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— as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))

[Continued on next page]

(54) Title: ACOUSTIC DOWNHOLE TOOL WITH RUBBER BOOT PROTECTED BY EXPANDABLE SLEEVE

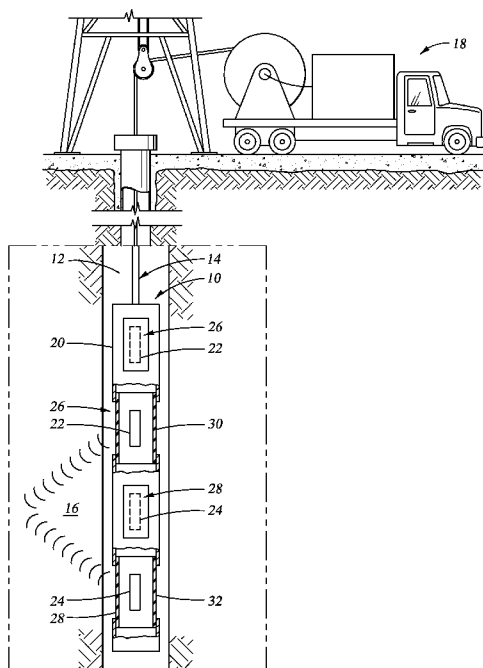


Fig. 1

(57) Abstract: A downhole tool having a body, a transducer within the body, and an opening formed through a sidewall of the body. The opening provides a port through which the transducer can communicate from within the body. An elastomeric boot in the body covers the opening and is a barrier that prevents fluid ingress into the downhole tool. An expandable sleeve envelops the elastomeric boot and provides support that limits bulging of the elastomeric boot from within the body through adjacent openings in the body. An example sleeve is made from elongated members woven into a tubular.



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- *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))* — *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

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ACOUSTIC DOWNHOLE TOOL WITH RUBBER BOOT PROTECTED BY EXPANDABLE SLEEVE

BACKGROUND

1. Field of Invention

[0001] The invention relates generally to the field of downhole acoustic measurement. More specifically, the present invention relates to a downhole tool having a rubber boot covered by an expandable sleeve.

2. Description of Prior Art

[0002] Figure 1 illustrates a side partial sectional view of a downhole tool 10 deployed on wireline 14 within a wellbore 12. The downhole tool 10 is used for interrogating a formation 16 adjacent the wellbore 12, gathering information about the formation 16, and either storing or transmitting the information via the wireline 14 to a surface truck 18 shown controlling the downhole tool 10. In this prior art example, the downhole tool 10 includes an elongated body 20 for housing components within the downhole tool 10. One example of a component shown is a transducer 22; which in this example is illustrated as an acoustic transmitter and emitting an acoustic signal from within an opening 26 formed through a side wall of the body 20. The signal propagates into the formation 16; a portion of the acoustic signal reflects back towards the downhole tool 10. A second transducer 24 is shown, also housed within the body 20, and in this example is an acoustic receiver configured for receiving the acoustic signal reflecting from the formation 16. A corresponding opening 28 is formed through the body 20 so the transducer 24 can receive the reflected signal.

[0003] A portion of the logging tool 10 is shown in sectional view to illustrate boots 30, 32 within the tool that cover the openings 26, 28. The boots 30, 32 are typically made from an elastomeric material, such as rubber or another type of flexible polymer. Often, dielectric

fluid, such as silicone, fills the inside of the body 20 for electrically insulating components within the body 20. Because fluids in the wellbore 12 typically include conductive materials damaging to components within the body 20; the boots 30, 32 form a barrier for preventing wellbore fluid ingress into the body 20. Also, as wellbore pressure overcomes dielectric fluid pressure, wellbore pressure through the openings 26, 28 causes the pliable boots 30, 32 to bow inward and impinge the dielectric fluid; thereby equalizing wellbore and dielectric fluid pressure.

[0004] Figure 2 illustrates a side partial sectional view of a portion of the downhole tool 10 of Figure 1. In this view, the tool 10 is being raised from within the wellbore 12 after having been immersed in wellbore fluids. While immersed downhole, wellbore fluid constituents, such as lower molecular weight compounds, can migrate through the boots 30, 32 and become trapped within the boots 30, 32 in the body 20. Raising the downhole tool 10 toward the surface reduces the hydrostatic pressure applied to the boots 30, 32 and dielectric fluid to allow lighter molecular weight fluids to expand or vaporize. As the trapped fluids expand and/or vaporize, the boots 30, 32 can bow outward through the opening 26, 28 and into contact with the inner walls of the wellbore 12. Contact against the wall of the wellbore 12 may damage the boots 30, 32. Additionally, once removed from within the wellbore 12, the trapped high pressure fluid within the boot 30, 32 must be vented so the tool 10 can be serviced. This can present added turnaround time and steps.

SUMMARY OF INVENTION

[0005] Disclosed herein is a downhole tool insertable within a wellbore. In an example embodiment the downhole tool includes a housing, a space in the housing, and an opening that is formed through a sidewall of the housing. The tool further includes a barrier between the opening and the space a membrane. A series of elongate members are arranged on a side

of the membrane that faces the opening. The members restrain the membrane from bulging through the space when pressure in the space exceeds pressure ambient to the housing. A transducer may be included within the housing, example transducers are acoustic transmitters, acoustic receivers, and those that can transmit and receive. In an example embodiment, the transducer acoustically communicates from within the housing and through the membrane and the series of elongate members. In an example embodiment, the barrier is formed from an elastomeric material and formed into a sleevelike configuration and wherein the elongate members define a sleeve that circumscribes the barrier. In an example embodiment, a mandrel is in the space and a coupling anchors the sleeve and barrier to the mandrel. In an example embodiment, the tool may further include a plurality of openings from through the sidewall of the housing, a barrier between each of the openings and the space, wherein each of barrier comprises a membrane, and a series of elongate members on the surface of each membrane facing the opening. In an example embodiment, at least some of the elongate members intersect some of the other elongate members to define a mesh.

[0006] Also disclosed herein is a method of wellbore operations. In an example embodiment, the method includes providing a downhole tool made up of a housing with an inside space and an opening through a sidewall of the housing. A barrier is set between the inside space and the openings. The method includes shielding the barrier from direct contact with a borehole wall by applying a series of elongate members between the barrier and the opening. Thus when the tool is inserted into the wellbore the barrier is protected from contact. The barrier elongate members also prevent the barrier from ballooning outward by retaining the barrier within the housing when the pressure in the space exceeds pressure ambient to the housing. The downhole tool is deployed in the wellbore. In an example embodiment, the elongate members are arranged in a mesh-like configuration and intertwined to form a cohesive member. In an example embodiment, the barrier and the cohesive

member are tubular members; the method can then further include clamping the barrier and cohesive member to a mandrel within the housing. In an example embodiment, the method further includes acoustically communicating from within the housing and through the barrier and elongate members. In an example embodiment, acoustically communicating includes actuating a transducer within the housing. In an example embodiment, the transducer can be an acoustic transmitter, an acoustic receiver, or can transmit and receive.

BRIEF DESCRIPTION OF DRAWINGS

[0007] Some of the features and benefits of the present invention having been stated, others will become apparent as the description proceeds when taken in conjunction with the accompanying drawings, in which:

[0008] Figure 1 is a partial side sectional view of a prior art downhole system.

[0009] Figure 2 is a partial side sectional view of a portion of the system of Figure 1.

[0010] Figure 3 is a side sectional view of an embodiment of a downhole tool with an expandable sleeve.

[0011] Figure 4 is side perspective view of an example of an expandable sleeve.

[0012] Figure 5 is a side partial sectional view of a portion of the downhole tool of Figure 3.

[0013] While the invention will be described in connection with the preferred embodiments, it will be understood that it is not intended to limit the invention to that embodiment. On the contrary, it is intended to cover all alternatives, modifications, and equivalents, as may be included within the spirit and scope of the invention as defined by the appended claims.

DETAILED DESCRIPTION OF INVENTION

[0014] The present invention will now be described more fully hereinafter with reference to the accompanying drawings in which embodiments of the invention are shown. This

invention may, however, be embodied in many different forms and should not be construed as limited to the illustrated embodiments set forth herein; rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. Like numbers refer to like elements throughout.

[0015] It is to be understood that the invention is not limited to the exact details of construction, operation, exact materials, or embodiments shown and described, as modifications and equivalents will be apparent to one skilled in the art. In the drawings and specification, there have been disclosed illustrative embodiments of the invention and, although specific terms are employed, they are used in a generic and descriptive sense only and not for the purpose of limitation. Accordingly, the invention is therefore to be limited only by the scope of the appended claims.

[0016] Shown in a side partial sectional view in Figure 3 is an example of a downhole acoustic logging system in accordance with the present disclosure. More specifically shown is a downhole logging tool 50 inserted within a wellbore 52. The downhole tool 50 includes an elongated body 54 shown deployed in the wellbore 52 on wireline 56. A surface truck 57 is shown for raising and lowering the downhole tool 50 within the wellbore 52, the surface truck 57 may also include data recording devices for recording data from within the wellbore 52. The downhole tool 50 of Figure 3 also includes transducers 58, 60 housed within the body 54. Shown adjacent each of the transducers 58, 60 are openings 64, 66 through the body 54 so that signals may communicate to and/or from the transducers 58, 60 to the outside of the downhole tool 50. In the example of Figure 3, the transducer 58 is an acoustic transmitter shown emitting an acoustic signal into the formation 62 surrounding the wellbore 52. Also the transducer 60 illustrated is shown as a receiver for receiving acoustic signals reflected from or otherwise propagating through the formation 62.

[0017] Boots 68, 70 are shown housed within the body 54 and covering openings 64, 66. The boots 68, 70 may be formed from any type of elastomer or other pliable material that may be used for sealing and transmitting or communicating pressure. In the embodiment of Figure 3, expandable sleeves 72, 74 are shown included over the boots 68, 70. In this example, the sleeves 72, 74 may extend past the ends of the boots 68, 70. However, other arrangements are available wherein the sleeves 72, 74 cover a portion of the boot 68, 70; as well as configurations where multiple sleeves 72, 74 may be placed over a single boot 68, 70.

[0018] Shown in Figure 4 is a side perspective view of an example of an expandable sleeve 72, 74. The sleeve 72, 74 of Figure 4 is made up of a series of elongated members 76, where the members 76 may be a filament, a monofilament, or a braided line. The elongated members 76 of Figure 4 are illustrated as woven into a tubular-shaped configuration. The weave of the element 76 is such that axial forces applied to opposing ends of the sleeve 72, 74 can elongate the sleeve 72, 74 and reduce the radius of the sleeve 72, 74. Similarly, applying a force on the inside wall of the sleeve 72, 74 and directed radially outward from its axis A_x can reduce the length of the sleeve 72, 74 while increasing the diameter of the sleeve 72, 74. An example of material for the elongated member 76 is a polyetheretherketone (PEEK). The expandable sleeve 72, 74 may be obtained from Federal-Mogul Corporation, 26555 Northwestern Highway, South Field, Michigan 48033, Ph: 248-354-7700.

[0019] Shown in Figure 5 is an example of a portion of the downhole tool 50 of Figure 3 being raised from within the wellbore 52. In this example, although lighter molecular weight fluids may have become trapped within the boot 68, 70, the sleeve 72, 74 covering the boot 68, 70 limits outward radial movement of the boot 68, 70, thereby maintaining a pressure within the body 54 of the downhole tool 50. The increased pressure can accelerate the escape of the trapped fluids within the boot 68, 70 to permeate through the wall of the boot 68, 70

and to outside of the tool 50. Because outward bulging of the boot 68, 70 may result in contact against the wall of the wellbore 52; the expandable sleeve 72, 74 can provide a protective layer between the boot 68, 70 and wall of the wellbore 52. Also, by limiting the boot 68, 70 from outwardly bulging through an adjacent opening 64, 66, the boot 68, 70 is less likely to grab or catch the wellbore wall, thus the expandable sleeve 72, 74 better facilitates removal of the tool 50 from within the wellbore. The sleeve 72, 74 may also protect the boot 68, 70 during maintenance, since high pressure water is often used for cleaning the downhole tool 50.

[0020] Referring back to Figure 5, a clamp 78 is schematically illustrated for anchoring the expandable sleeve 72 and boot 68 within the downhole tool 50. In the example of Figure 5, the clamp 78 couples both the expandable sleeve 72 and boot 54 around a mandrel 80 in the downhole tool 68; wherein the mandrel 80 may also be used to secure the transducer 58. The expandable sleeve 72 and boot 54 may be the same or different lengths, but both are shown having a length exceeding that of the opening 64.

[0021] The present invention described herein, therefore, is well adapted to carry out the objects and attain the ends and advantages mentioned, as well as others inherent therein. While a presently preferred embodiment of the invention has been given for purposes of disclosure, numerous changes exist in the details of procedures for accomplishing the desired results. These and other similar modifications will readily suggest themselves to those skilled in the art, and are intended to be encompassed within the spirit of the present invention disclosed herein and the scope of the appended claims.

CLAIMS

WHAT IS CLAIMED IS:

1. A downhole tool comprising:
 - a housing;
 - a space in the housing;
 - an opening formed through a sidewall of the housing;
 - a barrier between the opening and the space comprising a membrane; and
 - a series of elongate members arranged on a side of the membrane facing the opening,so that when pressure in the space exceeds pressure ambient to the housing, the members restrain the membrane from bulging through the space.
2. The downhole tool of claim 1, further comprising a transducer within the housing, wherein the transducer comprises a device selected from the group consisting of is an acoustic transmitter, an acoustic receiver, and combinations thereof.
3. The downhole tool of claim 2, wherein the transducer acoustically communicates from within the housing and through the membrane and the series of elongate members.
4. The downhole tool of claim 1, wherein the barrier is formed from an elastomeric material and formed into a sleevelike configuration and wherein the elongate members define a sleeve that circumscribes the barrier.
5. The downhole tool of claim 3, further comprising a mandrel in the space and a coupling anchoring the sleeve and barrier to the mandrel.
6. The downhole tool of claim 1, further comprising a plurality of openings from through the sidewall of the housing, a barrier between each of the openings and the space, wherein each of barrier comprises a membrane, and a series of elongate members on the surface of each membrane facing the opening.

7. The downhole tool of claim 1, wherein at least some of the elongate members intersect some of the other elongate members to define a mesh.

8. A method of wellbore operations comprising:

providing a downhole tool comprising: a housing with an inside space, an opening through a sidewall of the housing, and a barrier between the inside space and the openings;

applying a series of elongate members between the barrier and the opening that are coupled with the tool, thereby shielding the barrier from direct contact with a borehole wall when inserted into the wellbore and retaining the barrier within the housing when the pressure in the space exceeds pressure ambient to the housing and;

deploying the downhole tool in the wellbore.

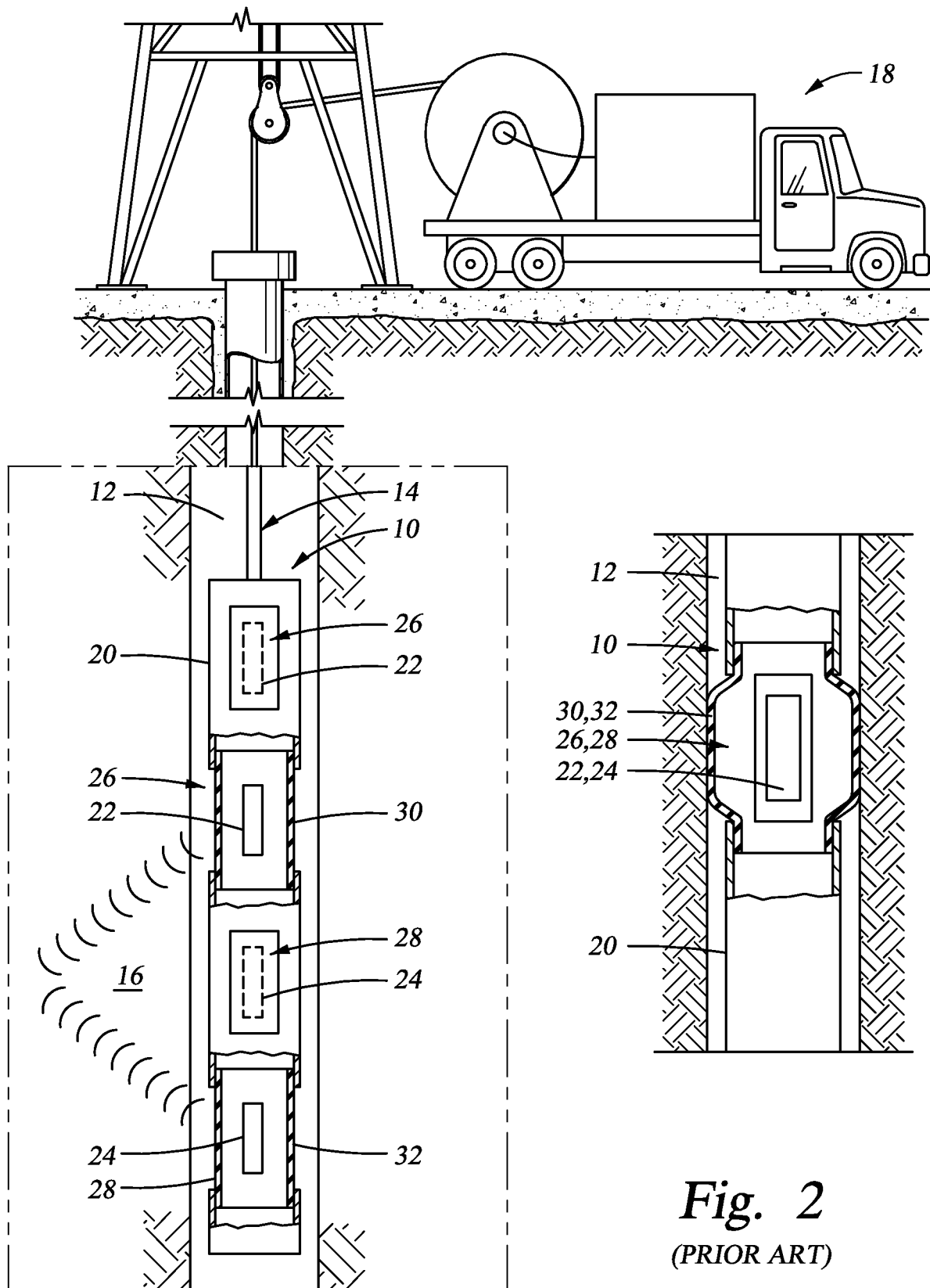
9. The method of claim 8, wherein the elongate members are arranged in a mesh-like configuration and intertwined to form a cohesive member.

10. The method of claim 9, wherein the barrier and the cohesive member are tubular members, the method further comprising clamping the barrier and cohesive member to a mandrel within the housing.

11. The method of claim 8, further comprising acoustically communicating from within the housing and through the barrier and elongate members.

12. The method of claim 11, wherein the step of acoustically communicating comprises actuating a transducer within the housing, wherein the transducer comprises a device selected from the group consisting of is an acoustic transmitter, an acoustic receiver, and combinations thereof.

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2/3

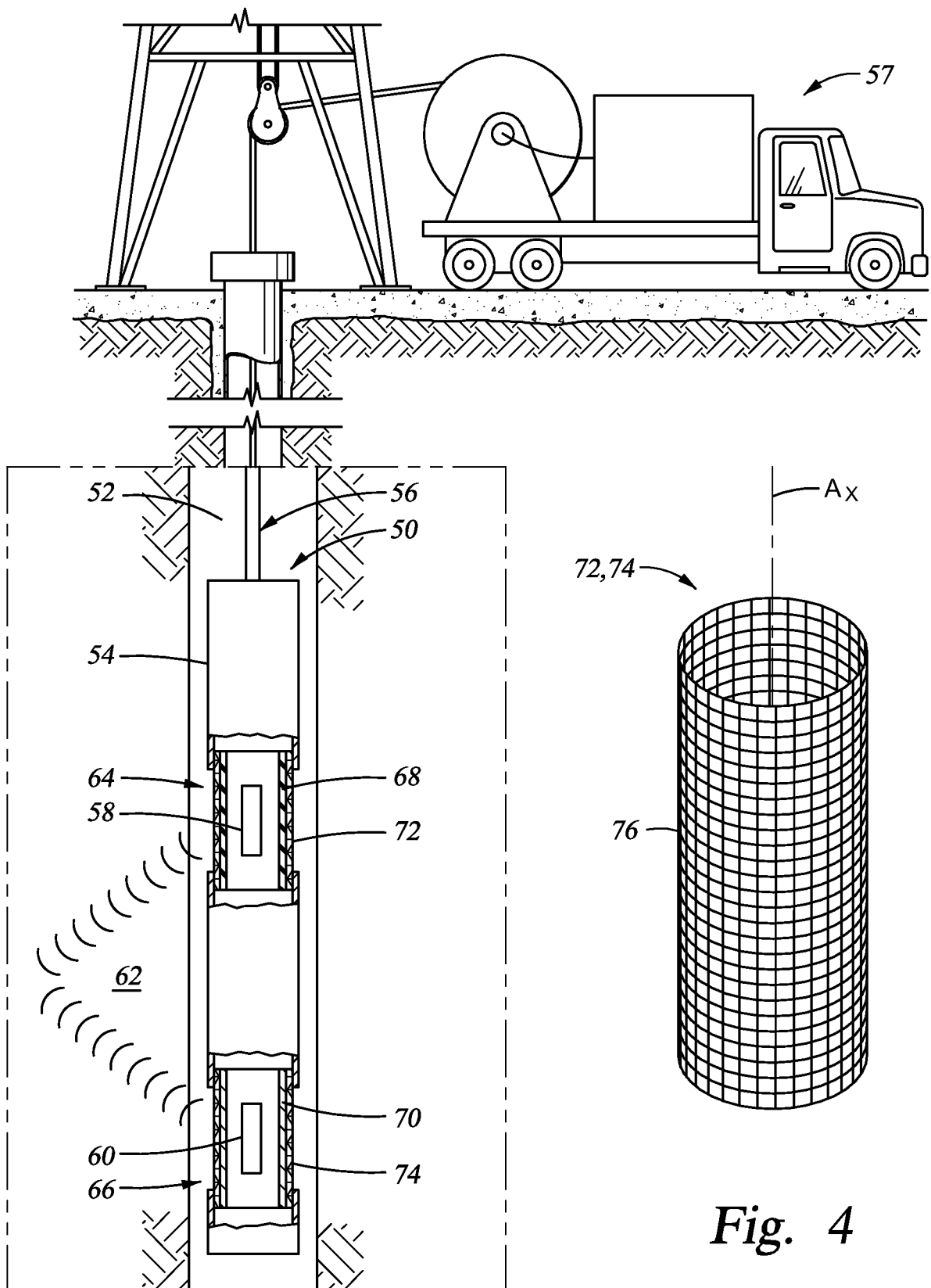


Fig. 3

Fig. 4

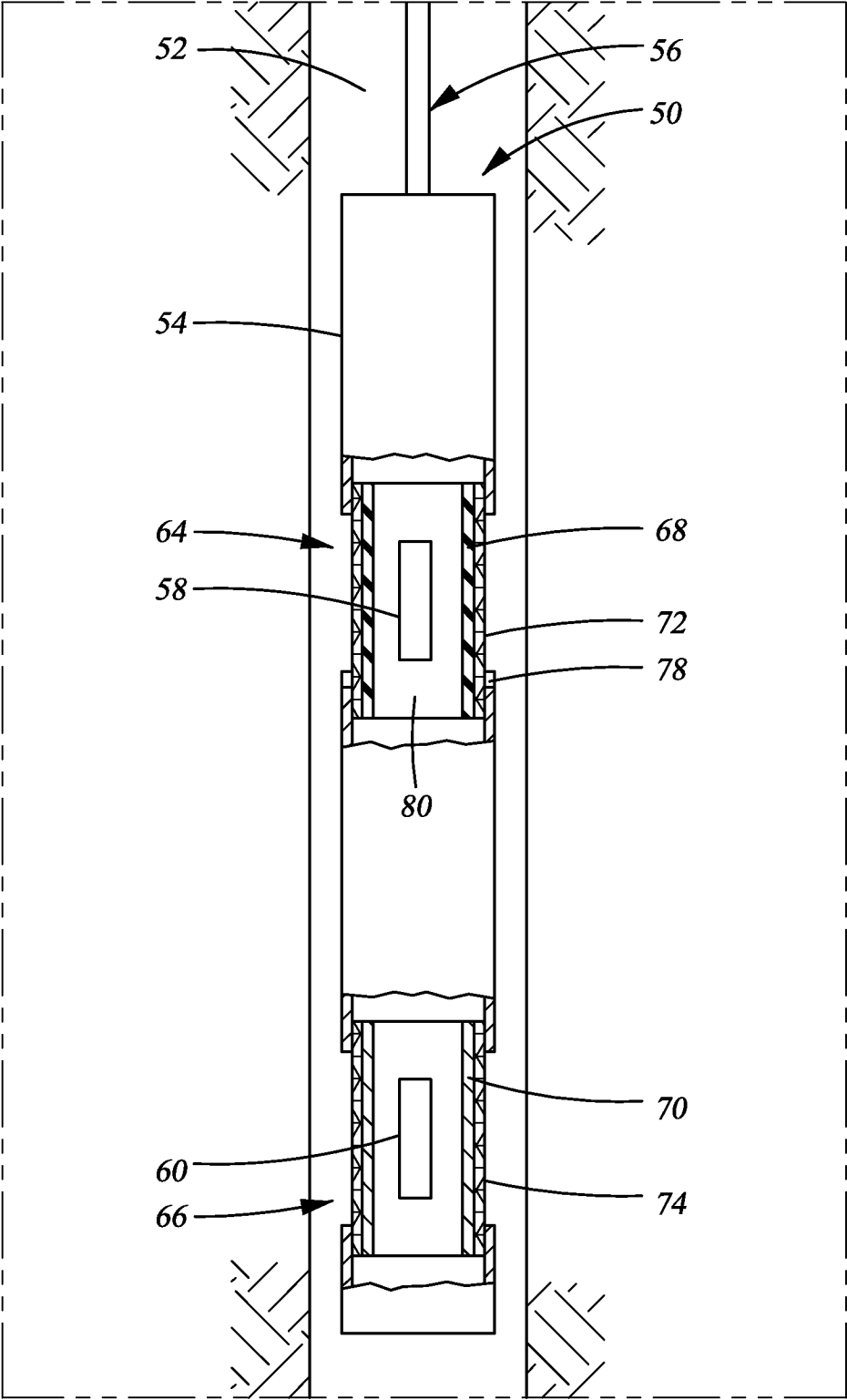


Fig. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2011/024713**A. CLASSIFICATION OF SUBJECT MATTER****E21B 47/14(2006.01)i, G01V 1/40(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 47/14; G01V 1/14; G01V 1/40; G01V 1/00

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: downhole tool, rubber boot, expandable sleeve, barrier, elongated member

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 04890687 A (MEDLIN; WILLIAM L. et al.) 02 January 1990 See abstract, column 4 and figure 3	1-12
A	US 04742495 A (MEDLIN; WILLIAM L. et al.) 03 May 1988 See abstract, columns 3,4 and figure 3	1-12
A	US 04706228 A (OWEN; THOMAS E. et al.) 10 November 1987 See abstract, columns 3,4 and figure 1	1-12
A	US 04674067 A (ZEMANEK, JR.; JOSEPH) 16 June 1987 See abstract, column 4, claim 1 and figure 3	1-12



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

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"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

26 JULY 2011 (26.07.2011)

Date of mailing of the international search report

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Name and mailing address of the ISA/KR

Korean Intellectual Property Office
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2011/024713

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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