



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
28.09.2016 Bulletin 2016/39

(51) Int Cl.:
E21B 21/10^(2006.01) E21B 21/08^(2006.01)

(21) Application number: **15290083.3**

(22) Date of filing: **23.03.2015**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

Designated Extension States:

BA ME

Designated Validation States:

MA

(71) Applicant: **Geoservices Equipements**
95971 Roissy en France (FR)

(72) Inventors:

- **Leblay, Florian**
67049 Roissy-en-France (FR)
- **Legendre, Ulysse**
67049 Roissy-en-France (FR)

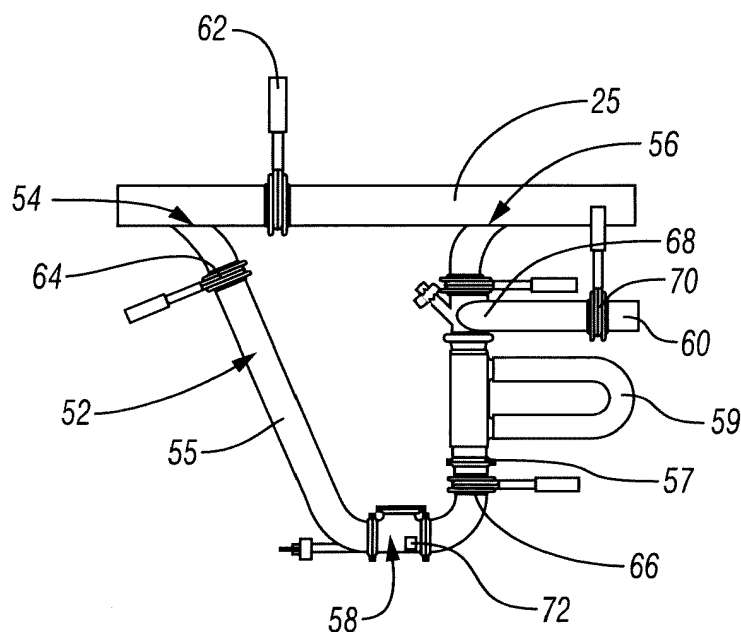
(74) Representative: **Leonori, Céline**
Etudes et Productions Schlumberger
Intellectual Property Department
1, rue Henri Becquerel
B.P. 202
92142 Clamart Cedex (FR)

(54) **INSTALLATION AND METHOD FOR MONITORING A DRILLING FLUID EXITING THE WELLBORE**

(57) The disclosure relates to an installation for monitoring a drilling fluid exiting a wellbore, the installation comprising a main pipe for discharging the drilling fluid out of the wellbore, a by-pass pipe having an inlet and an outlet in fluid communication with the main pipe, and a flow monitoring sensor situated in the by-pass pipe. The installation further comprises at least one of a main

closing device for opening and/or closing the main pipe and a by-pass closing device for opening and/or closing the bypass pipe, and at least an additional sensor for determining at least a parameter relative to the wellbore and a control device for controlling at least one of the main and by-pass closing devices in function of the parameter.

FIG. 2



Description

BACKGROUND

[0001] The disclosure is related to an installation for the circulation of a drilling fluid exiting a wellbore, comprising a flow monitoring sensor.

[0002] Such installation comprise a discharge pipe for discharging a drilling fluid with cuttings out of the wellbore and a U-shaped by-pass pipe tapped on the discharge pipe and a flow monitoring sensor in the by-pass pipe, for assessing a parameter relative to the fluid such as a Coriolis force exerted on the by-pass pipe, which leads to determining the volume flow rate of the drilling fluid.

SUMMARY

[0003] The disclosure relates to an installation for monitoring a drilling fluid exiting a wellbore comprising a main pipe for discharging the drilling fluid out of the wellbore, a by-pass pipe having an inlet and an outlet in fluid communication with the main pipe, and a flow monitoring sensor situated in the by-pass pipe. The installation also comprises a main closing device for opening or closing the main pipe and/or a by-pass closing device for opening or closing the bypass pipe, an additional sensor for determining a parameter of the wellbore and a control device for controlling the main or by-pass closing devices in function of the parameter.

[0004] Such an installation may be controlled automatically and is not subjected to human errors. It may also adapt quickly to the present state of the wellbore.

[0005] The disclosure also relates to a method for monitoring a drilling fluid exiting a wellbore, in an installation comprising a main pipe for discharging the drilling fluid out of the wellbore, a by-pass pipe having an inlet and an outlet in fluid communication with the main pipe, a flow monitoring sensor situated in the by-pass pipe as well as a main closing device for opening or closing the main pipe and/or a by-pass closing device for opening or closing the bypass pipe. The method comprises determining a parameter relative to the wellbore via an additional sensor; and in function of the determined parameter, controlling the main closing device or the by-pass closing device.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] Various aspects of this disclosure may be better understood upon reading the following detailed description and upon reference to the drawings in which:

FIG. 1 is a general diagram of a drilling rig comprising an installation according to the disclosure.

FIG. 2 is a diagram of an installation according to an embodiment of the disclosure;

FIG. 3 is a flow diagram of a general method according to an embodiment of the disclosure;

FIG. 4 to 6 are flow diagrams of methods according to several embodiments of the disclosure.

DETAILED DESCRIPTION

[0007] One or more specific embodiments of the present disclosure will be described below. These described embodiments are examples of the presently disclosed techniques. Additionally, in an effort to provide a concise description of these embodiments, some features of an actual implementation may not be described in the specification. It should be appreciated that in the development of any such actual implementation, as in any engineering or design project, numerous implementation-specific decisions may be made to achieve the developers' specific goals, such as compliance with system-related and business-related constraints, which may vary from one implementation to another. Moreover, it should be appreciated that such a development effort might be complex and time consuming, but would still be a routine undertaking of design, fabrication, and manufacture for those of ordinary skill having the benefit of this disclosure.

[0008] When introducing elements of various embodiments of the present disclosure, the articles "a," "an," and "the" are intended to mean that there are one or more of the elements. The terms "comprising," "including," and "having" are intended to be inclusive and mean that there may be additional elements other than the listed elements. Additionally, it should be understood that references to "one embodiment" or "an embodiment" of the present disclosure are not intended to be interpreted as excluding the existence of additional embodiments that also incorporate the recited features.

[0009] Throughout the following, the terms "upstream" and "downstream" are to be understood in relation to the direction of flow of a fluid in a pipe.

[0010] An analysis assembly according to the invention is used, for example, in an installation for drilling an oil production well.

[0011] As illustrated in FIG. 1, the installation 11 comprises a drilling duct 13 in a cavity 14 bored by a rotary drilling tool 15, a surface installation 17, and an analysis assembly 19 according to the an embodiment of the disclosure.

[0012] The drilling duct 13 is located in the cavity 14 bored in the sub-soil 21 by the rotary drilling tool 15. The duct 13 comprises, at the surface 22, a well head 23 provided with a draining or discharge pipe 25 for taking the drilling fluid out of wellbore.

[0013] The drilling tool 15 comprises a drilling head 27, a drilling fitting 29, and a head 31 for the injection of liquid.

[0014] The drilling head 27 comprises a drill bit 33 for boring through the rocks of the sub-soil 21. The drilling head 27 is mounted on the lower portion of the drilling

fitting 29 and is positioned at the bottom of the drilling duct 13.

[0015] The fitting 29 comprises a set of hollow drilling tubes. These tubes delimit an internal space 35 which enables a liquid to be supplied from the surface 22 to the drilling head 27. For that purpose, the head 31 for injecting liquid is screwed onto the upper portion of the fitting 29.

[0016] The surface installation 17 comprises an installation 41 for supporting and rotatably driving the drilling tool 15, an injector 43 for injecting the drilling liquid, and a vibrating screen 45.

[0017] The injector 43 is connected hydraulically to the injection head 31 in order to introduce a liquid and to cause it to flow in the internal space 35 of the drilling fitting 29.

[0018] When it reaches the bottom of the well, the drilling fluid goes back to surface and exits the wellbore by the discharge pipe 25.

[0019] The vibrating screen 45 collects the liquid which is charged with drilling residues and which is discharged from the discharge pipe 25, and separates the liquid from the solid drilling residues. The drilling residues may then be analyzed while samples of the drilling fluid are taken to another pipe 51 for analysis of the gases extracted from the wellbore and contained in the drilling fluid (not shown here). The drilling mud from which cuttings have been removed is recycled and taken back to the injector 43 via a pipe 47

[0020] An installation 50 for measuring the flow rate of the drilling fluid is already set between the exit of the wellbore and the vibrating screen 45. This installation will be described in more details in view of FIG.2.

[0021] This installation 50 comprises a main pipe, extending essentially horizontally, corresponding to the discharge pipe, and a by-pass pipe 52, U-shaped, in fluid communication with the discharge pipe 25 comprising an inlet 54 opening in the discharge pipe 25 at a first tapping point and an outlet 56 also opening in the discharge point at a second tapping point situated downstream from the first tapping point. In particular, the by-pass pipe has a first essentially vertical portion 55 extending downwards from the inlet, a second essentially vertical portion 57 extending downwards from the outlet 56 and a linking portion 58 for linking first and second vertical portion. "Essentially vertical" means that the portion has a angle of less than 45° with the vertical axis, but the vertical portions may be tilted relative to the vertical axis. For instance, the first vertical portion 55 is tilted so as to facilitate the entry of the drilling fluid in the bypass pipe.

[0022] The fluid coming from the wellbore and circulating in the bypass pipe engage in the first vertical portion, in the linking portion and then in the second vertical portion to come back to the discharge pipe 25. A Coriolis flowmeter 59, forming a flow monitoring sensor, is situated in the by-pass pipe, in the second vertical portion 57.

[0023] A trip tank pipe 60 is also in fluid communication with the by-pass pipe and in particular tapped in the sec-

ond vertical portion 57 of the by-pass pipe downstream from the Coriolis flow meter. This trip tank pipe leads to a trip tank for receiving the drilling fluid when trip tank is in use. The conditions in which the trip tank is in use are determined in relation with the drilling. It may for instance be used when tripping the drill string..

[0024] The installation also comprises several closing devices, for instance valves, for interrupting the flow in one of the pipes of the installation. In particular, the installation comprises a main closing device 62 for opening and/or closing the discharge pipe 25. It is situated between the inlet 54 and outlet 56 of the by-pass pipe 52 in the discharge pipe 25.

[0025] It also comprises several by-pass closing devices 64, 66 and 68 for opening and/or closing the by-pass pipe 52. In particular, it comprises a first by-pass closing device 64 situated in the first vertical portion 55 downstream of the inlet 54, a second by-pass closing device 66 situated in the second vertical portion 57 upstream of the flow meter 59 and a third by-pass closing device 68 situated in the second vertical portion downstream from the flow meter 59 and upstream from the trip tank pipe 60.

[0026] Further, the installation comprises a trip tank pipe closing device 70 for closing the trip tank pipe.

[0027] The valves or closing devices 62-70 are movable between a closed position in which they close the associated pipe, ie prevent the fluid from circulating in the associated pipe, and an open position, in which they open the associated pipe, ie allow the fluid to circulate in the associated pipe.

[0028] The installation also comprises sensors (not shown) for monitoring the state of each of the closing device 62-70. These sensors may be position sensors, such as infrared, sonic or optical sensors.

[0029] It also comprises a device for determining the mud level in the by-pass pipe 52. This device comprises a sensor 72 situated at the bottom of the by-pass pipe 52, in its linking portion, for instance a pressure sensor 72. The device for determining the mud level also comprises a calculation unit for obtaining the level of mud in the by-pass pipe 52 from the pressure taken by the pressure sensor 72 and the density of the mud, obtained with the flow monitoring sensor, i.e. in this example the Coriolis flow meter 59.

[0030] Other sensors may also be provided on the drilling rig, such as a sensor for obtaining a drilling state of a drill string or a parameter of the flow monitoring sensor. The sensor for obtaining the mud level may also be a level sensor such as sonic sensor, an optical or infrared sensor, etc..

[0031] The installation also comprises a driving device associated to each valve 62-70 for automatically changing the position of the valve and a control device for controlling the driving devices. The control device is in data communication with the sensors, such as sensor 72 and is configured to control the operation of the valves 62-70 in function of the data obtained from the sensors.

[0032] The control device comprises in particular a memory for storing data obtained from each sensor and a processor for executing instructions also recorded in the memory. The control device may be at the rig site or remote from the rig site.

[0033] The control device may also control the valves in function of commands obtained from an operator via a dedicated interface.

[0034] The installation may also comprise a back-up control device in case there is a failure of the control device. The back-up control device may for instance comprise a pneumatic control device provided with an interface triggered manually by the user so as to control the driving devices, in function of a command of the user on the interface. The back-up control device may be activated during the whole drilling process or solely at particular moments of the drilling process, for instance when operator triggers manually the activation or when communication between the control device and the sensors and/or valves is lost.

[0035] It may be noticed that the installation disclosed in this specification is an embodiment of the disclosure. For instance, the installation may not comprise five valves but only one in the discharge pipe and one in the by-pass pipe for instance. It may also comprise additional sensors compared to the ones that have been disclosed, less sensors and/or different sensors than what has been disclosed. The flow monitoring sensor may also be any type of flowmeter such as electromagnetic, ultrasonic, etc. The installation may not comprise a trip tank pipe, and/or the trip tank pipe may be tapped in the main pipe upstream of the by-pass pipe.

[0036] Now that the installation has been disclosed, the general method 100 associated will also be disclosed in reference to FIG.3.

[0037] First, the drill string is set in the borehole and the injection head is turned on so that injection of fluid and drilling in the wellbore may begin (box 102). The sensors associated to each of the valve 62-70, sends to the control device the state (open or close) of each of the valves and the sensors associated to the drill string, the discharge pipe, the by-pass pipe, the flow meter or any other element of the wellbore are also sending data to the control device (box 104). Optionally, the control device or a calculation unit separated from the control device performs a calculation with the data obtained from different sensors, for instance as explained earlier in relationship with the mud level (box 106).

[0038] Then, the control device compares at least one of the parameter relative to the wellbore obtained from the sensor data to a predetermined value (box 108). This may comprise comparing the state of one of the element of the wellbore (such as the open or closed state of a valve) with a predetermined state or comparing a measured value sent by one sensor with a threshold value. Several comparisons or a sequence of comparisons may be performed at box 108.

[0039] In view of the results of the comparison, the con-

trol device may send a command to the driving device associated to one of the valves to trigger its opening or its closing (box 110).

[0040] The method may perform these actions continuously so that the appropriate valves open or close in function of any event that happens at the rig site.

[0041] Actions that may be performed according to the preceding method will also be disclosed below in relationship with FIG.4 to 6.

[0042] Generally, when the flowmeter is not in operation, valves 64-70 of the by-pass pipe and trip tank pipe 52, 60 are closed while valve 62 from the main pipe is in an open position. The method 110 may then be applied. When the operator triggers the operation of the flowmeter (box 112), the control device commands the opening of the valves 64-70 (box 114). Then, it compares the state of the valves 64-68 with a predetermined value (i.e. "open state") -box 116- and if the state of all the valves matches the predetermined value, it closes the valve 62 of the discharge pipe (box 118). If the state of one of the valve does not match the predetermined value, it commands the associated driving device to open it (box 114 again) and does not close the valve 62 until valves 64-68 have been closed.

[0043] Method 110 may also be triggered when a change of the drilling state is detected. The flowmeter may for instance be automatically operated when the drilling begins.

[0044] When the flowmeter is in operation, method 120 may be applied. Sensor 72 measures the pressure at the bottom of the by-pass pipe (box 122) and sends the measured data to the control device that calculates the mud level with the help of the data otherwise obtained from the flowmeter (box 124). Then the control device compares the measured mud level with a threshold value (box 126). If the mud level does not exceed the predetermined value, no action is taken and the method goes back to box 122 for monitoring the data obtained from the sensors. If the mud level exceeds the threshold level, then the control device control the driving device associated with valve 62 to open this valve (box 128).

[0045] When valve 62 has been opened, the state of the valve obtained from position sensor associated with valve 62 are then compared (box 130) to a predetermined state ("open state"). If it indicates that this valve is in open position, the control device commands the driving devices associated with valves 64, 66 to move these valves in a closed position (box 132). Overflow of the drilling fluid exiting the wellbore may then be avoided.

[0046] If valve 62 is not open, the method goes back to box 128. It may also comprise communication with the operator in case the valve does not open after several trials, so the operator can close it manually from the back-up control device and/or order maintenance.

[0047] Another method 140 may be implemented for concerning the trip tank. The drilling state is obtained from a device remote from the control device and the data relative to valve 70 are obtained from the associated

sensor (box 142). The state of the valve is determined and is compared to the "open" state (box 144). Whatever the state of the valve, the drilling state is compared with the predetermined value "tripping" (box 146 and 148). When the valve is open and when the rig activity corresponds to tripping, no action is taken and the rig activity continues to be monitored. The same applies when the valve is closed and the drilling state is not identified as "tripping". But when the drilling state is identified as "non-tripping" and the valve is open, the control device commands the closing of the valve 70 of the trip tank pipe (box 150). On the contrary, when the drilling state is identified as "tripping" and the valve is closed, the control device commands the opening of the valve 70 of the trip tank pipe so that the drilling fluid may reach the trip tank (box 152). Once these actions have been taken, the method goes back to box 142 so that the parameters are monitored continuously.

[0048] Although the preceding description has been described herein with reference to particular means, materials and embodiments, it is not intended to be limited to the particulars disclosed herein; rather it extends to functionally equivalent structures, methods and uses, such as are within the scope of the appended claims.

[0049] For instance, the methods 110, 120, 140 are embodiments of the disclosure but many other methods for controlling the closing devices in function of parameters relative to the wellbore are included in the scope of the disclosure. For instance, valves 66, 68 may be closed when it is determined that a calibration of the flowmeter 59 is needed, for instance before operating the flow meter 59. Valves 66, 68 may be re-opened when the flowmeter 59 acknowledges that calibration has been done.

[0050] Further, these methods may be performed simultaneously, and/or combined in a master method that would handle all the valves and parameters relative to the well at once.

[0051] It may also comprise performing closing a valve when the operator commands it or monitoring the state of the valves and firing an alarm when the state of the valve changes without prior notice from the control device.

[0052] The disclosure generally relates to an installation for monitoring a drilling fluid exiting a wellbore, the installation comprising a main pipe for discharging the drilling fluid out of the wellbore, a by-pass pipe having an inlet and an outlet in fluid communication with the main pipe, and a flow monitoring sensor situated in the by-pass pipe, wherein the installation further comprises at least one of a main closing device for opening and/or closing the main pipe and a by-pass closing device for opening and/or closing the bypass pipe, and at least an additional sensor for determining at least a parameter relative to the wellbore and a control device for controlling at least one of the main and by-pass closing devices in function of the parameter.

[0053] The parameter may be relative to one of the following elements :

- a drill string situated in the wellbore,
- the main pipe or the bypass pipe,
- the first and/or the second closing device,

5 **[0054]** - the flow monitoring sensor. It may for instance be a mud level in the by-pass pipe, which may avoid overflow of the by-pass pipe.

[0055] It may as well be a state of the main or of the by-pass closing device. In particular, the control device may control the main, respectively by-pass, closing device in function of a parameter relative to the by-pass, respectively main, closing device.

10 **[0056]** The parameter relative to the drill string may also be a rig activity, such as drilling, tripping, etc. so as to trigger the flow monitoring sensor when appropriate only.

15 **[0057]** The main closing device may be situated downstream from the inlet of the by-pass pipe and upstream from the outlet of the by-pass pipe.

20 **[0058]** The by-pass pipe may comprise several by-pass closing devices situated at different locations in the bypass pipe, for instance upstream and downstream of the flow monitoring device.

[0059] A trip tank pipe may also be tapped in the by-pass pipe, an outlet of the trip tank pipe being in fluid communication with a tank for receiving the drilling fluid, the installation further comprising a trip tank pipe closing device for opening and/or closing the trip tank pipe. The trip tank pipe closing device may be controlled in function of at least one of the parameters measured by at least one of the additional sensors.

25 **[0060]** The flow monitoring device may be a Coriolis flow meter, or an electromagnetic flow meter, or a capacitive flow meter, or an ultrasonic flowmeter.

30 **[0061]** A driving device may be associated to each of the closing device, the control device being configured to command the operation of the driving device.

35 **[0062]** The disclosure also relates to a method for monitoring a drilling fluid exiting a wellbore, in an installation comprising a main pipe for guiding the drilling fluid out of the wellbore, a by-pass pipe having an inlet and an outlet in fluid communication with the main pipe and a flow monitoring sensor situated in the by-pass pipe, wherein the installation further comprises at least one of a main closing device for opening and/or closing the main pipe and a by-pass closing device for opening and/or closing the bypass pipe wherein the method comprises

- determining a parameter relative to the wellbore via an additional sensor;
- in function of the measured parameter, controlling one of a main closing device and a by-pass closing device.

40 **[0063]** The method may comprise :

- determining a parameter relative to the wellbore comprises measuring a level of drilling fluid in the

by-pass pipe,

- if the level of drilling fluid is higher than a predetermined level, opening the main closing device so that drilling fluid flows in the main pipe.

[0064] The method may also comprise :

- determining the state of the main closing device,
- if the main closing device is in an open state, closing the by-pass closing device.

Claims

1. Installation for monitoring a drilling fluid exiting a wellbore, the installation comprising a main pipe for discharging the drilling fluid out of the wellbore, a by-pass pipe having an inlet and an outlet in fluid communication with the main pipe, and a flow monitoring sensor situated in the by-pass pipe, wherein the installation further comprises at least one of a main closing device for opening and/or closing the main pipe and a by-pass closing device for opening and/or closing the bypass pipe, wherein the installation further comprises at least an additional sensor for determining at least a parameter relative to the wellbore and a control device for controlling at least one of the main and by-pass closing devices in function of the parameter. 15
2. Installation according to claim 1, wherein the parameter is relative to one of the following elements : 20
 - a drill string situated in the wellbore,
 - the main pipe or the bypass pipe,
 - the main and/or the by-pass closing device,
 - the flow monitoring sensor. 25
3. Installation according to claim 2, wherein the or at least one of the parameters is a level of mud in the by-pass pipe. 30
4. Installation according to claim 2, wherein the or at least one of the parameters is a state of the main or of the by-pass closing device. 35
5. Installation according to the preceding claim, wherein the control device controls the main, respectively by-pass, closing device in function of a parameter relative to the by-pass, respectively main, closing device. 40
6. Installation according to claim 2, wherein the or at least one of the parameters relative to the drill string is a rig activity. 45
7. Installation according to any of the preceding claims, wherein the main closing device is situated down-

stream from the inlet of the by-pass pipe and upstream from the outlet of the by-pass pipe.

8. Installation according to any of the preceding claims, wherein the by-pass pipe comprises several by-pass closing devices situated at different locations in the bypass pipe. 5
9. Installation according to any of the preceding claims, wherein a trip tank pipe is tapped in the by-pass pipe, an outlet of the trip tank pipe being in fluid communication with a tank for receiving the drilling fluid, the installation further comprising a trip tank pipe closing device for opening and/or closing the trip tank pipe. 10
10. Installation according to the preceding claim, wherein the trip tank pipe closing device is controlled in function of at least one of the parameters measured by at least one of the additional sensors. /
11. Installation according to the preceding claims, wherein the flow monitoring device is a Coriolis flow meter, or an electromagnetic flow meter, or a capacitive flow meter, or an ultrasonic flowmeter. 15
12. Method for monitoring a drilling fluid exiting a wellbore, in an installation comprising a main pipe for guiding the drilling fluid out of the wellbore, a by-pass pipe having an inlet and an outlet in fluid communication with the main pipe, and a flow monitoring sensor situated in the by-pass pipe, wherein the installation further comprises at least one of a main closing device for opening and/or closing the main pipe and a by-pass closing device for opening and/or closing the bypass pipe wherein the method comprises : 20
 - determining a parameter relative to the wellbore via an additional sensor;
 - in function of the measured parameter, controlling one of a main closing device and a by-pass closing device. 25
13. Method according to the preceding claim, wherein : 30
 - determining a parameter relative to the wellbore comprises measuring a level of drilling fluid in the by-pass pipe,
 - if the level of drilling fluid is higher than a predetermined level, opening the main closing device so that drilling fluid flows in the main pipe. 35
14. Method according to the preceding claim, further comprising : 40
 - determining the state of the main closing device,
 - if the main closing device is in an open state, closing the by-pass closing device. 45

FIG. 1

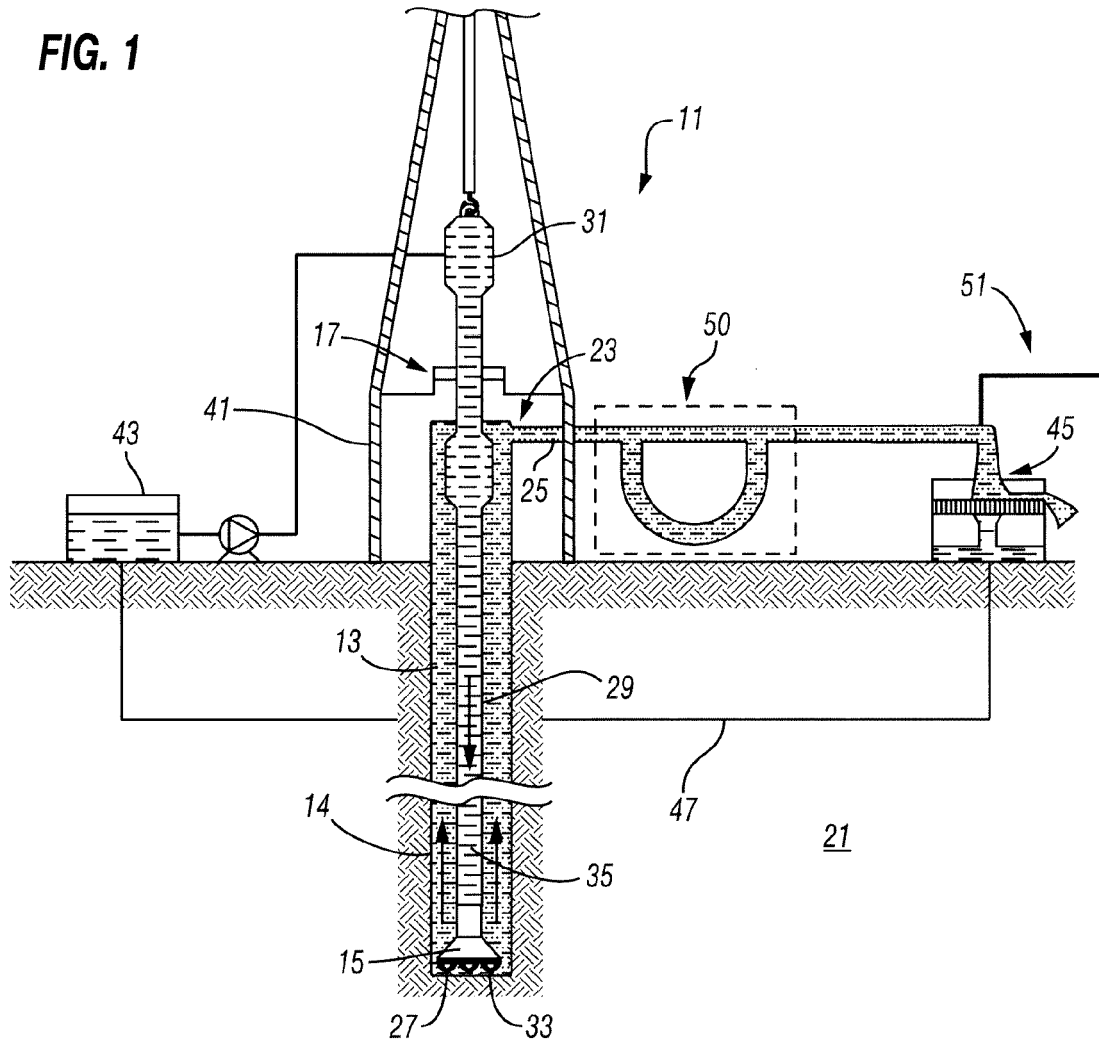
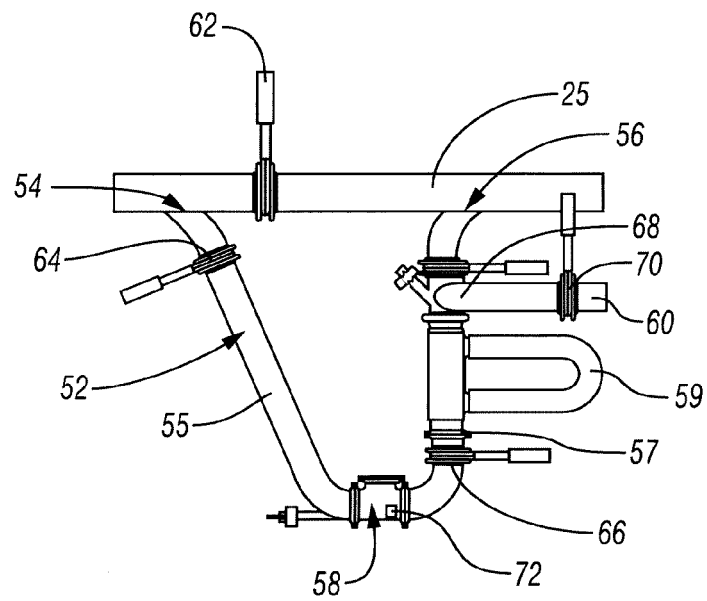
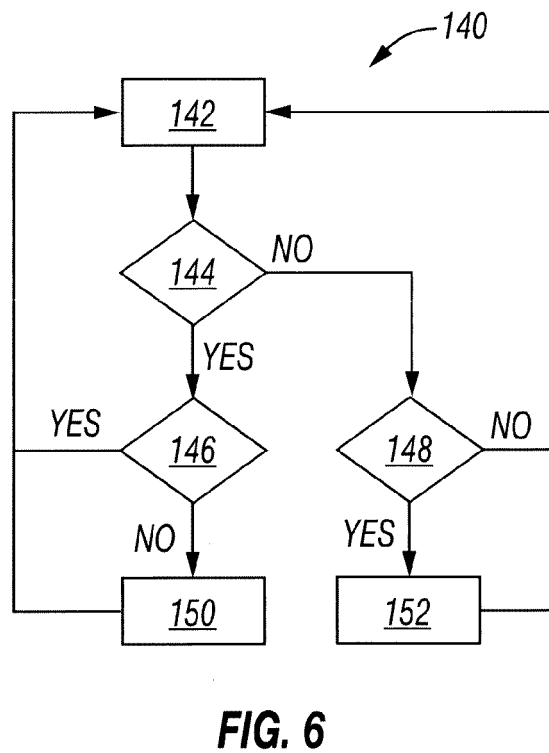
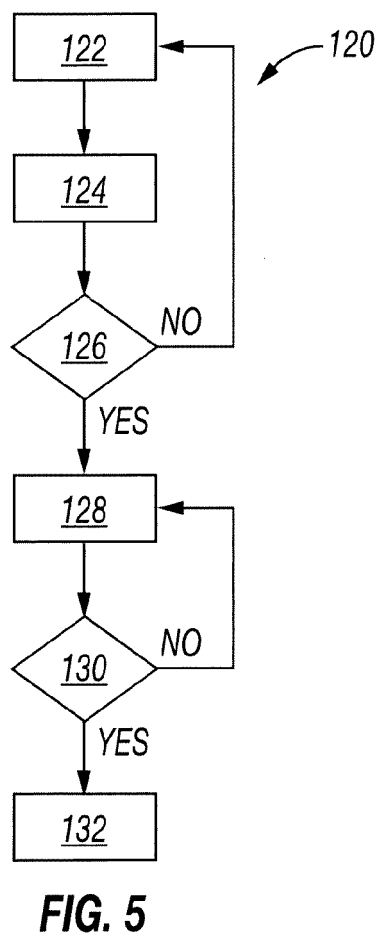
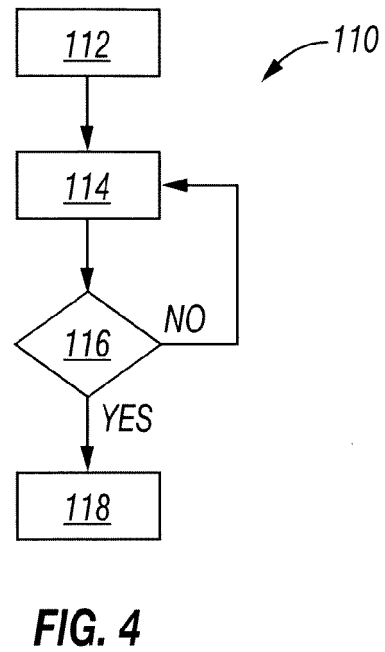
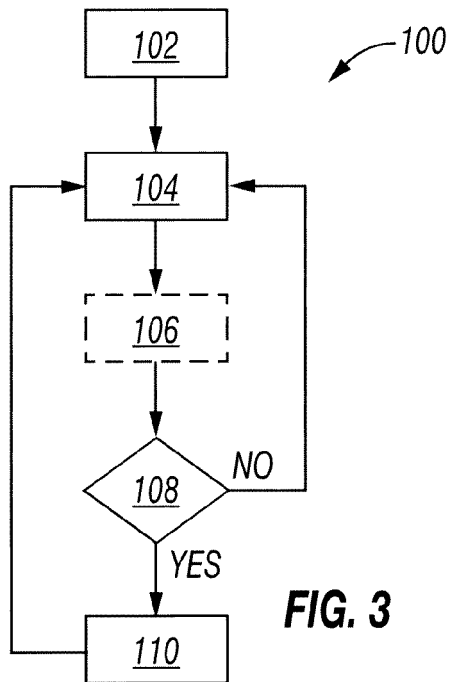


FIG. 2







EUROPEAN SEARCH REPORT

Application Number
EP 15 29 0083

5

10

15

20

25

30

35

40

45

50

55

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	FLORIAN LE BLAY ET AL: "A New Generation of Well Surveillance for Early Detection of Gains and Losses When Drilling Very High Profile Ultradeepwater Wells, Improving Safety, and Optimizing Operating Procedures (SPE 158374)", SPETT 2012 ENERGY CONFERENCE AND EXHIBITION, 11 June 2012 (2012-06-11), pages 1-10, XP055208505, DOI: 10.2118/158374-MS ISBN: 978-1-61-399244-9 * Abstract, line 1-5 * * page 2, lines 1-14 * * page 3, lines 6-7 * * page 2, lines 28-30; figure 1 *	1-14	INV. E21B21/10 E21B21/08
Y	WO 2010/071656 A1 (HALLIBURTON ENERGY SERV INC [US]; LOVORN JAMES R [US]; BRUDER CARLOS []) 24 June 2010 (2010-06-24) * page 7, lines 11-27 * * page 8, lines 9-28 * * page 13, lines 10-14 * * page 14, lines 11-18 * * page 15, lines 7-26; figures 1-3 *	1-14	TECHNICAL FIELDS SEARCHED (IPC) E21B
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 20 August 2015	Examiner Kecman, Ivan
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	

EPO FORM 1503 03.82 (P04C01)

20-08-2015

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2010071656 A1	24-06-2010	AU 2008365249 A1	24-06-2010
		CA 2742623 A1	24-06-2010
		EP 2358968 A1	24-08-2011
		GB 2477880 A	17-08-2011
		WO 2010071656 A1	24-06-2010

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82