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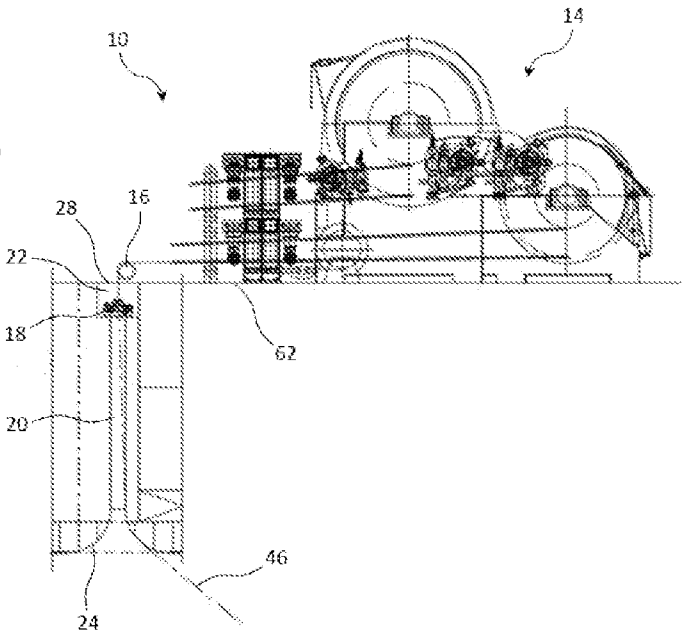
(54) Title **Mooring tensioning arrangement and a method for longitudinal cross tension of a mooring system.**

(56) References Cited: US 2010/098498 A1, JP H07187057 A, US 3552343 A, US 2010/098498 A1, NL 2004529 C

(57) Abstract

Mooring arrangement (10) on a vessel (60), comprising: a moonpool (20) having an through running vertical channel with an upper moonpool opening (22) in proximity to a deck (62) of the vessel (60), and a bottom moonpool opening (24) open to surrounding sea (30); a winch (14) located above the moonpool (20), wherein a mooring line (46) runs from the winch (14), through the moonpool (20) and into the sea (30); and a wire/chain stopper (18) securing the mooring line (46) in the moonpool (20). The invention also related to a method for longitudinal cross tension mooring of a vessel.



Field of the invention

The present invention relates to a method for longitudinal cross tension of a mooring system, in where a vessel comprises a mooring tensioning arrangement with a moonpool having a through running vertical channel with an upper moonpool opening in proximity to a deck of the vessel, and a bottom moonpool opening open to surrounding sea, and a winch located above the moonpool, wherein a second anchor wire pennant runs from the winch, through the moonpool and into the sea, and a wire/chain stopper securing the second anchor wire pennant in the moonpool.

Background of the invention

Tensioning of offshore mooring systems is typically done by high BP vessel and possibly tandem operation with two vessels or by means of transverse cross-tensioning.

High BP vessels can be expensive vessels, while inline tandem operation has the danger of one single vessel with full tension and transverse cross tension danger for high sideways loads.

All these methods either have a high cost or have safety risks.

US 2010/098498 A1 discloses an anchor system for offshore dynamically positioned drilling platform.

JPH 07187057 A discloses anchoring equipment.

US 3552343 A discloses a drilling ship mooring system.

NL 2004529 C discloses a vessel and a method for raising a load under water using the vessel.

Objects of the present invention

It is an object to provide a method that makes it possible to arrange the vessel for longitudinal cross tension of the mooring system. It may thus be possible to perform anchor bedding and mooring system tensioning with lower BP vessels, and perform the cross tension without the risk for high sideways loads and heeling moments.

Advantages with the present invention is that the mooring system elements are only loaded in their intended way. Upon breakage or loss of one of the mooring lines, the vessel is either pull straight ahead or astern, which gives no sideways force/heeling moment. Downward force will always be on or near the centerline of the vessel, which also gives no large heeling moments.

The invention uses winch pull rather than BP/engine power to create tension, which is more environmentally friendly. It might be possible that it also gives less power required for heading control, and possibly less trimming moment.

Using the mooring tensioning method according to the invention may also potentially give faster operation compared to single system tensioning.

Summary of the invention

The above objects are achieved with a method for longitudinal cross tension of a mooring system, in where a vessel comprises a mooring tensioning arrangement with a moonpool having a through running vertical channel with an upper moonpool opening in proximity to a deck of the vessel, and a bottom moonpool opening open to surrounding sea, and a winch located above the moonpool, wherein a second anchor wire pennant runs from the winch, through the moonpool and into the sea, and a wire/chain stopper securing the second anchor wire pennant in the moonpool. The method comprises the steps:

- placing the mooring tensioning arrangement centrally and in or close to a centerline of the vessel,
- connecting the vessel to a first anchor wire using a first anchor wire pennant, said first anchor wire pennant runs from aft of the vessel to the first anchor wire,
- sailing the vessel to a second anchor wire, while paying out the first anchor wire pennant,
- lowering a pick-up line through the moonpool of the vessel to connect to the second anchor wire, and pulling the second anchor wire through the moonpool onto the deck of the vessel,
- connecting the second anchor wire to the second anchor wire pennant,
- lowering the second anchor wire and the second anchor wire pennant through the moonpool,
- paying out the second anchor wire pennant to a predetermined length,
- securing the second anchor wire pennant in the wire/chain stopper in the moonpool, and

- pulling the vessel to a central location by hauling in the first anchor wire pennant.

Alternative embodiments are given in the dependent method claims.

The vessel can be pulled in to the central location until desired tension in the anchor wires and/or anchor wire pennants are reached.

Further, auxiliary anchor lines can be connected to the vessel in a conventional manner.

The pick-up line lowered through the moonpool can be connected to the second anchor wire using an ROV.

Alternatively, the pick-up line lowered through the moonpool can be connected to the second anchor wire using a guide rope through the moonpool.

Description of the drawings

Embodiments of the present invention will now be described, by way of example only, with reference to the following drawings, wherein:

Figure 1 shows a mooring arrangement.

Figure 2 shows a set up for a typical transverse cross tensioning mooring.

Figure 3 shows a set up for a longitudinal cross tensioning mooring according to the invention.

Figures 4-11 show a procedure for performing the longitudinal cross tensioning of a mooring system according to the invention.

Description of preferred embodiments of the invention

Figure 1 shows a mooring tensioning arrangement. The mooring tensioning arrangement 10 is placed on a vessel 60, however preferably partly integrated and partly placed on a deck 62 of the vessel 60.

The mooring tensioning arrangement 10 comprises a winch 14 placed on the deck 62 of the vessel 60. A moonpool 20 runs in vertical direction through the hull of the vessel 60, i.e. the moonpool 20 has a through running vertical channel with an upper moonpool opening 22 in proximity to the deck 62 of the vessel 60, and a bottom moonpool bell end 24 open to surrounding sea 30. The bottom bell end 24 of the

moonpool 20 can shaped to match bending radius of pennant and mooring system elements.

A mooring line 46 runs from the winch 14, through the moonpool 20 and into the sea 30. The mooring line can be a pennant, wire, rope, chain, anchor wire, anchor wire pennant, or similar, for mooring purposes.

The moonpool 20 also comprises a wire/chain stopper 18 for securing the mooring line 46 in the moonpool 20. The wire/chain stopper 18 is preferably arranged to enable inline load transfer into the vessel 60 and makes it possible to avoid additional 90 degrees bend under full tension.

Further, a turning block 16 is placed above the moonpool 20. The turning block 16 can be a roller/sheave arrangement guiding the mooring line 46 to the winch 14, in order to lower or haul in the mooring system.

The upper moonpool opening 22 may further be equipped with a hatch 28 to close the deck 62 of the vessel 60, thereby creating an undisturbed cargo deck.

Figure 2 shows a typical transverse cross tensioning set up, in where a vessel 60' is at aft connected to two mooring lines, i.e. the first mooring lines 40,42 on port side and the second mooring lines 46,44 on starboard side. The vessel 60' is thus perpendicular to the mooring system. Additional mooring lines 70 can be used. Figure 3 shows longitudinal cross tensioning mooring set up according to the invention. As shown, first mooring lines 40,42 are (near) longitudinal with the vessel 60 and connected to the aft of the vessel. The second mooring lines 46,44 are also (near) longitudinal with the vessel 60 and connected through the moonpool 20 to the vessel. Additional mooring lines 70 can also be used in this case.

The method for performing the longitudinal cross tensioning mooring according to the invention shall now be described in relation to figures 4-11.

Starting from figure 4, the vessel 60 is connecting to a first anchor wire 40 in a conventional way using a first anchor wire pennant 42 running from aft of the vessel 60. The vessel 60 is in figure 5 sailing towards a second anchor wire 44, paying out the first anchor wire pennant 42. In figure 6 a pick up wire 48 is lowered through the moonpool 20 to connect to the second anchor wire 44.

Connection to the second anchor wire 44 can be established by means of an ROV 50, as shown in figure 7, or otherwise.

The second anchor wire 44 is pulled onto deck 62 and can be secured in the wire/chain stopper 18, as shown in figure 8. At least the connection shackle is pulled on deck to connect the vessel's pennant wire, i.e. the second anchor pennant 46. The second anchor pennant 46 is preferably a chain. Thereafter, as shown in figure 9, is the second anchor wire 44 lowered and the vessel's moonpool pennant, i.e. the second anchor pennant 46, is paid out to a predetermined length and secured in the wire/chain stopper 18. The second anchor pennant 46 can then be disconnected from the winch 14.

As shown in figure 10, the vessel 60 is thereafter pulled to a desired center location by hauling in the first anchor pennant wire 42 and pulled in until test or desired tension is reached.

Figure 11 shows that after bedding, the tension is released from the first anchor wire 40 and the vessel is sailed to the second anchor wire 44 location where this one is released as well. Hence, the procedure is reversed and both systems are released.

Claims

1. A method for longitudinal cross tension of a mooring system, in where a vessel (60) comprises a mooring tensioning arrangement (10) with a moonpool (20) having a through running vertical channel with an upper moonpool opening (22) in proximity to a deck (62) of the vessel (60), and a bottom moonpool opening (24) open to surrounding sea (30), and a winch (14) located above the moonpool (20), wherein a second anchor wire pennant (46) runs from the winch (14), through the moonpool (20) and into the sea (30), and a wire/chain stopper (18) securing the second anchor wire pennant (46) in the moonpool (20), characterized in that the method comprises the steps:

- placing the mooring tensioning arrangement (10) centrally and in or close to a centerline of the vessel (60),
- connecting the vessel (60) to a first anchor wire (40) using a first anchor wire pennant (42), said first anchor wire pennant (42) runs from aft of the vessel (60) to the first anchor wire (40),
- sailing the vessel (60) to a second anchor wire (44), while paying out the first anchor wire pennant (42),
- lowering a pick-up line (48) through the moonpool (20) of the vessel (60) to connect to the second anchor wire (44), and pulling the second anchor wire (44) through the moonpool (20) onto the deck (62) of the vessel (60),
- connecting the second anchor wire (44) to the second anchor wire pennant (46),
- lowering the second anchor wire (44) and the second anchor wire pennant (46) through the moonpool (20),
- paying out the second anchor wire pennant (46) to a predetermined length,
- securing the second anchor wire pennant (46) in the wire/chain stopper (18) in the moonpool (20), and
- pulling the vessel (60) to a central location by hauling in the first anchor wire pennant (42).

2. The method according to claim 1, wherein the vessel (60) is pulled in to the central location until desired tension in the first and second anchor wires (40,44) and/or the first and second anchor wire pennants (42,46) are reached.

3. The method according to claim 1, wherein auxiliary anchor lines (70) are connected to the vessel (60) in a conventional manner.

4. The method according to claim 1, wherein the pick-up line (48) lowered through the moonpool (20) is connected to the second anchor wire (44) using an ROV (50).

5. The method according to claim 1, wherein the pick-up line (48) lowered through the moonpool (20) is connected to the second anchor wire (44) using a guide rope through the moonpool (20).

Patentkrav

1. Fremgangsmåte for langsgående kryss-strekk av et fortøyningssystem, hvori et fartøy (60) omfatter et forankringsstrammearrangement (10) med en moonpool (20) som har en gjennomløpende vertikal kanal med en øvre moonpool åpning (22) i nærheten av et dekk (62) til fartøyet (60), og en nedre moonpool åpning (24) som er åpen til omliggende sjø (30), og en vinsj (14) plassert over moonpoolen (20), hvori en andre forankringsbøyeline (46) løper fra vinsjen (14), gjennom moonpoolen (20) og inn i sjøen (30), og en wire/kjetting-stopper (18) som sikrer forankringsbøyelinen (46) i moonpoolen (20), karakterisert ved at fremgangsmåten omfatter trinnene:

- plassering av forankringsstrammearrangementet (10) sentralt og i eller nært til en senterlinje til fartøyet (60),
- tilkobling av fartøyet (60) til en første forankringsline (40) ved bruk av en første forankringsbøyeline (42), der den første forankringsbøyelinen (42) løper fra akter av fartøyet (60) til den første forankringslinen (40),
- seile fartøyet (60) til en andre forankringsline (44), under utslipp av den første forankringsbøyelinen (42),
- nedsenkning av en opplukkingsline (48) gjennom moonpoolen (20) til fartøyet (60) for å kobles til den andre forankringslinen (44), og opptrekk av den andre forankringslinen (44) gjennom moonpoolen (20) og inn på dekket (62) til fartøyet (60),
- tilkobling av den andre forankringslinen (44) til den andre forankrings-bøyelinen (46),
- nedsenkning av den andre forankringslinen (44) og den andre forankringsbøyelinen (46) gjennom moonpoolen (20),
- utslipp av den andre forankringsbøyelinen (46) til en forhåndsbestemt lengde,
- sikring av den andre forankringsbøyelinen (46) i wire/kjetting-stopperen (18) i moonpoolen (20), og
- trekking av fartøyet (60) til en sentral lokasjon ved forhaling i den første forankringsbøyelinen (42).

2. Fremgangsmåte i samsvar med krav 1, hvori fartøyet (60 trekkes til den sentrale lokasjonen inntil ønsket strekk i de første og andre forankringslinene (40,44) og/eller de første og andre forankringsbøyelinene (42,46) er oppnådd.

3. Fremgangsmåte i samsvar med krav 1, hvori ekstra forankringsliner (70) kobles til fartøyet (70) på en konvensjonell måte.

4. Fremgangsmåte i samsvar med krav 1, hvori opplukkingslinen (48) senket ned gjennom moonpoolen (20) kobles til den andre forankringslinen (44) ved bruk av en ROV (50).

5. Fremgangsmåte i samsvar med krav 1, hvori opplukkingslinen (48) senket ned gjennom moonpoolen (20) kobles til den andre forankringslinen (44) ved bruk av et ledetau gjennom moonpoolen (20).

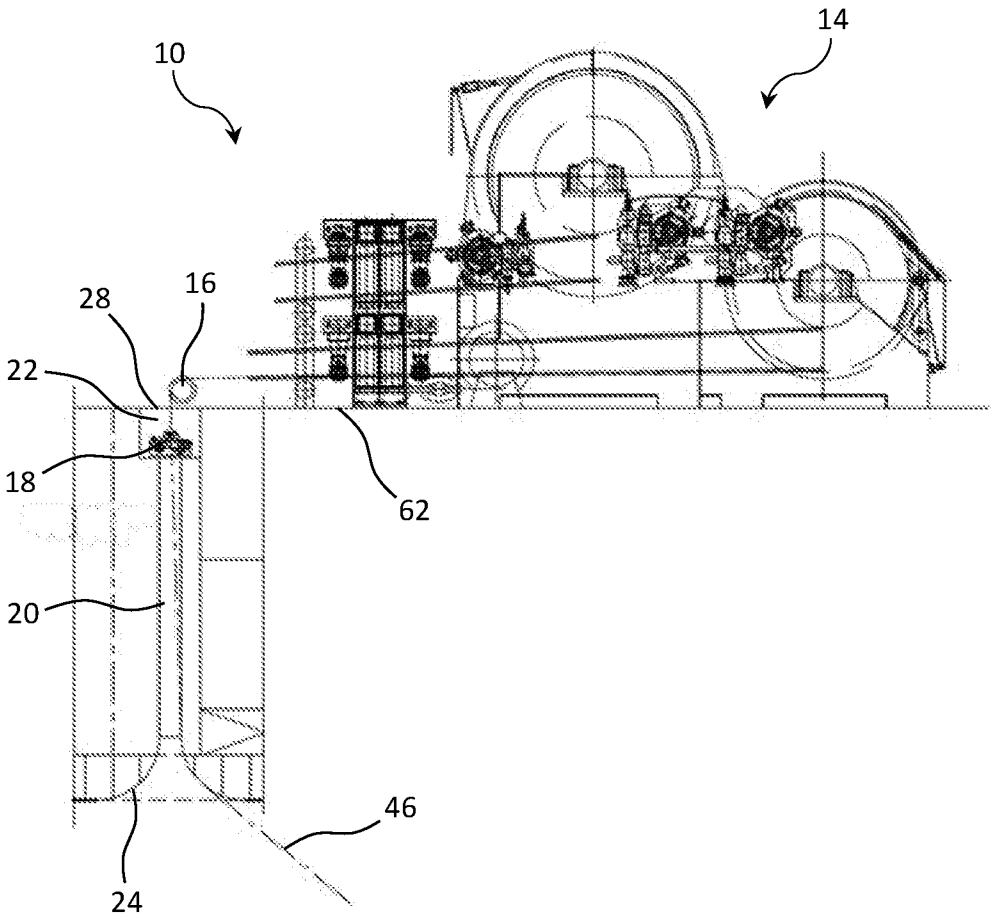


Fig. 1

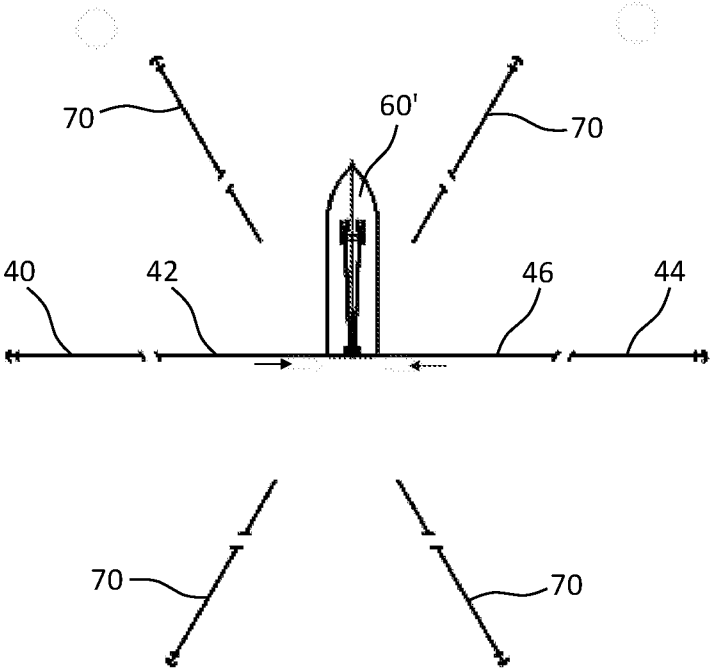


Fig. 2

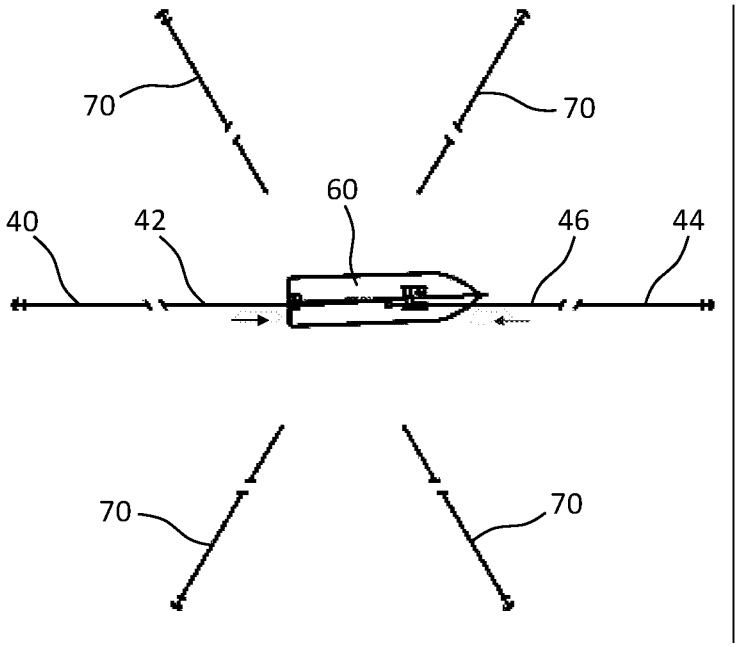


Fig. 3

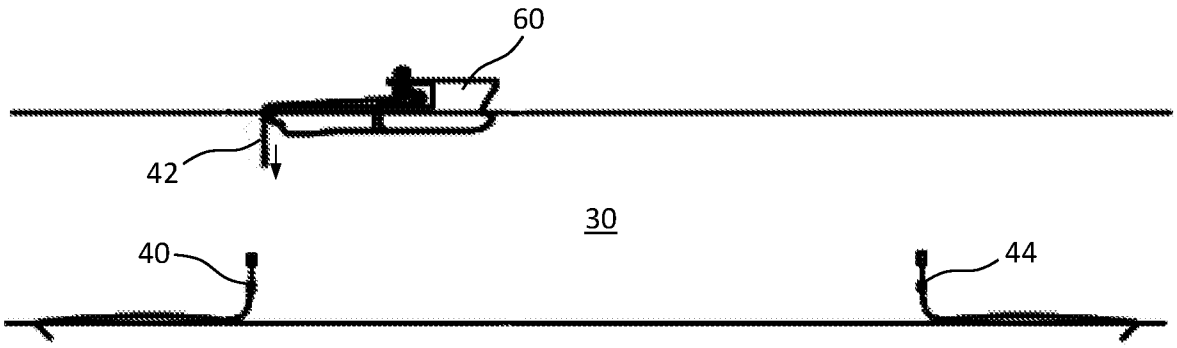


Fig. 4

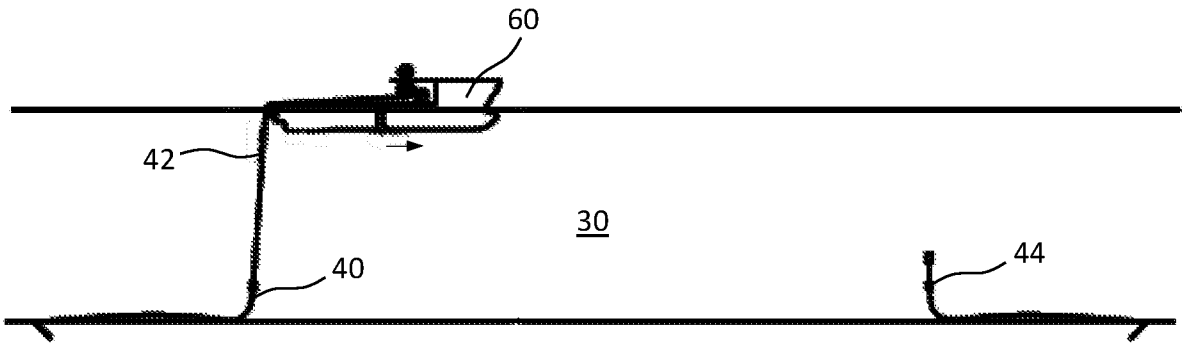


Fig. 5

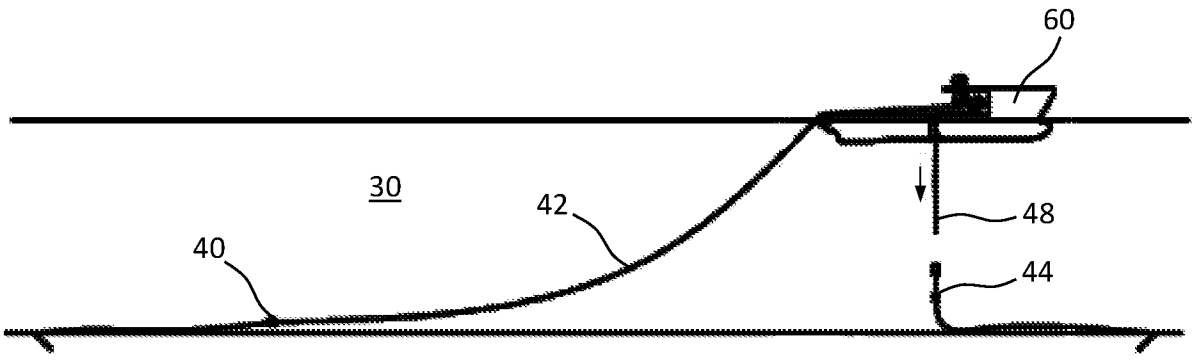


Fig. 6

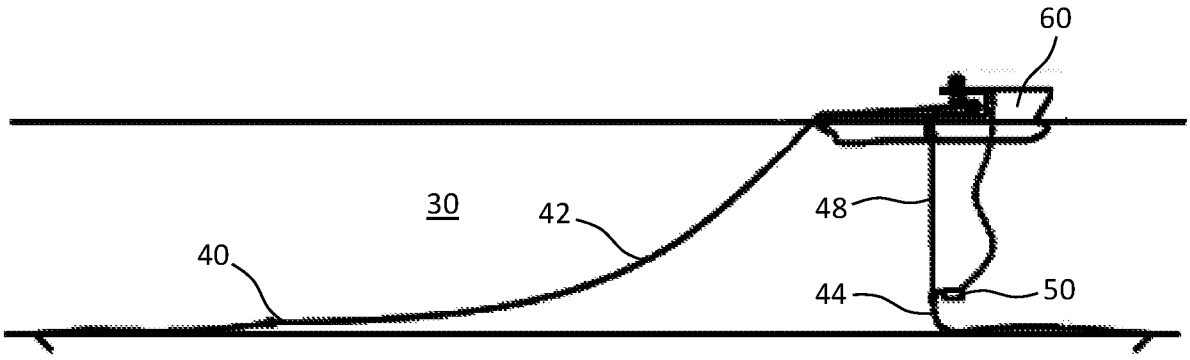


Fig. 7

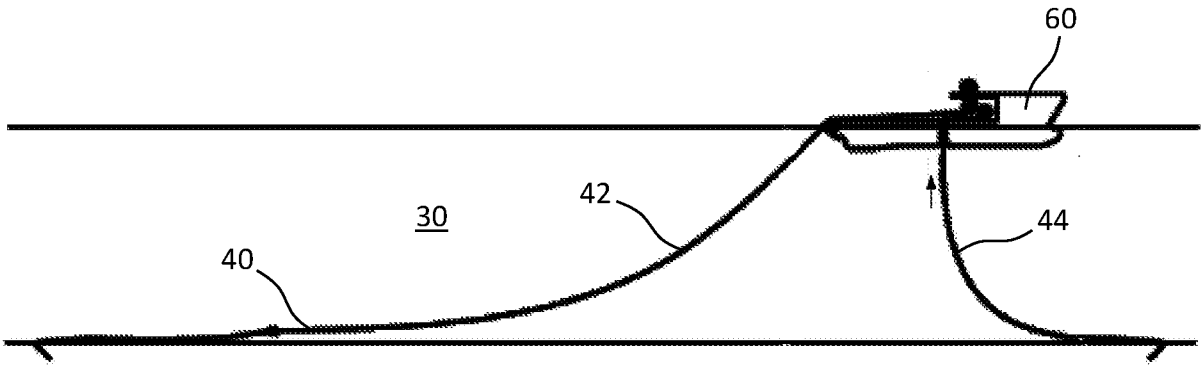


Fig. 8

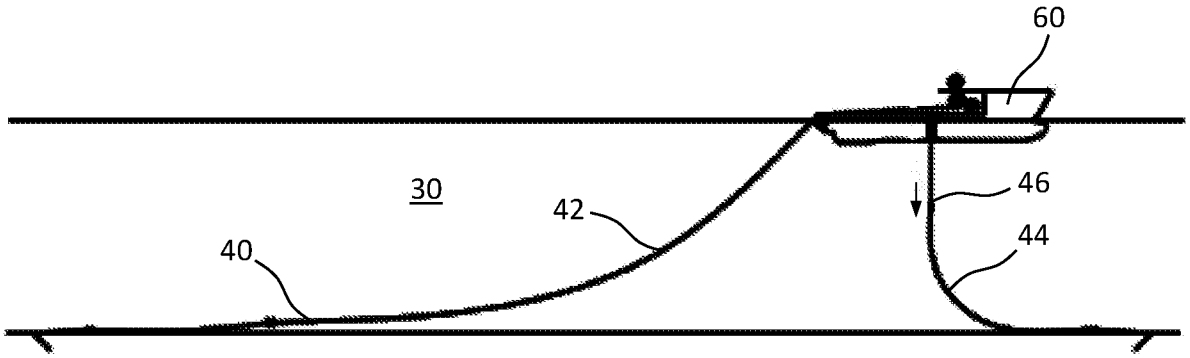


Fig. 9

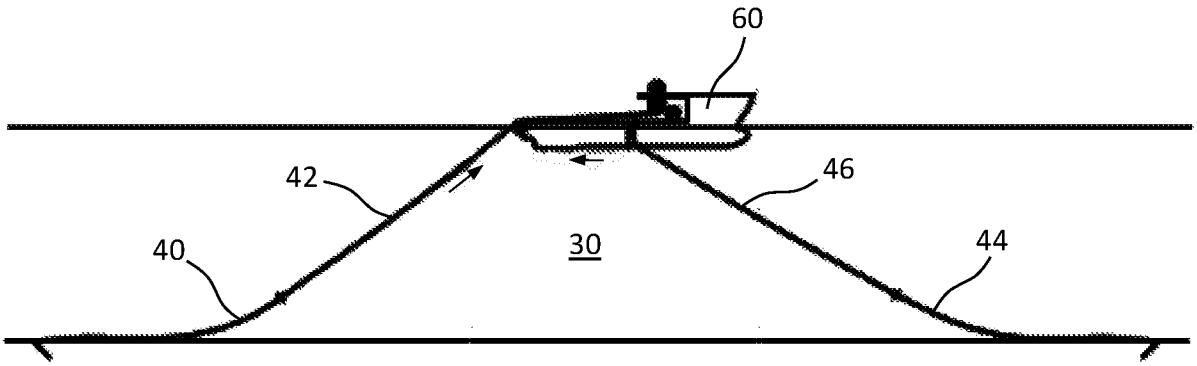


Fig. 10

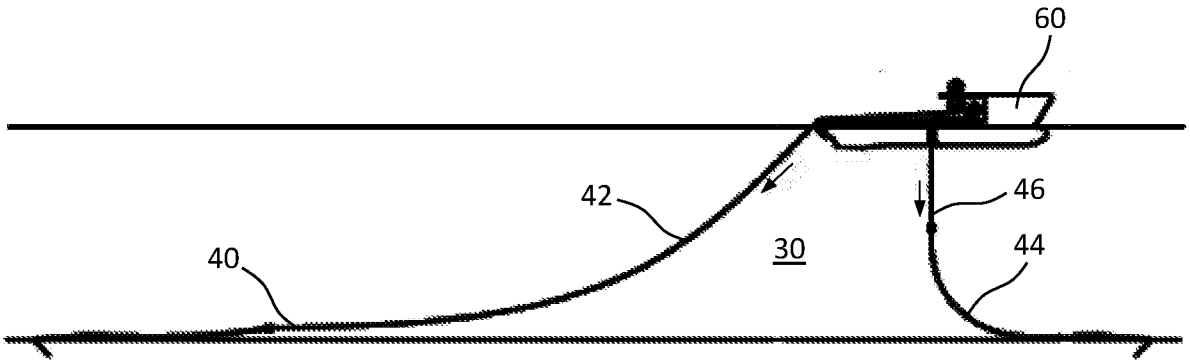


Fig. 11