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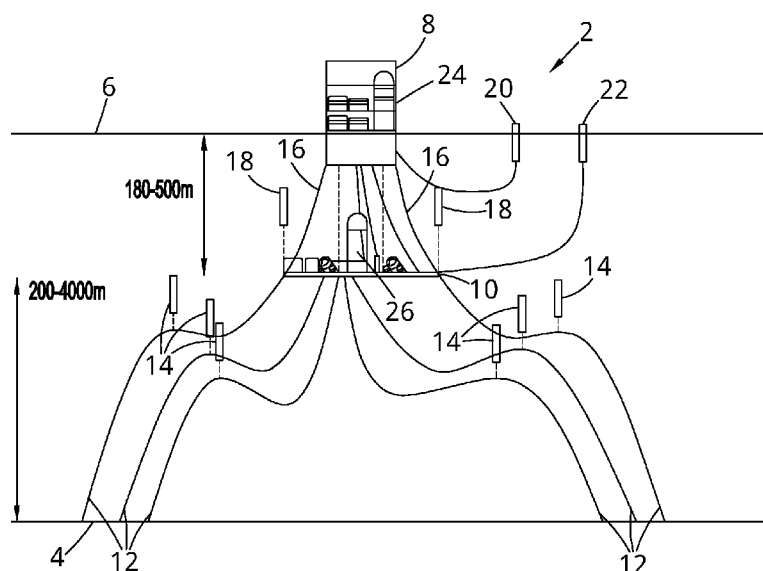


Fig. 1

(57) Abstract: An offshore hydrocarbon processing facility (2) comprises an offshore floating structure (8) and a submerged floating riser deck (10). The submerged floating riser deck is operatively connected to a subsea hydrocarbon riser (12). Hydrocarbon processing equipment (26) is disposed on the submerged floating riser deck. The offshore floating structure (8) may be connected to the submerged floating riser deck (10) using a riser (16) that can be disconnected if there is inclement weather.



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OFFSHORE HYDROCARBON PROCESSING FACILITY
AND METHOD OF OPERATION

The present invention relates to an offshore hydrocarbon processing facility.

5 A main source of hydrocarbons is offshore oil wells located on the sea bed. Sea bed installations have risers through which hydrocarbons can flow towards a surface installation, which is either a fixed or a floating installation at or near the surface of the sea.

10 At the surface installation, the hydrocarbons are processed, for example, by separating natural gas from liquid hydrocarbons and often compressing the natural gas into a liquefied state. These products can then be transferred from the surface installation to tankers or other floating vessels, for subsequent transport to the shore.

15 Another possibility is that some products are processed at the sea bed and may be piped via a pipeline to shore, without the need for flowing through a riser to the surface of the sea. One problem with this set-up is that the sea bed is often 2-3km below the surface of the water. This means that it is complicated to carry out maintenance work at the sea bed installation, particularly maintenance of the seabed processing equipment.

20 Another problem is that surface conditions offshore are more severe in terms of weather, water and ice. For example, high winds, precipitation, hurricanes, monsoons, icebergs, waves and ice floes and other adverse conditions can cause weathering and damage to the riser near the surface of the sea.

25 According to a first aspect of the present invention, there is provided an offshore hydrocarbon processing facility comprising: an offshore floating structure; a submerged floating riser deck operatively connected to a subsea hydrocarbon riser; and hydrocarbon processing equipment disposed on the submerged floating riser deck.

30 With this arrangement, hydrocarbons can flow from the sea bed to the submerged floating riser deck for processing there. This reduces or eliminates the need for processing equipment at the sea bed and so less maintenance will be required there. Moreover, since the submerged riser deck is floating, it is not as far underwater as the sea bed and so the processing equipment on the submerged floating riser deck which needs to be maintained is much easier to maintain. Since hydrocarbon processing can take place at the submerged floating riser deck, the risers, hydrocarbons and processing equipment are unaffected by sea surface conditions such as wind, waves, precipitation
35 and ice floes.

The submerged floating riser deck may be located at a depth of between 180m and 500m below the surface of the sea. The sea bed may be between 200m and 4000m deeper than the floating riser deck. Thus the effective level for maintenance can be raised from the sea bed to the more easily accessible location of the submerged riser deck. The riser may be a riser of the conventional type used in offshore hydrocarbon installations.

The submerged floating riser deck is supported in the water in a freely floating fashion. It may float suspended due to its own buoyancy or it may be coupled to positive buoyancy elements. It may hang suspended from the offshore floating structure, and thus may float together with the offshore floating structure. This can be aided by buoyancy of the offshore floating structure and/or by positive buoyancy elements connected to the offshore floating structure to aid floating. Thus, the submerged floating riser deck in example embodiments is not tethered to the sea bed using tension cables. Instead it may be anchored to the sea bed in a way that permits free floating, such as via a catenary mooring system, which may include catenary anchor cables or catenary risers. The catenary mooring system may be coupled to the submerged floating riser deck and/or to the offshore floating structure. As is known in the art it is possible to hold an offshore floating structure in a generally fixed location whilst permitting movement with tide and wave motion by using a catenary mooring of various types. Movement may also be permitted to avoid drifting ice, as discussed below. The presence of a catenary mooring arrangement as opposed to tension cables forming a taut mooring arrangement can provide one way to distinguish a freely floating structure from a tautly moored structure with positive buoyancy. The latter has a tendency to float but is not freely floating due to the moorings used.

The offshore hydrocarbon processing facility may comprise a riser arranged for disconnectable connection between the offshore floating platform and the submerged floating riser deck. This may be a catenary riser as mentioned above.

With this arrangement, when the surface conditions are not damaging, a riser may carry processed and/or unprocessed hydrocarbons from the submerged floating riser deck up to the offshore floating platform, for processing and/or transfer to a tanker, floating vessel or the like. When the surface conditions are deemed to be potentially damaging, the riser can be disconnected from the offshore floating platform, to avoid damage.

The floating structure (e.g. the platform or spar buoy) may have a mooring system enabling safe use of the structure where drifting ice may be present, such as in

artic/sub-arctic regions. In one arrangement this may be based on an adjustable mooring system or an active mooring system that enables the platform to move horizontally to avoid drifting ice without disconnecting from the risers. In a second possibility a partly disconnected mooring solution may be used for the floating structure.

5 In some examples, depending on the nature of the possible horizontal movement of the floating structure it may be advantageous for the floating structure to partially or fully disconnect from the submerged riser deck. For example, this may involve the use of disconnectable risers between the submerged riser deck and the floating structure, and/or a disconnectable mooring system coupling the submerged riser deck to the
10 floating structure. In the case where full disconnection is required then the submerged riser deck should be able to float independent of the floating structure. Thus, as noted above the submerged riser deck may have its own inherent buoyancy or it may be supported by additional positive buoyancy elements, such as floats tethered to the submerged deck.

15 The offshore hydrocarbon processing facility may be an unmanned hydrocarbon processing facility. This may be unmanned in that it has at least one of: no permanent personnel; no provision of facilities for personnel to stay on the offshore hydrocarbon processing facility, for example there may be no shelters for personnel, no toilet facilities, no drinking water, no personnel operated communications equipment and/or
20 no lifeboat; and/or a requirement that personnel be present for fewer than 10,000 maintenance hours per year.

The offshore floating structure may be any structure suitable for use in an offshore hydrocarbon processing facility. It may be an offshore floating platform, which in this sense is taken to include structures such as spar buoys as well as platform
25 structures with decks. The offshore floating structure can float with a proportion of the structure above sea level and a proportion of the structure below sea level. As discussed above the offshore floating structure may provide buoyancy for supporting the submerged floating riser deck.

30 The offshore floating structure may be an unmanned structure such as an unmanned platform. In some examples it is an unmanned production platform. The structure may be unmanned in that it has at least one of: no permanent personnel; no provision of facilities for personnel to stay on the platform, for example there may be no shelters for personnel, no toilet facilities, no drinking water, no personnel operated communications equipment and/or no lifeboat; and/or a requirement that personnel be
35 present for fewer than 10,000 maintenance hours per year.

An unmanned offshore floating structure has no permanent personnel and may only be occupied for particular operations such as maintenance and/or installation of equipment. The unmanned offshore floating structure may be a structure where no personnel are required to be present for the structure to carry out its normal function, for example day-to-day functions relating to handling of oil and/or gas products at the structure.

An unmanned offshore floating structure may be a structure with no provision of facilities for personnel to stay on the platform, for example there may be no shelters for personnel, no toilet facilities, no drinking water and/or no personnel operated communications equipment. The unmanned offshore floating structure may also include no heli-deck and/or no lifeboat, and advantageously may be accessed in normal use solely by a gangway or bridge connected to a service vessel or to another offshore floating structure. For example, the unmanned offshore floating structure may be accessed in normal use solely via a Walk to Work (W2W) system.

An unmanned offshore floating structure may alternatively or additionally be defined as unmanned based on the relative amount of time that personnel are needed to be present on the offshore floating structure during operation. This relative amount of time may be defined as maintenance hours needed per annum, for example, and an unmanned structure may be a structure requiring fewer than 10,000 maintenance hours per year, optionally fewer than 5000 maintenance hours per year, perhaps fewer than 3000 maintenance hours per year.

All of the hydrocarbon processing equipment for the offshore hydrocarbon processing facility may be entirely disposed on the submerged floating riser deck. In this arrangement, the processing can all take place in a submerged location unaffected by surface conditions such as waves, wind, precipitation or ice floes. The processed products are then ready for transfer to floating vessels, tankers or the like whenever surface conditions are appropriate, and/or for piping along pipelines to shore.

Alternatively, the offshore floating structure may comprise topside hydrocarbon processing equipment located on the offshore floating structure in addition to the subsea hydrocarbon processing equipment. The hydrocarbon processing facility may be configured such that a hydrocarbon fluid to be processed is processed first by the subsea hydrocarbon processing equipment and then by the topside hydrocarbon processing equipment. This may involve just a part of the hydrocarbon fluid being passed to the offshore floating structure from the subsea riser deck, with another part of the hydrocarbon fluid, which may be a product of the processing at the subsea riser

deck, being retained at the subsea riser deck or directed to a destination other than the offshore platform. This other destination may for example be a buoy as discussed below.

5 In this arrangement, all of or a part of the processing can take place at the subsea riser deck before the hydrocarbons are transferred to the offshore floating structure, allowing processing to carry on even during adverse surface conditions.

10 The hydrocarbon processing equipment at the subsea riser deck and/or at the floating structure (where present) may be arranged to produce at least one of a hydrocarbon liquid product, a hydrocarbon semi-stable liquid product and a liquefied gas product.

A semi-stable liquid product may consist of any or all of water, oil, condensate, Liquid Petroleum Gas, LPG, and Natural Gas Liquids, NGL. A liquefied gas product may be stored under pressure or may be exported via a pipeline to the shore or a host such as a floating vessel or tanker.

15 The processing equipment at the submerged floating riser deck may be arranged to separate liquid hydrocarbons, flash the separated liquid hydrocarbons and store the flashed hydrocarbons at the submerged floating riser deck. In this arrangement, this processing step can be done underwater and so avoid the need for transferring all of the hydrocarbons to the offshore floating structure.

20 The submerged floating riser deck may comprise a tank for storage of hydrocarbons, for example for storage of unprocessed or processed hydrocarbons, i.e. hydrocarbons before or after processing with the processing equipment at the submerged floating riser deck. In some examples there is a tank for storage of the flashed hydrocarbons.

25 The offshore floating structure may be horizontally offset from the submerged floating riser deck, such that the two are not vertically aligned.

30 With this arrangement, an intervention vessel, such as a tanker, floating vessel or the like, may position itself directly above the submerged floating riser deck, for direct communication with the submerged floating riser deck. This allows more direct communication between the submerged floating riser deck and an intervention vessel, without the need to communicate all fluids via the offshore floating platform.

35 The offshore hydrocarbon processing facility may comprise a buoy in addition to the offshore floating structure, wherein the submerged floating riser deck may be operatively connected to the buoy for offload of hydrocarbon products to a floating vessel.

With this arrangement, hydrocarbons do not need to be transferred via the offshore floating structure before being transferred to a floating vessel, tanker or the like.

The processing equipment at the submerged floating riser deck may comprise a separator. The separator may also act as a drain for the hydrocarbon processing
5 equipment and piping, and hence may be at a low point in relation to other parts of the processing equipment.

Electric power for the submerged riser deck may all be provided by submerged and topside units, i.e. units above the surface of the sea on the offshore floating platform. Alternatively, there may be local Hydraulic Power Units, HPU, subsea for
10 providing the power. The power system may include Variable Speed Drive, VSD, for subsea pumps.

According to a second aspect of the invention, there is provided a method of operating the offshore hydrocarbon processing facility of the first aspect, comprising: receiving hydrocarbons at the submerged floating riser deck from the subsea
15 hydrocarbon riser; and processing the hydrocarbons using the hydrocarbon processing equipment.

This method may include the use of any or all of the features described above in relation to the first aspect, thus achieving the same advantages.

The method may include disconnectably connecting the submerged floating riser
20 deck to the offshore floating structure using a disconnectable riser for transfer of hydrocarbons between them.

This allows a riser to be disconnected from the offshore floating structure when the surface conditions such as wind, precipitation, waves, ice floes and the like are deemed to be potentially damaging. When the surface conditions are not deemed to be
25 damaging, the riser can carry up processed and/or unprocessed hydrocarbons from the submerged floating riser deck to the offshore floating structure, for processing and/or transfer to a tanker, floating vessel or the like.

The method may comprise fluidly connecting the submerged floating riser deck to a floating vessel for transfer of hydrocarbons from the submerged floating riser deck
30 to the floating vessel; and/or fluidly connecting the submerged floating riser deck to a pipeline for transfer of hydrocarbons from the submerged floating riser deck via the pipeline. The pipeline may be for transporting the hydrocarbons to shore.

With this method, hydrocarbons can be transported either directly from the submerged floating riser deck to shore, or via a floating vessel, tanker or the like to
35 shore, or both. There is no necessity to transfer the hydrocarbons via the offshore

floating structure. In this manner, the hydrocarbon risers and the like need only minimally emerge, or not emerge at all from the surface of the sea and thus can reduce or avoid damage due to surface conditions.

The method may comprise fluidly connecting the submerged floating riser deck to a buoy; and transferring hydrocarbons from the buoy to a floating vessel.

In some instances, a permanent buoy can be used for floating vessels to connect to for transfer of hydrocarbons. This arrangement allows the hydrocarbons to remain almost entirely submerged until the buoy and thus significantly avoids damage due to adverse surface conditions.

The method may comprise: separating and flashing liquid hydrocarbons at the submerged floating riser deck; and storing the flashed hydrocarbons in storage tanks at the submerged floating riser deck. This processing step can be done underwater and so avoid the need for transferring all of the hydrocarbons to the offshore floating structure.

The method may further comprise drying and pressuring the gas obtained from the received hydrocarbons, for example as set out in WO2016192813 A1. Optionally, a water stream obtained from the drying process may be reinjected into a well, for example via the riser.

Certain preferred embodiments of the present invention will now be described in greater detail by way of example only and with reference to the accompanying drawings, in which:

Figure 1 shows an offshore hydrocarbon processing facility where an offshore floating structure includes a platform with decks; and

Figure 2 shows another offshore hydrocarbon processing facility where an offshore floating structure is a spar buoy.

Figure 1 shows an offshore hydrocarbon processing facility 2, located offshore, comprising an offshore floating structure 8 (designed to be unmanned as discussed above) and a submerged floating riser deck 10. The offshore floating structure 8 is a platform with decks that may hold equipment as required for the intended use of the offshore facility 2. The submerged floating riser deck 10 is operatively connected to a number of subsea hydrocarbon risers 12, through which hydrocarbons can flow from the seabed 4. The hydrocarbon risers 12 may be steel catenary risers, supported by buoyancy aids 14. The submerged floating riser deck 10 comprises hydrocarbon processing equipment 26 for processing hydrocarbons received via the hydrocarbon risers 12. The submerged floating riser deck 10 is submerged, i.e. fully below sea level 6, but remains floating through the use of buoyancy aids 18 and/or through suspension

from the offshore floating structure 8. The platform 8 can be secured to the seabed via a catenary mooring system (not shown).

Floating near the surface of the sea (sea level 6) and at least partially protruding above the surface of the sea level 6 is the offshore floating platform 8, which has hydrocarbon processing equipment 24. The offshore floating platform 8 is connected to the submerged floating riser deck 10 via several risers 16. The risers 16 can be disconnected from the offshore floating platform 8 in case of inclement surface conditions.

Figures 2, 3 and 4 show another hydrocarbon processing facility where the offshore floating structure 8 is a spar buoy 8. In this example the spar buoy 8 floats due to its own buoyancy and the submerged floating riser deck 10 is suspended from the spar buoy 8 via a cable suspension system 32. The submerged floating riser deck 10 is fully supported by the cable suspension system 32 and does not need any additional positive buoyancy elements. The spar buoy 8 is moored via catenary mooring cables 30 and hydrocarbons are transported between the seabed 4, the submerged floating riser deck 10 and the spar buoy (offshore floating structure) 8 via catenary hydrocarbon risers 12 and disconnectable risers 16 in a similar way to Figure 1. The catenary risers 12 are supported by buoyancy aids 14.

Figures 2 and 3 show an example of this spar buoy system at a realistic scale and also include vessels servicing the offshore facility 2, along with subsea structures to which the offshore facility is connected. Figure 4 shows a similar system in a more schematic arrangement similar to Figure 1, with the scale distorted and the catenary mooring cables 30 omitted from the drawing.

In relation to the offshore facilities 2 of both of Figure 1 and Figure 2 the hydrocarbon processing facility 2 has a buoy 20 connected to the offshore floating platform 8 for transferring gas or pressured and cooled gas therefrom to a tanker, floating vessel or the like which can connect to the buoy 20.

The hydrocarbon processing facility 2 also has a buoy 22 connected to the submerged floating riser deck 10 for transferring semi-stable liquid therefrom to a tanker, floating vessel 34 or the like, as shown in Figure 2, which can connect to the buoy 22.

In operation, hydrocarbons flow from the seabed 4 through the risers 12 to the submerged floating riser deck 10. Here, the hydrocarbons may be fully processed, partially processed or not processed at all. Any processing is carried out by the hydrocarbon processing equipment 26. One or more storage tanks at the submerged floating riser deck 10 can be used for storage of fully processed, part processed or

unprocessed hydrocarbons. In the exemplary diagram shown in the Figures, the hydrocarbons can be processed out by the hydrocarbon processing equipment 26 at the subsea riser deck 10 to produce two products, namely a gaseous product and a semi-stable liquid product. The former is transferred to the offshore floating structure 8 via the disconnectable risers 16, while the latter is transferred to the semi-stable liquid buoy 22. The semi-stable liquid product may comprise any or all of water, oil condensate, LPG and NGL.

At the offshore floating structure 8, the received gas product is optionally processed using hydrocarbon processing equipment 24. The processing may include drying and/or cooling and pressurising. The final product, which may be liquefied, is transferred to buoy 20. Alternatively, the offshore facility 2 may be arranged so that all of the required processing is done at the submerged riser deck 10 with no processing equipment on the offshore floating structure 8. This can allow the offshore floating structure 8 to be a smaller floating platform such as the spar buoy 8 of Figure 2.

Tankers, other floating vessels and the like can connect to buoys 20 and 22 to be loaded with the gas and semi-stable liquid products respectively.

In the case of inclement weather conditions at sea level 6, such as wind, waves, hurricanes, tropical monsoons, precipitation, icebergs, ice floes or other conditions deemed to be harmful to the riser 16, the riser 16 can be disconnected from the offshore floating structure 8 for the duration of the harmful conditions, and can be reconnected once these conditions pass.

Any maintenance work which needs to be carried out on the submerged hydrocarbon processing equipment 26 can be done more easily than in the prior art where the equipment is at the sea bed, since the hydrocarbon processing equipment 26 is not as deep underwater as the sea bed 4.

In some embodiments the offshore floating structure does not have any role in processing the hydrocarbons that are processed at the submerged floating riser deck. For example, the spar buoy Thus, hydrocarbons may be processed at the submerged riser deck and transferred elsewhere, via the offshore floating structure or via other means such as the buoys, without any processing aboard the floating structure.

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CLAIMS:

1. An offshore hydrocarbon processing facility comprising:
an offshore floating structure;
5 a submerged floating riser deck operatively connected to a subsea hydrocarbon riser; and
hydrocarbon processing equipment disposed on the submerged floating riser deck.
- 10 2. An offshore hydrocarbon processing facility according to claim 1, wherein the submerged floating riser deck floats suspended from the offshore floating structure.
3. An offshore hydrocarbon processing facility according to claim 1 or 2, comprising
15 a riser arranged for disconnectable connection between the offshore floating structure and the submerged floating riser deck.
4. An offshore hydrocarbon processing facility according to claim 1, 2 or 3, wherein
20 the hydrocarbon processing equipment is entirely disposed on the submerged floating riser deck.
5. An offshore hydrocarbon processing facility as claimed in any preceding claim,
wherein the offshore hydrocarbon processing facility is an unmanned hydrocarbon
processing facility, comprising at least one of:
no permanent personnel;
25 no provision of facilities for personnel to stay on the offshore hydrocarbon processing facility, for example there may be no shelters for personnel, no toilet facilities, no drinking water, no personnel operated communications equipment and/or
no lifeboat; and/or
a requirement that personnel be present for fewer than 10,000 maintenance
30 hours per year.
6. An offshore hydrocarbon processing facility as claimed in any preceding claim,
wherein the offshore floating structure is an unmanned structure and/or an unmanned
production structure, comprising at least one of:
35 no permanent personnel;

no provision of facilities for personnel to stay on the platform, for example there may be no shelters for personnel, no toilet facilities, no drinking water, no personnel operated communications equipment and/or no lifeboat; and/or

5 a requirement that personnel be present for fewer than 10,000 maintenance hours per year.

7. An offshore hydrocarbon processing facility as claimed in claim 1, wherein the offshore floating structure further comprises topside processing equipment located on the offshore floating structure, arranged to produce at least one of a hydrocarbon liquid
10 product, a hydrocarbon semi-stable liquid product and a liquefied gas product.

8. An offshore hydrocarbon processing facility as claimed in claim 7, wherein the facility is configured such that a hydrocarbon fluid to be processed is processed first by the subsea equipment and then by the topside equipment.
15

9. An offshore hydrocarbon processing facility as claimed in any preceding claim, wherein the offshore floating structure is horizontally offset from the submerged floating riser deck, such that the two are not vertically aligned.

20 10. An offshore hydrocarbon processing facility as claimed in any preceding claim, wherein the submerged floating riser deck is arranged to separate liquid hydrocarbons, flash the separated liquid hydrocarbons and store the flashed hydrocarbons at the submerged floating riser deck.

25 11. An offshore hydrocarbon processing facility as claimed in any preceding claim further comprising a buoy, wherein the submerged floating riser deck is operatively connected to the buoy for offload of hydrocarbon products to a floating vessel.

30 12. A method of operating the offshore hydrocarbon processing facility of any of claims 1 to 11, comprising:

receiving hydrocarbons at the submerged floating riser deck from the subsea hydrocarbon riser; and

processing the hydrocarbons using the hydrocarbon processing equipment.

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13. A method of operating the offshore hydrocarbon processing facility as claimed in claim 12, comprising disconnectably connecting the submerged floating riser deck to the offshore floating platform using a riser for transfer of hydrocarbons between them.

5 14. A method of operating the offshore hydrocarbon processing facility as claimed in claim 12 or 13, comprising:

fluidly connecting the submerged floating riser deck to a floating vessel for transfer of hydrocarbons from the submerged floating riser deck to the floating vessel; and/or

10 fluidly connecting the submerged floating riser deck to a pipeline for transfer of hydrocarbons from the submerged floating riser deck via the pipeline.

15. A method of operating the offshore hydrocarbon processing facility as claimed in claim 12, 13 or 14, comprising:

15 fluidly connecting the submerged floating riser deck to a buoy; and transferring hydrocarbons from the buoy to a floating vessel.

16. A method of using the offshore hydrocarbon processing facility as claimed in any of claims 12 to 15, comprising:

20 separating and flashing liquid hydrocarbons at the submerged floating riser deck; and

storing the flashed hydrocarbons in storage tanks at the submerged floating riser deck.

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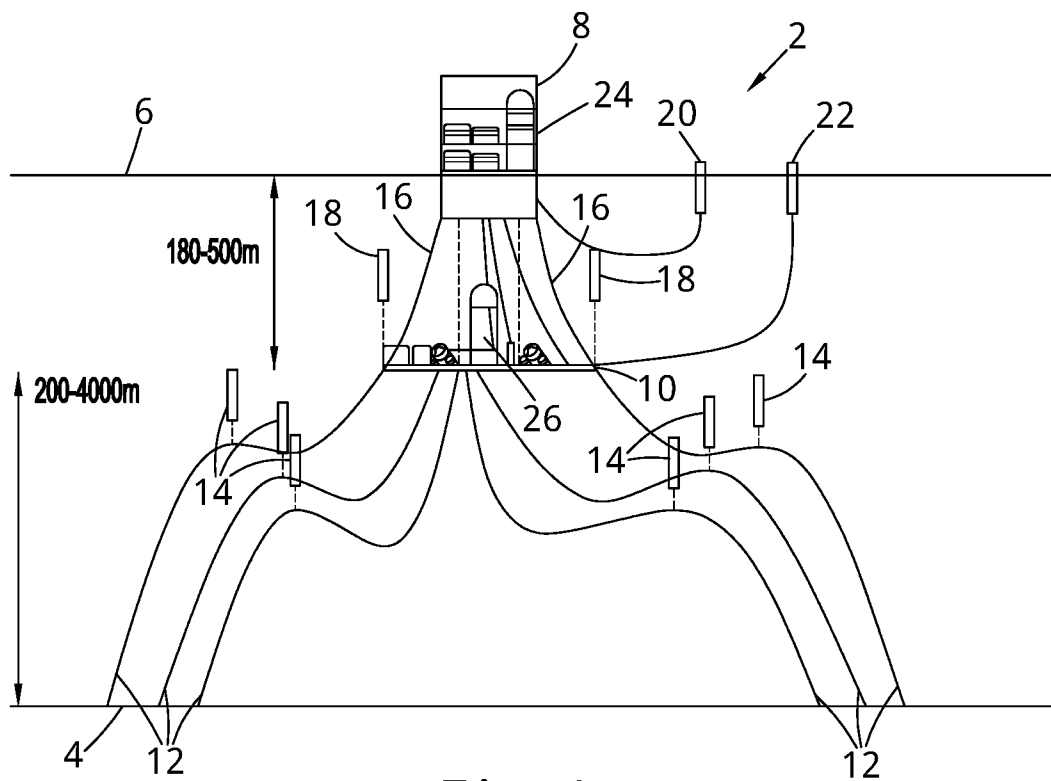


Fig. 1

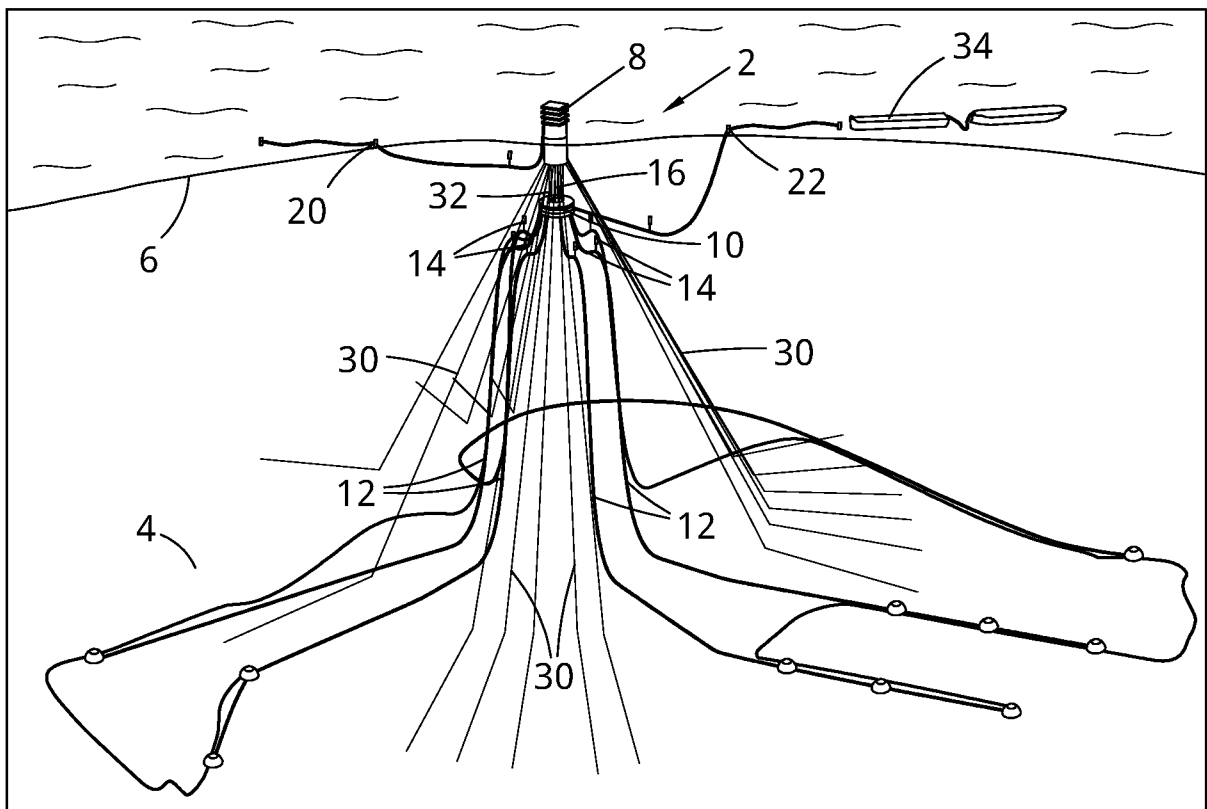


Fig. 2

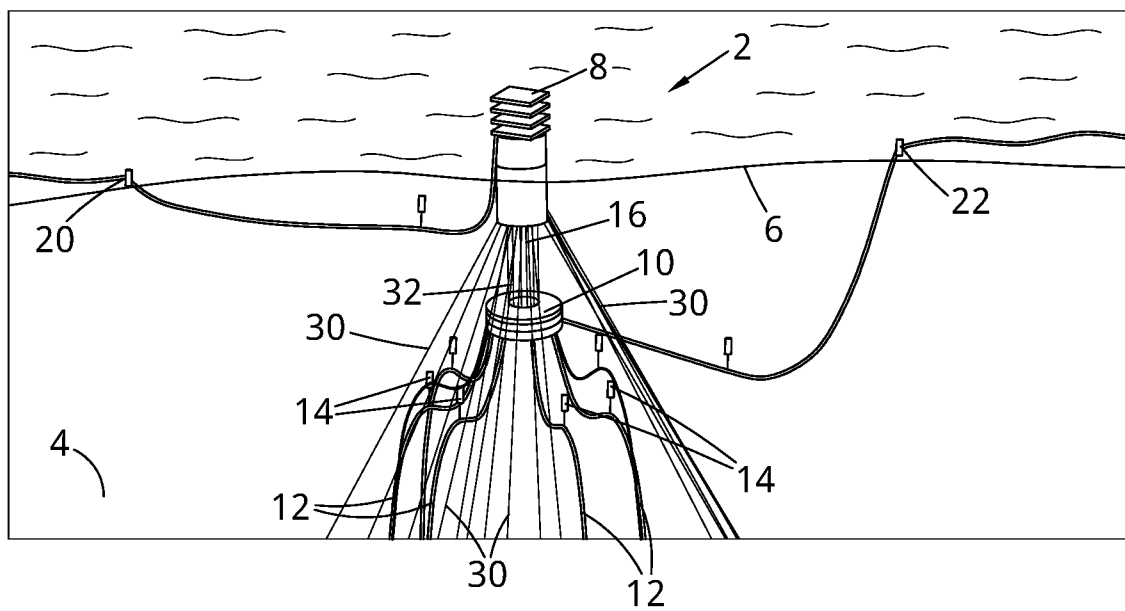


Fig. 3

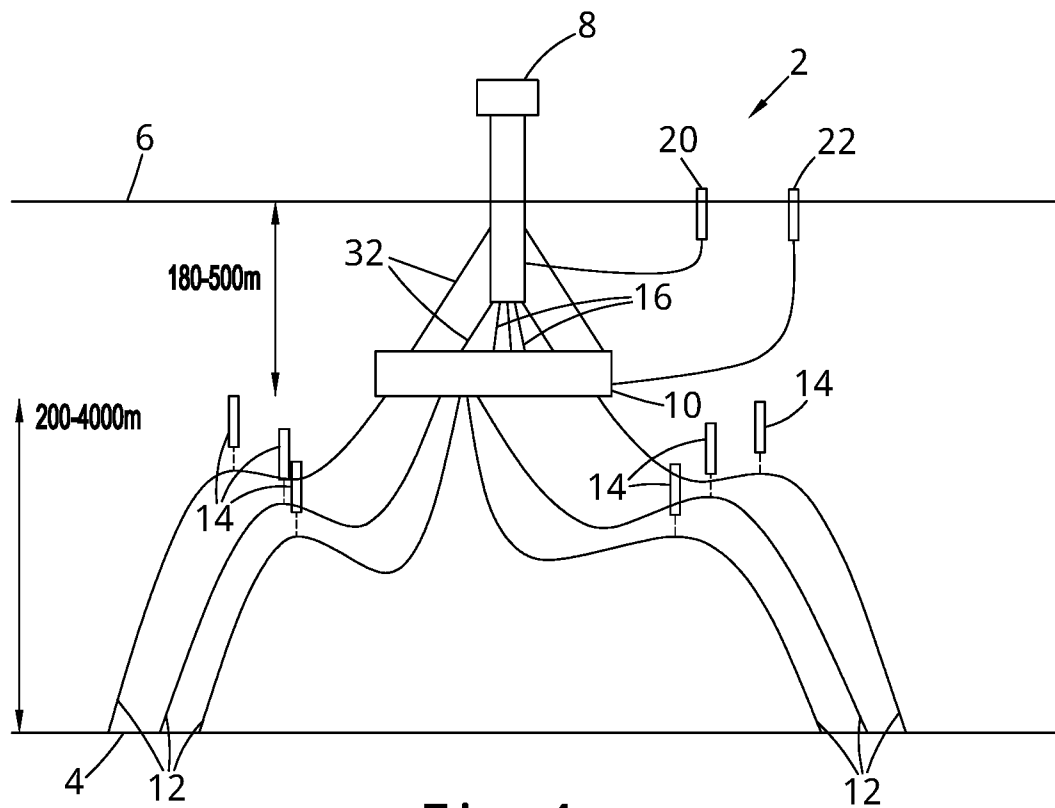


Fig. 4

INTERNATIONAL SEARCH REPORT

International application No.

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A. CLASSIFICATION OF SUBJECT MATTER IPC: B63B 21/50 (2006.01), E21B 43/36 (2006.01), B63B 27/00 (2006.01), B63B 35/44 (2006.01), E21B 43/01 (2006.01) According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) E21B, B63B Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched DK, NO, SE, FI: Classes as above. Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) EPODOC, WPI, FULL TEXT: ENGLISH, GERMAN, FRENCH		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6263971 B1 (GIANNESINI, J.) 2001.07.24 Figures 1-3 and related text in description.	1-16
X	US 2010/0025043 A1 (INGEBRIGTSEN, A. ET AL.) 2010.02.04 Figures 1-4 and paragraph [0055].	1-3, 12
X	US 2015/0128840 A1 (SEAHORSE EQUIP CORP) 2015.05.14 Figures 1-4, abstract, paragraph [0018] and claim 1.	1, 12
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A	US 2003/0188873 A1 (ANDERSON, C. F. ET AL.) 2003.10.09 Figures 1, 4-6, paragraphs [0013]-[0027], [0031].	1-16
A	WO 2009/042307 A1 (EXXONMOBIL UPSTREAM RES CO) 2009.04.02 Figure 3 and related text in description.	1-16
X, P	WO 2017/168143 A1 (SLLP 134 LTD) 2017.10.05 Figures 1A-1C, 12, 13 and related text in description.	1, 12
☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
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INTERNATIONAL SEARCH REPORT

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