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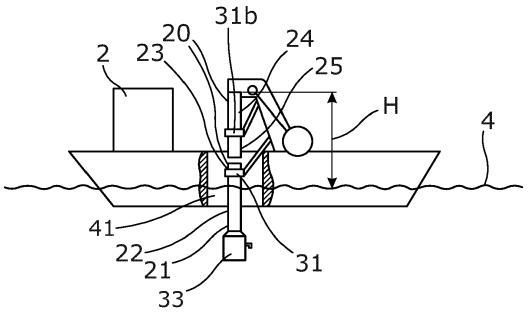
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(54) **A RISERLESS INTERVENTION METHOD**

(57) The present invention relates to a riserless intervention method for offshore intervention of a well from a vessel by means of a tool string, the vessel having a waterline. The method comprises the steps of submerging a first end of a first part of the tool string below the waterline so that a second end of the first part extends above the waterline; arranging a second part of the tool string on top of the first part of the tool string; connecting a first end of the second part of the tool string with the second end of the first part of the tool string above the waterline; and submerging the second part of the tool string below the waterline.



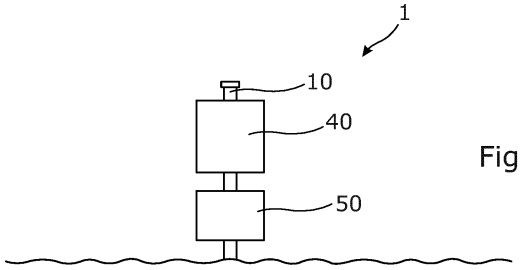


Fig. 2

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Description

Field of the invention

[0001] The present invention relates to a riserless intervention method for offshore intervention of a well from a vessel by means of a tool string, the vessel having a waterline.

Background art

[0002] When performing a subsea intervention of a well where a tool string is submerged into the well to perform an operation, a riser is often installed at the top of the well from a vessel, and the tool string is subsequently assembled and submerged into the riser. However, setting up a riser takes approximately 90 days, and a vessel with sufficient capacity is rarely available with a few days' notice, and the operation thus requires more time for planning. Therefore, a riserless solution has been developed where a lubricator pipe is installed above a blowout preventer on the well head or Christmas tree. The tool string is then mounted on the vessel using a grease head and submerged into the water where it enters the lubricator pipe. The grease head is mounted on top of the lubricator pipe and encloses the tool in the lubricator pipe. Then, a flushing system surrounding the lubricator pipe exchanges the seawater in the lubricator pipe with glycol or ethylene glycol, and the lubricator pipe is subsequently pressurised and valves in the top of the well are opened and the intervention operation can occur.

[0003] To enable mounting of a tool string on a vessel, the vessel has a derrick or a large crane for handling the 60 feet or longer tool string. A vessel capable of handling such long tool strings and lubricator pipes is one of the larger vessels, meaning that more planning is required and higher rental costs are involved.

[0004] However, with the increased focus on the costs related to performing such interventions, the time saved using a large vessel is money saved. There is therefore a need for a method of performing riserless interventions in shorter time to minimise or possibly eliminate the need for these large vessels with sufficient mounting height.

Summary of the invention

[0005] It is an object of the present invention to wholly or partly overcome the above disadvantages and drawbacks of the prior art. More specifically, it is an object to provide an improved method of performing riserless interventions in shorter time to minimise or possibly eliminate the need for large vessels.

[0006] The above objects, together with numerous other objects, advantages and features, which will become evident from the below description, are accomplished by a solution in accordance with the present invention by a riserless intervention method for offshore intervention of a well from a vessel by means of a tool string, the vessel having a waterline, the method comprising the steps of:

- submerging a first end of a first part of the tool string below the waterline so that a second end of the first part extends above the waterline,
- arranging a second part of the tool string on top of the first part of the tool string,
- connecting a first end of the second part of the tool string with the second end of the first part of the tool string above the waterline, and
- submerging the second part of the tool string below the waterline.

[0007] In an embodiment, the riserless intervention method described above may further comprise the step of introducing the tool string in a lubricator pipe.

[0008] Furthermore, before the step of submerging the first end of the first part of the tool string below the waterline, the riserless intervention method may comprise the steps of submerging a first end of a first lubricator part of a lubricator pipe below the waterline so that a second end of the first lubricator part extends above the waterline; arranging a second lubricator part on top of the first lubricator part; and connecting a first end of the second lubricator part to the second end of the first lubricator part.

[0009] In an embodiment, the tool string may be submerged into the lubricator pipe.

[0010] Also, the riserless intervention method described above may further comprise the step of connecting a grease head to the lubricator pipe above the waterline.

[0011] In addition, the lubricator pipe may be connected with a top of the well.

[0012] Moreover, the lubricator pipe may be connected with the top of the well while the tool string is arranged within the lubricator pipe.

[0013] In an embodiment, the riserless intervention method described above may further comprise the step of arranging the tool string or the lubricator pipe in a suspension unit so that movements of the vessel are absorbed by the suspension unit.

[0014] Furthermore, the riserless intervention method described above according to any may further comprise the step of disconnecting the lubricator pipe from the top of the well.

[0015] In addition, the riserless intervention method may further comprise the step of pulling the lubricator pipe at least partly above the waterline.

[0016] Moreover, the riserless intervention method may further comprise the step of disconnecting the parts of the tool string.

[0017] Additionally, the riserless intervention method may further comprise the step of disconnecting the parts of the lubricator pipe.

[0018] In an embodiment, before the step of disconnecting the lubricator pipe from the top of the well, the riserless intervention method may further comprise the

step of closing the end of the lubricator pipe closest to the top of the well.

[0019] By closing the end of the lubricator pipe closest to the top of the well, the lubricator pipe is sealed from below, and its content is thereby brought to surface.

[0020] The vessel has a mounting height above the waterline which is smaller than a length of the tool string or a length of the lubricator pipe.

[0021] The riserless intervention method described above may further comprise the step of connecting a first end of a third part of the tool string to a second end of the second part of the tool string above the waterline.

[0022] In addition, the riserless intervention method may further comprise the step of connecting a first end of a third lubricator part of the lubricator pipe to a second end of the second lubricator part of the lubricator pipe above the waterline.

[0023] Also, the riserless intervention method may further comprise the step of introducing the tool string into the well to perform the intervention.

[0024] Moreover, the riserless intervention method may further comprise the step of moving the tool string back into the lubricator pipe.

[0025] Furthermore, the riserless intervention method may further comprise the step of opening a valve in a blowout preventer, a Christmas tree or a well head.

[0026] Finally, the riserless intervention method may further comprise the step of opening a tool catcher.

Brief description of the drawings

[0027] The invention and its many advantages will be described in more detail below with reference to the accompanying schematic drawings, which for the purpose of illustration show some non-limiting embodiments and in which

Fig. 1 shows a partially cross-sectional view of a small vessel in the process of mounting a first part and a second part of a tool string,

Fig. 2 shows a partially cross-sectional view of a small vessel in the process of mounting a first lubricator part and a second lubricator part of a lubricator pipe,

Fig. 3 shows a partially cross-sectional view of a small vessel in the process of mounting a first part and a second part of a tool string where the first part is partly within the lubricator pipe,

Fig. 4 shows a partially cross-sectional view of a small vessel in the process of lowering a lubricator pipe having a tool string therein into the sea,

Fig. 5 shows the lubricator pipe of Fig. 4 being mounted on a top of a well,

Fig. 6 shows a partially cross-sectional view of a small vessel in the process of mounting a third part and a second part of a tool string, and

Fig. 7 shows a partially cross-sectional view of a small vessel in the process of mounting a third lubricator part and a second lubricator part of a lubricator pipe.

[0028] All the figures are highly schematic and not necessarily to scale, and they show only those parts which are necessary in order to elucidate the invention, other parts being omitted or merely suggested.

Detailed description of the invention

[0029] Fig. 1 shows a well 1 about to be intervened from a vessel 2 by an intervention tool 3 in the form of a tool string 3 comprising at least a first part 6 and a second part 8. When assembled, the tool string 3 is lowered into a lubricator pipe 20 mounted on e.g. a blowout preventer 40 or directly on a Christmas tree 50 forming a top 10 of the well 1.

[0030] The tool string 3 is mounted from the vessel 2 which is a small vessel having a mounting height smaller than a length of the lubricator pipe 20 and/or the tool string. The tool string 3 is mounted by submerging a first end 5 of the first part 6 of the tool string 3 below the waterline 4 of the vessel 2 so that a second end 7 of the first part extends above the waterline and is suspended in a suspension unit 31. The vessel 2 may have a moon pool 41 into which the tool part is lowered, or the tool string may be lowered over the side of the vessel (not shown). Then, the second part 8 of the tool string 3 is arranged on top of the first part 6 of the tool string by a second suspension unit 31b, and a first end 9 of the second part 8 of the tool string is connected with the second end 7 of the first part of the tool string above the waterline 4 while the remaining part of the first part is below the waterline. In this way, the mounting height of the vessel 2 can be substantially reduced, which eliminates the a need for a large vessel, which in turn substantially reduces costs related to renting a vessel and further reduces the time needed for planning and performing the operation. Furthermore, the length of the tool string 3 is no longer restricted by the mounting height available on the vessel 2, and the tool string can now in theory be mounted with an endless length.

[0031] As shown in Fig. 6, the second part 8 of the tool string 3 is partly submerged into the water and a first end 11 of a third part 12 of the tool string is mounted to a second end 14 of the second part 8 of the tool string. Subsequently, further parts can be mounted on top of the third part 12 in the same manner by first partly submerging the previously mounted part below the waterline and then connecting the further part thereto until the entire tool string is assembled. Then, the tool string 3 can be introduced into a lubricator pipe 20.

[0032] In Fig. 2, a lubricator pipe 20 is mounted from the vessel 2 having a mounting height H smaller than a length of the lubricator pipe 20. The mounting height extends from the deck of the waterline 4 of the vessel 2 to the summit of the highest possible reach of the lubricator pipe or tool string in the upward direction. The lubricator pipe 20 is mounted by submerging a first end 21 of a first lubricator part 22 of the lubricator pipe 20 below the waterline 4 so that a second end 23 of the first lubricator part is above the waterline. Then, a second lubricator part 24 is arranged on top of the first lubricator part 22 and a first end 25 of the second lubricator part is connected to the second end 23 of the first lubricator part. Finally, the lubricator pipe 20 is submerged into the sea and is connected to the top 10 of the well 1.

[0033] Alternatively, the lubricator pipe may be maintained while being suspended in the suspension unit 31 of the vessel 2 while the tool string 3 is mounted, as shown in Fig. 3 where the first end of the first part 6 of the tool string 3 is submerged below the waterline 4 of the vessel into the lubricator pipe 20 so that the second end 7 of the first part 6 extends above the waterline 4 and is suspended in a third suspension unit 31a while the second part 8 of the tool string is suspended in the second suspension unit 31b. When the tool string is fully mounted and arranged in the lubricator pipe, a grease head 30 is connected to the lubricator pipe above the waterline 4, as shown in Fig. 4, and the lubricator pipe is connected with the top 10 of the well 1, as shown in Fig. 5. Thus, the lubricator pipe is connected with the top 10 of the well 1 while the tool string is arranged within the lubricator pipe.

[0034] The tool string or the lubricator pipe is arranged in a suspension unit 31 which may be a gyroscopic suspension unit causing movements of the vessel 2 to be absorbed by the suspension unit.

[0035] After performing an intervention operation by means of the tool string, e.g. pulling a crown plug or milling out a safety valve, the tool string 3 re-enters the lubricator pipe and is fastened in a tool catcher 32 (shown in Fig. 5). Then, the valves in top 10 of the well 1, e.g. in the blowout preventer, are closed and the lubricator pipe is disconnected from the top 10 of the well 1. Before the lubricator pipe is disconnected, a closing unit 33 may be closed, thereby closing an opening (not shown) in the first end of the first lubricator part arranged closest to the top 10 of the well 1 so that the fluid inside the lubricator pipe remains therein while the pipe is brought to surface. The grease head 30 (shown in Fig. 5) is then disconnected and the tool string is dismounted part by part by pulling the lubricator pipe partly above the waterline 4 while it is still suspended from the vessel 2. Thus, the dirty fluid is kept in the lubricator pipe when the tool string is reconstructed or re-rigged, and the grease head 30 is subsequently re-mounted and the lubricator pipe with the tool string is mounted for another operation.

[0036] When all the intervention operations have been performed, the tool string is disconnected part by part, and subsequently, the lubricator pipe is disconnected part by part until all the lubricator parts are above the waterline.

[0037] Before submerging the lubricator pipe 20, the end of the lubricator pipe closest to the top 10 of the well 1 is closed by closing the closing unit 33 (shown in Fig. 6) and the lubricator pipe is filled with glycol or ethylene glycol so that the fluid inside the lubricator pipe does not freeze if the temperature is sufficiently low when the intervention is performed.

[0038] As shown in Fig. 7, the second end 28 of the second lubricator part 24 is partly submerged into the water and a first end 26 of a third lubricator part 27 of the lubricator pipe is mounted to a second end 28 of the second lubricator part 24. Subsequently, further lubricator parts can be mounted on top of the third lubricator part in the same manner by first partly submerging the previously mounted part below the waterline and then connecting the further part thereto until the entire lubricator pipe has been assembled.

[0039] The tool string may comprise several parts and operational tools arranged in the end facing the well. The parts of the tool string may be a stroker tool for pulling a crown plug, a key tool for moving a sliding sleeve, a milling tool for milling out a safety valve, etc.

[0040] A stroking tool is a tool providing an axial force. The stroking tool comprises an electrical motor for driving a pump. The pump pumps fluid into a piston housing to move a piston acting therein. The piston is arranged on the stroker shaft. The pump may pump fluid into the piston housing on one side and simultaneously suck fluid out on the other side of the piston.

[0041] By fluid or well fluid is meant any kind of fluid that may be present in oil or gas wells downhole, such as natural gas, oil, oil mud, crude oil, water, etc. By gas is meant any kind of gas composition present in a well, completion, or open hole, and by oil is meant any kind of oil composition, such as crude oil, an oil-containing fluid, etc. Gas, oil, and water fluids may thus all comprise other elements or substances than gas, oil, and/or water, respectively.

[0042] In the event that the tool is not submergible all the way into the casing, a downhole tractor can be used to push the tool all the way into position in the well. The downhole tractor may have projectable arms having wheels, wherein the wheels contact the inner surface of the casing for propelling the tractor and the tool forward in the casing. A downhole tractor is any kind of driving tool capable of pushing or pulling tools in a well downhole, such as a Well Tractor®.

[0043] By a casing is meant any kind of pipe, tubing, tubular, liner, string etc. used downhole in relation to oil or natural gas production.

[0044] Although the invention has been described in the above in connection with preferred embodiments of the invention, it will be evident for a person skilled in the art that several modifications are conceivable without departing from the invention as defined by the following claims.

Claims

1. A riserless intervention method for offshore intervention of a well (1) from a vessel (2) by means of a tool string (3), the vessel having a waterline (4), the method comprising the steps of:

   - submerging a first end (5) of a first part (6) of the tool string below the waterline so that a second end (7) of the first part extends above the waterline,
   - arranging a second part (8) of the tool string on top of the first part of the tool string,
   - connecting a first end (9) of the second part of the tool string with the second end of the first part of the tool string above the waterline, and
   - submerging the second part of the tool string below the waterline.

2. A riserless intervention method according to claim 1, further comprising the step of introducing the tool string in a lubricator pipe (20).

3. A riserless intervention method according to claim 1, which before the step of submerging the first end of the first part of the tool string below the waterline comprises the steps of:

   - submerging a first end (21) of a first lubricator part (22) of a lubricator pipe below the waterline so that a second end (23) of the first lubricator part extends above the waterline,
   - arranging a second lubricator part (24) on top of the first lubricator part, and
   - connecting a first end (25) of the second lubricator part to the second end of the first lubricator part.

4. A riserless intervention method according to claim 3, wherein the tool string is submerged into the lubricator pipe.

5. A riserless intervention method according to any one of claims 2-4, further comprising the step of connecting a grease head (30) to the lubricator pipe above the waterline.

6. A riserless intervention method according to any one of claims 2-5, wherein the lubricator pipe is connected with a top (10) of the well.

7. A riserless intervention method according to claim 6, wherein the lubricator pipe is connected with the top of the well while the tool string is arranged within the lubricator pipe.

8. A riserless intervention method according to any one of the preceding claims, further comprising the step of arranging the tool string or the lubricator pipe in a suspension unit (31) so that movements of the vessel are absorbed by the suspension unit.

9. A riserless intervention method according to any one of claims 2-8, further comprising the step of disconnecting the lubricator pipe from the top of the well.

10. A riserless intervention method according to claim 9, further comprising the step of pulling the lubricator pipe at least partly above the waterline.

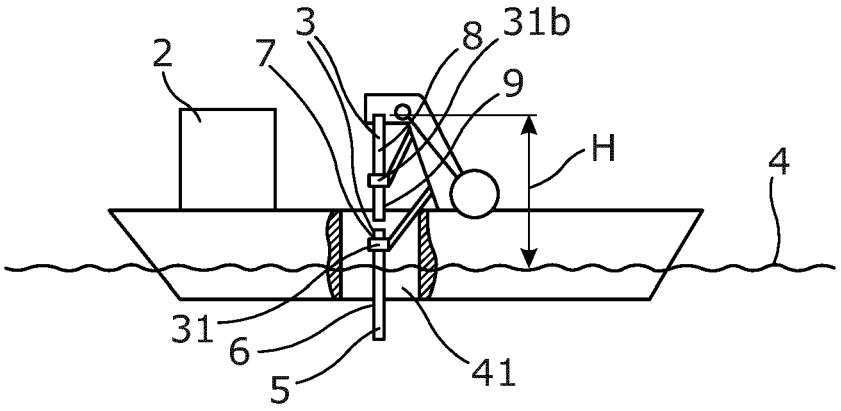
11. A riserless intervention method according to claim 10, further comprising the step of disconnecting the parts of the tool string.

12. A riserless intervention method according to claim 10 or 11, further comprising the step of disconnecting the parts of the lubricator pipe.

13. A riserless intervention method according to any one of the preceding claims, which before the step of disconnecting the lubricator pipe from the top of the well further comprises the step of closing the end of the lubricator pipe closest to the top of the well.

14. A riserless intervention method according to any one of the preceding claims, further comprising the step of connecting a first end (11) of a third part (12) of the tool string to a second end (14) of the second part of the tool string above the waterline.

15. A riserless intervention method according to claim 3, further comprising the step of connecting a first end (26) of a third lubricator part (27) of the lubricator pipe to a second end (28) of the second lubricator part of the lubricator pipe above the waterline.



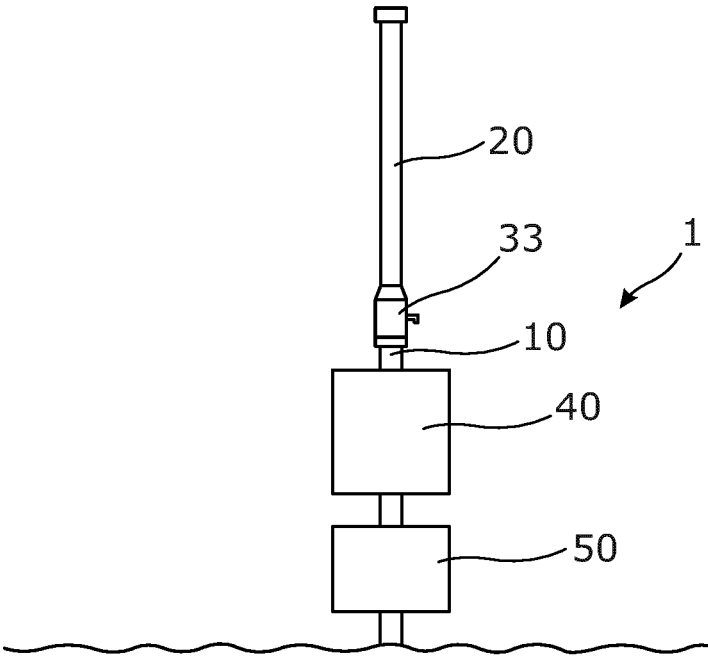
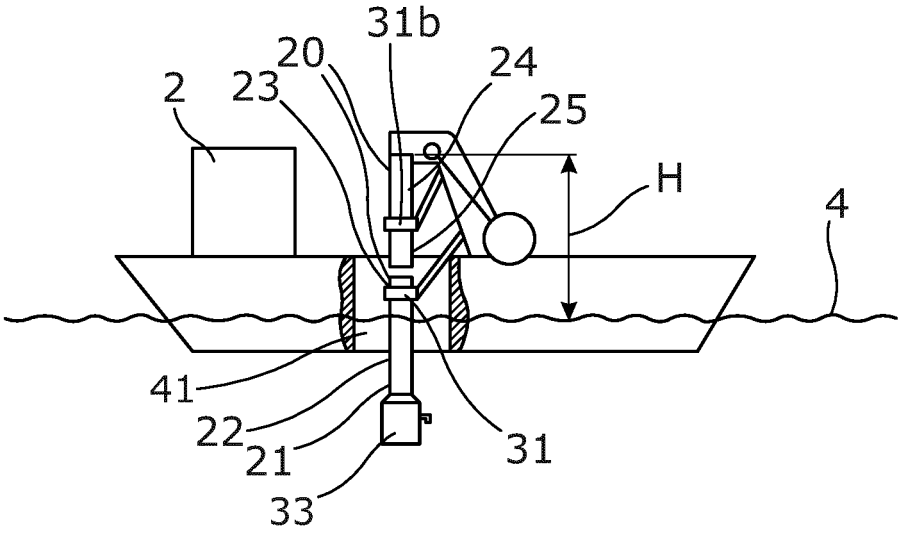


Fig. 1



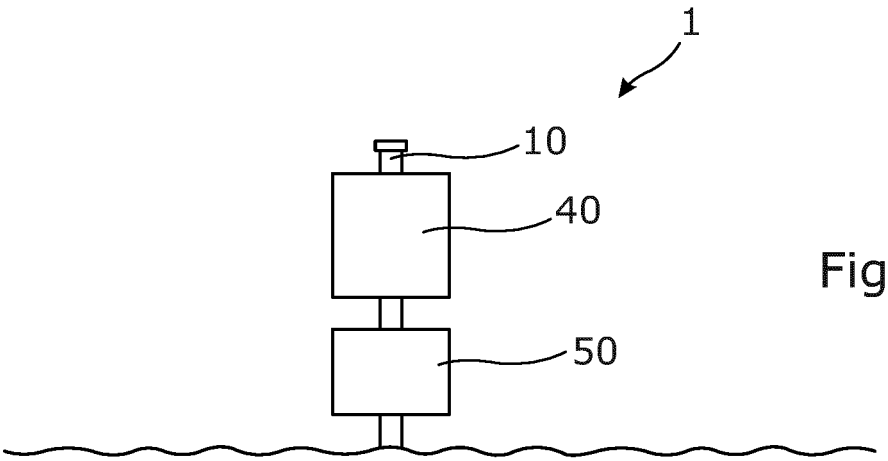
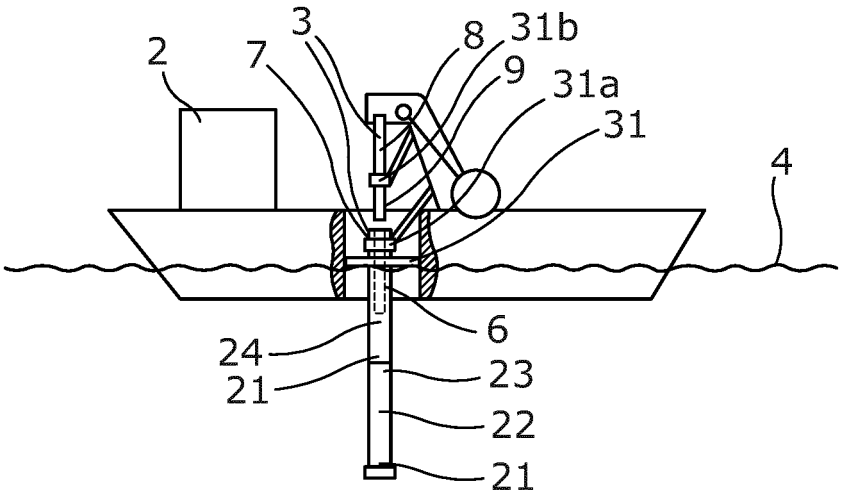


Fig. 2



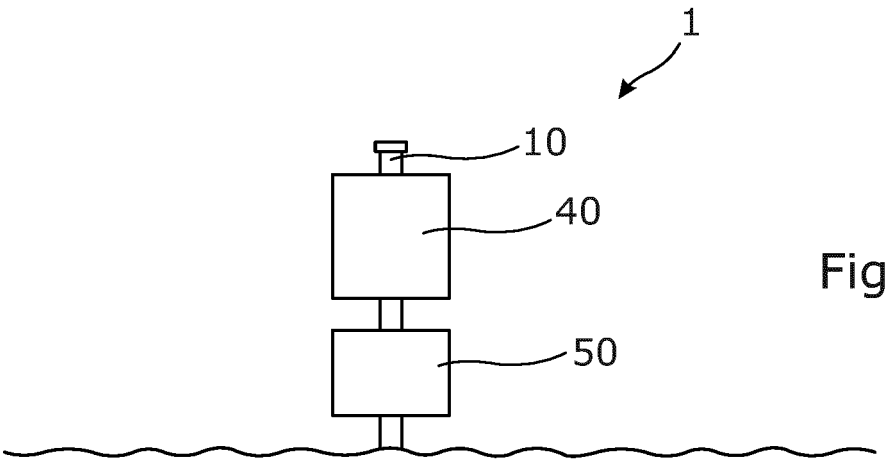
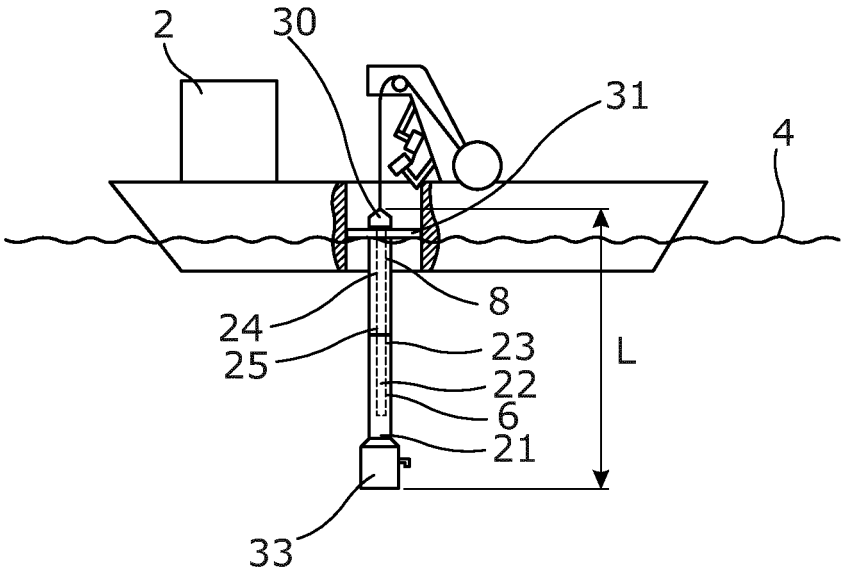


Fig. 3



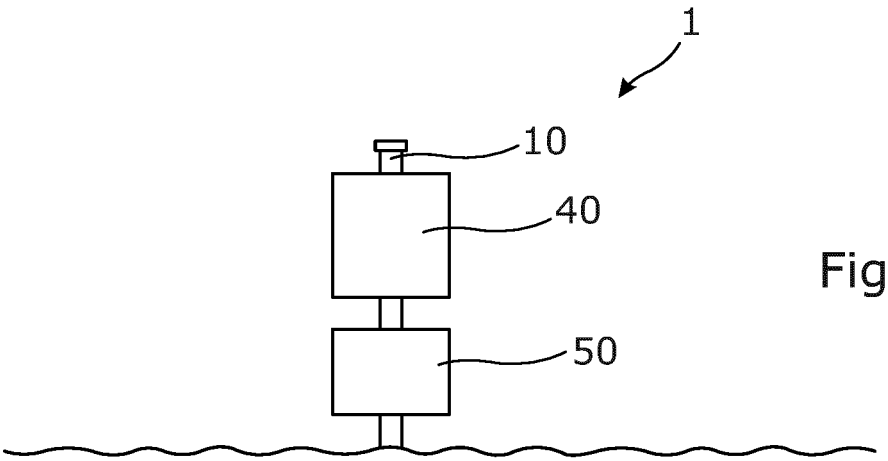


Fig. 4

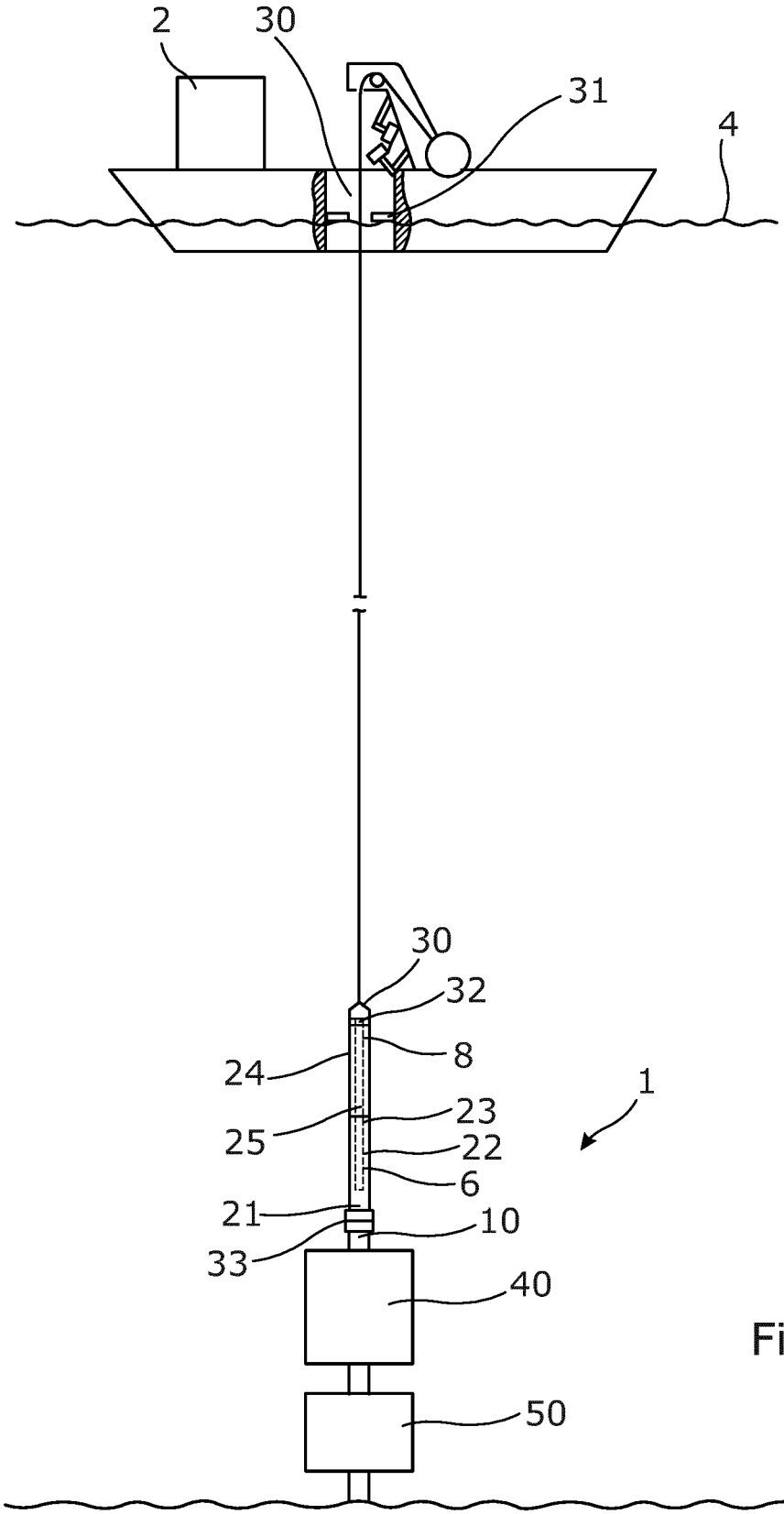
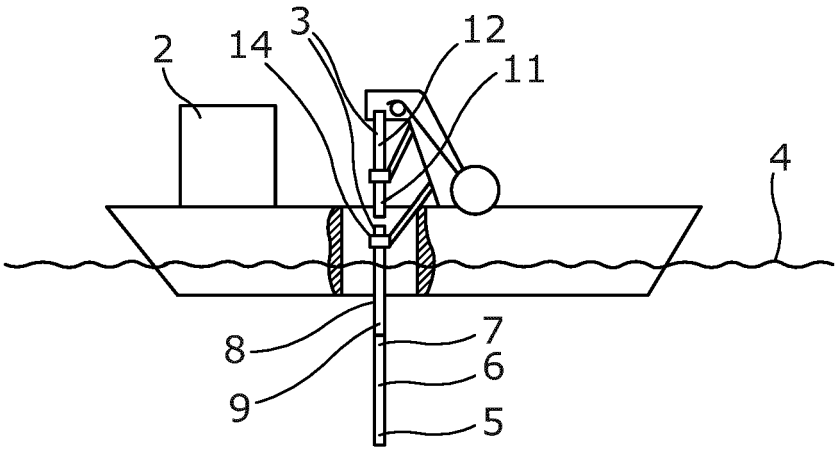


Fig. 5



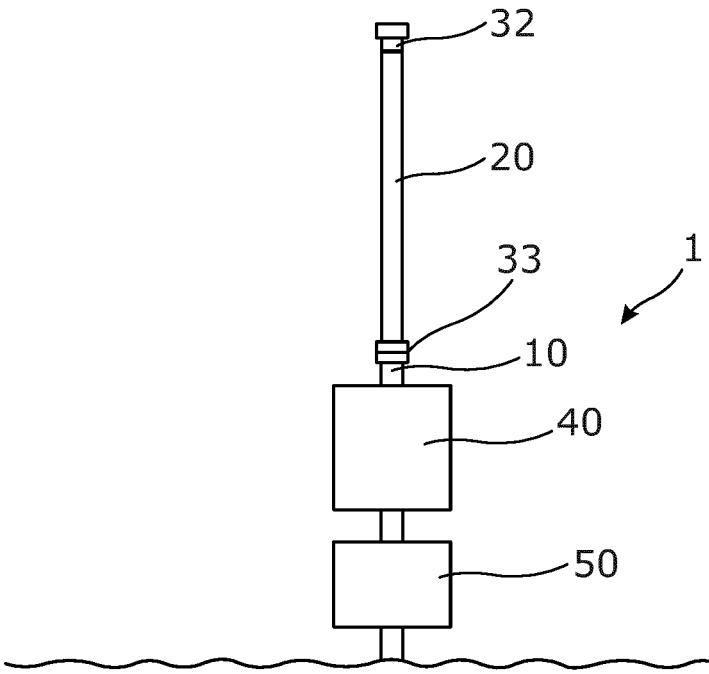
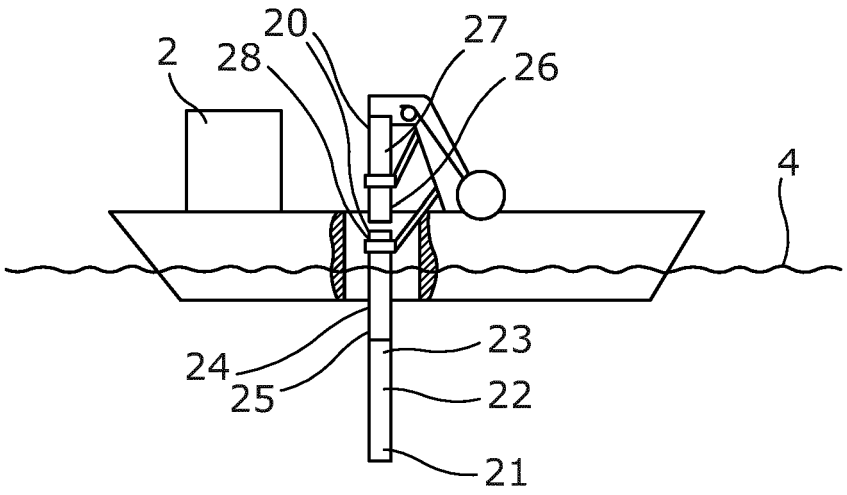


Fig. 6



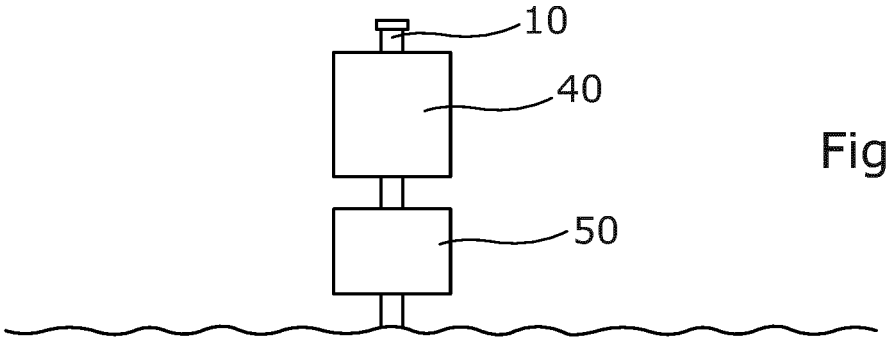


Fig. 7

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EUROPEAN SEARCH REPORT

Application Number
EP 16 16 0230

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y	US 6 250 395 B1 (TORRES CARLOS A [US]) 26 June 2001 (2001-06-26) * column 6, lines 4-16; figures 6,11 * * column 10, lines 28-34 * -----	1 2,6-9	INV. E21B33/076 E21B19/00
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TECHNICAL FIELDS SEARCHED (IPC)

E21B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	18 August 2016	Simunec, Duro

CATEGORY OF CITED DOCUMENTS

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