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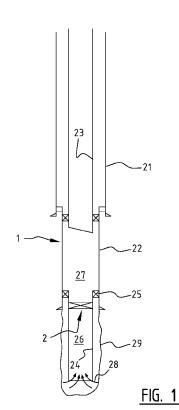
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(54) Title: METHOD AND SYSTEM FOR MANIPULATING A DOWNHOLE ISOLATION DEVICE OF AN UNDERWATER WELLHEAD ASSEMBLY



(57) Abstract: A method for manipulating a downhole isolation device(2) within a subsea well(1) below a subsea xmas tree(32) comprises: - lowering a xmas tree running tool (3), a hydraulic power accumulation and fluid supply module(4) and a Remotely Operated underwater Vehicle(ROV) assembly(11, 12) from the water surface to the subsea xmas tree(32); - connecting the hydraulic power accumulation and fluid supply module(4) to the xmas tree running tool(3); - connecting the hydraulic power accumulation and fluid supply module(4) to the ROV assembly(11,12); - connecting the xmas tree running tool(3) to the xmas tree; and - inducing the ROV assembly(11,12) to activate the hydraulic power accumulation and fluid supply module(4) to induce the xmas tree running tool(3) to apply hydraulic pressure cycles to fluid inside well tubulars(22,23) between the xmas tree(32) and the downhole isolation device(2). The method allows the downhole isolation device (2) to be pressure cycled open standalone without the requirement for a drilling rig or vessel to apply the fluid and/or pressure cycles.



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# METHOD AND SYSTEM FOR MANIPULATING A DOWNHOLE ISOLATION DEVICE OF AN UNDERWATER WELLHEAD ASSEMBLY

### **CROSS-REFERENCE TO RELATED APPLICATIONS**

This application claims priority to European Patent Application No. 12191927.8, filed November 9, 2012, the entirety of which is incorporated herein by reference.

#### BACKGROUND OF THE INVENTION

The invention relates to a method and system for manipulating a downhole isolation device installed within a subsea well.

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Conventional subsea wells may comprise a downhole isolation device that is installed within the completion hardware. Such downhole isolation devices are generally required to be hydraulically opened by the application using a number of fluid pressure cycles. Typically this pressure cycling is done either by a drilling rig or vessel that requires to be connected to the subsea xmas tree.

There is a need for an improved method and system for manipulating a downhole isolation device of a subsea well that does not require connection to a drilling rig or vessel.

#### SUMMARY OF THE INVENTION

In accordance with the invention there is provided a method for manipulating a downhole isolation device within a subsea well below a subsea xmas tree, the method comprising:

- lowering an xmas tree running tool, a hydraulic power accumulation and supply module and a Remotely Operated underwater Vehicle(ROV) assembly from the water surface to the subsea xmas tree;
  - connecting the hydraulic power accumulation and supply module to the xmas tree;
  - the hydraulic power accumulation and supply module to the ROV assembly;
  - connecting the xmas tree running tool to the xmas tree; and
- inducing the ROV assembly to activate the hydraulic power accumulation and supply module to induce the xmas tree running tool to apply hydraulic pressure cycles to fluid inside well tubular between the xmas tree and the downhole isolation device to manipulate the downhole isolation device.

The downhole isolation device may be manipulated to the open position by the application of a number of pressure pulse cycles provided by fluid delivered by the hydraulic power accumulation and supply module to the xmas tree running tool.

The hydraulic power accumulation and supply module may be detachably connected to the xmas tree by a flexible hydraulic fluid supply conduit.

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In accordance with the invention there is furthermore provided a system for manipulating a downhole isolation device of a subsea well, the system comprising:

- a hydraulic power accumulation and supply module and a Remotely Operated underwater Vehicle (ROV) assembly, that are configured to be lowered from the water surface to the subsea xmas tree;
- a conduit for connecting the hydraulic power accumulation and supply module to the subsea xmas tree;
- a connector for connecting the hydraulic power accumulation and supply module to the ROV assembly; and
- means for inducing the ROV assembly to activate the hydraulic power accumulation and supply module to manipulate the downhole isolation device.

These and other features, embodiments and advantages of the method and/or system according to the invention are described in the accompanying claims, abstract and the following detailed description of a non-limiting embodiment depicted in the accompanying drawings, in which description reference numerals are used which refer to corresponding reference numerals that are depicted in the drawings.

Similar reference numerals in different figures denote the same or similar objects.

## BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows a subsea well with a downhole isolation device installed as part of the completion hardware.

Figure 2 shows a hydraulic power accumulation and supply module and xmas tree running tool and ROV used in the system and method according to the invention; and

Figure 3 shows a hydraulic power accumulation and supply module and xmas tree running tool and ROV of Figure 2 mounted on the subsea xmas tree of the well shown in Figure 1.

#### DETAILED DESCRIPTION OF THE DEPICTED EMBODIMENTS

Figure 1 shows a subsea well 1 with a downhole isolation device 2 installed as part of the completion hardware.

The well 1 further comprises a pair of telescoping casing sections 21 and 22, a production tubing 23 and a liner 24 that extends into a well inflow region 25.

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The liner 24 may have a perforated lower region and is suspended within the lower casing section 22 by means of a liner hanger 25.

The downhole isolation device is sealingly connected within the liner 24 so that if the downhole isolation device is closed upward flux of well effluents from the interior 26 of the liner 24 below the downhole isolation device 2 into the interior of the liner 24, casing 22 and production tubing 23 above the downhole isolation device 2 is stopped. Only after opening the downhole isolation device 2 well effluents are allowed to flow up through the well tubulars 22 and 23 to the subsea wellhead assembly 30 shown in Figure 3.

Figure 3 shows a subsea wellhead assembly 30 comprising a template 31 on which a subsea xmas tree 32 and a manifold 14 are mounted.

Figures 2 and 3 furthermore show a hydraulic power accumulation and supply module 4 and ROV assembly 11,12 used in the system and method according to the invention that can be operated standalone to manipulate the downhole isolation device 2 without requiring physical connection to a drilling rig or vessel.

The downhole isolation device 2 and the hydraulic power accumulation and supply module 4 and xmas tree running tool 3 are interconnected by a flexible hose 5.

The hydraulic power accumulation and supply module 4 comprises a compressed fluid accumulation tank 6 which is connected by a conduit and valve assembly 7 to the flexible hose 5.

The hydraulic power accumulation and supply module 4 and xmas tree running tool 3 are connected to hoisting cables 8 and 9 that are connected to hoisting equipment mounted at a vessel (not shown) floating at the water surface.

By paying out the hoisting cables 8 and 9 the hydraulic power accumulation and supply module 4 and xmas tree running tool 3 are lowered through a body of water 10, which may be a sea, ocean or lake, to the subsea xmas tree 32.

Figure 3 shows the hydraulic power accumulation and supply module 4 and xmas tree running tool 3 after connection to the subsea xmas tree 32.

The hydraulic power accumulation and supply module 4 is connected to a first Remotely Operated underwater Vehicle (ROV) 12 by a first power and control cable assembly 15 and the xmas tree running tool 3 is connected to a second Remotely Operated underwater Vehicle (ROV) 11 by a second power and control cable assembly 16.

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The downhole isolation device 2 shown in Figure 1 may be installed in the well 1 after the well has been drilled and during completion of the well 1. In that case the interior 26,27 of the liner 26, casing 22 and production tubing 23 may be filled with a liquid, such as a base oil, whereupon the downhole isolation device 2 is closed until the production facilities, such as the subsea manifold 14, topsides and/or subsea well effluent export and treatment facilities have been installed and are ready for start up. Such topside and/or subsea facility installation may take from several months up till several years. During the period of installation the downhole isolation device 2 is closed and when production of well effluents 28 is started the downhole isolation device 2 is opened by pressure cycles exerted by the xmas tree running tool 3 to the liquid, such as base oil, within the interior 27 of the well tubular 23, 22 above the downhole isolation device 2, which pressure cycles are configured to open the downhole isolation device 2 and allow influx of well effluents 28 into the well 1 and to flow through the interior 26, 27 of the well tubulars 22,23 and 24 to the xmas tree 32 and manifold 14.

The method according to the invention allows the downhole isolation device (2) to be pressure cycled open standalone using submarine ROVs 11,12 that may be launched from a supply vessel without the requirement for a drilling rig or floating vessel to apply the fluid and/or pressure cycles via a drill string or elongate fluid injection conduits extending from the water surface (not shown) to the Xmas tree 32.

#### **CLAIMS**

1. A method for manipulating a downhole isolation device within a subsea well below a subsea xmas tree, the method comprising:

- lowering a hydraulic power accumulation and supply module and a Remotely Operated underwater Vehicle(ROV) assembly from the water surface to the subsea xmas tree;
- connecting the hydraulic power accumulation and supply module to the xmas tree;
   connecting the hydraulic power accumulation and supply module to the ROV assembly;
- connecting the xmas running tool to the xmas tree; and
- inducing the ROV assembly to activate the hydraulic power accumulation and supply module to activate the xmas running tool to exert pressure pulses to fluid inside well tubulars within the well below the xmas tree to manipulate the downhole isolation device.
- 2. The method of claim 1, wherein the downhole isolation device is opened by a series of hydraulic fluid pulse cycles via the hydraulic power accumulation and supply module.
- 3. The method of claim 2, wherein the downhole isolation device is hydraulically opened by application of a number of pressure pulse cycles provided by fluid delivered by the hydraulic power accumulation and supply module.
- 4. The method of claim 3, wherein the hydraulic power accumulation and supply module is detachably connected to the subsea xmas tree by a flexible hydraulic fluid supply conduit.
- 5. The method of any one of claims 1-4, wherein the ROV assembly is detachably connected to the xmas tree running tool and the hydraulic fluid accumulation and supply module by a flexible power and/or signal communication cable assembly.
- 6. The method of claim 5, wherein the ROV assembly comprises a first ROV which is connected to the hydraulic accumulation module by a first flexible power and/or signal communication cable and a second ROV which is connected to the xmas tree running tool by a second flexible power and/or signal communication cable and to the subsea xmas tree by a third flexible power and/or signal communication cable.

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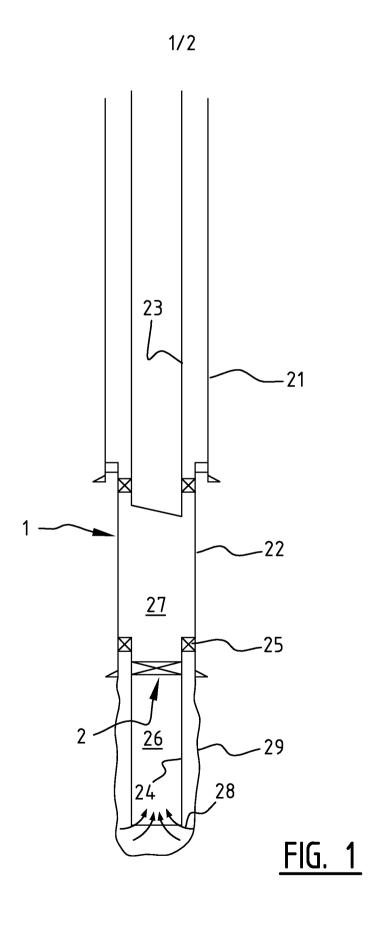
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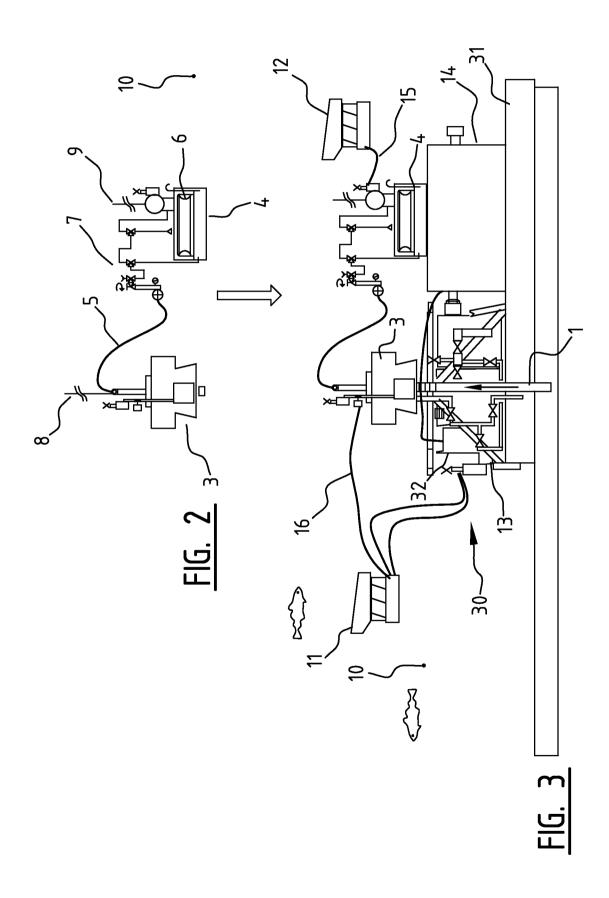
7. A system for manipulating a downhole isolation device, the system comprising:

- a hydraulic power accumulation and supply module and a Remotely Operated underwater Vehicle (ROV) assembly, that are configured to be lowered from the water surface to the subsea xmas tree;
- a conduit for connecting the hydraulic power accumulation and supply module to the subsea xmas tree;

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- a connector for connecting the hydraulic power accumulation and supply module to the ROV assembly; and
- means for inducing the ROV assembly to activate the hydraulic power accumulation and supply module to manipulate the downhole isolation device.





International application No. PCT/US2013/068890

#### CLASSIFICATION OF SUBJECT MATTER

E21B 33/03(2006.01)i, E21B 33/035(2006.01)i, E21B 33/038(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

#### FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols) E21B 33/03; E21B 33/00; B63C; E21B 33/12; E21B 33/076; E21B 19/00; E21B 33/035; H04W 40/00; E21B 33/038

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Korean utility models and applications for utility models Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) eKOMPASS(KIPO internal) & Keywords:underwater wellhead assembly, hydraulic power accumulation, remotely operated underwater vehicle, xmas tree, and downhole isolation device

#### DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 03-070565 A2 (FOX, PRESTON et al.) 28 August 2003 See page 14, line 15 - page 16, line 26, page 20, line 33 - page 23, line 18, page 28, lines 12-25, and figure 1.	1-7
A	US 2012-0043089 A1 (HOFFMAN, COREY EUGENE et al.) 23 February 2012 See paragraphs [0023]-[0027], [0036]-[0037], [0087] and figures 2A-2B, 7B.	1-7
A	WO 2006-099316 A1 (SAIPEM AMERICA INC.) 21 September 2006 See page 9, line 22 - page 10, line 8 and figure 9.	1-7
A	WO 2011-128355 A2 (AKER SUBSEA AS) 20 October 2011 See page 4, line 33 - page 5, line 17 and figures 1-3.	1-7
A	WO 2009-122168 A1 (VETCO GRAY CONTROLS LIMITED) 08 October 2009 See page 7, lines 4-25 and figure 2.	1-7

	Further documents are listed in the continuation of Box C.		See patent family annex.
*	Special categories of cited documents:	"T"	later document published after the international filing date or priority
"A"	document defining the general state of the art which is not considered		date and not in conflict with the application but cited to understand
	to be of particular relevance		the principle or theory underlying the invention
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Date of the actual completion of the international search	Date of mailing of the international search report
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# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

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