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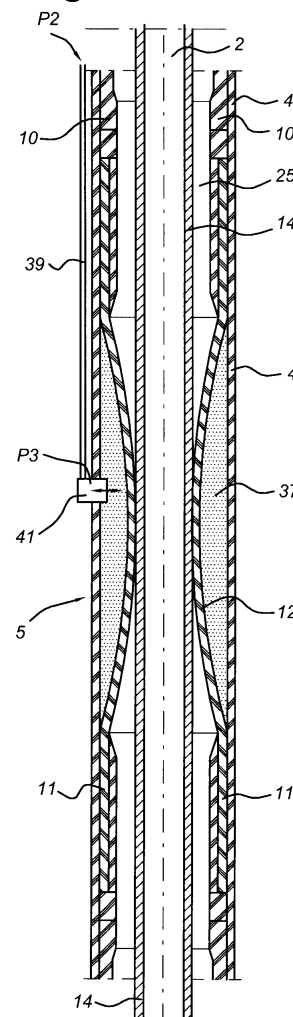
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2501 CJ The Hague (NL)(54) **System and method for controlling the pressure in a wellbore**

(57) The pressure control system comprises:

- a tubular element (4) having a valve member arranged and construed to at least partially block a flow path through a bore of the tubular element,
- at least one control member for controlling the blocking operation of the valve member;

wherein the valve member is a pressure seal comprising a flexible sleeve (12) inside the tubular element (4) and at least one pressurization chamber (37) between the casing and the sleeve, and wherein the control member includes an hydraulic control line (39) connected to the pressurization chamber, the pressure seal being arranged and construed so as to at least partially block the flow path on pressurization of the pressurization chamber. The invention also relates to providing a pressure control system and controlling the pressure in the well bore by pressurizing or depressurizing the at least one pressurization chamber causing the volume of the pressure seal to increase/decrease respectively so as to at least partially block or unblock the flow path.

Fig 3**EP 2 053 196 A1**

Description

[0001] The present invention relates to a pressure control system for controlling the pressure in a well bore formed in a subsurface. The invention also relates to a method of controlling the pressure in a well bore formed in a subsurface.

[0002] The exploration and production of hydrocarbons from subsurface hydrocarbon-bearing formations requires a method and system to reach and extract the hydrocarbons from the formation. Reaching the formations is accomplished by drilling a borehole in the earth (i.e. the subsurface) to a depth adjacent the formation. Drilling a borehole is typically done by a drilling rig. For instance, if the drilling is land-based, it supports a drill bit that is rotatably mounted on the end of a drill string. A fluid comprised of a base fluid, typically water and oil, is pumped down the drill string and exits through the rotating drill bit. The fluid then circulates back up the annulus formed between the borehole wall and the drill bit, taking with it the cuttings from the drill bit and clearing the borehole. After the borehole is drilled to a certain depth, tubing or casing is inserted in the borehole to form a well bore and the annular space between this tubing or casing and the subsurface is optionally filled with cement. The tubing or casing strengthens the borehole, while the cement forms a seal to prevent fluid flow outside the casing.

[0003] Wells may be drilled in an overbalanced condition. The fluid used in the overbalanced condition has a hydrostatic fluid pressure in excess of the formation fluid pressure, thereby preventing formation fluids from entering into the borehole. However, because the fluid pressure is higher than the formation pressure, some fluid will invade the formations adjacent the well bore. This may cause damage to the formations, adversely affecting hydrocarbon production during the lifecycle of the well.

[0004] Alternatively, wells may be drilled in an underbalanced condition, wherein the wellbore fluid is at a pressure lower than the natural pressure of the formation fluids. To avoid the well conditions to cause a blow out, underbalanced wells must be drilled through a pressure control device, for instance a rotating control head (RCH) on top of a blow out preventer (BOP) and a choke manifold provided at the surface. The rotating control head permits a tubular drill string to be rotated and lowered there through while retaining a pressure seal around the drill string.

[0005] Running a drill string or a tool string in and out of a pressurized wellbore is often difficult. Usually a lubricator is used, possibly in combination with snubbing equipment for running the string at a high pressure into the wellbore or stripping equipment for stripping the string, or the well is brought to an overbalanced condition allowing the string to be tripped conventionally to the surface. Both these processes are time consuming and expensive.

[0006] To simplify this process the industry has developed the concept of a casing shutoff mechanism or down-

hole deployment valve (DDV). The downhole deployment valve is located within the tubing or casing and is operated remotely through hydraulic control lines running from the valve to the surface. The downhole deployment valve is used to temporarily isolate a lower part of the wellbore from an upper part thereof. The pressure inside the lower part of the wellbore, i.e. essentially the formation pressure, may be isolated from the upper part, wherein the pressure may be reduced considerably, for instance relieved to atmospheric pressure. A drill string or tool string present in the upper part of the wellbore may then be easily removed from the wellbore and another string may be easily run into it.

[0007] Typically the downhole deployment valve has a downward opening flapper design. Controlled by a hydraulic line the flapper may be moved in downward direction to open the passage through the well bore and in an upward direction to close the same. There is a number of disadvantages associated with this known flapper valve design. First of all, the flapper valve can only hold a relatively low pressure difference from the top down. With an increasing pressure difference this may eventually result in erratic opening of the valve, causing the isolation of the well bore part above the valve from the remaining part of the wellbore be compromised. In order to safeguard the proper functioning of a typical flapper valve, the pressure difference should be kept relatively low.

[0008] The flapper type of downhole deployment valve is furthermore susceptible to damage of the sealing area and to obstruction by solids. Solids or other substances sticking to the wall of the well or to the valve itself may (partially) block the valve when it is moved from the open to a closed position. In this case the valve will not seal off the upper part of the wellbore, effectively creating a failure of the valve which can potentially lead to a dangerous pressure increase. The deployment valve is also vulnerable to falling objects. For instance, an object accidentally dropped onto the valve that is closed during running a drill string or tool string out of the wellbore, may cause the valve to (partially) open. The pressure below the valve then bypasses the valve and either eject the dropped object or create a potentially dangerous pressure increase at the surface.

[0009] The design of a typical flapper valve is furthermore fairly complicated, which makes the valve vulnerable to malfunctions or defects and increases the costs for manufacturing the valve.

[0010] A further drawback is that it might prove to be impossible to open the flapper valve in case of an excessive pressure build-up below the valve. More generally, it is difficult to repair or to even remove the valve in case of malfunction of the valve in closed position.

[0011] Finally, the known flapper valves cannot be closed when a drill string or tool string is present inside the well bore at the location of the valve. When the pressure in the upper part of the wellbore is to be isolated from the pressure in the lower part, the string has to be

tripped first to a position above the valve and only then the valve may be closed. Under certain circumstances this may slow down the drilling process considerably.

[0012] Therefore there exists a need for improved apparatus and methods wherein the above stated disadvantages associated with the known flapper design valve have been reduced.

[0013] According to a first aspect of the invention a pressure control system for controlling the pressure in a well bore formed in a subsurface is provided, the pressure control system comprising:

- a tubular element having a valve member arranged and construed to at least partially block a flow path through a bore of the casing,
- at least one control member for controlling the blocking operation of the valve member;

wherein the valve member is a pressure seal comprising a flexible sleeve inside the tubular element and at least one pressurization chamber between the casing and the sleeve, and wherein the control member includes an hydraulic control line connected to the pressurization chamber, the pressure seal being arranged and construed so as to at least partially block the flow path on pressurization of the pressurization chamber.

[0014] When the pressurization chamber is pressurized, the volume of the pressure seal is caused to increase and to gradually reduce the area available for the fluid to flow. If the pressure inside the seal is further increased, the flow path inside the tubing may even become blocked entirely. On the other hand, when the chamber is depressurized, the volume of the pressure seal is caused to decrease again so that the area available for the fluid to flow is increased and the pressure drop across the seal is reduced. If the pressure in the seal is further (completely) reduced, the fluid may even flow substantially uninterrupted along the pressure seal and the pressure drop across the seal has minimal value.

[0015] In an embodiment of the present invention the flexible sleeve of the pressure seal is arranged along the inner circumference of the tubular element. The sleeve may be extend along one or more parts of the inner circumference, but when it extends along substantially the entire length of the inner circumference of the tubing, a more uniform distribution of the fluid flow may be achieved. In case of a symmetrical seal with respect to the axial direction of the tubular element, the sealing characteristics may be improved, especially when the flow path is to be obstructed completely.

[0016] In an embodiment of the present invention the tubular element comprises an upper support for attachment of the upper portion of the sleeve and a bottom support for attachment of the lower portion of the sleeve to the inner surface of the tubular element. The supports keep the flexible sleeve at the desired position. In case the sleeve extends along the entire inner circumference of the casing, the upper and lower support suffice to de-

fine the pressurization chamber between the inner surface of the casing and the inner surface of the sleeve.

[0017] In an embodiment of the present invention the pressure control system comprises control means being operative so as to control the pressure drop across the pressure seal by applying a predefined hydraulic pressure in the pressure chamber. The pressure drop across the pressure seal may take any value between a maximum value when the flow path is closed completely and a minimum value when the flow path is open.

[0018] The pressure seal having a flexible sleeve makes it possible to use the seal also when equipment, such as a pipe of a drill string or a tool string, is present at the location of the seal. In this situation the flow path is defined between the outer surface of this equipment and the inner surface of the tubular element. The flow path, which usually defines an annular flow area, may be blocked or unblocked by pressurizing or depressurizing the flexible sleeve of the pressure seal.

[0019] In an embodiment the sleeve is an elastic sleeve, preferably made of (reinforced) rubber. Other suitable materials include Kevlar or other high-strength flexible materials.

[0020] One important application of the pressure control system according to the present invention relates to downhole pressure control, wherein the tubular element is arranged in the subsurface within a well bore and the pressure seal is positioned at a predefined depth below the surface. In another application the pressure control system is used as a seal in a rotating control head at the surface instead of a Dynamic Annular Pressure Control (DAPC) choke manifold by controlling the pressure between the sleeve and allowing fluid (including liquid, gas and/or mud) flow to pass between the drill string and the sleeve.

[0021] According to another aspect of the present invention a method of controlling the pressure in a well bore formed in a subsurface, method comprising:

- providing a tubular element having a valve member for at least partially blocking a flow path through a bore of the casing, and at least one control member for controlling the operation of the valve member, wherein the valve member is a pressure seal comprising a flexible sleeve inside the tubular element and at least one pressurization chamber between the casing and the sleeve, and wherein the control member is an hydraulic control line connected to the pressurization chamber,
- controlling the pressure in the well bore by pressurizing or depressurizing the at least one pressurization chamber causing the volume of the valve pressure seal to increase or decrease respectively so as to at least partially block or unblock said flow path.

[0022] Further advantages, characteristics and details of the present invention will become apparent from the following description of preferred embodiments thereof.

In the description reference is made to the annexed drawings, that show:

- figure 1 a schematic view of a first embodiment of the pressure control system in an wellbore operation when a drill string extends through the pressure seal area;
- figure 2 a more detailed longitudinal section of the pressure seal according to the embodiment, wherein the seal is in open condition;
- figure 3 the section of figure 2, wherein the seal is in a closed condition;
- figure 4 a detailed longitudinal section of the pressure control system without a drill string extending through the pressure seal, wherein the seal is in open condition;
- figure 5 the section shown in figure 4, wherein the seal is in closed condition; and
- figure 6 an elevational view of an embodiment of a rotating control head (RCH) pressure control system according to the present invention.

[0023] Referring to the figures there is shown a surface drilling system employing a downhole deployment valve system in accordance with an embodiment of the present invention. It will be appreciated that an offshore drilling system may likewise employ the current invention. The drilling system 1 comprises of a drilling rig that is used to support drilling operations and numerous components used on a rig to accomplish the drilling operation. Many of the components are not shown for ease of description. As depicted in figure 1 the borehole 8 has already been partially drilled and a tubular element has already been arranged in the borehole. In the embodiment shown the tubular element comprises a fixed casing 4, that has been set and cemented in the borehole 8. In other embodiments (not shown) the tubular element is retrievable.

[0024] A drill string has been deployed, the drill string including a drill pipe 14 supporting a bottom hole assembly (BHA) 3 that includes a drill bit 13. The drill bit 13 is drilling in the subsurface S and extends through well bore formation 21 into a reservoir formation 22. The well may be drilled underbalanced so that, due to the downhole formation pressure, formation fluids may flow through the annular space 25 between the drill pipe 14 and the casing 4 towards the upper portion of the wellbore and even may reach the surface equipment. The well may also be drilled overbalanced so that fluids pumped down the drill string, exiting from the bottom hole assembly 3 and returning to the surface, also through the annular space between drill pipe 14 and casing 4. In both situations fluid may flow from the lower part of the casing to the upper part and even to the surface (direction P_1 , figure 2).

[0025] The pressure may be controlled at the surface by a blow out preventer (BOP) 30, optionally including a RCH, flow lines 31 and a backpressure system 32. The rotating blow out preventer 30 seals around the pipe 14 as it moves in and out the well bore 8, isolating the pres-

sure, but still permitting drill string rotation. The pressure may also be controlled downhole at the position of a pressure control valve 5.

[0026] Figures 2 and 3 show the pressure control valve 5 in more detail. Figure 2 shows an upper support 10 and a lower support 11 to which respectively the upper and lower ends of an elastic, rubber sleeve element 12 are attached. The supports 10 and 11 and the rubber sleeve 12 extend along the entire inner circumference of the casing 4 and the sleeve defines an annulus, extending concentrically with the tubular element. Between the inner surface of the elastic sleeve 12 and the inner surface of the tubular element 4 a space is defined (hereafter called the pressurisation chamber 37), that may be pressurized or depressurized through a hydraulic pressurisation line 39 and pressurisation control device 41. The pressurisation line 39 is connected to a hydraulic system 18 arranged at the surface, as schematically shown in figure 1. The hydraulic system 18 and pressurisation control device 41 control the flow (direction P_2) of hydraulic fluid to and from (direction P_3) the pressurisation chamber 37.

[0027] Figure 2 shows the pressure valve in the fully opened position. When hydraulic fluid is introduced into the pressurisation chamber 37, the pressure inside the chamber increases, causing the volume of the elastic sleeve 12 to increase (direction P_4 in figure 2). An increase of the volume of the elastic sleeve 12 brings about a corresponding reduction of the space 25 between the sleeve and the drill pipe 14. The result is an increasing pressure drop across the pressure valve 5. When the volume of sleeve 12 is increased further, the sleeve will eventually seal off the flow path between the sleeve and the drill pipe 14. The situation wherein the pressure valve is completely closed is shown in figure 3.

[0028] When starting from the situation shown in 3 the pressure inside the pressurisation chamber 37 is reduced (or, in other words, when the pressurisation chamber 37 is depressurised), the volume of the chamber 37 is reduced and the flow path between the casing and the drill pipe 14 is unblocked.

[0029] In figures 4 and 5 these are shown wherein no drill string or other equipment is present at the location of the pressure valve 5. For instance, when the drill pipe 14 is to be removed for maintenance reasons, the pipe 14 is pulled up. Once the bit 13 of the drill string is located above the pressure valve 5, the valve can be shut in order to close the open hole section. Valve 5 is shut by pressurizing the pressurisation chamber 37 to a sufficient extent. In the closed (shut) state, the valve seals off the open hole section in a "drop tight" manner.

[0030] Once the pressure valve has been closed, the pressure inside the casing 4 and above the pressure seal 5 can then be bled off and the drill pipe 14 may be removed safely from the casing 4. The drill string may then be run back into the casing 4 to a position just above the pressure seal 5. The upper portion of the casing (i.e. the portion above the pressure seal 5) is pressurized again

prior to opening the pressure seal 5 again so as to equalize the pressures above and below the valve. This may be accomplished by slowly opening the pressure seal so that the pressure equalisation takes place in a controlled manner.

[0031] In another embodiment of the present invention the system comprises a pressure sensor 40 provided in the hydraulic control line at the surface. By measuring at the surface the pressure in the hydraulic line 39 and compensating for the hydrostatic head in the hydraulic line 39, the downhole pressure of the fluid in the annulus 25 at the location of the pressure valve 5 may be determined easily, without needing a downhole pressure sensor located in or near the pressure valve.

[0032] In figure 6 another embodiment of the pressure control system in accordance with the present invention is shown. This embodiment relates to a rotating control head (RCH) pressure control system arranged at the surface. As noted earlier, the drilling process requires the use of a drilling fluid 36, which is stored in a storage (not shown). The storage is in fluid communication with one or more mud pumps 35 which pump the drilling fluid 36 through a conduit connected to the last joint of the drill string (drill pipe 14) that passes through a RCH and BOP (BOP) 30. A blow out preventer as such is known in the art and a detailed description can be omitted here. The blow out preventer 30 provides for a seal around the drill pipe 14, isolating the pressure, but still permitting drill string rotation and axial movement. The fluid 36 is pumped down (P_5) through the drill string 14', 14 and the bottom hole assembly (BHA) 3 and exits the drill bit 13, where it circulates the cuttings away from the bit 13 and returns them up the open hole annulus and the annulus 25 formed between the drill pipe 14 and casing 4 (direction P_6). The fluid then returns to the surface through annulus 25 formed between drill pipe 14 and casing 4' (direction P_7).

[0033] Usually the fluid then goes through a diverter, through a conduit 31 (cf. figure 1) and proceeds to what is generally referred to as the backpressure system 32. A typical backpressure system 32 comprises a backpressure pump and a dynamic annular pressure control (DAPC) choke manifold. By controlling the backpressure pump and the choke manifold, the backpressure system 32 may add backpressure to the pressure in the annulus 25. In this way the annular pressure can be controlled to some extent. A further explanation about existing backpressure systems may for instance be found in document WO 03/071091 A1, which is considered to be incorporated herein by reference.

[0034] Instead of or in addition to the backpressure system described above, a pressure control system in accordance with the present invention may be used to control the annular pressure. Figure 6 shows an example of a blow out preventer 30 equipped with a pressure seal in accordance with the present invention. A typical blow-out preventer (BOP) encases the wellbore and includes one or more valves that may be closed if uncontrolled

inflow of formation fluids occurs. By closing this valve, the drilling crew can prevent uncontrolled fluid and/or pressure release, thus maintaining control of the well. Basically blowout preventers come in two varieties. A ram blowout preventer utilizes two horizontally opposed hydraulic rams that either close around the drill string or shear through the drill string. An annular blowout preventer (also known as a spherical blowout preventer) utilizes a hemispherical piece of rubber reinforced with steel. Unlike a ram BOP which closes with a sharp horizontal motion, an annular BOP closes around the drill string in a smooth simultaneous upward and inward motion. Typically a blow out preventer has two or more ram type preventers and one annular type preventer. The ram type and annular type preventers are not shown in figure 6 for ease of description.

[0035] In an embodiment of the blow out preventer 30 according to the invention (cf. figure 6) the diverter is omitted and the returning fluid is guided upward through the flow space between the casing 4' and the drill pipe 14. After having passed a pressure valve 27 to be described later, the fluid is discharged (direction P_8) through a discharge conduit 38 to the storage mentioned earlier.

[0036] The pressure valve 27 is provided for controlling the pressure drop from the annulus 25 to the conduit 38 and comprises an elastic sleeve 28 attached to the inner side of casing 4'. Between the material of the sleeve 28 and the inner side of the casing 4' a pressurization chamber 29 is defined. The chamber 29 may be pressurized or depressurized using one or more hydraulic lines 49 that are in fluid communication with the pressurization chamber 29, and a hydraulic pressure control unit 24. By pressurizing or depressurizing the sleeve 28 and allowing mud flow to pass between the drill string and the rubber sleeve, the pressure drop across the pressure seal 27 is set. Therefore the pressure inside the wellbore during circulation can be controlled by applying a controlled pressure outside the rubber sleeve and allowing fluid (mud) flow from the well through the valve at the same time. Another advantage is that due to the fluid film between the rubber sleeve and the drill string or drill pipe, wear can be relatively low.

[0037] Some of the additional advantages of the pressure control system in accordance with the invention are listed below.

- In comparison to the flapper design downhole deployment valve, which is basically a one-way valve, the present pressure seal may hold pressure in two directions;
- The new downhole deployment valve is less vulnerable to damage from dropped objects;
- The design is relatively simple and straightforward (for instance no bearings or sliding parts are needed), which improves the reliability of the system;
- The present downhole deployment valve always opens, even in case of excessive pressure build-up below the valve; and even if there is a problem with

the valve, the (rubber) sleeve may easily be removed, for instance by drilling the seal out.

[0038] In the embodiments described so far in connection with the drawings, the downhole deployment valve is part of a fixed casing string. In other embodiments the downhole deployment valve may be part of a retrievable workstring which is not cemented in place. The tubular element, also simply referred to as the "tubular", containing the valve can be removed after completion of the drilling operation.

[0039] Although the present embodiments have been described for wells extending vertically in the subsurface, it is to be understood that the pressure control system may also be used in horizontal wells or, more generally, may be positioned at any borehole angle. Furthermore, more than one pressure seal may be used and if various pressure seals are used, they may be operated differently.

[0040] Although the invention has been described with reference to specific embodiments thereof, it will be appreciated that invention is not limited to these embodiments and that changes and modifications to the system and method described herein may be made without departing from the invention. The rights applied for are defined by the following claims.

Claims

1. Pressure control system for controlling the pressure in a wellbore formed in a subsurface, the pressure control system comprising:

- a tubular element having a valve member arranged and construed to at least partially block a flow path through a bore of the tubular element,
- at least one control member for controlling the blocking operation of the valve member;

wherein the valve member is a pressure seal comprising a flexible sleeve inside the tubular element and at least one pressurization chamber between the tubular element and the sleeve, and wherein the control member includes an hydraulic control line connected to the pressurization chamber, the pressure seal being arranged and construed so as to at least partially block the flow path on pressurization of the pressurization chamber.

2. Pressure control system as claimed in claim 1, wherein upon pressurization of the pressurization chamber, the volume of the pressure seal is caused to increase, whereas upon depressurization, the volume of the pressure seal is caused to decrease.
3. Pressure control system as claimed in claim 1 or 2, wherein the flexible sleeve is arranged along the in-

ner circumference of the tubular element.

4. Pressure control system as claimed in claim 3, wherein the flexible sleeve is substantially symmetrical with respect to the axial direction of the tubular element.
5. Pressure control system as claimed in any of the preceding claims, wherein the tubular element comprises an upper support for attachment of the upper portion of the sleeve and a bottom support for attachment of the lower portion of the sleeve to the inner surface of the tubular element.
6. Pressure control system as claimed in any of the preceding claims, comprising control means being operative so as to control the pressure drop across the pressure seal by applying a predefined hydraulic pressure in the pressure chamber.
7. Pressure control system as claimed in any of claims 1-6, also comprising a pipe extending into the tubular element, wherein the pressure seal is arranged and construed so as to at least partially block the annular flow path between the inner surface of the tubular element and the outer surface of the pipe.
8. Pressure control system as claimed in any of the preceding claims, wherein the sleeve is an elastic sleeve, preferably made of rubber.
9. Downhole deployment valve (DDV) system, comprising a pressure control system as claimed in any of the preceding claims, wherein the tubular element is arranged in the subsurface within a well bore and the pressure seal is positioned at a predefined depth below the surface.
10. Downhole deployment valve (DDV) system as claimed in claim 9, comprising a pressure sensor provided in the hydraulic control.
11. Rotating control head (RCH) pressure control system, comprising a pressure control system as claimed in any of the preceding claims, wherein the tubular element is part of a rotating control head blow out preventer (BOP) positioned at the surface.
12. Method of controlling the pressure in a well bore formed in a subsurface, method comprising:
 - providing a tubular element having a valve member for at least partially blocking a flow path through a bore of the casing, and at least one control member for controlling the operation of the valve member, wherein the valve member is a pressure seal comprising an flexible sleeve inside the tubular element and at least one pres-

surization chamber between the casing and the sleeve, and wherein the control member is an hydraulic control line connected to the pressurization chamber,

- controlling the pressure in the well bore by pressurizing or depressurizing the at least one pressurization chamber causing volume of the valve member to increase or decrease respectively so as to at least partially block or unblock said flow path.

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13. Method as claimed in claim 12, comprising:

- deploying a pipe, preferably of a drill string or tool string, in the bore of the casing;
- providing the pressure seal in the annular space between the casing and the pipe;
- controlling the pressure drop across the pressure seal by pressurizing and/or depressurizing the pressure seal.

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14. Method as claimed in claim 11 or 12, comprising:

- providing a pressure sensor in the hydraulic control line and, preferably, locating the pressure sensor close to or at the surface;
- measuring the pressure in the hydraulic line;
- determining the hydrostatic head in the hydraulic line with respect to the downhole valve member;
- determining the downhole pressure based on the measured hydraulic pressure and compensated for the hydrostatic head.

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Fig 1

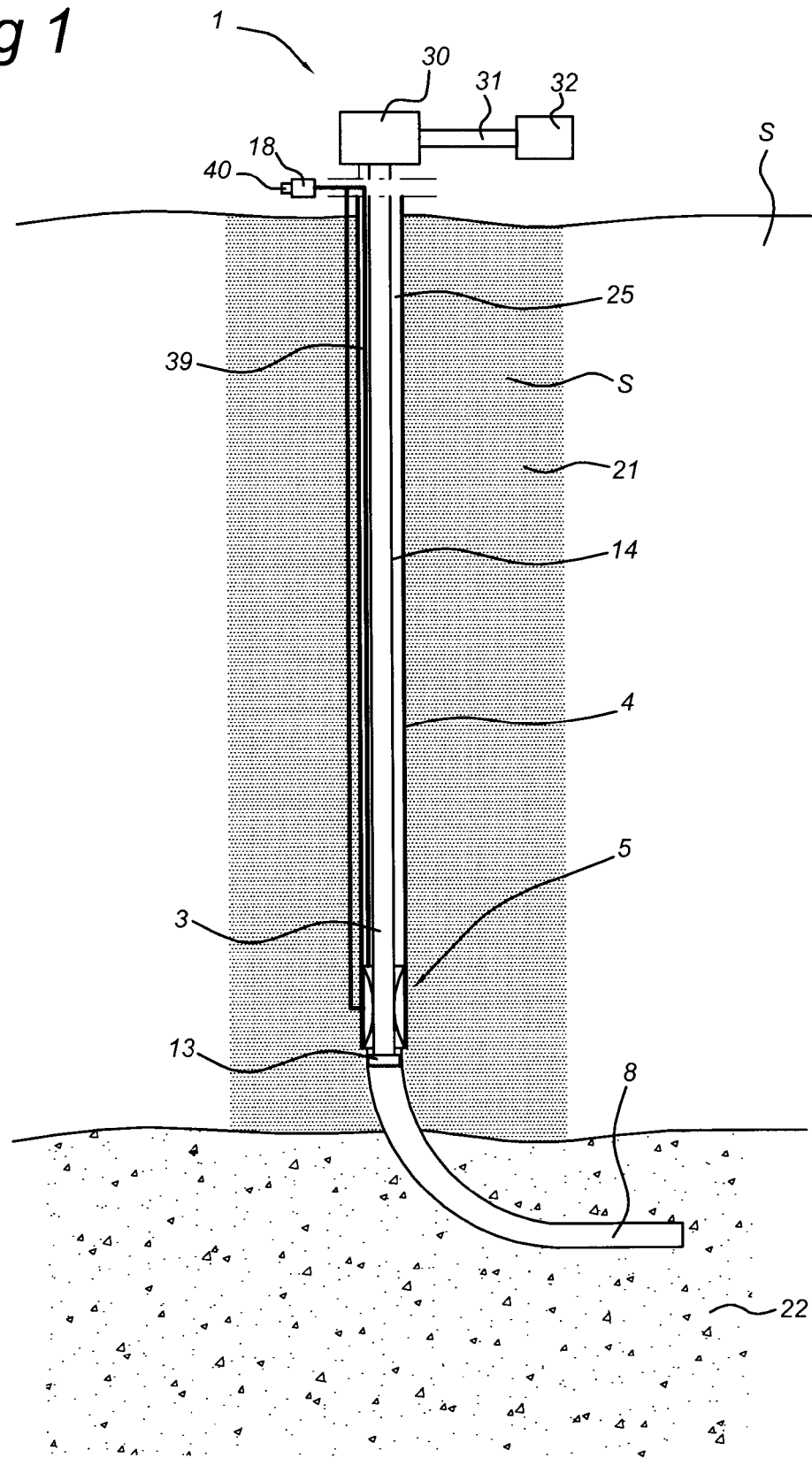


Fig 2

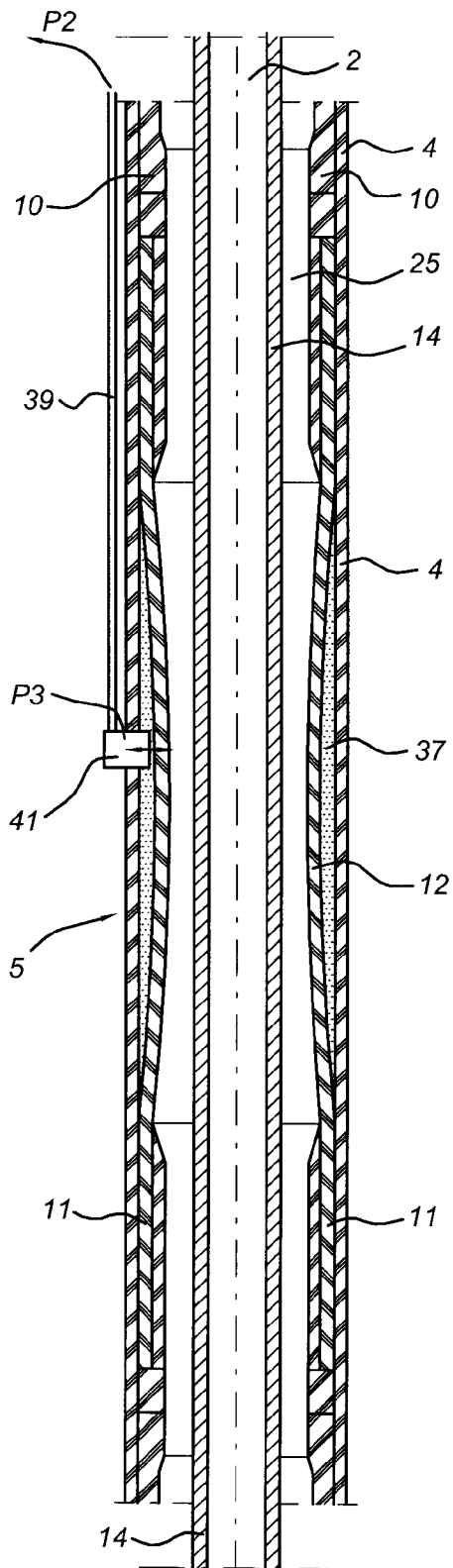


Fig 3

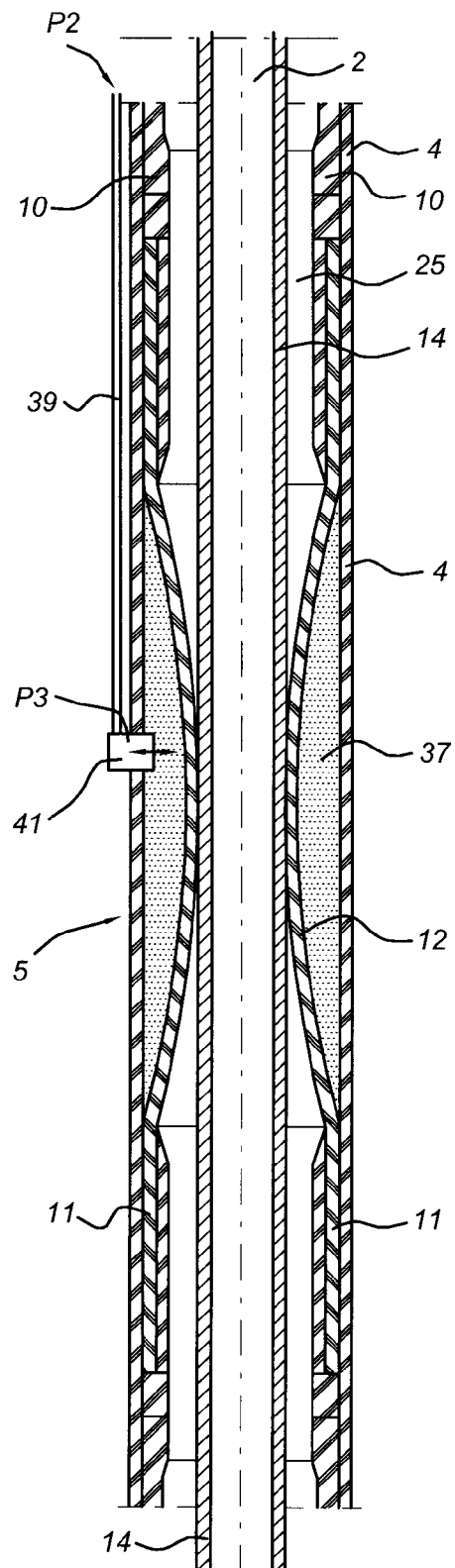


Fig 4

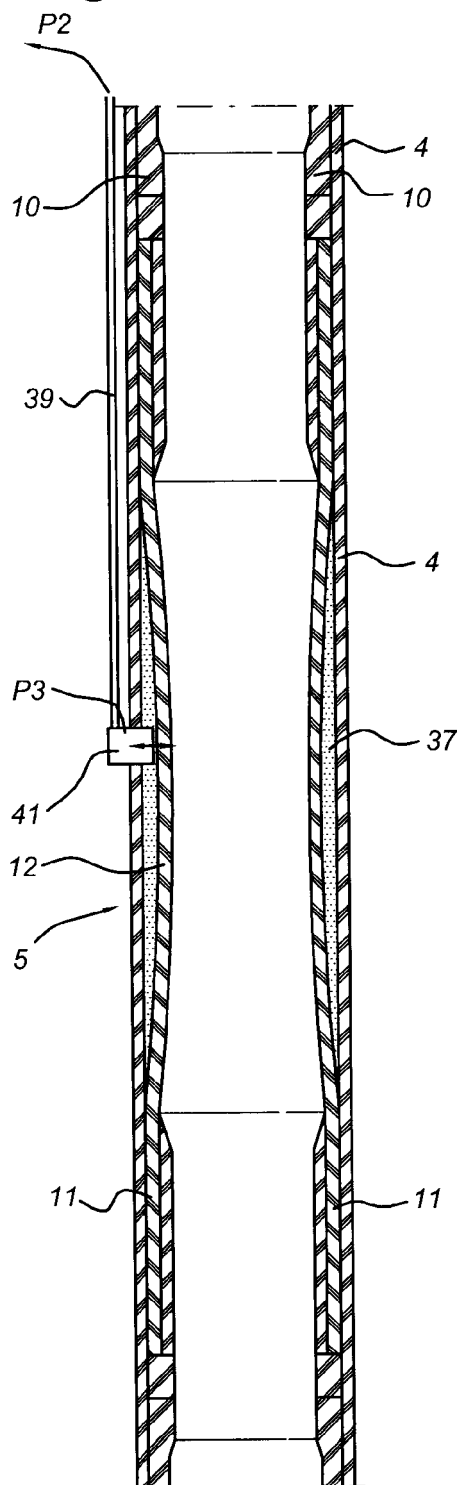


Fig 5

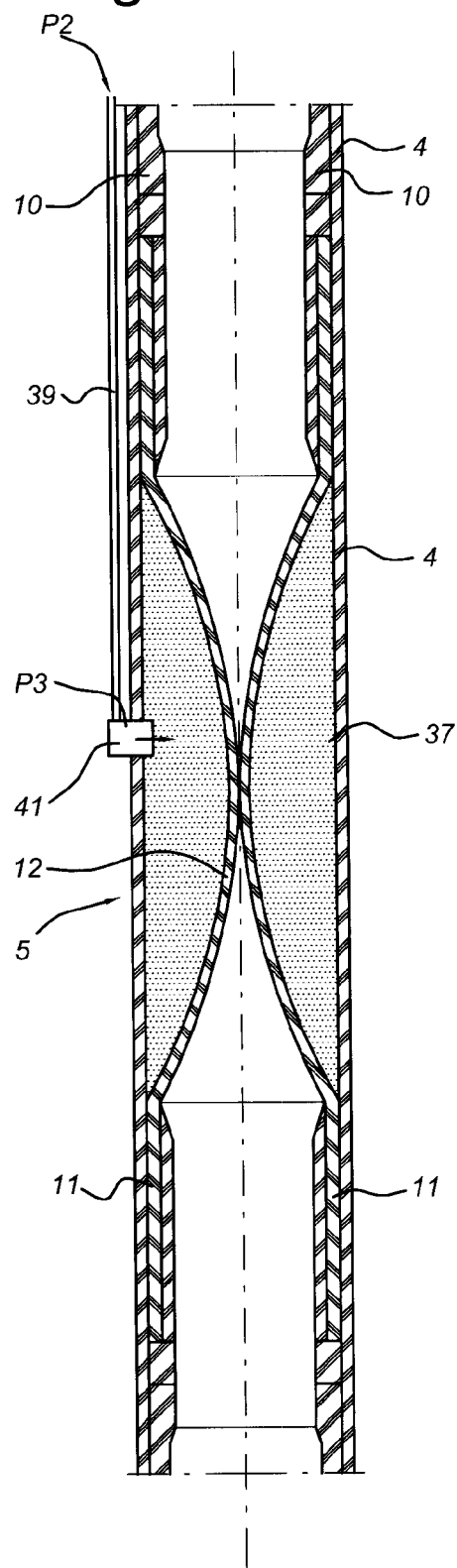
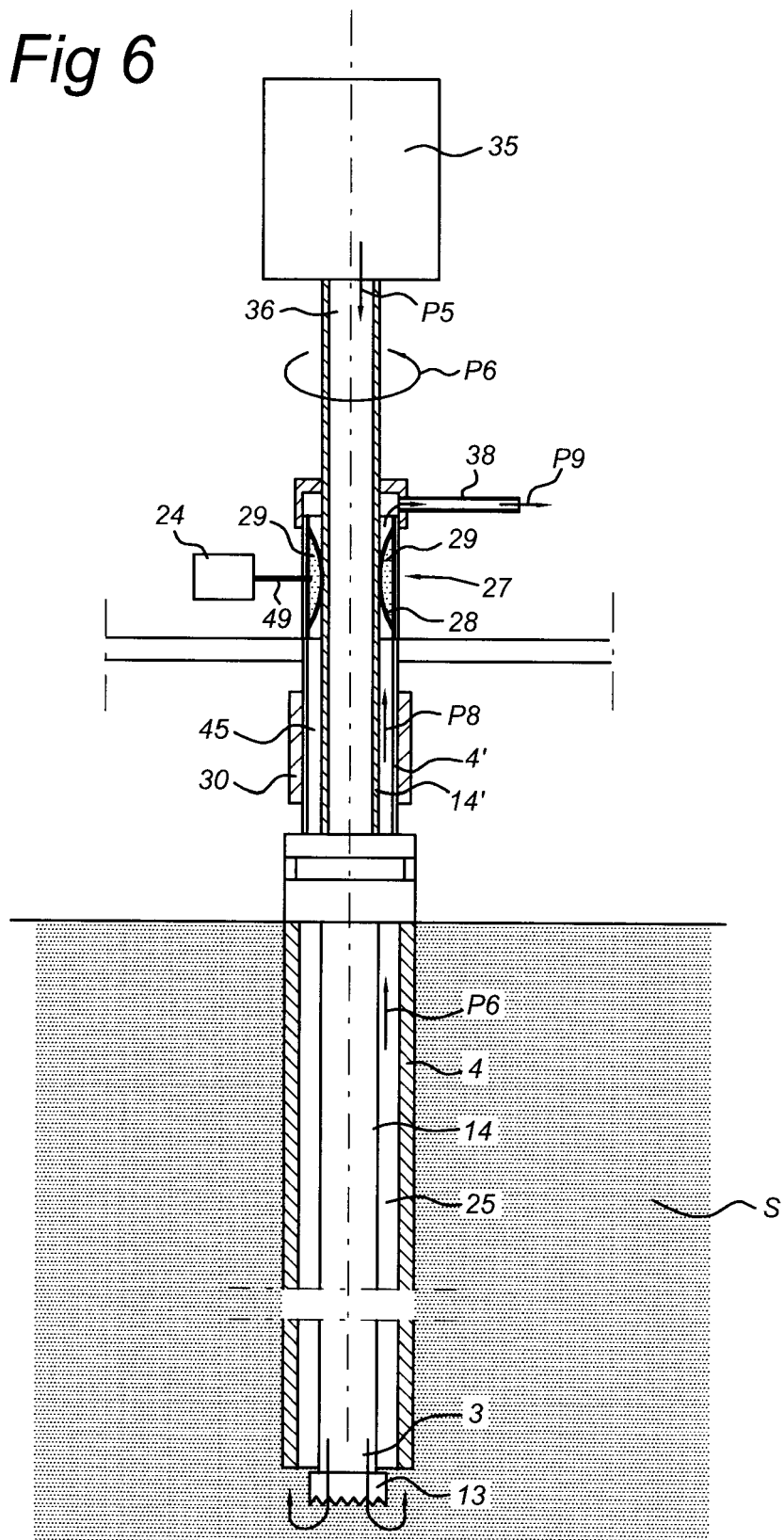


Fig 6





European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 07 11 9135

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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Place of search Munich		Date of completion of the search 7 March 2008	Examiner Bellingacci, F
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 07 11 9135

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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