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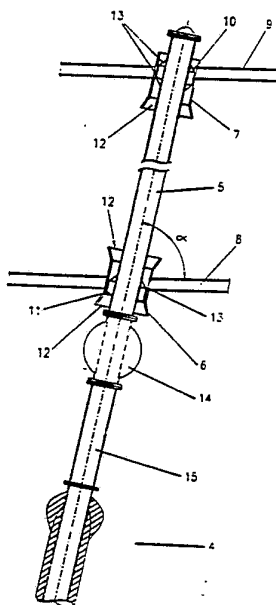
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With international search report.

(54) Title: DEVICE ASSOCIATED WITH FLEXIBLE RISER



(57) Abstract

Device associated with a flexible riser for floating structures such as drilling or production vessels for recovery of oil and gas. The flexible riser (4) extends from a wellhead on the sea-bed to a pipe system on a turret (2) on the floating structure through a guide pipe in the turret. The riser (4) is connected with a rigid pipe (5) which extends from the lower edge of the turret (2) through the guide pipe in the turret and to the pipe system on the deck. The rigid pipe (5) is fitted at an angle (α) to the vertical, which essentially corresponds to the natural angle of the riser.

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Device associated with flexible riser

The present invention concerns a device associated with a flexible riser for floating structures such as drilling or production ships for recovery of oil and gas, where the riser extends from a wellhead on the sea-bed to a pipe system on the floating structure.

Since oil and gas are recovered from steadily greater depths, there has been a growing need to use floating structures. Since floating structures move in relation to the sea-bed, it is necessary to use flexible risers which, as mentioned above, extend from a wellhead on the sea-bed to a pipe system on the floating structure. The floating structure may be either dynamically positioned, or moored to the sea-bed by means of mooring lines.

To enable the floating structure to turn in response to wind or weather, the riser and if relevant mooring lines are led via a so-called turret which is rotatably mounted on the structure. The flexible risers are normally led through a continuous guide pipe in the turret, and are connected directly to the pipe system on the deck of the turret by means of a coupling. The guide pipes are installed vertically in the turret, and to avoid the risers being subject to kinking and rubbing against the underside of the turret, it is commonly known either to supply the risers with a bend restrictor or to supply the guide pipes with a funnel-shaped termination, to ensure that the flexible riser has a limited bending radius.

Using continuous guide piping makes it difficult or (depending on the diameter) impossible to inspect the part of the risers which is inside the guide pipes.

One major disadvantage of using bend restrictors is that the flexible pipes are subject to extra strain because of the pressure forces exerted by the restrictors. These forces create pressure forces between the various layers within the flexible pipes, which in turn leads to internal wear and tear in the pipe wall.

Wobble may also occur between the attached restrictor and the pipe wall because of the internal wear and tear in the pipe wall, wear and tear between the pipe wall and the restrictor, and shrinkage of the plastic materials. This wobble may lead to the restrictor being displaced so that the riser is subject to harmful bending, and further external wear and tear on the riser in the area where it enters the guide pipe. Detection of this wear and tear and wobble can not be detected through an external inspection, incidentally.

One disadvantage of using a funnel-shaped termination on the guide pipe is that the riser is subject to concentrated lateral loads. A further disadvantage is that wear and tear occurs on the surface between the riser and the funnel, and internal wear and tear in the riser wall as a result of these concentrated lateral loads.

To reduce the unnecessary wear and tear on the riser, spacers are sometimes used between the riser and the guide pipe. However, these spacers make it quite impossible to inspect the part of the flexible riser which is inside the guide pipe.

Both the solutions described above, using a bend restrictor or a funnel-shaped part, thus entail a number of disadvantages which could lead to rupture of the riser and thus harmful release of oil and gas.

The aim of the present invention is to produce a solution for flexible risers which eliminates the disadvantages described above, i.e. where uncontrolled bending and stretching of the riser is eliminated. The solution arrived at is moreover fire-

proof, and eliminates internal and external wear and tear. In addition it will enable a full inspection to be made in the area where the riser passes through the turret.

The invention is characterised by the features as defined in the appended claims 1-5.

The invention will now be described in more detail by means of an example, and with reference to the appended drawings in which:

Fig. 1 shows part of a ship with a turret and a number of risers.

Fig. 2 shows on a larger scale the upper part of a riser as shown in Fig. 1.

Fig. 1 shows, as mentioned above, part of a floating structure in the form of a drilling or production ship 1 with a turret 2. The ship is moored via the turret 2 by means of mooring lines 3. Oil and gas is streaming from the wellhead on the sea-bed (not shown) to a pipe system on the ship, through risers 4. The upper part of one of the risers, which passes through the turret 2 is shown on a larger scale in Fig. 2. Instead of using a flexible riser which extends up through a continuous guide pipe and is coupled directly to the pipe system on the deck of the turret, as is commonly known, the present invention is based on a solution whereby the flexible riser is coupled to a rigid pipe 5 of metal or other material which extends from the lower edge of the turret through a lower guide sleeve 6 in the base structure 8, on through an upper guide sleeve 7 in the deck structure 9 of the turret and to the pipe system on deck. The rigid pipe 5 is appropriately provided with spacers 10, 11 to prevent wear and tear between this pipe and the guide sleeves 6, 7. To facilitate introduction and extraction (installation and dismantling) of the pipe 5, the sleeves are also equipped with funnel-shaped ends 12 and the spacers are equipped with conical ends 13.

By using a divided guide pipe in the form of an upper and lower guide sleeve, it is possible to carry out a full external inspection of the riser in the turret. Application of a rigid pipe also makes it possible to carry out a complete internal inspection of the riser, by means of ultrasound, for example. This is not possible with flexible risers.

In accordance with one important feature of the invention, the rigid pipe is fitted at an angle α which is essentially the same as the natural angle of the riser. The advantage of this angled installation of the riser, is that it is subject to lower average strain due to bending at the lower edge of the guide sleeve. One advantage of using a rigid pipe 5, as mentioned above, is, incidentally, that load-bearing forces from the flexible riser are absorbed by the rigid spacers 10, 11 which can be welded to the rigid pipe 5, and that the rigid pipe is not subjected to wear and tear (wear only occurs between the spacers and the guide sleeves).

A flexible joint 14 may preferably be installed between the flexible riser 4 and the rigid pipe 5. This will further reduce bending effects in the flexible riser. Furthermore, a short, rigid pipe 15 may preferably be inserted between the flexible joint 14 and the flexible pipe 4. The advantage of this short, rigid pipe 15 is that the flexion occurs in the section (rigid pipe on both sides) and not in the flexible riser 4.

In other respects, the flexible section may be either of a standard type of "flex joint", which is made of reinforced elastomer with an internal pipelining. A metal pipe with a high modulus of elasticity, for example titanium, could also be used.

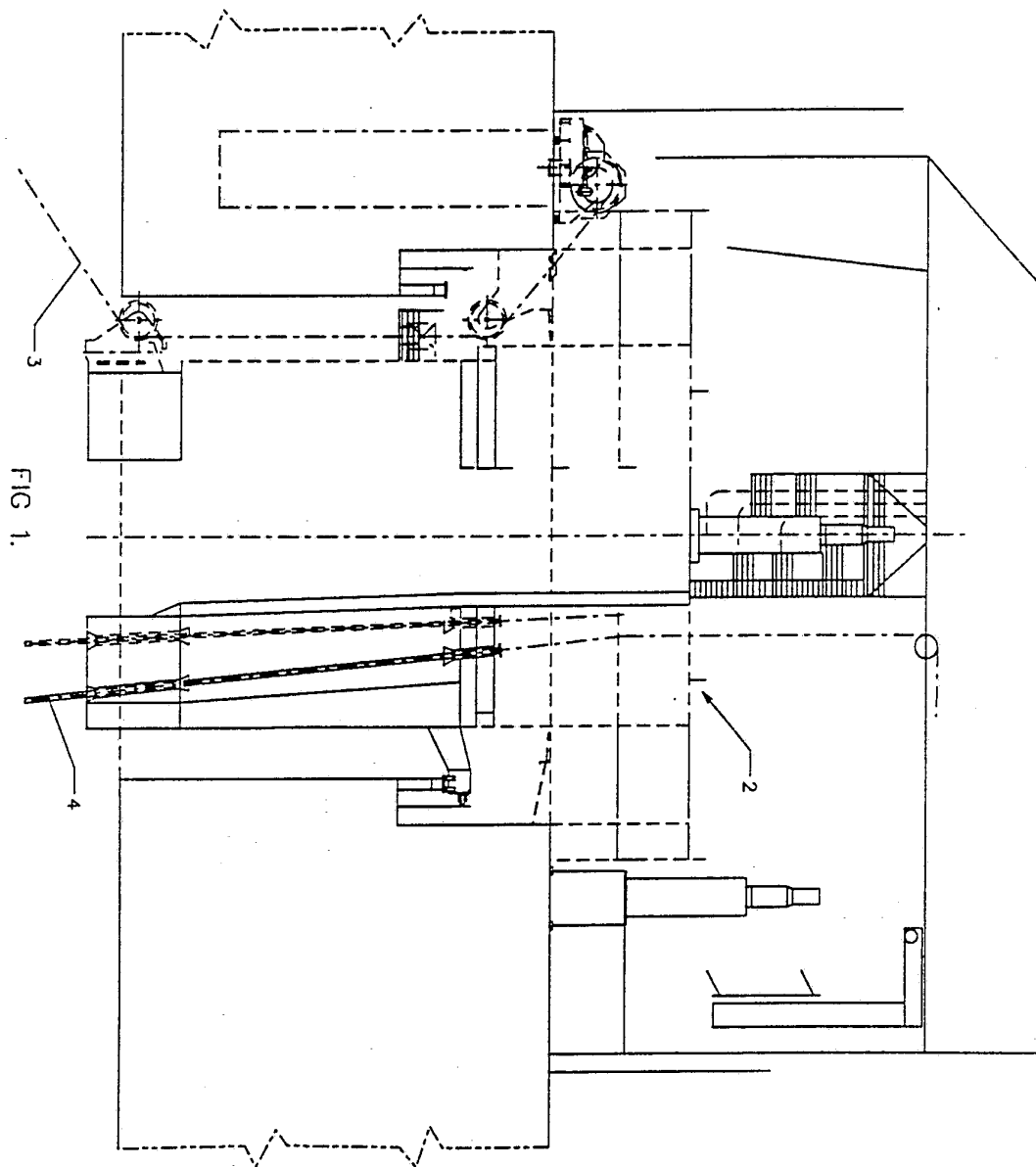
Although the above shows an example of how a divided guide pipe in the form of two guide sleeves can be used to advantage, it should be noted that the invention as defined in the claims is not limited to this example, but can be executed with a continuous guide pipe.

With the present invention is provided a riser which is not subject to harmful wear and tear or uncontrolled bending or stretching which will lead to breaking with subsequent leakage of oil and gas. Further the invention is substantially more fireproof, since a metal pipe is used for the part of the riser which is led through the vessel instead of a flexible pipe of plastic material. Still further the solution according to the invention is considerably less space-consuming.

Claims

1. Device associated with a flexible riser for floating structures such as drilling or production vessels for the production of oil and gas in which a flexible riser (4) extends from a wellhead on the sea-bed to a pipe system on a turret (2) on the floating structure, through a guide pipe in the turret,
c h a r a c t e r i s e d i n t h a t
the flexible riser (4) is coupled to a rigid pipe (5) which extends from the lower edge of the turret (2) through the guide pipe in the turret and to the pipe system on the deck, and that the rigid pipe (5) is fitted at an angle (α) to the vertical, which by and large corresponds to the natural angle of the riser.
2. Device according to claim 1,
c h a r a c t e r i s e d i n t h a t
the guide pipe is divided and includes an upper guide sleeve (7) in the deck structure (9) of the turret, and a lower guide sleeve (6) in the basal structure (9) of the turret.
3. Device according to claim 1,
c h a r a c t e r i s e d i n t h a t
a flexible joint (14) is provided between the flexible riser (4) and the rigid pipe (5).
4. Device according to claims 1 and 3,
c h a r a c t e r i s e d i n t h a t
a short rigid pipe (15) is provided between the flexible joint (14) and the flexible pipe (4).
5. Device according to the preceding claims 1-3,
c h a r a c t e r i s e d i n t h a t
the rigid pipe (5) is equipped with spacers (10) and (11) in the area for the guide sleeves (6) and (7).

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SUBSTITUTE SHEET

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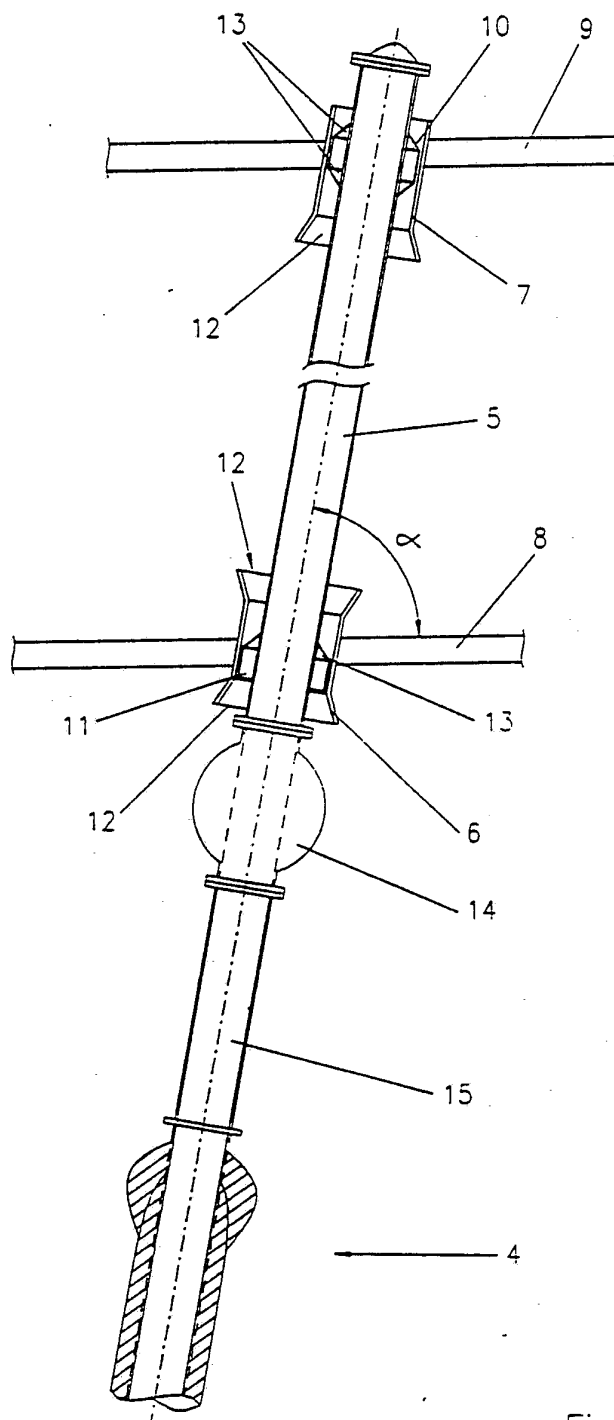


Fig. 2

INTERNATIONAL SEARCH REPORT

International Application No PCT/NO 92/00164

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ⁶ According to International Patent Classification (IPC) or to both National Classification and IPC IPC5: B 63 B 21/50														
II. FIELDS SEARCHED Minimum Documentation Searched⁷ <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 25%; border-bottom: 1px solid black;">Classification System</td> <td style="border-bottom: 1px solid black;">Classification Symbols</td> </tr> <tr> <td style="height: 40px; vertical-align: bottom;">IPC5</td> <td style="height: 40px; vertical-align: bottom;">B 63 B</td> </tr> </table> Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in Fields Searched⁸ SE,DK,FI,NO classes as above			Classification System	Classification Symbols	IPC5	B 63 B								
Classification System	Classification Symbols													
IPC5	B 63 B													
III. DOCUMENTS CONSIDERED TO BE RELEVANT⁹ <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 10%;">Category *</th> <th style="width: 70%;">Citation of Document,¹¹ with indication, where appropriate, of the relevant passages¹²</th> <th style="width: 20%;">Relevant to Claim No.¹³</th> </tr> </thead> <tbody> <tr> <td style="vertical-align: top;">X A</td> <td style="vertical-align: top;">US, A, 3735435 (MIKULICIC ET AL.) 29 May 1973, see column 4, line 6 - line 10; column 4, line 57 - line 65; figure 4 --</td> <td style="vertical-align: top;">1 3,4,5</td> </tr> <tr> <td style="vertical-align: top;">X A</td> <td style="vertical-align: top;">US, A, 3921557 (KAPTEIJN ET AL.) 25 November 1975, see column 3, line 1 - line 8; column 5, line 12 - line 25; figures 1,6,7 --</td> <td style="vertical-align: top;">1 3,4,5</td> </tr> <tr> <td style="vertical-align: top;">A</td> <td style="vertical-align: top;">US, A, 3407768 (J.F. GRAHAM) 29 October 1968, see figure 4 --</td> <td style="vertical-align: top;">1-5</td> </tr> </tbody> </table>			Category *	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³	X A	US, A, 3735435 (MIKULICIC ET AL.) 29 May 1973, see column 4, line 6 - line 10; column 4, line 57 - line 65; figure 4 --	1 3,4,5	X A	US, A, 3921557 (KAPTEIJN ET AL.) 25 November 1975, see column 3, line 1 - line 8; column 5, line 12 - line 25; figures 1,6,7 --	1 3,4,5	A	US, A, 3407768 (J.F. GRAHAM) 29 October 1968, see figure 4 --	1-5
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X A	US, A, 3921557 (KAPTEIJN ET AL.) 25 November 1975, see column 3, line 1 - line 8; column 5, line 12 - line 25; figures 1,6,7 --	1 3,4,5												
A	US, A, 3407768 (J.F. GRAHAM) 29 October 1968, see figure 4 --	1-5												
* Special categories of cited documents:¹⁰ "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "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 "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														
IV. CERTIFICATION <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; border-bottom: 1px solid black; vertical-align: bottom;"> Date of the Actual Completion of the International Search 21st December 1992 </td> <td style="width: 50%; border-bottom: 1px solid black; vertical-align: bottom;"> Date of Mailing of this International Search Report 05 -01- 1993 </td> </tr> <tr> <td style="border-bottom: 1px solid black; vertical-align: bottom;"> International Searching Authority SWEDISH PATENT OFFICE </td> <td style="border-bottom: 1px solid black; vertical-align: bottom;"> Signature of Authorized Officer Christer Jönsson </td> </tr> </table>			Date of the Actual Completion of the International Search 21st December 1992	Date of Mailing of this International Search Report 05 -01- 1993	International Searching Authority SWEDISH PATENT OFFICE	Signature of Authorized Officer Christer Jönsson								
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III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)		
Category *	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No
A	US, A, 4606727 (KOENIG ET AL.) 19 August 1986, see figure 2 --	1-5
A	US, A, 4650431 (KENTOSH) 17 March 1987, see figures 3,4 -- -----	1-5

**ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO.PCT/NO 92/00164**

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the Swedish Patent Office EDP file on **02/12/92**
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A- 3735435	73-05-29	NONE	
US-A- 3921557	75-11-25	AU-D- 6314173	75-06-05
		CA-A- 976812	75-10-28
		DE-A-C- 2360213	74-09-05
		FR-A-B- 2230544	74-12-20
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		JP-B- 56043955	81-10-16
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		SE-B-C- 390011	76-11-29
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		FR-A- 2556307	85-06-14
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		US-A- 4654015	87-03-31