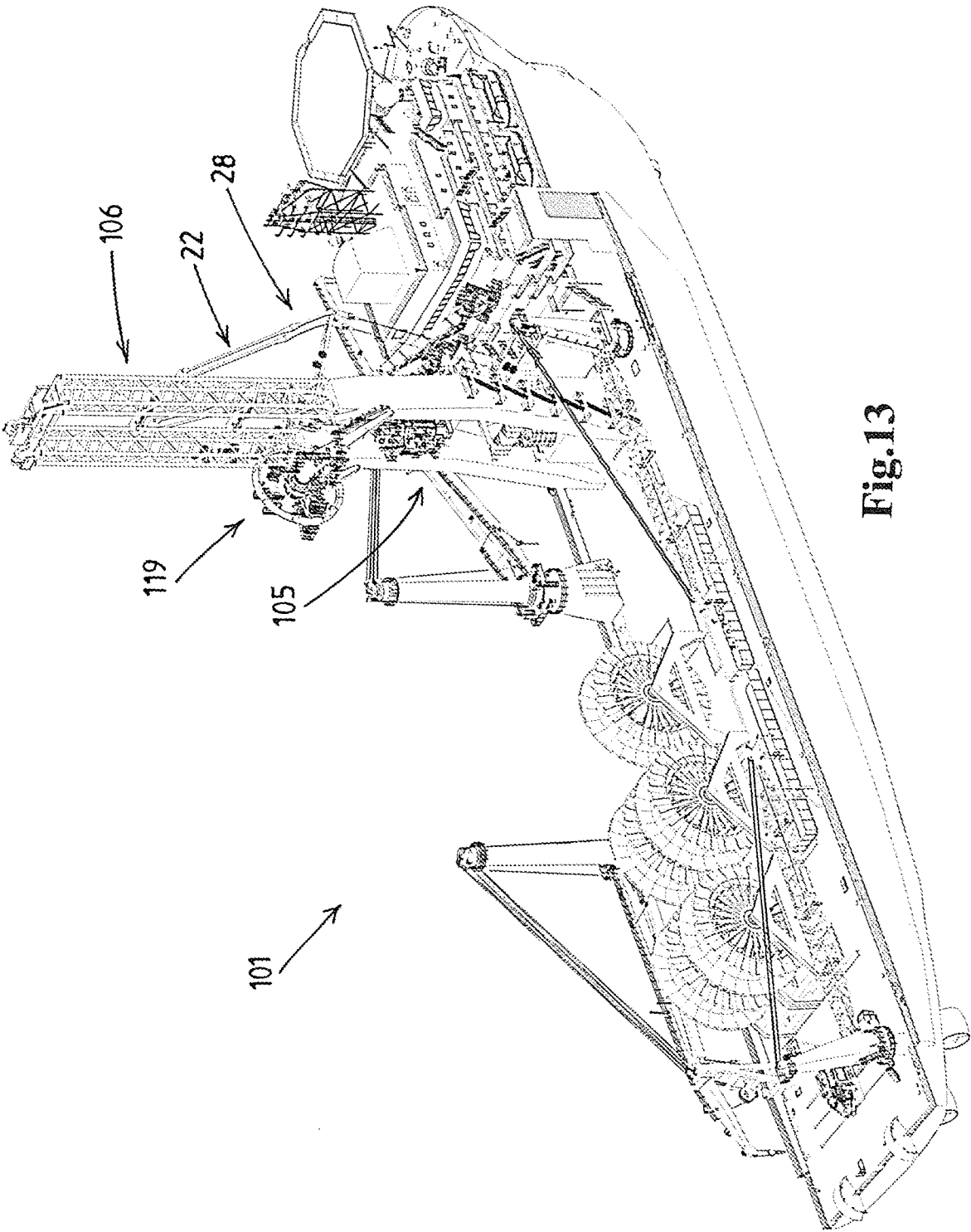


Fig.13

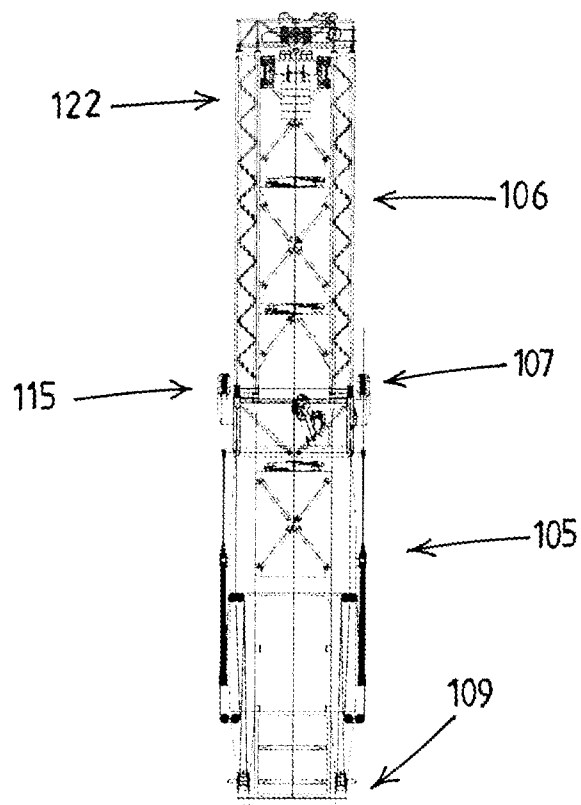


Fig.14

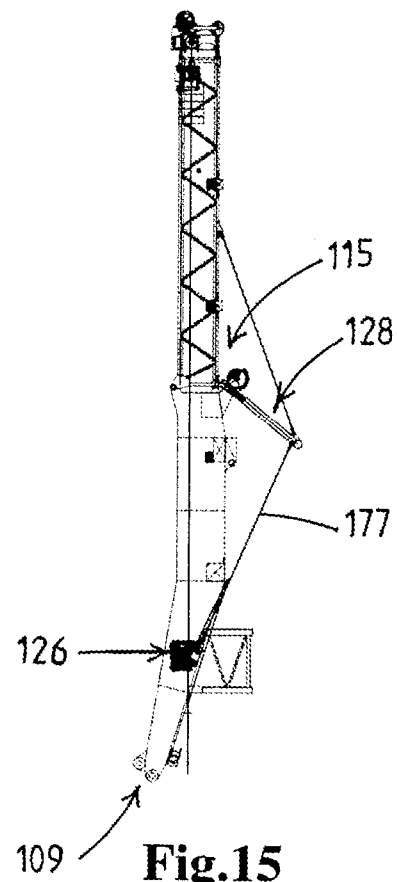


Fig.15

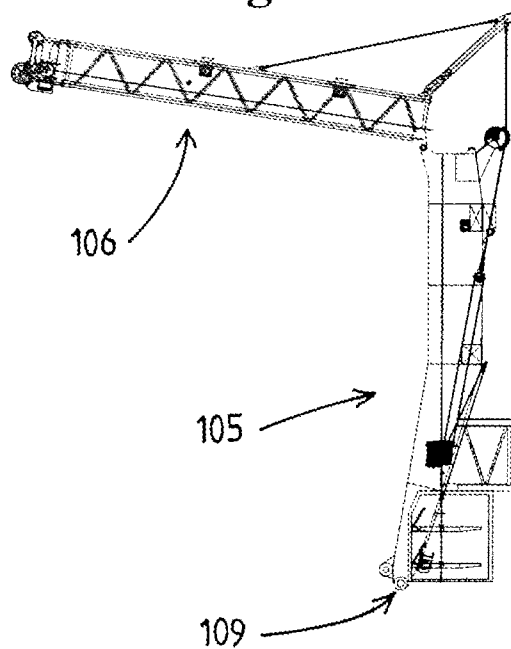


Fig.16

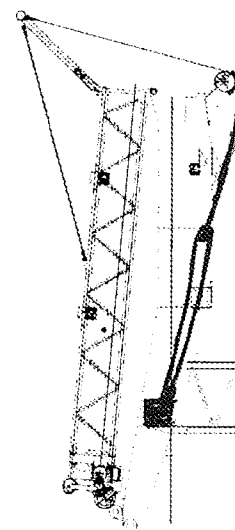


Fig.17

INTERNATIONAL SEARCH REPORT

International application No

PCT/NL2018/050157

A. CLASSIFICATION OF SUBJECT MATTER
 INV. F16L1/19 F16L1/20
 ADD.

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
 F16L

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

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

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2007/108673 A1 (ITREC BV [NL]; ROODENBURG JOOP [NL]; DE GROOT ANNE KLAAS [US]; WIJNING) 27 September 2007 (2007-09-27) cited in the application	12,15,16
A	abstract; figures	1-11,13, 14
A	----- WO 2016/175652 A1 (ITREC BV [NL]) 3 November 2016 (2016-11-03) abstract; figures	1
A	----- WO 2007/027087 A1 (HEEREMA MARINE CONTRACTORS NL [NL]; VAN ZANDWIJK CORNELIS [NL]; BEREND) 8 March 2007 (2007-03-08) abstract; figures -----	1



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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

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

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

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

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

"&" document member of the same patent family

Date of the actual completion of the international search

26 April 2018

Date of mailing of the international search report

07/05/2018

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
 NL - 2280 HV Rijswijk
 Tel. (+31-70) 340-2040,
 Fax: (+31-70) 340-3016

Authorized officer

Balzer, Ralf

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/NL2018/050157

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2007108673	A1	27-09-2007	AT 470815 T 15-06-2010
		BR PI0621558 A2	09-10-2012
		EP 2005050 A1	24-12-2008
		EP 2218953 A2	18-08-2010
		EP 2667070 A1	27-11-2013
		US 2010232884 A1	16-09-2010
		US 2011182671 A1	28-07-2011
		WO 2007108673 A1	27-09-2007

WO 2016175652	A1	03-11-2016	EP 3289263 A1 07-03-2018
		EP 3289264 A1	07-03-2018
		WO 2016175651 A1	03-11-2016
		WO 2016175652 A1	03-11-2016

WO 2007027087	A1	08-03-2007	NONE
