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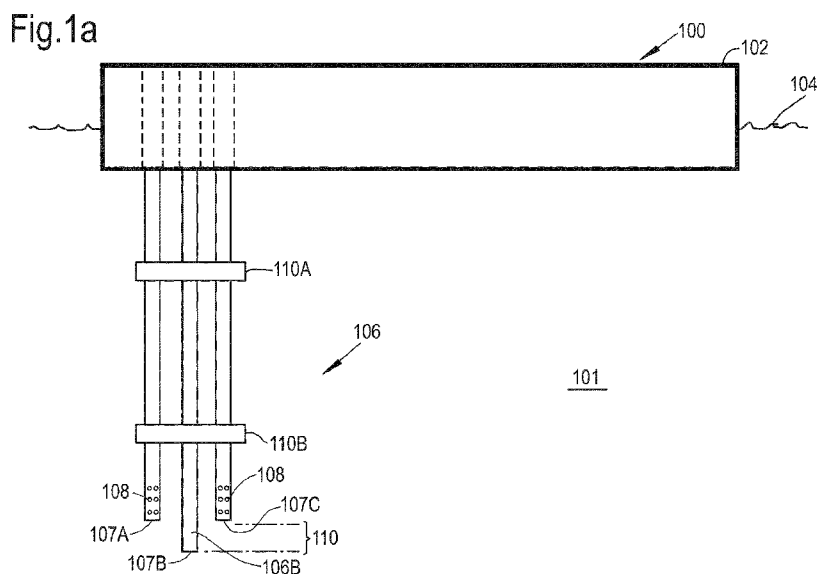
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(54) Title: FLOATING STRUCTURE COMPRISING A WATER INTAKE RISER BUNDLE



(57) Abstract: The invention relates to a floating structure (100) arranged in a body of water (101), comprising a floating body (102) and a water intake riser bundle (106) being suspended from the floating body (102) hanging downwardly into the body of water (101). The water intake riser bundle (106) comprises a structural riser (106B) and at least one water intake riser (106A, 106C). A distal end of the structural riser (106B) is located at a depth greater than the distal ends of the at least one water intake riser (106A, 106C).

**Floating structure comprising a
water intake riser bundle**

TECHNICAL FIELD

The present invention relates to a floating structure, in particular a floating structure comprising a liquid natural gas plant, arranged in a body of water, comprising a floating
5 body and a water intake riser bundle being suspended from the floating body hanging downwardly into the body of water, the water intake riser bundle comprising a structural riser and at least one water intake riser. The invention further relates to a method of installing such a floating structure,
10 a method of producing a liquefied hydrocarbon stream and a method of producing a vaporous hydrocarbon stream.

STATE OF THE ART

A commercially important liquefied hydrocarbon is
15 liquefied natural gas (LNG), which is typically produced by extracting heat from a natural gas stream whereby the natural gas is cooled to reach a temperature that is below the bubble point of the LNG at atmospheric pressure. The temperature is typically about -162 °C. The removed heat is generally
20 brought into the ambient. In case of a water-cooled LNG production process, the heat is removed by cooling water and generally released into the sea.

Before use by an end user, the LNG is typically revaporized, which involves withdrawing heat from the ambient
25 and adding this heat to the LNG. The heat may be taken from a stream of sea water.

WO2012066039 discloses an off-shore structure from which a water intake riser assembly is suspended into a body of water. The water riser assembly is employed to take in water
30 from a certain depth from the body of water, and supply the

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water to the off-shore structure via the water intake riser assembly. The water is used to add heat to, or remove heat from, a hydrocarbon stream. Subsequently the water is disposed of.

5 The water intake riser assemblies can be formed as a water intake riser bundle comprising a plurality of risers that generally extend side by side along a length direction. The term riser is used in this text to denote a substantially vertical element, such as a pipe or a conduit. Risers are
10 typically tubular shaped. The distal end of the water intake riser assembly may hang free from the ocean floor, for instance at a depth of between around 130 to 170 meters from the surface of the body of water. It is further disclosed that the water intake riser assembly may be employed at other
15 depths as well.

 The water intake riser bundle comprises a plurality of risers, of which one may serve as a structural riser, also referred to as a structural conduit. For instance, the bundle may comprise nine tubular risers arranged in a three by three
20 array, wherein the tubular riser at the centre serves as structural riser. The structural riser may serve as a support for one or more spacers. In this example, each spacer comprises eight guiding sleeves, through which the other eight tubular risers are guided to keep the tubular risers
25 bundled, although spaced apart. The spacers may be provided at predetermined locations along the structural riser. The structural riser may, or may not, convey water to the surface (i.e., may or may not serve as a water intake riser).

 With the present design it is cumbersome to establish a
30 transmission path for signals, fluids other than the cooling water or energy (e.g. electric/pneumatic/hydraulic) between the off-shore structure and the lower or distal end of the water riser intake bundle. Also, with the present design it

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is difficult to reach the distal end of the structural riser for maintenance or other purposes.

SHORT DESCRIPTION

5 It is an object to provide a floating structure which overcomes at least one of the above drawbacks.

The term 'comprising' is used in this text to indicate that all the enlisted elements are encompassed without excluding the presence of additional non-named elements.

10 In accordance with an aspect of the present invention there is provided a floating structure 100 arranged in a body of water 101, comprising a floating body 102 and a water intake riser bundle 106 being suspended from the floating body 102 hanging downwardly into the body of water 101, the
15 water intake riser bundle 106 comprising a structural riser 106B and at least one water intake riser 106A, 106C, wherein a distal end of the structural riser 106B is located at a depth greater than the distal ends of the at least one water intake riser 106A, 106C.

20 The distal end of the structural riser may in particular be located at a depth greater than the depth of distal ends of each water intake risers.

The structural riser 106B has a length which is greater than the length of the respective water intake risers 106A,
25 106C.

The portion of the structural riser extending beyond the distal end of the at least one water intake riser is referred to as the protruding portion.

The structural riser and the water intake risers each
30 comprise a proximal end, via which they are suspended from the floating body and a distal end, located away from the floating structure. The distal ends of the risers are the ends of the risers which are, when suspended from the

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floating body, furthest away from the floating body and closest to the seabed.

The proximal ends may be connected to the floating structure by a coupling, providing some freedom of movement
5 for the water intake riser bundle when being suspended from the floating structure. The coupling may comprise a swivel joint, a ball joint, a riser hanger, or other pivotable or hingeable couplings. Particular reference is made to US Patent 7,318,387 which describes a riser hanger construction
10 involving a flexible load transfer element and a hose to convey the water.

The water intake risers comprise a water inlet section, preferably located in a distal portion of the water intake riser. The water intake sections may be provided with water
15 intake openings distributed along the water-intake sections. The water intake openings may be distributed along the length and the circumference of the water intake sections. The water inlet section may be formed as a perforated sleeve. An example thereof is described in WO2012066039.

20 It is noted that the water intake risers may be provided in a staggered orientation as for instance described in WO2012066039, having distal ends at different depths. In such a case, the distal end of the structural riser is at a depth greater than the distal end of the water intake riser having
25 its distal end at the greatest depth. The protruding portion of the structural riser is the portion extending beyond the distal end of the water intake riser having its distal end at the greatest depth.

The above described floating structure allows divers or
30 ROVs (remotely operated underwater vehicles) to be able to access the distal end of the structural riser, for instance to connect transmission lines or cables, e.g. flying leads, between the distal end/protruding portion of the structural

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riser and one or more of the water intake risers. Such transmission lines or cables may be used to transmit signals (control signals/sensor data), fluids other than the cooling water or energy (e.g. electric/pneumatic/hydraulic) between
5 the distal portion of structural riser and the water intake risers.

Such a construction also allows easy access to the distal end/protruding portion of the structural riser for maintenance.

10 The construction also allows sensor equipment or parts thereof, such as a memory unit comprising sensor data, to be positioned, replaced and/or removed to/from the distal end or protruding portion of the structural riser.

The structural riser and the water intake risers are
15 preferably made of steel, e.g. carbon-steel.

According to an embodiment the water intake riser bundle 106 comprises at least one transmission line between the structural riser and at least one of the water intake risers.

Such a transmission line may be formed by a (flexible)
20 cable or a conduit, for instance in the form of a flying lead and may be used to transmit signals (control signals/sensor data), fluids other than the cooling water (e.g. anti-fouling agents to prevent clogging of the water intake riser) or energy (e.g. electric/pneumatic/hydraulic).

25 According to an embodiment the structural riser 106B comprises transmission lines running between the proximal end and the distal end or protruding portion of the structural riser.

These transmission lines, which may also be referred to
30 as umbilicals, may be connected to transmission line connectors positioned at the distal end of the structural riser or along the protruding portion of the structural riser, and/or may be connected to equipment positioned at the

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distal end or protruding portion of the structural riser, such as a measurement unit.

The structural riser 106B may comprise transmission lines which run through the inside of the structural riser between the proximal end and the distal end or protruding portion. At the proximal end, the transmission lines may be connected to further equipment on the floating body. The transmission lines may serve to transmit signals (control signals/sensor data), fluids other than the cooling water (e.g. anti-fouling agents to prevent clogging of the water intake riser) or energy (e.g. electric/pneumatic/hydraulic). The term transmission line comprises transmission cables and transmission conduits.

According to an embodiment the structural riser comprises one or more transmission line connectors.

Such transmission line connectors may be positioned at the distal end of the structural riser or along the protruding portion of the structural riser. This allows easy connection of transmission lines between the structural riser and the water intake riser(s) by a diver or ROV.

In case one or more transmission lines are to be provided between the structural riser and the water intake riser(s), transmission line connectors may also be provided on the water intake risers. This way a transmission path can be established between the structural riser and the water intake riser(s).

So, according to an embodiment, the structural riser comprises one or more transmission lines which are connected to transmission line connectors provided at the distal end or protruding portion of the structural riser and transmission lines are further provided to connect the transmission line connectors provided at the distal end or protruding portion of the structural riser to the water intake risers.

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According to an embodiment the structural riser comprises a measurement unit positioned at the distal end or protruding portion of the structural riser.

The measurement unit may comprise measurement equipment
5 for measuring movement of the structural riser, an energy source for energizing the measurement equipment and a memory unit for storing measurement data.

The measurement unit may be connected to transmission lines running through the structural riser to the floating
10 body to energize the measurement unit and/or to establish a data connection between the measurement unit and the floating body.

Now the distal end or protruding portion of the structural riser is easily accessible, replacing the energy
15 source of the measurement unit is made easier. Also, a memory unit present in the measurement unit may be replaced in an easy manner by using a ROV or diver.

According to an embodiment the structural riser comprises one or more spacers 110 arranged to keep the at least one
20 water intake riser at a predetermined position with respect to the structural riser.

The distal end of the structural riser is located at a greater depth than the lowest spacer.

As described above, the structural riser may serve as a
25 support for one or more spacers. The spacers may be formed as guiding sleeves, through which the water intake risers are guided to keep the structural riser and the water intake risers bundled, but avoiding collisions. The spacers may be provided at predetermined locations along the structural
30 riser. The structural riser may, or may not, convey water to the surface (i.e., may or may not serve as a water intake riser).

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According to an embodiment the structural riser comprises a riser element extending between the proximal end and the distal end which is formed as a single piece.

The riser element, in particular being a tubular riser element, may be formed as a single piece, which includes being formed by a plurality of (tubular) riser segments being connected in a non-releasable manner, in particular being connected by welding. Although it is understood that parts connected by welding can be separated, for this text direct welding is considered to be a non-releasable connection.

This has the advantage that the structural riser, or at least the tubular riser element thereof, can be assembled on-shore with the transmission lines running between the proximal end and the distal end of the structural riser already in place. This makes complicated off-shore assembling of the structural riser no longer necessary, as the riser element can be manufactured on-shore. The term on-shore relates to activities performed on land or in the harbour.

The tubular riser element may have a length of more than 100 meter, preferably more than 150 meter, more than 200 meter, more than 250 meter or even more than 300 meter.

Additional parts may be connected to the riser element, such as spacers formed as guiding sleeves for other risers and a coupling for coupling the risers to the floating structure providing some freedom of movement for the water intake riser bundle when being suspended from the floating structure as described above.

In case a water intake riser bundle is needed with a longer length than the riser element, additional riser segments may be attached to the riser element. This may be done off-shore.

According to an embodiment the floating structure comprises a LNG (liquid natural gas) plant.

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Such a floating structure is usually referred to as a floating LNG plant. The LNG plant may be floating plant for liquefying a vaporous hydrocarbon containing feed stream. The floating body may also be a floating plant for gasifying a liquefied hydrocarbon stream. In other words, the LNG plant may cool and liquefy natural gas to form LNG, and/or heat and gasify LNG.

In case of a liquefaction plant, the water riser bundle is suspended from the floating structure to take in water at depth and convey the water upward to the LNG plant for cooling purposes. In case of a gasification plant, the water riser bundle is suspended from the floating structure to take in water at depth and convey the water upward to the LNG plant for heating purposes.

In both cases the water may be input to heat exchangers provided on the floating structure as part of the LNG plant to add or remove heat to/from a process performed on the off-shore structure. Heated or cooled water from the outlet of the heat exchangers may be discharged back into the ocean at the surface, or alternatively conveyed back to depth with a discharge system.

According to another aspect there is provided a method of installing a floating structure 100, the method comprising

- a) providing a floating structure 100 in a body of water (101), the floating structure 100 comprising a floating body 102,
- b) moving the floating structure 102 to its production location,
- c) suspending a water intake riser bundle 106 from the floating body 102, the water intake riser bundle hanging downwardly into the body of water 101, the water intake riser bundle 106 comprising a structural riser 106B and at least one water intake riser 106A, 106C, wherein a distal end of the structural riser 106B is located at a depth greater than the distal

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ends of the at least one water intake riser 106A,
106C,

d) deploying a remotely operated vehicle into the body of
water 101 and operating the remotely operated vehicle
5 to mechanically interact with the distal end of the
structural riser 106B.

The mechanical interaction may involve connecting or
disconnecting transmission lines. The mechanical interaction
may comprise removing, installing or replacing a device to
10 the distal end of the structural riser, such as measurement
equipment, an energy source, e.g. a battery, or a memory
unit.

The floating body may be a FLNG, i.e. a floating plant
for liquefying a vaporous hydrocarbon containing feed stream.
15 The floating body may also be a floating plant for gasifying
a liquefied hydrocarbon stream.

The structural riser may comprise transmission lines
running between the proximal end and the distal end of the
structural riser. The distal end or protruding portion of the
20 structural riser may comprise transmission line connectors.
The water intake risers may also comprise transmission line
connectors.

According to an embodiment d) comprises providing at
least one transmission line between the structural riser and
25 at least one of the water intake risers.

Such a transmission line may be formed by a cable or a
conduit, for instance in the form of a flying lead and may be
used to transmit signals (control signals/sensor data),
fluids other than the cooling water (e.g. anti-fouling agents
30 to prevent clogging of the water intake riser) or energy
(e.g. electric/pneumatic/hydraulic).

According to an embodiment the water intake riser bundle
comprises first water intake risers have distal ends at a
first depth and second water intake risers have distal ends

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at a second depth, the first depth being deeper than the second depth and step d) comprises

d1) providing transmission lines between the structural riser and the first water intake risers and

5 d2) providing transmission lines between respective first water intake risers and respective second water intake risers.

In this embodiment, the distal end of the structural riser is located at a depth greater than the first depth.

10 According to a further aspect there is provided a method of producing a liquefied hydrocarbon stream, comprising:

- feeding a vaporous hydrocarbon containing feed stream to a floating structure according to the above;
- on the floating structure, forming a liquefied hydrocarbon stream from at least a part of the vaporous hydrocarbon containing feed stream comprising at least extracting heat from at least said part of the vaporous hydrocarbon containing feed stream;
- supplying water to the floating body via the water intake riser bundle of the floating structure;
- adding at least part of the heat removed from said at least a part of the hydrocarbon containing feed stream to at least part of the water supplied via the water intake riser bundle;
- 25 - subsequently disposing of the at least part of the water.

According to a further aspect there is provided a method of producing a vaporous hydrocarbon stream, comprising:

- providing a liquefied hydrocarbon stream on a floating structure according to the above;
- 30 - on the floating structure, forming a vaporous hydrocarbon stream from at least a part of the liquefied

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hydrocarbon stream comprising adding heat to the said part of the liquefied hydrocarbon stream;

- supplying water to the floating body via the water intake riser bundle of the floating structure;

5 - drawing at least part of the heat for adding to the said part of the liquefied hydrocarbon stream from at least part of the water supplied via the water intake riser bundle;

10 - subsequently disposing of the at least part of the water.

SHORT DESCRIPTION OF THE DRAWINGS

The invention will be further illustrated hereinafter by way of example only, and with reference to the non-limiting
15 drawings in which:

Fig. 1a-1c schematically illustrate a floating structure arranged in a body of water comprising a water intake riser bundle according to embodiments of the present invention.

20 DETAILED DESCRIPTION

In this description same reference numbers refer to similar components. The person skilled in the art will readily understand that, while the invention is illustrated making reference to one or more a specific combinations of
25 features and measures, many of those features and measures are functionally independent from other features and measures such that they can be equally or similarly applied independently in other embodiments or combinations.

Figure 1a schematically illustrates a floating structure
30 100 arranged in a body of water 101. The floating structure 100 comprises a floating body 102, and a water intake riser bundle 106 suspended from the floating body 102 into the body of water 101. The floating body 102 floats on a water

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surface 104 of the body of water 101. The floating body 102 may be moored to a turret (not shown) in weathervaning relationship with the turret comprising rotatability about a vertical axis through the turret.

5 The water intake riser bundle 106 comprises at least one, preferably more than one, risers 106A - C. The risers may be formed as tubulars.

10 The term "bundle" is used to imply that a plurality of risers 106A-C are positioned parallel and close to each other such that the plurality of risers behave like a bundle. Preferably, the risers are bundled together side-by-side forming a single water intake riser assembly, as described for instance in US 2013/0239480.

15 In the example of Figure 1a, for instance, the risers 106A-C are laterally connected to each other by means of at least one spacer 110A-B. By means of such spacers 110A-B, the risers 106A-C are physically associated or connected together. In one embodiment, enough spacers 110A-B may be provided to keep the risers 106A-C from striking into one
20 another and to make the risers 106A-C behave as one unified bundle 106.

 The water intake riser bundle 106 hangs freely downwardly into the body of water 101.

25 The one or more risers 106A-C are configured to take in cold water at depth via water intake sections 108 provided with water intake openings, and to convey the cold water upward to the floating body 102. The water intake openings may be provided as a plurality of through holes through the side wall of the one or more water intake risers.

30 The cold water may be input to heat exchangers to add or remove heat to/from a process performed on the off-shore structure 100. The hardware needed for adding/removing heat is not shown. Heated or cooled ocean water from the outlet of

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the heat exchangers may be discharged back into the body of water 101 at the surface, or alternatively conveyed back to depth with a discharge system.

One of the risers 106B may be a structural riser,
5 possibly not arranged for taking in water. The structural riser 106B supports the spacers 110A-B.

The water intake risers and the structural riser each comprise a proximal end, closest to the floating body 102 and a distal end 107 A-C. The distal ends 107A-C are considered
10 to be the part furthest removed from the floating body 102.

The structural riser 106B comprises a protruding portion 110, being the portion extending beyond the (deepest) distal ends 107A, C of the water intake risers 106A, C.

The distal ends of the water intake risers 106A, C may
15 be arranged in a staggered configuration such as proposed in US 2013/0239480.

Although the examples shown in the figures show three risers 106A-C, the water intake riser bundle 106 can comprise any suitable number of risers, preferably a larger number.
20 The water intake riser bundle 106 may comprise nine risers arranged in a three-by-three rectangular array or circular pattern, according to one particular embodiment. The array has eight water intake risers along the periphery and one at the center. The riser at the centre may serve as a structural
25 support riser or structural riser for the spacers through which the other eight risers guided. Such a configuration is known from US pre-grant application publication No. 2013/0239480. The structural riser may or may not serve to take in water.

30 Fig. 1b shows an alternative embodiment further comprising transmission lines 120 inside the structural riser 106B, transmission line connectors 121 positioned at the distal end 107B of the structural riser 106B connected to the

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transmission lines 120 inside the structural riser 106B,
further transmission line connectors 123 positioned on the
water intake risers 106A, C and further transmission lines
connecting the respective transmission line connectors 121 on
5 the structural riser 106B to the further transmission line
connectors 123 on the water intake risers 106A, C.

This embodiment may for instance be used to supply anti-
fouling agents to the water intake risers 106A, C to prevent
clogging of the water intake riser

10 Fig. 1c shows an alternative embodiment wherein the
structural riser 106B comprises a measurement unit 130
positioned at the protruding portion of the structural riser
106B. A transmission line 131 is provided running through the
structural riser 106B to the floating body, e.g. for
15 energizing the measurement unit 130 or transmitting
measurement data.

The water intake riser bundle as described above may be
used to supply process water to any process carried out on
the floating body of the floating structure.

20 In one specific example, it may be used in a method of
producing a liquefied hydrocarbon stream, comprising:
- feeding a vaporous hydrocarbon containing feed stream to
the floating structure;
- forming a liquefied hydrocarbon stream from at least a part
25 of the vaporous hydrocarbon containing feed stream comprising
at least extracting heat from at least said part of the
vaporous hydrocarbon containing feed stream;
- supplying water to the floating body via the water intake
riser bundle;
30 - adding at least part of the heat removed from said at least
a part of the hydrocarbon containing feed stream to at least
part of the water supplied via the water intake riser bundle;
- subsequently disposing of the at least part of the water.

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A well known example of a liquefied hydrocarbon stream is a liquefied natural gas stream. A variety of suitable installations and line ups are available in the art for extracting heat from a vaporous hydrocarbon containing feed stream, particularly a natural gas stream, as well as other treatment steps such as removal of unwanted contaminants and components from the feed stream often performed in conjunction with producing a liquefied hydrocarbon stream, and need not be further explained herein.

- 10 In another specific example, the water intake riser bundle may be used in a method of producing a vaporous hydrocarbon stream, comprising:
- providing a liquefied hydrocarbon stream to the floating structure;
 - 15 - forming a vaporous hydrocarbon stream from at least a part of the liquefied hydrocarbon stream comprising adding heat to the said part of the liquefied hydrocarbon stream;
 - supplying water to the floating body via the water intake riser bundle;
 - 20 - drawing at least part of the heat for adding to the said part of the liquefied hydrocarbon stream from at least part of the water supplied via the water intake riser bundle; and
 - subsequently disposing of the at least part of the water.

A variety of suitable installations and line ups are available in the art for regasification or vaporisation of previously liquefied hydrocarbons streams and adding heat to such a liquefied hydrocarbon stream, and need not be further explained herein.

The person skilled in the art will understand that the present invention can be carried out in many various ways without departing from the scope of the appended claims.

C L A I M S

1. Floating structure (100) arranged in a body of water (101), comprising a floating body (102) and a water intake riser bundle (106) being suspended from the floating body (102) hanging downwardly into the body of water (101), the water intake riser bundle (106) comprising a structural riser (106B) and at least one water intake riser (106A, 106C), wherein a distal end of the structural riser (106B) is located at a depth greater than the distal ends of the at least one water intake riser (106A, 106C).
2. Floating structure (100) according to claim 1, wherein the water intake riser bundle (106) comprises at least one transmission line (122) between the structural riser and at least one of the water intake risers.
3. Floating structure (100) according to any one of the preceding claims, wherein the structural riser (106B) comprises transmission lines (120) running between the proximal end and the distal end (107B) or protruding portion of the structural riser (110).
4. Floating structure (100) according to any one of the preceding claims, wherein the structural riser (106B) comprises one or more transmission line connectors (121).
5. Floating structure (100) according to any one of the preceding claims, wherein the structural riser (106B) comprises a measurement unit (130) positioned at the distal end or protruding portion of the structural riser.

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6. Floating structure (100) according to any one of the preceding claims, wherein the structural riser (106B) comprises one or more spacers (110) arranged to keep the at least one water intake riser at a predetermined position with respect to the structural riser.

7. Floating structure (100) according to any one of the preceding claims, wherein the structural riser comprises a riser element extending between the proximal end and the distal end which is formed as a single piece.

8. Floating structure (100) according to any one of the preceding claims, wherein the floating structure comprises a LNG (liquid natural gas) plant.

15

9. Method of installing a floating structure (100), the method comprising

a) providing a floating structure (100) in a body of water (101), the floating structure (100) comprising a floating body (102)

b) moving the floating structure (102) to its production location,

c) suspending a water intake riser bundle (106) from the floating body (102), the water intake riser bundle hanging downwardly into the body of water (101), the water intake riser bundle (106) comprising a structural riser (106B) and at least one water intake riser (106A, 106C), wherein a distal end of the structural riser (106B) is located at a depth greater than the distal ends of the at least one water intake riser (106A, 106C),

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d) deploying a remotely operated vehicle into the body of water (101) and operating the remotely operated

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vehicle to mechanically interact with the distal end of the structural riser (106B).

10. Method according to claim 9, wherein d) comprises
5 providing at least one transmission line between the structural riser and at least one of the water intake risers.

11. Method according to any one of the claim 10, wherein the water intake riser bundle comprises first water intake risers
10 have distal ends at a first depth and second water intake risers have distal ends at a second depth, the first depth being deeper than the second depth and step d) comprises
d1) providing transmission lines between the structural riser and the respective first water intake risers and
15 d2) providing transmission lines between respective first water intake risers and respective second water intake risers.

12. Method of producing a liquefied hydrocarbon stream,
20 comprising:
- feeding a vaporous hydrocarbon containing feed stream to a floating structure according to any one of the claims 1 - 8;
- on the floating structure, forming a liquefied
25 hydrocarbon stream from at least a part of the vaporous hydrocarbon containing feed stream comprising at least extracting heat from at least said part of the vaporous hydrocarbon containing feed stream;
- supplying water to the floating body via the water
30 intake riser bundle of the floating structure;
- adding at least part of the heat removed from said at least a part of the hydrocarbon containing feed stream to

- 20 -

at least part of the water supplied via the water intake riser bundle;

- subsequently disposing of the at least part of the water.

5

13. Method of producing a vaporous hydrocarbon stream, comprising:

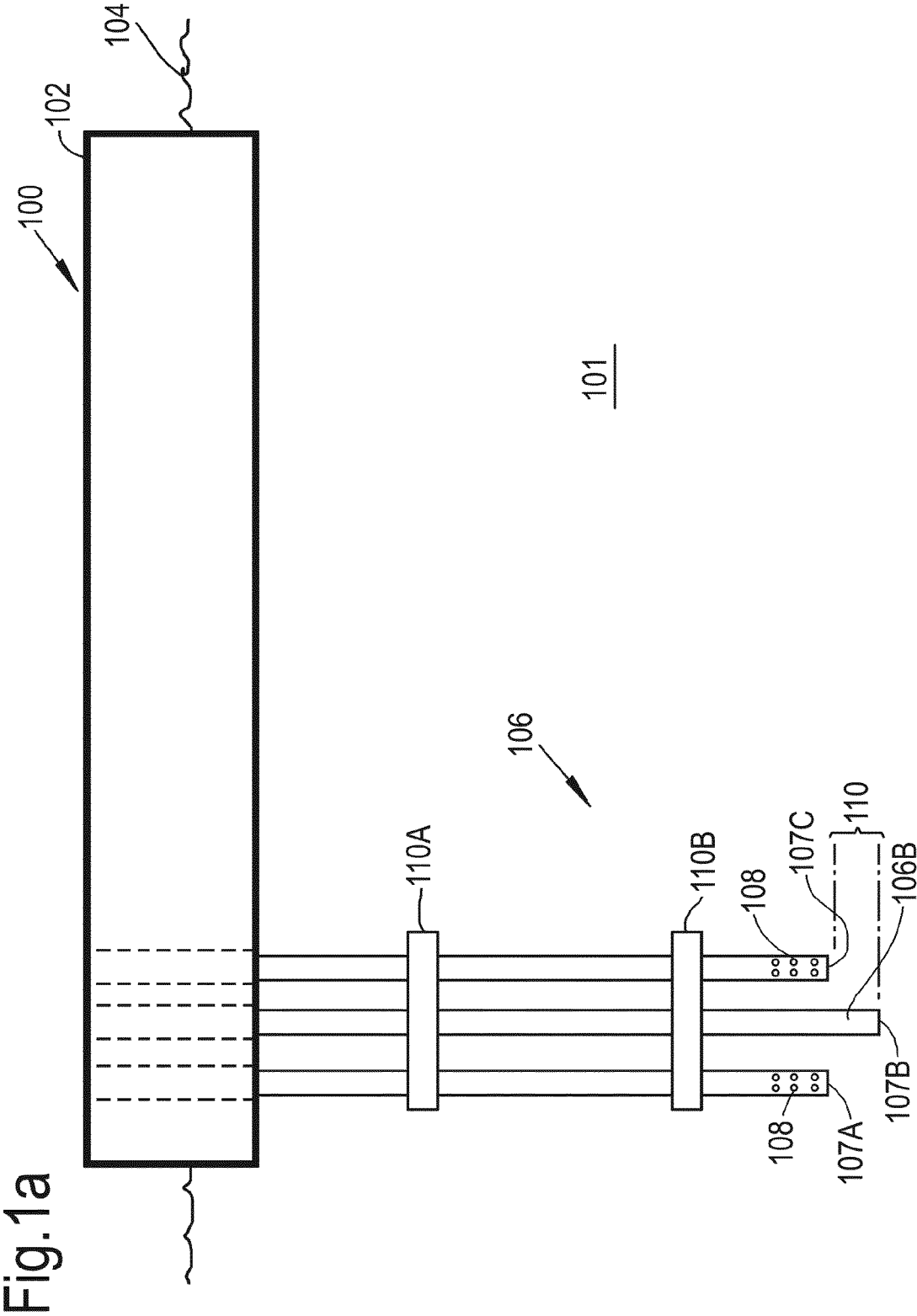
- providing a liquefied hydrocarbon stream on a floating structure according to any one of the claims 1 - 8;

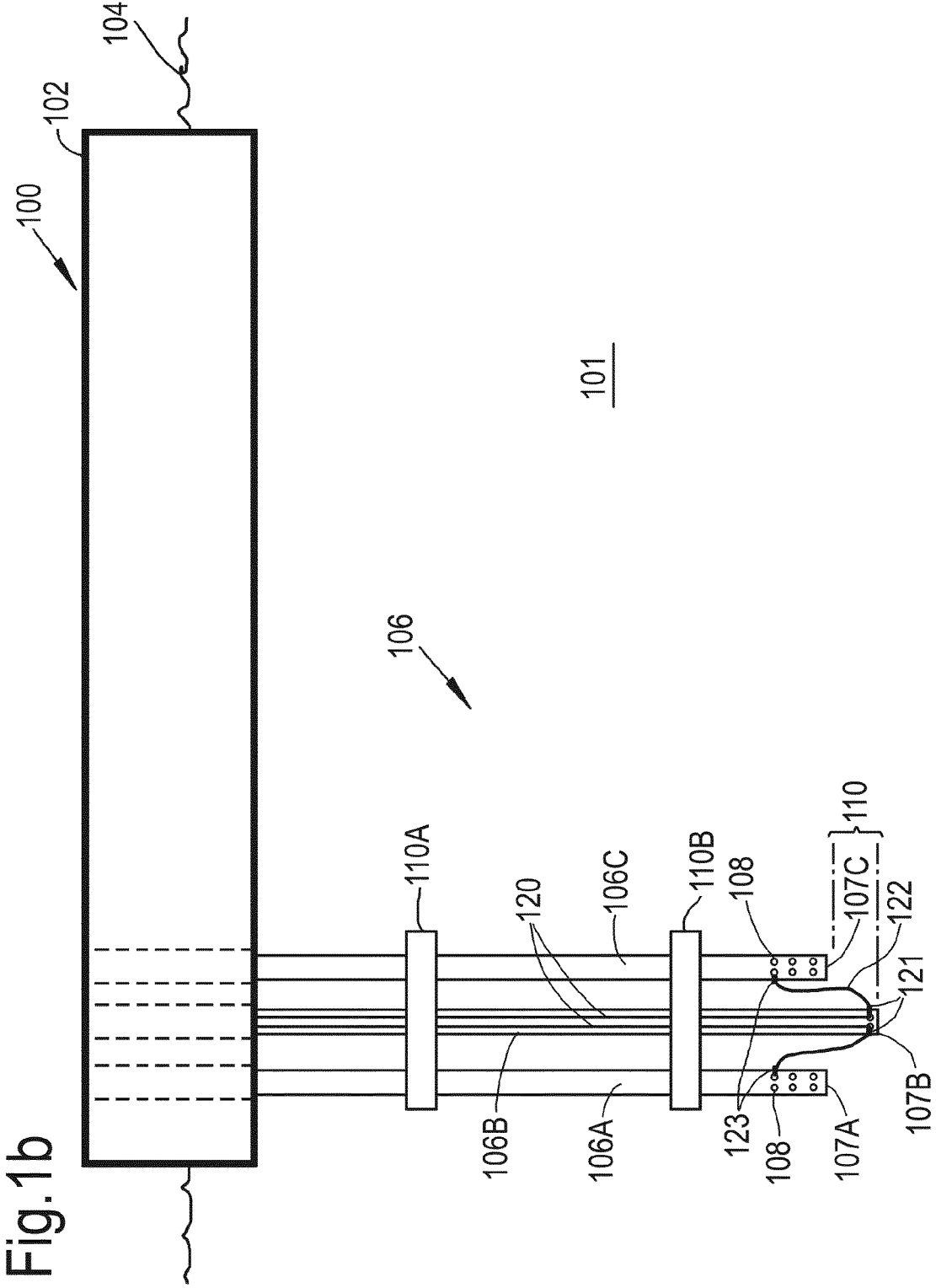
10 - on the floating structure, forming a vaporous hydrocarbon stream from at least a part of the liquefied hydrocarbon stream comprising adding heat to the said part of the liquefied hydrocarbon stream;

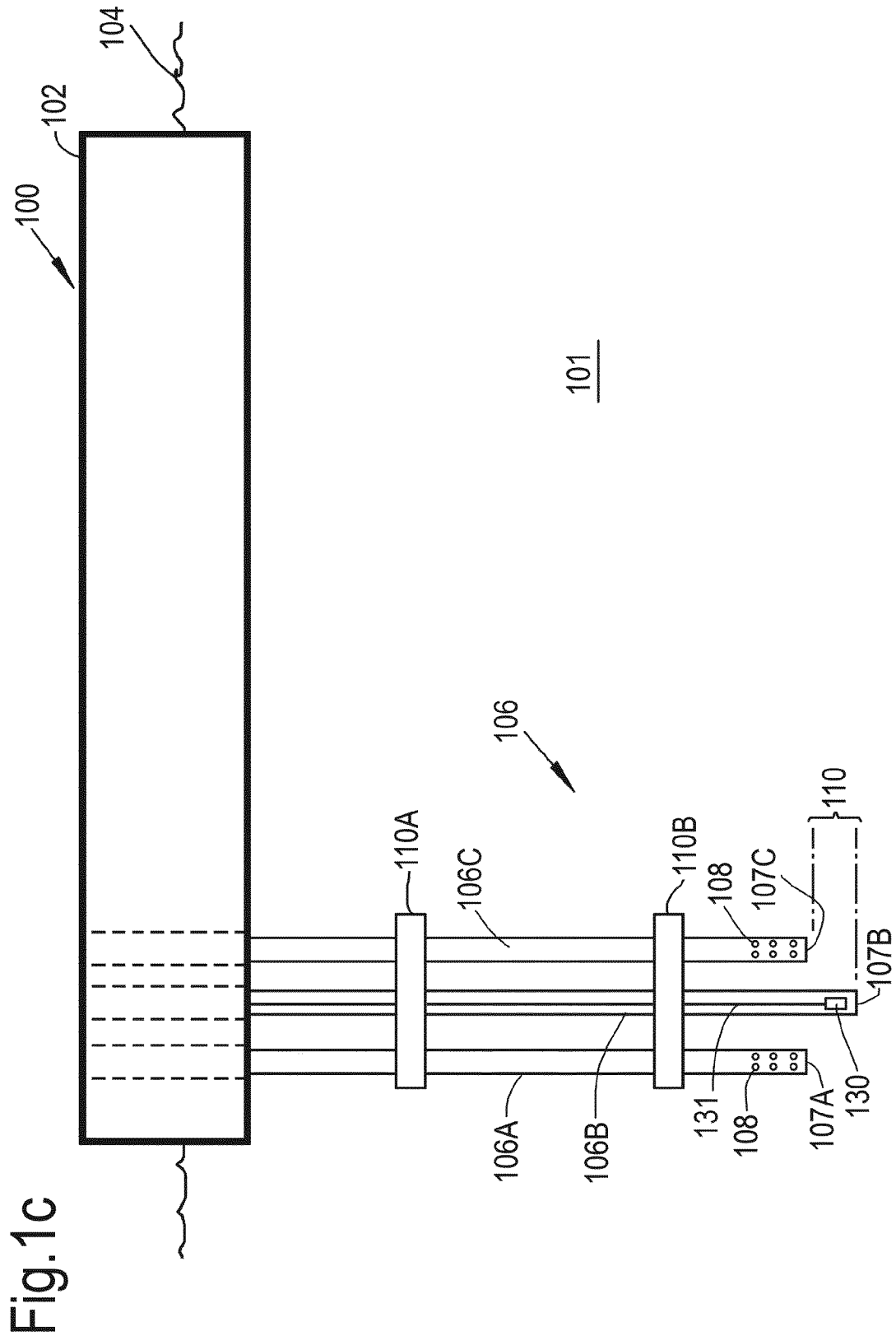
15 - supplying water to the floating body via the water intake riser bundle of the floating structure;

- drawing at least part of the heat for adding to the said part of the liquefied hydrocarbon stream from at least part of the water supplied via the water intake riser bundle;

20 - subsequently disposing of the at least part of the water.







INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2015/064197

A. CLASSIFICATION OF SUBJECT MATTER

INV. B63J2/12 F25J1/02
ADD. B63B9/06 B63B35/44

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)

B63J B63B F25J

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2012/066039 A1 (SHELL INT RESEARCH [NL]; EFTHYMIU MICHALAKIS [NL]; KUIPER GUIDO LEON) 24 May 2012 (2012-05-24) page 13, line 31 - page 17, line 19; figure 6 -----	1-13
X	WO 2012/066040 A1 (SHELL INT RESEARCH [NL]; EFTHYMIU MICHALAKIS [NL]; KUIPER GUIDO LEON) 24 May 2012 (2012-05-24) page 6, line 24 - page 7, line 29; figure 1 -----	1-13
X	US 2012/006053 A1 (ALLEN DONALD WAYNE [US] ET AL) 12 January 2012 (2012-01-12) paragraphs [0117] - [0120]; figure 6a -----	1-13



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

22 September 2015

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2015/064197

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2012066039 A1	24-05-2012	AU 2011331211 A1 CA 2814912 A1 CN 103221301 A EP 2640631 A1 ES 2528128 T3 JP 2014503402 A KR 20130121871 A RU 2013127571 A SG 189888 A1 US 2013239480 A1 WO 2012066039 A1	02-05-2013 24-05-2012 24-07-2013 25-09-2013 04-02-2015 13-02-2014 06-11-2013 27-12-2014 28-06-2013 19-09-2013 24-05-2012
WO 2012066040 A1	24-05-2012	AU 2011331212 A1 CN 103221768 A GB 2497708 A KR 20130122641 A WO 2012066040 A1	28-02-2013 24-07-2013 19-06-2013 07-11-2013 24-05-2012
US 2012006053 A1	12-01-2012	AP 3188 A AU 2009338154 A1 CN 102292556 A EP 2379895 A2 KR 20110117096 A RU 2011134832 A US 2012006053 A1 WO 2010085302 A2	31-03-2015 21-07-2011 21-12-2011 26-10-2011 26-10-2011 27-02-2013 12-01-2012 29-07-2010