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[Continued on next page]

(54) Title: DOWNHOLE SAMPLING PROBE WITH PENETRATING INLET AND METHOD OF USING SAME

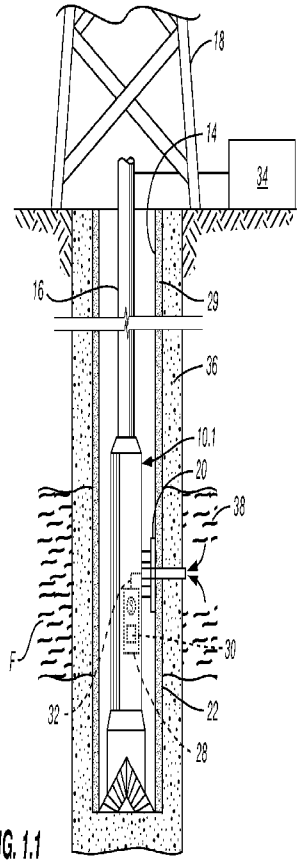


FIG. 1.1

(57) Abstract: A probe of a downhole tool deployable into a wellbore penetrating a subterranean formation is provided. The downhole tool has at least one flowline extendable therein. The formation has a clean fluid therein. The probe includes a base carried by the downhole tool and positionable adjacent a wall of the wellbore, a penetrating inlet carried by the base and having a tip about a sampling end thereof to receive the clean fluid, and an inlet packer. The penetrating inlet is in fluid communication with the at least one flowline, and extendable through the wall of the wellbore a distance into the formation. The inlet packer is inflatably positionable about the penetrating inlet to form a seal with the formation and isolate the tip therein whereby the clean fluid may be drawn from the formation and into the downhole tool.

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DOWNHOLE SAMPLING PROBE WITH PENETRATING INLET AND METHOD OF USING SAME

BACKGROUND

The present disclosure relates generally to wellsite operations. In particular, the present disclosure relates to formation evaluation involving testing, sampling and/or analyzing downhole fluids.

Wellbores are drilled to locate and produce hydrocarbons. A downhole drilling tool with a bit at an end thereof is advanced into the ground to form a wellbore. As the drilling tool is advanced, drilling mud is pumped through the drilling tool and out the drill bit to cool the drilling tool and carry away cuttings. The fluid exits the drill bit and flows back up to the surface for recirculation through the drilling tool. The drilling mud is also used to form a mudcake to line the wellbore.

During a drilling operation, various downhole evaluations may be performed to determine characteristics of the wellbore and surrounding formations. In some cases, the drilling tool may be provided with devices to test and/or sample the surrounding formation and/or fluid contained in reservoirs therein. In some cases, the drilling tool may be removed and a downhole wireline tool may be deployed into the wellbore to test and/or sample the formation. These tests or samples may be used, for example, to determine whether valuable hydrocarbons are present.

Formation evaluation may involve drawing fluid from the formation into the downhole tool for testing and/or sampling. Various devices, such as probes or packers, may be extended from the downhole tool to establish fluid communication with the formation surrounding the wellbore and to draw fluid into the downhole tool. Downhole tools may be provided with fluid analyzers and/or sensors to measure downhole parameters, such as fluid properties. Examples of downhole devices are provided in US Patent/Publication Nos. 8397817, 8499831, 7703526, 3934468, 3782191, 20040083805 and 20020189334, the entire contents of which are hereby incorporated by reference herein.

SUMMARY

In at least one aspect, the disclosure relates to a probe of a downhole tool deployable into a wellbore penetrating a subterranean formation. The downhole tool has at least one flowline extendable therein. The formation has a clean fluid therein. The probe includes a base, a penetrating inlet, and an inlet packer. The base is carried by the downhole tool and positionable adjacent a wall of the wellbore. The penetrating inlet is carried by the base and

has a tip about a sampling end thereof to receive the clean fluid. The penetrating inlet is in fluid communication with the at least one flowline, and is extendable through the wall of the wellbore a distance into the formation. The inlet packer is inflatably positionable about the penetrating inlet to form a seal with the formation and isolate the tip therein whereby the clean fluid may be drawn from the formation and into the downhole tool.

In another aspect, the disclosure relates to a downhole tool deployable into a wellbore penetrating a subterranean formation, the formation having a clean fluid therein. The downhole tool includes a housing having at least one flowline extending therein and a probe. The probe includes a base, a penetrating inlet, and an inlet packer. The base is carried by the housing and positionable adjacent a wall of the wellbore. The penetrating inlet is carried by the base and has a tip about a sampling end thereof to receive the clean fluid. The penetrating inlet is in fluid communication with the at least one flowline, and is extendable through the wall of the wellbore a distance into the formation. The inlet packer is inflatably positionable about the penetrating inlet to form a seal with the formation and isolate the tip therein whereby the clean fluid may be drawn from the formation and into the housing.

Finally, in another aspect, the disclosure relates to a method of sampling a downhole fluid of a subterranean formation. The formation has a wellbore extending therein, a clean fluid therein. The method involves deploying a downhole tool into the wellbore. The downhole tool includes a housing with at least one flowline extending therein and a probe. The probe includes a base carried by the housing, a penetrating inlet carried by the base and having a tip about a sampling end thereof, and an inlet packer positionable about the penetrating inlet. The penetrating inlet is in fluid communication with the flowline. The method also involves positioning the base adjacent a wall of the wellbore, selectively extending the penetrating inlet through the wall of the wellbore a distance into the subterranean formation, isolating the tip from contaminated fluid by inflating the inlet packer about the penetrating inlet and forming a seal with the formation, and drawing the clean fluid from the formation and into the housing through the tip.

This summary is provided to introduce a selection of concepts that are further described below in the detailed description. This summary is not intended to identify key or essential features of the claimed subject matter, nor is it intended to be used as an aid in limiting the scope of the claimed subject matter.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the method of formation evaluation are described with reference to the

following figures. The same numbers are used throughout the figures to reference like features and components.

FIGS. 1.1 and 1.2 are schematic views, partially in cross-section, illustrating a wellsite with a downhole drilling tool and a downhole wireline tool, respectively, having a probe for sampling downhole fluid in accordance with embodiments of the present disclosure;

FIGS. 2.1 and 2.2 are schematic views illustrating a portion of a downhole tool having a probe with a penetrating inlet for drawing downhole fluid therein in accordance with embodiments of the present disclosure;

FIG. 3 is a schematic view illustrating another probe with a penetrating inlet and packer in accordance with embodiments of the present disclosure; and

FIG. 4 is a flow chart illustrating a method of sampling downhole fluid in accordance with embodiments of the present disclosure.

DETAILED DESCRIPTION

The description that follows includes exemplary apparatuses, methods, techniques, and instruction sequences that embody techniques of the inventive subject matter. However, it is understood that the described embodiments may be practiced without these specific details.

The present disclosure relates to downhole tools used to sample downhole fluid. In particular, the disclosure describes a probe carried by a downhole tool and positionable in sealing engagement with a wall of a wellbore. The probe has a penetrating inlet with a tip at an end thereof extendable from the downhole tool, through the wellbore wall and into the surrounding formation. The tip may extend through the wall lined with mudcake, past an invaded zone containing contaminated fluid, and to clean fluid in the formation. The tip may also have a packer for forming a seal about the penetrating inlet. The packer may be positioned to isolate the tip from contaminated fluid to permit sampling of clean fluid.

FIGS. 1.1 and 1.2 depict environments in which subject matter of the present disclosure may be implemented. FIG. 1.1 depicts a downhole drilling tool 10.1 and FIG. 1.2 depicts a downhole wireline tool 10.2 that may be used for performing formation evaluation. The downhole drilling tool 10.1 may be advanced into a subterranean formation F to form a wellbore 14. The downhole drilling tool 10.1 may be conveyed alone or among one or more (or itself may be) measurement-while-drilling (MWD) drilling tools, logging-while-drilling (LWD) drilling tools, or other drilling tools. The downhole tool 10.1 is attached to a conveyor (e.g., drillstring) 16 driven by a rig 18 to form the wellbore 14. The downhole tool 10.1 includes a probe 20 adapted to seal with a wall 22 of the wellbore 14 to draw fluid from the

formation F into the downhole tool 10.1 as depicted by the arrows.

The downhole drilling tool 10.1 may be withdrawn from the wellbore 14, and the downhole wireline tool 10.2 of FIG. 1.2 may be deployed from the rig 18 into the wellbore 14 via conveyance (e.g., a wireline cable) 16. The downhole wireline tool 10.2 is provided with the probe 20 adapted to seal with the wellbore wall 22 and draw fluid from the formation F into the downhole tool 10.2. Backup pistons 24 may be used to assist in pushing the downhole tool 10.2 and probe 20 against the wellbore wall 22 and adjacent the formation F.

The downhole tools 10.1, 10.2 may be also provided with a formation evaluation tool 28 with a fluid collection and measurement means 30 for analyzing the formation fluid drawn into the downhole tools 10.1, 10.2. The formation evaluation tool 28 includes a flowline 32 for receiving the formation fluid from the probe 20 and passing the fluid to the fluid collection and measurement means 30 for analysis as will be described more fully herein.

The probe 20 may be extended from the downhole tools 10.1,10.2 for engagement with the wellbore wall 22. The probe 20 contacts the wellbore wall 22 and forms a seal with a mudcake 29 lining the wellbore wall 22. A mud filtrate of the mudcake 29 seeps into the wellbore wall 22 and creates an invaded zone 36 about the wellbore 14. The invaded zone 36 contains contaminated fluid including mud filtrate and other wellbore fluids that may contaminate surrounding formations, such as formation F, and a portion of clean formation fluid 38 in the formation F.

A surface unit 34 may be provided to communicate with the downhole tool 10.1, 10.2 for passage of signals (e.g., data, power, command, etc.) therebetween. Outputs may be generated from the surface unit 34 based on the measurements collected by the formation evaluation tool 28 and/or the fluid collection and measurement means 30. Such outputs may be in the form of data, measurements, reports, and/or other outputs.

While FIGS. 1.1 and 1.2 depict specific types of downhole tools 10.1 and 10.2, any downhole tool capable of performing formation evaluation may be used, such as drilling, coiled tubing, wireline or other downhole tool. Also, while FIGS. 1.1 and 1.2 depict a single probe 20, one or more probes, sets of dual packers and/or other fluid inlet devices may be used to draw fluid into the downhole tool for fluid analysis.

Fluid drawn into the downhole tool through the probe 20 may be tested and/or sampled. The fluid may be tested using sensors S to measure various downhole parameters and/or fluid properties. The sensor(s) may include, for example, gauges (e.g., quartz), densitometers, viscometers, resistivity sensors, nuclear sensors, and/or other measurement and/or detection

devices capable of taking downhole data relating to, for example, downhole conditions and/or fluid properties.

It may also be desirable and/or necessary to evaluate fluids at surface and/or offsite locations. In such cases, fluid samples may be collected in the downhole tool and taken to a surface and/or offsite location, and analyzed. Data and test results from various locations and/or using various methods and/or apparatuses may be analyzed and compared.

FIGS. 2.1 and 2.2 are schematic views depicting portions of a downhole tool 210 having a probe 220. The downhole tool 210 and the probe 220 may be similar to the downhole tools and probe of Figures 1.1 and/or 1.2. As shown in this version, the downhole tool 210 includes a housing with a primary flowline 232 therein. The flowline 232 extends from the probe 220 and to a formation evaluation tool 228.

The probe 220 includes a base 236 and a penetrating inlet 242 extending from the base 236. The base 236 is operatively connectable to the downhole tool 210 by supports 240. The supports 240 may be movably positionable about the downhole tool 210 to selectively extend and retract the base 236. The supports 240 may have means, such as telescoping arms, selectively extendable from the downhole tool 210 using hydraulic, mechanical, electrical or other means. The probe 220 may be positioned on an exterior end of the supports 240 and selectively extendable thereby.

The base 236 is sealingly positionable adjacent the wall 22 of the wellbore 14. The base 236 may be sealable with a mudcake 29 lining the wellbore wall 22. The base 236 may have a sealing surface 244 to sealingly engage the wellbore wall 22 to fluidly isolate the penetrating inlet 242 from fluid in the wellbore 14. The sealing surface 244 may be, for example, a flexible or elastomeric member, such as a packer, sealingly engageable with the wellbore wall 22 and/or mudcake 29. The base 236 may be, for example, a metal plate carried by the supports 240 with a packer thereon positionable for engagement with the wellbore wall 22.

The penetrating inlet 242 may be a tubular member extending from the base 236. The penetrating inlet 242 may be perpendicular to the base 236 and extend laterally therefrom for insertion through the wall 22 of the wellbore 14. The penetrating inlet 242 may be positionable through the mudcake 29, the invaded zone 36 and into an uncontaminated portion of the formation F. The penetrating inlet 242 may be positionable a distance into the formation F to reach clean fluid 38 therein for testing and/or sampling.

As shown in Figures 2.1 and 2.2, the penetrating inlet may be extendable a desired

distance through the wall 22 and into the formation F. In Figure 2.1, the penetrating inlet 242 extends a distance into the invaded zone 36. In Figure 2.2, the penetrating inlet 242 extends past the invaded zone 36. As also shown by Figures 2.1 and 2.2, the penetrating inlet 242 may have an extendable tip 246 extendable a distance from a sampling end of the penetrating inlet 242 and into the formation F. The tip 246 may be extendable through the penetrating inlet 242 by extension or retraction thereof from or with the penetrating inlet 242.

The probe 220 may also have an inlet connector 248 extending from the base 236 and to the downhole tool 210. The inlet connector 248 may fluidly couple the penetrating inlet 242 with the primary flowline 232 for fluid communication therebetween. The penetrating inlet 242 may be used to pass fluid from the formation F and into the primary flowline 232. The penetrating inlet 242 and/or the inlet connector 248 may be selectively extendable and retractable about the base 236 and/or downhole tool 210.

The penetrating inlet 242 and/or inlet connector 248 may be provided with, for example, drilling capabilities for forming a perforation and extending the penetrating inlet 242 into the formation. The drilling and extension of the tip 246, penetrating inlet 242 and/or inlet connector 248 may be provided by drilling means, such as a drilling tube 243 positioned about the penetrating inlet 242 and activatable to drill through the formation using a driver 245 (e.g., motor), or by separately drilling a perforation using a separate tool as provided, for example, in US7703526, previously incorporated by reference herein..

The primary flowline 232 may fluidly couple the probe 220 to the formation evaluation tool 228 for fluid communication therebetween. The formation evaluation tool 228 may receive the fluid for evaluation thereof. The formation evaluation tool 228 may have a variety of devices, such as a flow evaluation module 250, sample chamber 252, and/or other fluid collection and measurement means. The flow evaluation module 250 may have various measurement and/or analysis tools, such as sensors, gauges, fluid analyzers, and/or other devices for sensing, detecting, measuring, and/or determining various parameters of the downhole fluid.

The flow evaluation module 250 may also have a downhole unit 234 for receiving and/or processing data. The downhole unit 234 may be coupled to the surface unit 34 (FIGS. 1.1 and 1.2) for passing signals therebetween. Data may be collected in the downhole unit 234 for retrieval to the surface and/or passed to the surface unit 34 by wired or wireless means. The surface and/or downhole units 34, 234 may be used to receive and/or analyze data.

The fluid may be passed from the primary flowline 232a through the downhole tool 210

by a secondary flowline 254. The secondary flowline 254 fluidly connects the flow evaluation module 250 with the sample chamber 252. The fluid may optionally be discharged from the downhole tool 210 or collected in the sample chamber 252. The fluid collected in the sample chamber 252 may be maintained under pressure, and retrieved to the surface for further analysis.

Fluid may be drawn from the surrounding formation through the probe and into the downhole tool 210 via the primary flowline 232. The fluid may then be passed from the primary flowline 232 to the flow evaluation module 250, sample chamber 252, and/or other portions of the downhole tool via the secondary flowline 254. The downhole tool 210 and/or formation evaluation tool 228 may be provided with other flow control devices, such as pumps, valves, pretests, etc.

Figure 3 depicts another version of a probe 320 of a downhole tool 310. In this version, the probe 320 has a base 336 with a penetrating inlet 342 extendable therefrom via supports 340 and an inlet packer 360 inflatable thereabout. The penetrating inlet 342 extends through the wall 22 of the wellbore 14 a distance therein. The penetrating inlet 342 may create a perforation 362 in the wall 22 of the wellbore by extension therein. Alternately, the perforation 362 may be formed using a drilling or perforating tool using, for example, the techniques as described in US Patent No. 7,703,526, previously incorporated by reference herein.

The penetrating inlet 342 includes a sampling intake 364 and a packer flow tube 366. The sampling intake 364 is a tubular member with a tip 346 at an end thereof. The packer flow tube 366 is concentrically positioned about the sampling intake 364. The tip 346 may extend a distance radially from the base 336 beyond the packer flow tube 366. Fluid may be drawn into the sampling intake 364 through the tip 346 as indicated by the arrows.

The sampling intake 364 may be coupled to the downhole tool 310 by an inlet connector 348. The inlet connector 348 may have a sampling connector 349a to provide fluid communication between the sampling intake 364 and a flowline 332 in the downhole tool 310 for the passage of fluid therebetween. Fluid sampled from the formation F may be passed into the sampling intake 364, through the inlet connector 348 and into the sampling flowline 332.

The packer flow tube 366 may have the inlet packer 360 thereabout. The inlet packer 360 may be a ring shaped member fluidly coupled to the packer flow tube 366 and expandable thereabout to fluidly isolate a portion of the perforation 362. The packer flow tube 366 may be coupled to the downhole tool 310 by a packer connector 349b of the inlet connector 348. The packer connector 349b may provide fluid communication between the packer flow tube 366

and a fluid source 368 as schematically depicted. The fluid source 368 may be selectively activated to inflate and deflate the inlet packer 360 as needed.

The inlet packer 360 extends radially about the packer flow tube 366 for sealing engagement with the perforation 362. As shown, the inlet packer 360 is positioned between a sampling end and a base end of the packer flow tube 366. The inlet packer 360 is positioned about the packer flow tube 366 between the invaded zone and the formation F to isolate a portion of the perforation 362. The inlet packer 360 may be used, for example, to prevent contaminated fluid from the wellbore and/or invaded zone from entering the sampling intake 364 or from contaminating the clean fluid 38 in the formation F.

FIG. 4 shows an example method 400 of sampling a downhole fluid. The method 400 involves 470 – deploying a downhole tool into a wellbore. The downhole tool includes a housing with at least one flowline extending therein and a probe. The probe includes a base carried by the housing, a penetrating inlet carried by the base and having a tip about a sampling end thereof, and an inlet packer positionable about the penetrating inlet (the penetrating inlet is in fluid communication with the flowline). The method also involves 472 - positioning the base adjacent a wall of the wellbore, 474 - selectively extending the penetrating inlet through the wall of the wellbore a distance into the formation, 476 - isolating the tip from contaminated fluid by inflating the inlet packer about the penetrating inlet and forming a seal with the formation, and 478 - drawing the clean fluid from the formation and into the housing through the tip.

The method may also involve collecting a sample of the downhole fluid, perforating the wall of the wellbore and deploying the penetrating inlet in the perforation, and/or retracting the penetrating inlet. The extending may involve selectively extending at least one of the tip and the penetrating inlet. The method may also involve performing a pretest, monitoring fluid properties, and measuring various downhole parameters. The method may be performed in a desired order and repeated in part or in whole as desired.

Plural instances may be provided for components, operations or structures described herein as a single instance. In general, structures and functionality presented as separate components in the exemplary configurations may be implemented as a combined structure or component. Similarly, structures and functionality presented as a single component may be implemented as separate components. These and other variations, modifications, additions, and improvements may fall within the scope of the inventive subject matter.

Although only a few example embodiments have been described in detail above, those

skilled in the art will readily appreciate that many modifications are possible in the example embodiments without materially departing from this invention. Accordingly, all such modifications are intended to be included within the scope of this disclosure as defined in the following claims. In the claims, means-plus-function clauses are intended to cover the structures described herein as performing the recited function and not only structural equivalents, but also equivalent structures. Thus, although a nail and a screw may not be structural equivalents in that a nail employs a cylindrical surface to secure wooden parts together, whereas a screw employs a helical surface, in the environment of fastening wooden parts, a nail and a screw may be equivalent structures. It is the express intention of the applicant not to invoke 35 U.S.C. § 112, paragraph 6 for any limitations of any of the claims herein, except for those in which the claim expressly uses the words 'means for' together with an associated function.

CLAIMS

What is claimed is:

1. A probe (220, 320) of a downhole tool (10) deployable into a wellbore (14) penetrating a subterranean formation (F), the downhole tool having at least one flowline (232, 254, 332) extendable therein, the formation having a clean fluid (38) therein, the probe comprising:

a base (236, 336) carried by the downhole tool (10) and positionable adjacent a wall (22) of the wellbore;

a penetrating inlet (242, 342) carried by the base and having a tip (246, 346) about a sampling end thereof to receive the clean fluid, the penetrating inlet in fluid communication with the at least one flowline, the penetrating inlet extendable through the wall of the wellbore a distance into the formation; and

an inlet packer (360) inflatably positionable about the penetrating inlet to form a seal with the formation and isolate the tip therein whereby the clean fluid may be drawn from the formation and into the downhole tool.

2. The probe of Claim 1, wherein the tip is selectively extendable from the penetrating inlet.

3. The probe of any preceding Claim, wherein the tip is extendable from the penetrating inlet.

4. The probe of any preceding Claim, wherein the penetrating inlet comprises a sampling intake (364) and a packer flow tube (366) positionable about the sampling intake, the sampling intake operatively connectable to the at least one flowline, the packer flow tube operatively connectable to a fluid source (368) to selectively inflate the inlet packer.

5. The probe of any preceding Claim, further comprising an inlet connector (248, 348) operatively connecting the penetrating inlet to the at least one flowline.

6. The probe of any preceding Claim, wherein the tip is positionable through the wall of the wellbore and a distance beyond an invaded zone (36) in the formation, the invaded zone having contaminated fluid therein.

7. The probe of any preceding Claim, wherein the penetrating inlet is positionable in a perforation (362) extending through the wall of the wellbore, the inlet packer inflatable in the perforation to isolate the tip therein.

8. The probe of any preceding Claim, further comprising supports to selectively extend the base.

9. The probe of any preceding Claim, wherein the base comprises a sealing surface (244) sealable with the wall of the wellbore.

10. A method of sampling a downhole fluid of a subterranean formation (F), the formation having a wellbore (14) extending therein, the formation having a clean fluid (38) therein, the method comprising:

deploying a downhole tool (10) into the wellbore, the downhole tool comprising a housing (210) with at least one flowline (232, 254, 332) extending therein and a probe, the probe comprising a base (236, 336) carried by the housing, a penetrating inlet (242, 342) carried by the base and having a tip (246, 346) about a sampling end thereof, and an inlet packer (360) positionable about the penetrating inlet, the penetrating inlet in fluid communication with the at least one flowline;

positioning the base adjacent a wall (22) of the wellbore;

selectively extending the penetrating inlet through the wall of the wellbore a distance into the formation;

isolating the tip from contaminated fluid by inflating the inlet packer about the penetrating inlet and forming a seal with the formation; and

drawing the clean fluid from the formation and into the housing through the tip.

11. The method of Claim 10, further comprising perforating the wall of the wellbore and deploying the penetrating inlet in the perforation.

12. The method of Claim 10 or 11, wherein the selectively extending comprises selectively extending and retracting at least one of the tip and the penetrating inlet.

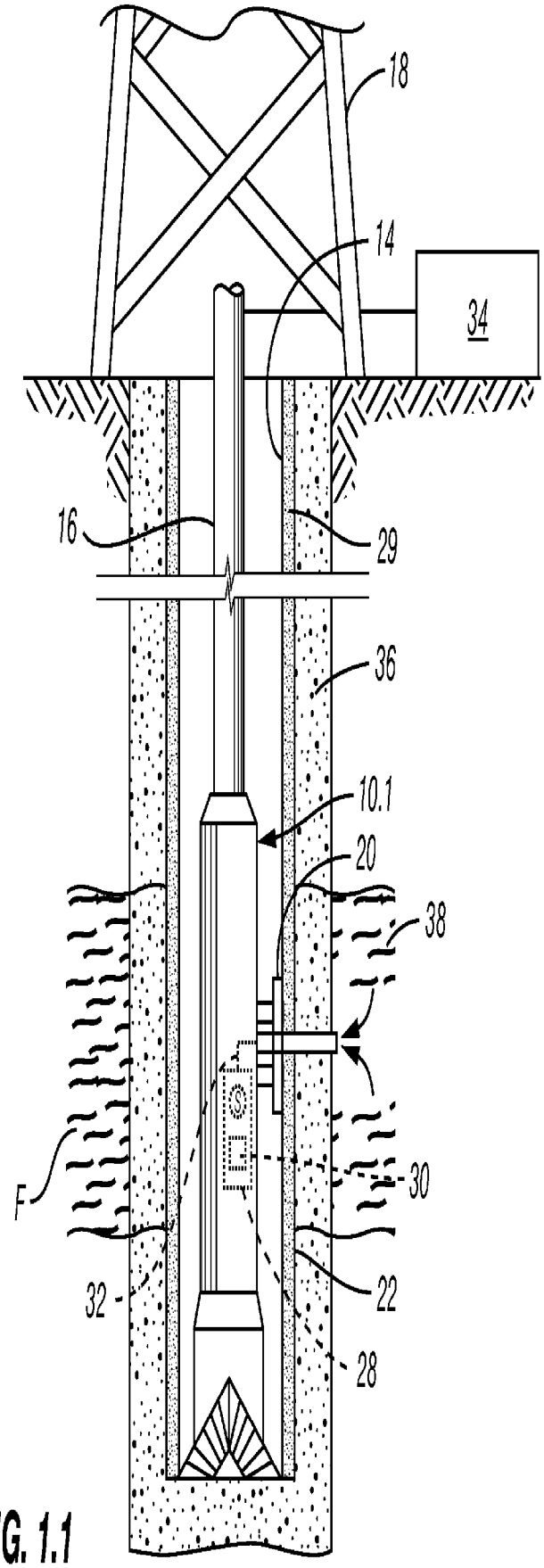

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FIG. 1.1

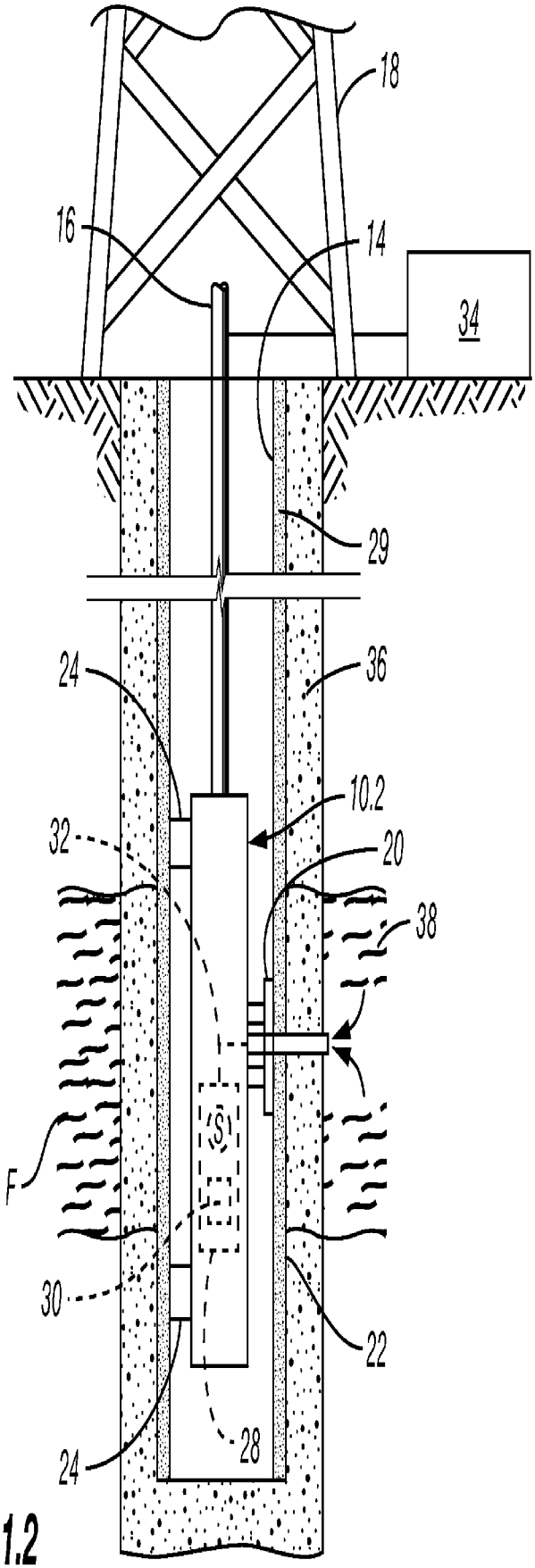

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FIG. 1.2

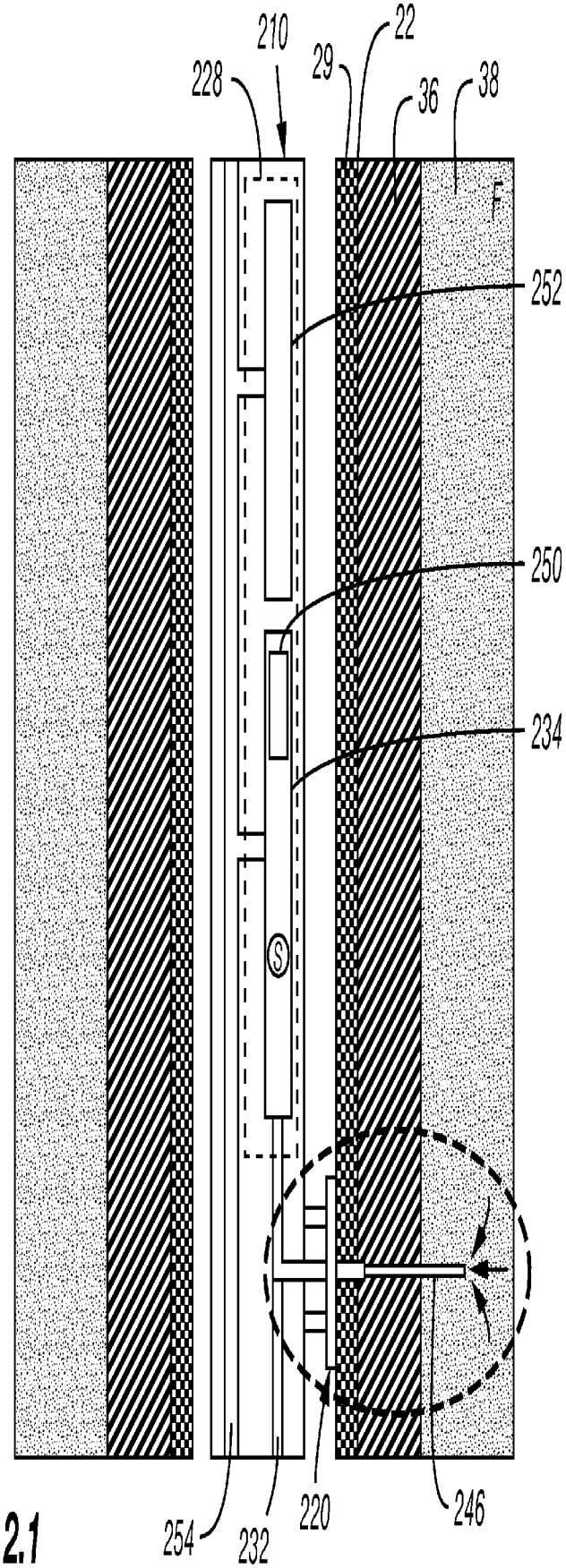

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FIG. 2.1

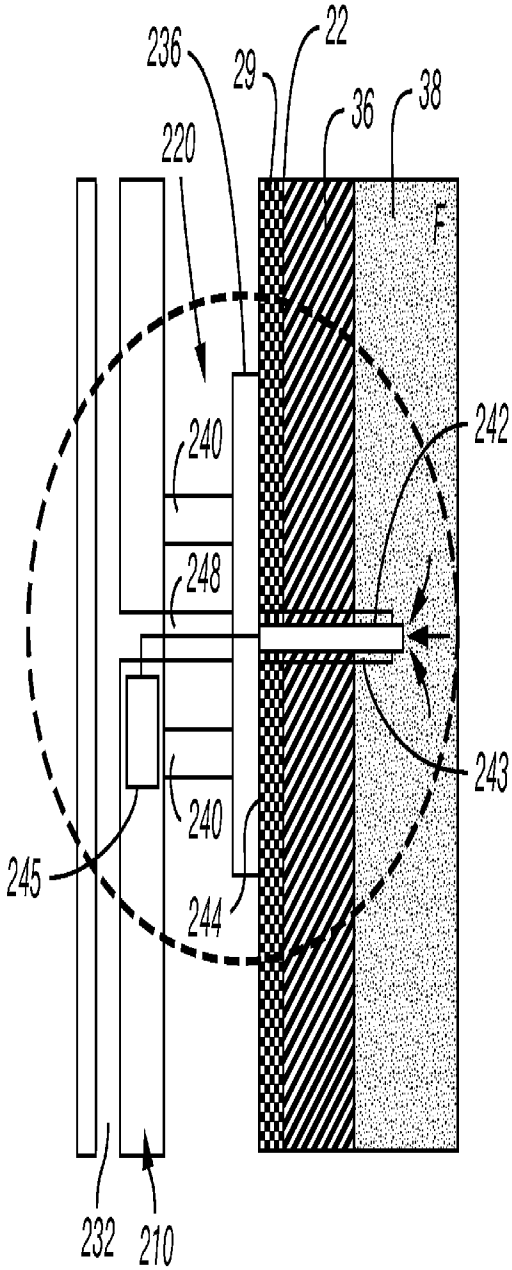

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FIG. 2.2

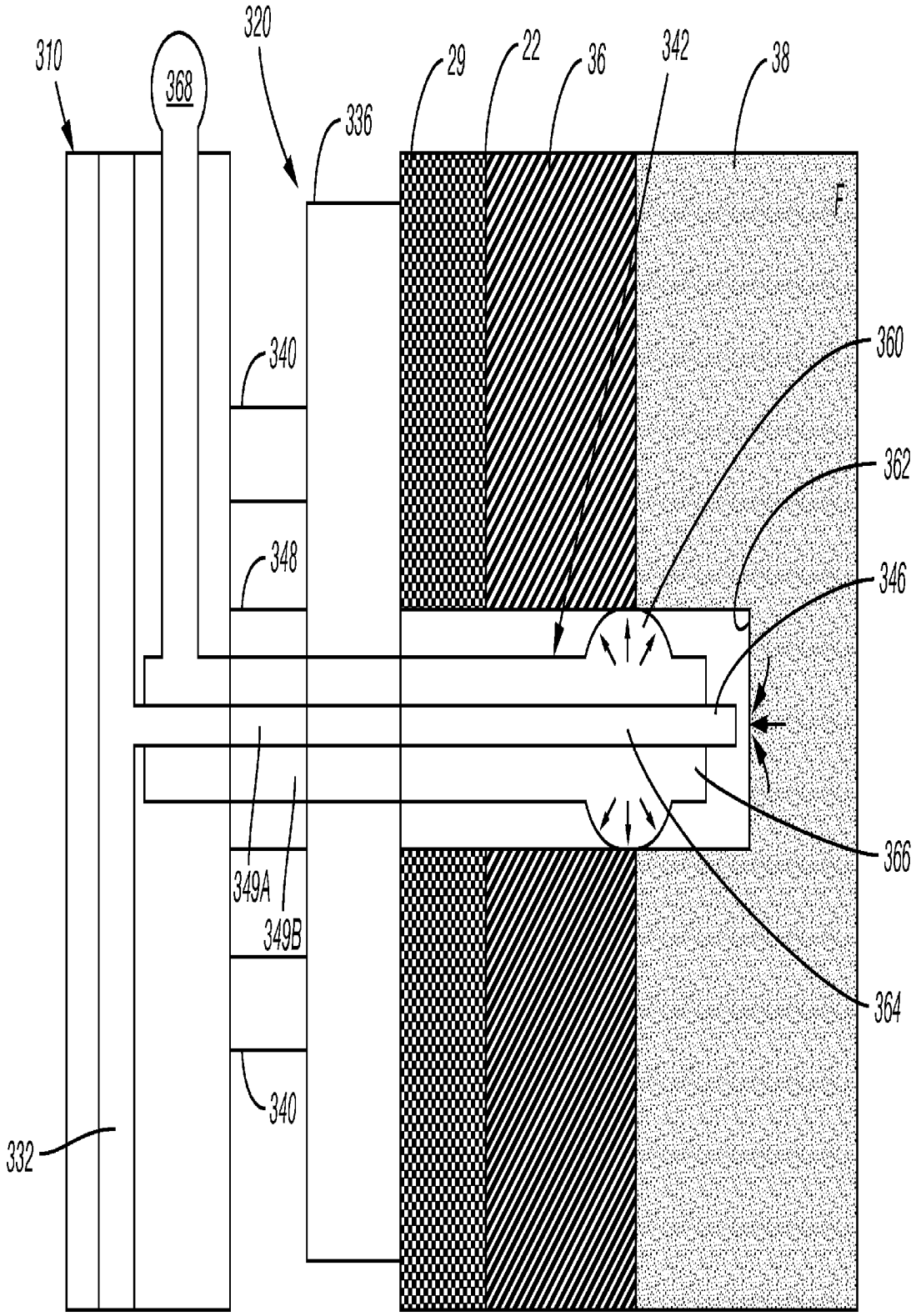

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FIG. 3

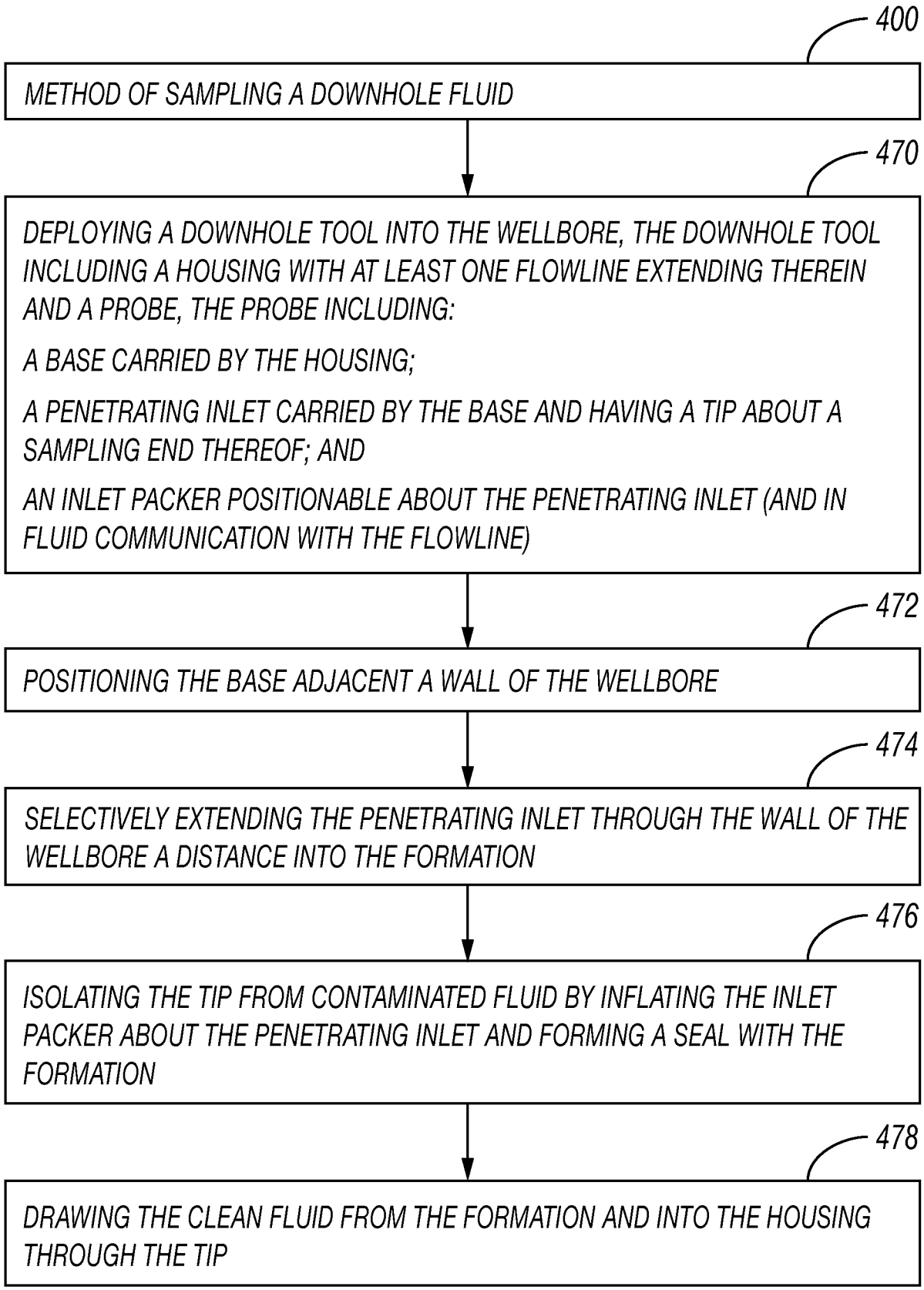

400
METHOD OF SAMPLING A DOWNHOLE FLUID
470
DEPLOYING A DOWNHOLE TOOL INTO THE WELLBORE, THE DOWNHOLE TOOL INCLUDING A HOUSING WITH AT LEAST ONE FLOWLINE EXTENDING THEREIN AND A PROBE, THE PROBE INCLUDING:
A BASE CARRIED BY THE HOUSING;
A PENETRATING INLET CARRIED BY THE BASE AND HAVING A TIP ABOUT A SAMPLING END THEREOF; AND
AN INLET PACKER POSITIONABLE ABOUT THE PENETRATING INLET (AND IN FLUID COMMUNICATION WITH THE FLOWLINE)
472
POSITIONING THE BASE ADJACENT A WALL OF THE WELLBORE
474
SELECTIVELY EXTENDING THE PENETRATING INLET THROUGH THE WALL OF THE WELLBORE A DISTANCE INTO THE FORMATION
476
ISOLATING THE TIP FROM CONTAMINATED FLUID BY INFLATING THE INLET PACKER ABOUT THE PENETRATING INLET AND FORMING A SEAL WITH THE FORMATION
478
DRAWING THE CLEAN FLUID FROM THE FORMATION AND INTO THE HOUSING THROUGH THE TIP

FIG. 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2014/057726

A. CLASSIFICATION OF SUBJECT MATTER

E21B 49/08(2006.01)i, E21B 47/00(2006.01)i, G01N 1/10(2006.01)i

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)
E21B 49/08; E21B 49/10; E21B 47/00; E21B 19/00; G01N 1/10

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: wellbore, sampling, probe, penetrating inlet, tip, and inlet packer

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2006-0075813 A1 (FISSELER et al.) 13 April 2006 See paragraphs [0024]-[0038] and figures 3A-3B.	1-3,10-12
Y	US 2009-0194279 A1 (TARVIN et al.) 06 August 2009 See paragraphs [0034],[0063]-[0064] and figures 5A-5D.	1-3,10-12
A	US 2011-0198078 A1 (HARRIGAN et al.) 18 August 2011 See paragraphs [0055]-[0077] and figures 3-4D.	1-3,10-12
A	US 6223822 B1 (JONES, TIMOTHY GARETH JOHN) 01 May 2001 See abstract, column 4, line 45 - column 5, line 8 and figure 1.	1-3,10-12
A	US 2012-0043080 A1 (EDWARDS, JOHN E.) 23 February 2012 See paragraphs [0024]-[0034] and figures 1-3B.	1-3,10-12

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
22 January 2015 (22.01.2015)	**22 January 2015 (22.01.2015)**

Name and mailing address of the ISA/KR
International Application Division
Korean Intellectual Property Office
189 Cheongsa-ro, Seo-gu, Daejeon Metropolitan City, 302-701,
Republic of Korea
Facsimile No. ++82 42 472 3473

Authorized officer
LEE, Jong Kyung
Telephone No. +82-42-481-3360

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2014/057726

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☒ Claims Nos.: 4-9
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required addtional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of any additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/US2014/057726

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2006-0075813 A1	13/04/2006	CA 2521209 A1	07/04/2006
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		EP 2313610 B1	17/10/2012
		MX 2011000484 A	22/02/2011
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		WO 2010-008994 A2	21/01/2010
		WO 2010-008994 A3	15/04/2010
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		GB 2344365 B	03/01/2001
		GB 9826557 D0	27/01/1999
US 2012-0043080 A1	23/02/2012	US 8397817 B2	19/03/2013
		WO 2012-024496 A2	23/02/2012
		WO 2012-024496 A3	26/07/2012