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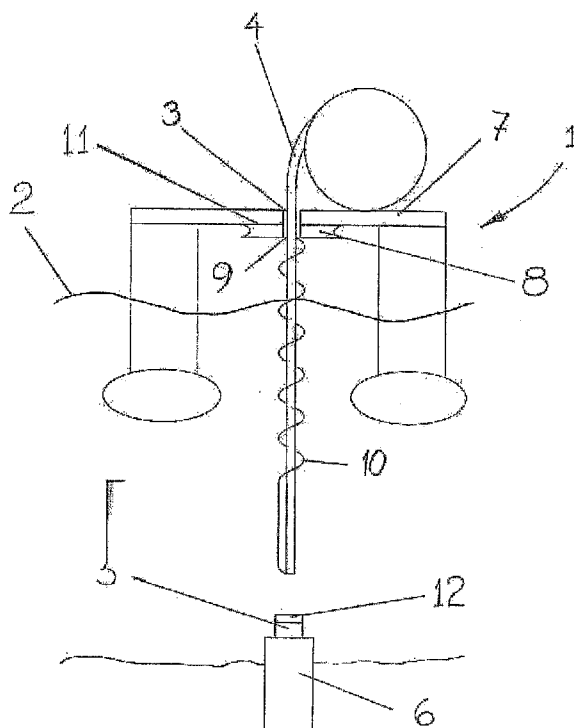
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(54) Title: VIBRATION DAMPER AND METHOD FOR INSTALLATION



(57) Abstract: Method to reduce current induced vibrations for a pipe, particularly a riser or coiled tubing, by installing a line that may be a rope, wire, hose or similar, around the pipe in axial direction to hinder that current vortices be generated around the pipe, distinguished by fastening at least one line that is to function as a damper in the lower end of the pipe and while the pipe is lowered down to an intended position in the sea, wind/turn the line around the pipe such that the whole length of the pipe surrounded by fluid will have the line wound/turned around the pipe as a spiral.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

Vibration damper and method for installation

Field of the invention

The present invention relates to damping of current induced vibrations in pipes, in particular risers and coiled tubing. More specifically, the invention relates to a method for installing a vibration damper in the form of a line around a riser or coiled tubing.

Background of the invention and prior art

It is known that a current of water generates vortices on the downstream side of risers and pipelines. These vortices are shed or thrown away from the pipe body at a frequency dependent on the diameter of the pipe, the coarseness of the surface of the pipe body and the velocity of the water particles of the current. The vortex shedding from side to side may lead to generation of vibrations/oscillations in the riser or pipeline. Masts and chimneys are exposed to the same phenomenon by winds. Risers and pipelines, chimneys and masts can vibrate substantially in situations where the natural frequency of resonance coincides with the current induced frequency of vibration.

To reduce the vortices it is known to equip the bodies with one or several (as for example up to three) helix strakes that are fasten to the outer surface of the body to provide a body of varying diameter, whereby the vortices are thrown to the side of the body at different frequencies along the body, to avoid resonance with the resonant frequency. Such helix strakes may be prepared from steel or aluminium or be welded to the body, but they may also be made of polymer.

New challenges are caused by the fact that the oil industry works in ever increasing depths of water. This requires longer risers which are often more susceptible to vibrations than those already installed. Further, some risers are considered which are thinner than those normally used today, to reduce the weight. Operation may nevertheless be performed safely if the wells are protected by automatic shut down valves.

There are however disadvantages with the prior art devices for vibration damping. The known devices require that units be installed/de-installed as sections on a riser while the riser is lowered/raised, which results in a large demand for labour. Further, the equipment used according to the prior art requires significant storage space on board the rig or vessel, which sometimes is not available.

However, it is not considered practical to use a temporary riser with "spiral formed plates" while the riser is being installed, as the spiral formed plates will increase the difficulty in handling the riser. A method must be found to install the spiral formed plates as the riser is lowered into the sea.

Increasing use of subsea facilities also leads to a demand for intervention operations in subsea wells. An ongoing development program in Statoil aims at an increased production from subsea wells where the well intervention will be an important factor. The intervention operations will require access through a riser from the surface.

Use of coiled tubing may be a new method for well intervention where pipes of smaller diameter are run out from a large drum before the pipe is lowered (with tension if required) into the well. It is not practical to use the coiled tubing with any form of spiral formed plates, and a method must be found to install the spiral formed plates as the pipe is being deployed into the sea/well.

Patent publication application US 2002/0074133 A1 contains a thorough description of a general method to dampen current induced vibrations, and a more specific description of a device and a method that simplifies installation of the vibration damping device by using special clamps that are mounted as pairs having holes/fastenings for one or several copper pipes, and the clamp pairs are mounted in different positions along the riser. Then pairs of clamps are rotated relative to each other and fastened so that the copper pipes are spiral formed around the riser. By using copper the spiral formed pipes will not be overgrown by algae, marine growths, etc, but it would be more preferable with a device without a requirement for fastening to the riser or similar.

In patent publications GB 2 378 493 A and GB 2 315 797 A, devices are described to dampen current induced vibrations, and more particularly sleeve segments having spiral formed fins that will protect the inner pipes and break the current vortices. The sleeve segments are designed in different ways to produce space for storage as several of them are required on a riser, however they still require lots of space. Common for both devices is that they require a lot of manual labour to install/de-install the segments on a riser.

There is a demand for equipment that can reduce some of the disadvantages of the equipment and methods previously described, in particular equipment that are less space demanding, simpler in operation and that do not affect the production in the same way.

Summary of the invention

It is an objective of the present invention to provide a method and a vibration damper that meet the above demand.

Method to reduce current induced vibrations for a pipe, in particular a riser or a coiled tubing, by installing a vibration damper in form of a line that may be a rope, wire, hose or similar, around the pipe in axial direction to hinder that current vortices be generated around the pipe, distinguished by fastening at least one line that is to function as a damper in the lower end of the pipe or at an aimed position along the pipe, and while the pipe is lowered to an aimed position in the sea, or subsequently for an already installed pipe, wind/turn the line around the pipe such that the whole length of the pipe or

the aimed or intended length of the pipe will have the line winded/turned around the pipe as a spiral or helix.

With the invention also a vibration damper is provided, as set forth in claim 8.

Drawings

The invention will be further described with some embodiments and with reference to the drawings, of which

Figure 1 is a sketch illustrating how the coiled tubing/riser is lowered down from a vessel/rig and the line wound/turned around the part that is lowered into the sea,

Figure 2 is a sketch illustrating how the coiled tubing/riser first has been lowered down, the line has been brought down to a BOP, fastened and wound/turned around the pipe n number of times,

Figure 3 illustrates what has happened from figure 2 after the line has been tensioned to place the windings/turns evenly distributed over the whole length of the riser/coiled tubing, and

Figure 4 illustrates further details at deck level of the vessel/rig.

Detailed description

Figure 1 illustrates a rig or a vessel 1 or another suitable installation floating on the surface 2. This vessel or rig 1 may have/has an opening 3 in the hull to pass a coiled tubing/riser 4, subsequently termed "pipe", through and down to the sea and further down to a subsea Christmas tree 5 for connection or further deployment into the well 6.

On deck 7 or in the lower part of the opening in the hull there will be fastened a drum 8. The drum 8 will have a hole 9 in the centre, making it possible for the pipe 4 to pass through. On the drum 8 there will be a line 10, that can either be a wire, rope, hose or similar, that may be wound/turned around the pipe 4 when this is lowered into the sea. When the pipe and line reach the seabed, the line is tensioned and fastened to an anchoring point in the vessel or rig.

The line 10 will function to dampen current induced vibrations in the pipe 4, but will not give any guidance or affect the strength in any substantial way of the pipe 4 that the line 10 is wound around. Since the line 10 and the pipe 4 are not fixedly connected to each other the line 10 and the pipe 4 can be lowered or be taken up independently of each other, but most appropriately the line 10 will be lowered or taken up together with the pipe 4. The line 10 is assumed to cover the whole pipe 4 exposed for current induced vibrations, or an aimed length thereof, and will ensure that the conditions for current induced loads no longer will be present as the fluid flow pattern close to the pipe is "disturbed" by the line.

The number of lines 10 that will be wound/turned around the pipe 4 is at least one, but may be several dependent on the intended effect on the outer surface of the pipe

4. Further, the number of windings/turns around the pipe 4 relative to the length of the pipe 4 may be determined by the deployment velocity of the pipe 4 and the rotation velocity of the drum 8.

If the pipe 4 is to be deployed further into the well 6 under pressure, through e.g. a blow out preventer 12, it must be possible for the line 10 to slide relative to the surface of the pipe 4 that is used without the friction being too excessive or the pipe 4 being damaged. It may then be a demand to pre-treat the surface of the pipe 4 and/or the line 10 with e.g. epoxy.

The drum 8 is mounted so that it has a possibility to rotate around its own axis which coincides with the centre line of pipe 4 which passes through the centre of the drum 8. A fastening device 11 for the drum 8 must be able to carry both the drum with the required length of line 10 and the force that will be used to pull the line 10 to a Christmas tree 6 on the seabed. In figure 4 a drum 8 with line guide 14 is illustrated. The drum will normally have a diameter that is substantially larger than the pipe, and accordingly to guide the line around the pipe, a line guide rotating in the same direction as the drum and with a rotational axis coinciding with the drum, is required. However, the drum 8 and the line guide do not have to rotate at the same speed around the rotational axis. This is required to be able to wind/turn a line around a pipe of different diameter and to have different velocities for deployment/bringing up of the pipe.

If the line for example is to have one rotation per meter deployment or lowering of the pipe, where the pipe has a diameter of 15.24 cm (6") and the drum has a diameter of 79 cm, the following will be the situation:

The line guide 14 is to rotate 360° around the pipe, but if the drum is standing still this means that 248 cm of the line will be let out of the drum and there will be no tensioning in the line. The total length of line that must be out is about 148 cm (1m lowering of the pipe and the circumference of the pipe of about 48 cm). This means that the drum 8 must rotate together with the line guide 14, but only with a rotational angle of about 145° (angle = $100 \text{ cm} \cdot 360^\circ / 248 \text{ cm}$) which corresponds to 100 cm less line at 360° rotation of the line guide 14.

Further, the line guide 14 must withstand a force/or exert a force when the line is let out or taken in or is tensioned. The line may be let out/brought inn from the internal or external diameter of the drum.

On figures 2 and 3 a situation is illustrated where it is desirable to use a coiled tubing 4 that is urged into a well 6 under pressure to perform a job. It will then be most appropriate to install the line 10 on the part of the coiled tubing 4 that is surrounded by water to avoid current induced vibrations, after the coiled tubing has been urged through the blow out preventer 12 at the Christmas tree 5 and possibly a bit further. Then the line 10 will be pulled down to a fastening point on the Christmas tree 5/the seabed, e.g. by a remotely operated vehicle. The drum will then be rotated a number of times around the

coiled tubing 4, which will provide the desired lead, angle of helix or inclination of the spiral that will be formed by the line 10. Now the situation will be that the windings/turnings are not evenly distributed along the coiled tubing 4, as illustrated on figure 2, and to correct this the line 10 will be tensioned in order to stretch it out and thereby distribute the windings/turnings evenly over the length of the coiled tubing, ending up as illustrated in figure 3. Tensioning of the line is important in order to distribute the line evenly over the length of the pipe, in addition to holding the line in place along the pipe, as "fastened". The tensioning must be maintained as long as the line is to function as a vibration damper.

The method as described above will also be used if there for some reason is a demand to replace the line 10 after a pipe 4 is installed, as the line 10 must be re-installed around the pipe 4 which already is lowered and in operation. This saves both time and money. For the line 10 to be released, a release device 13 is required at the end of the line 10.

An embodiment of the invention comprises a drum arranged at the seabed, on which drum the line can be wound up. A further embodiment is, in stead of a drum on the seabed, to return the line to the surface via a wheel on the seabed, with free return of the line to the surface. Thereby the line or each line may constitute a closed loop, as the line is wound onto the riser at deck level while a part of the line is brought freely through the sea from the wheel to the surface. The line loop may be standing installed without any riser, while spinning around the riser is undertaken after deployment of the riser, which can provide a better control over the tensioning and the lead, as the tensioning may take place from two ends or sides, which means from top and bottom on the riser. To avoid problems with twisting, the drum on or just below deck level can be a double drum comprising two independently rotating drums, preferably with a swivel device in the line between the drums.

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Claims

1. Method to reduce current induced vibrations for a pipe, particularly a riser or coiled tubing, by installing a vibration damper in the form of a line that may be a rope, wire, hose or similar, around the pipe in axial direction to hinder that current vortices be generated around the pipe, **characterised by** fastening at least one line which is to function as a damper in the lower end of the pipe or at an intended position along the pipe, and while the pipe is lowered to an intended position in the sea, or subsequently for an already installed pipe, wind/turn the line around the pipe such that the whole length of the pipe or an intended length of the pipe will have the line wound/turned around the pipe as a spiral.

2. Method according to claim 1, **characterised by** mounting the line releaseably to the end of the pipe, such that the line may be installed simultaneously with or after installation of the pipe.

3. Method according to claim 1, **characterised by** passing the pipe through a drum, whereby the centre axes of the drum and the pipe are coinciding.

4. Method according to claim 1, **characterised by** running out or bringing in the line that lies wound up on the drum, by rotating the drum around its own axis.

5. Method according to claim 1, **characterised by** running out or bringing in the line through a guiding means for the line, which guiding means rotates around the centre axis of the drum, such that the line will be wound/turned on/off the pipe when the guiding means is rotating.

6. Method according to claim 1, **characterised by** mounting the drum either on the deck of the vessel or alternatively below the deck closer to the surface.

7. Method according to claim 1, **characterised by** varying the intended effect of the vibration damper by varying the number of windings along the intended length.

8. Vibration damper in the form of a device arranged as a spiral around a pipe in an intended length, **characterised in** that the vibration damper consists of a line (rope, wire, hose or similar) that is releaseably fastened in a lower end of the intended length and is wound as a spiral around the pipe, abutting the pipe loosely, wherein the number of windings around the intended length and the tensioning of the line determines the form of the spiral.

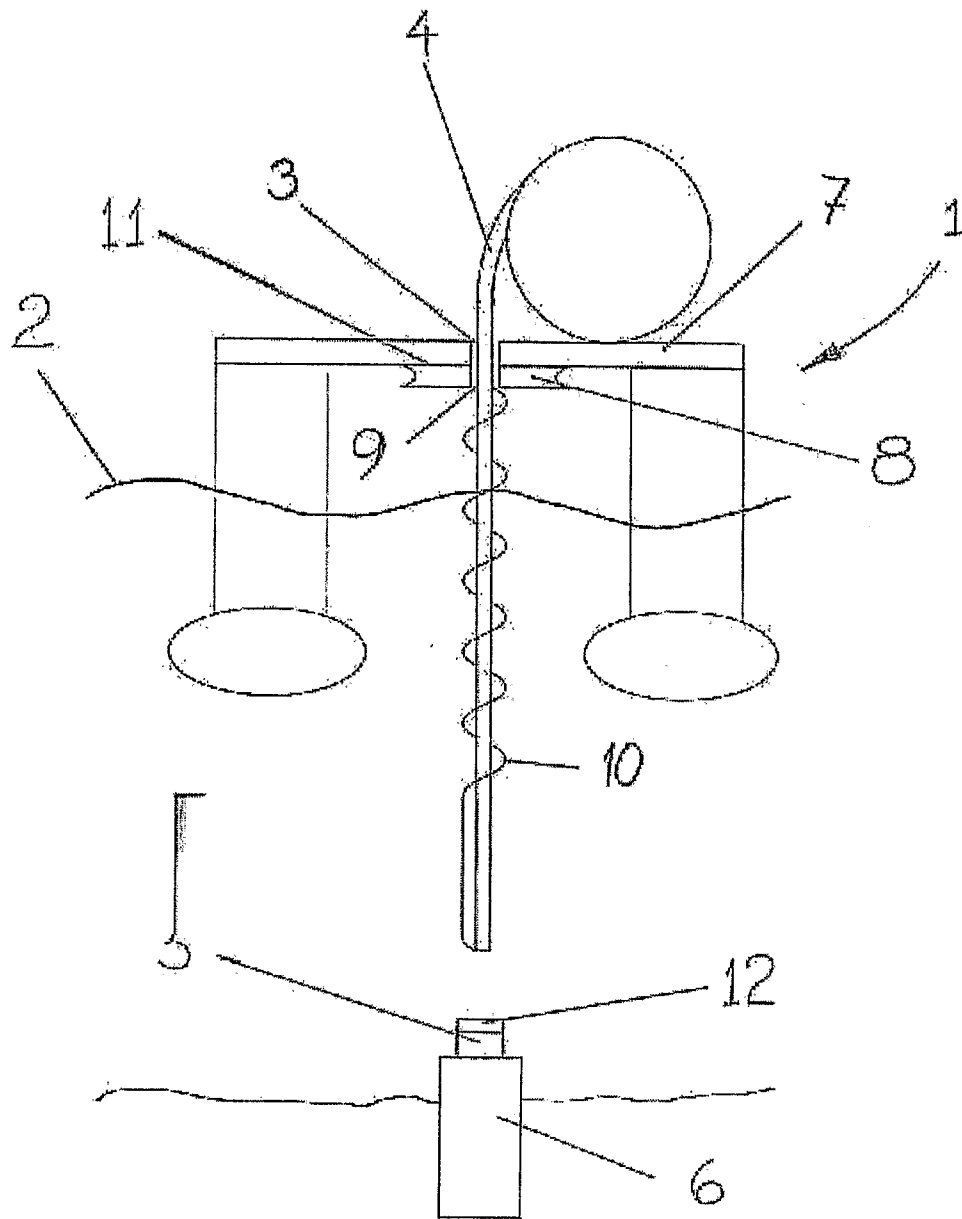
**Fig. 1**

Fig. 2

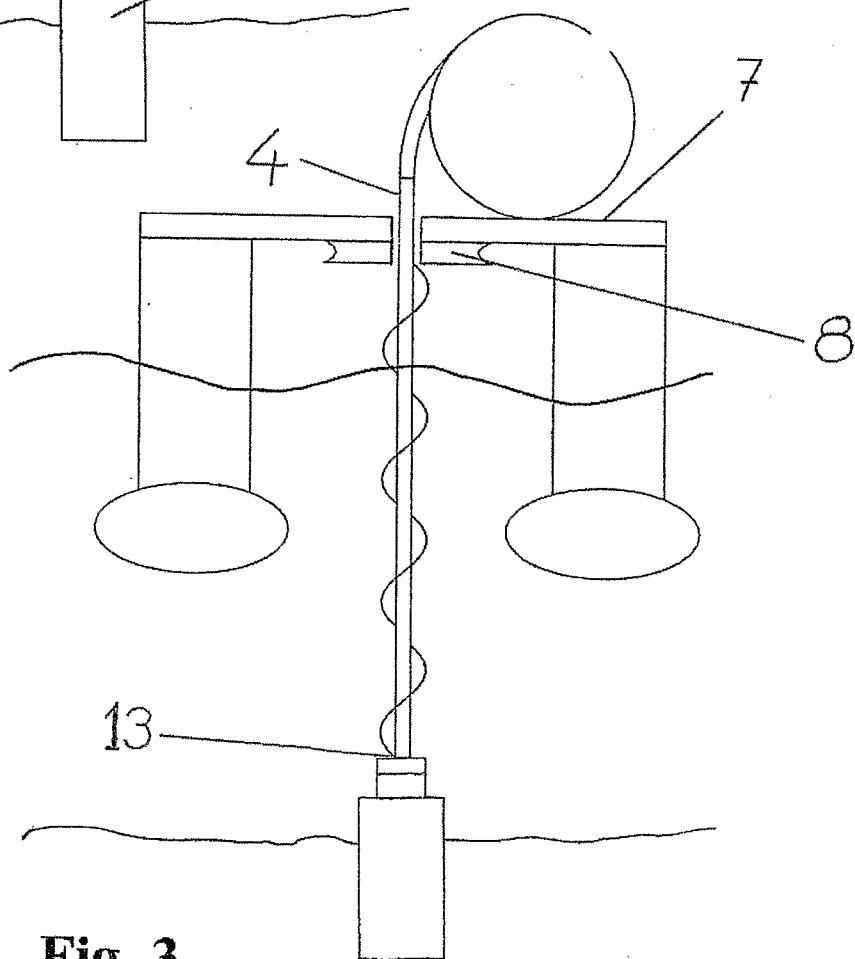
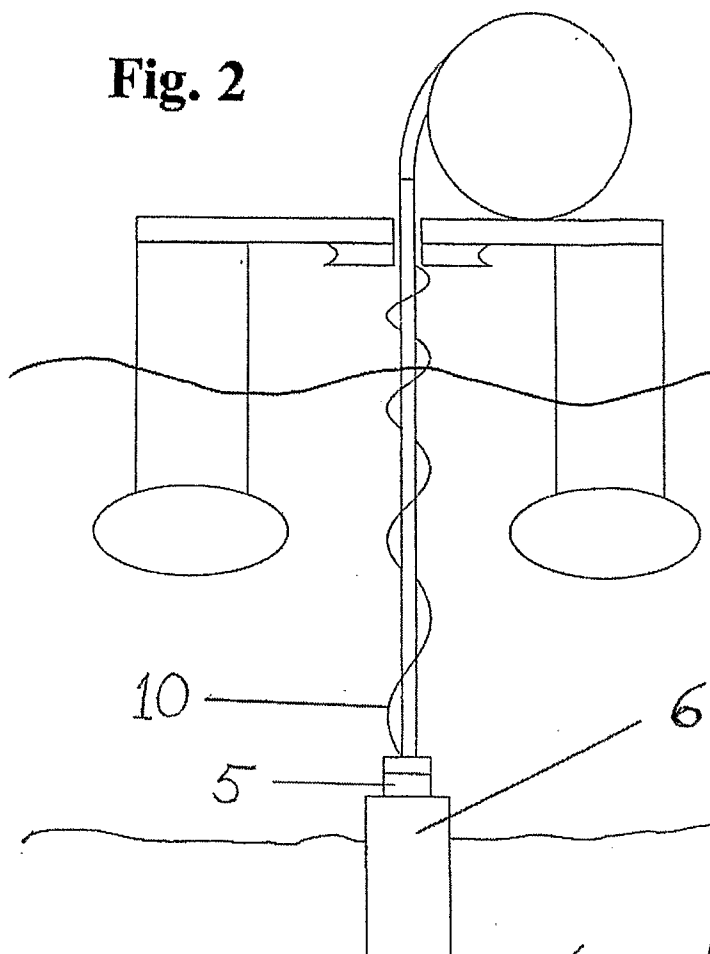


Fig. 3

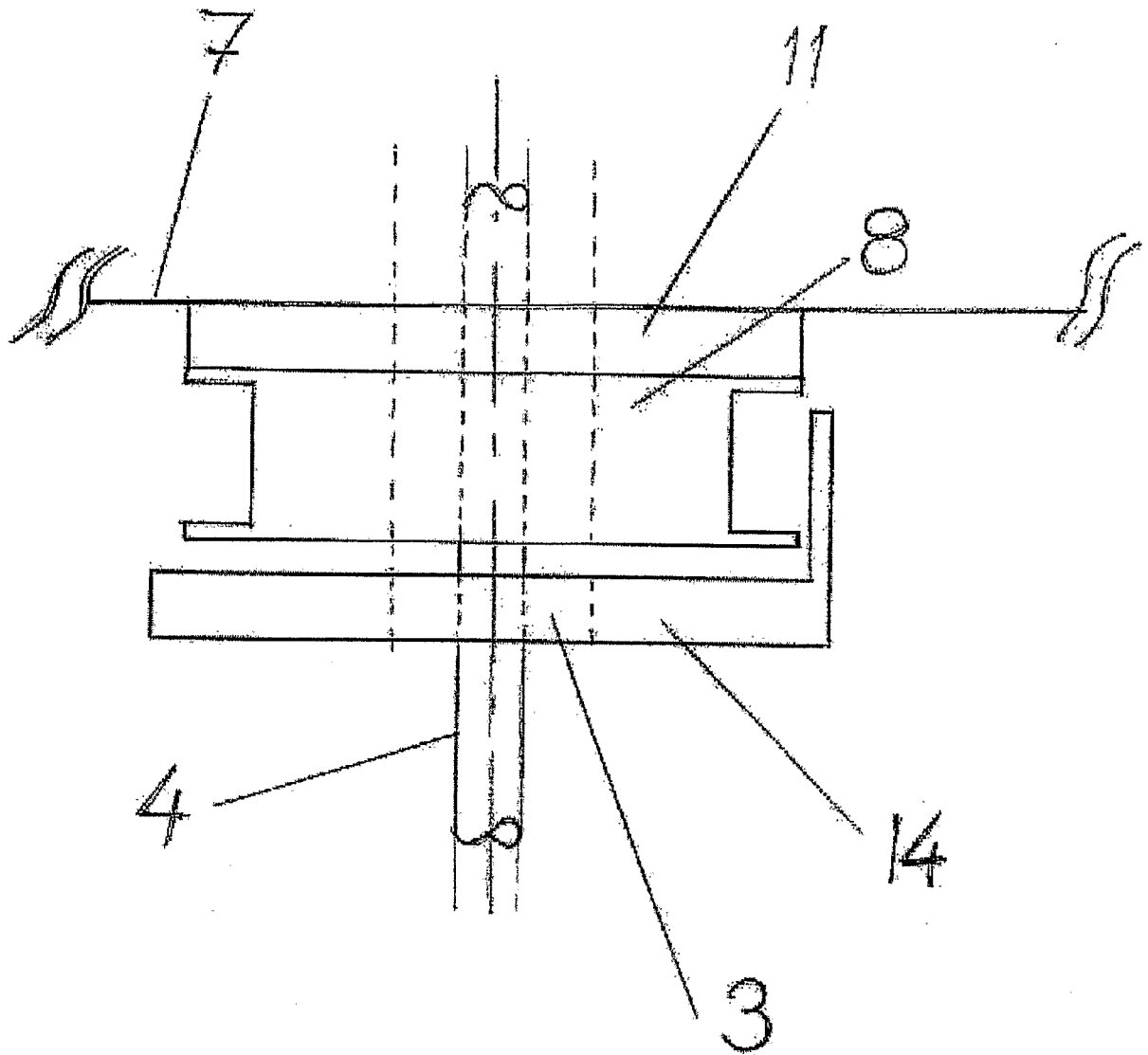


Fig. 4

INTERNATIONAL SEARCH REPORT

International application No.

PCT/NO2006/000386

A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet

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)

IPC: E21B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL, WPI DATA, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 3991550 A (S.H. COHEN), 16 November 1976 (16.11.1976) --	1-8
A	US 6565287 B2 (D.W. MCMILLAN ET AL), 20 May 2003 (20.05.2003) --	1-8
A	WO 9819018 A1 (N.I.C.C. LIMITED), 7 May 1998 (07.05.1998) -- -----	1-8



Further documents are listed in the continuation of Box C.



See patent family annex.

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Paper copies can be ordered at a cost of 50 SEK per copy from PRV InterPat (telephone number 08-782 28 85).

Cited literature, if any, will be enclosed in paper form.

INTERNATIONAL SEARCH REPORT

Information on patent family members

30/12/2006

International application No.

PCT/NO2006/000386

US	3991550	A	16/11/1976	NONE		
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