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(71) Applicant: **BAKER HUGHES INCORPORATED** [US/US]; P.O. Box 4740, Houston, Texas 77210-4740 (US).

(72) Inventor: **O'BRIEN, Robert**; 2929 Allen Parkway, Suite 2100, Houston, Texas 77019-2118 (US).

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Declarations under Rule 4.17:

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

— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

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(54) Title: SCREEN ASSEMBLY

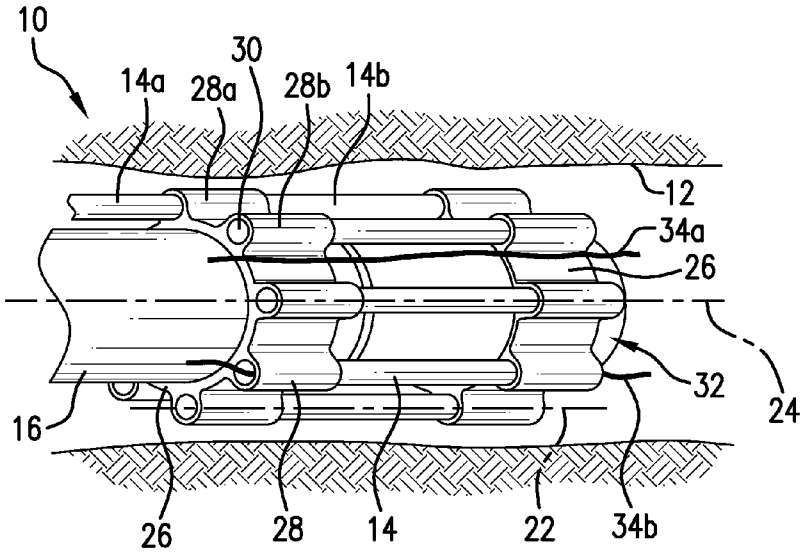


FIG. 1

(57) Abstract: A screen assembly including one or more screen members that correspondingly form one or more flow paths. The one or more flow paths are discrete from a tubular with which the one or more screen members are associated, but in fluid communication with an axial passageway of the tubular. A method of using a screen assembly is also included.

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SCREEN ASSEMBLY

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Application No. 13/873431, filed on April 30, 2013, which is incorporated herein by reference in its entirety.

BACKGROUND

[0002] Screens and other filtering assemblies are ubiquitous in the downhole drilling and completions industry. These assemblies are primarily used to filter solids or particulate matter while enabling the production of fluids such as hydrocarbons. Due at least partially to their prevalence in the industry, advances and alternatives in downhole screen assemblies are always well received.

SUMMARY

[0003] A screen assembly, comprising one or more screen members that correspondingly form one or more flow paths, the one or more flow paths discrete from a tubular with which the one or more screen members are associated, but in fluid communication with an axial passageway of the tubular.

[0004] A screen assembly, comprising a plurality of screen members arranged at a same longitudinal position along a tubular, each of the screen members having a discrete closed shape that forms one of a plurality of discrete flow paths corresponding to the plurality of screen members.

[0005] A method of using a screen assembly, comprising positioning the screen assembly in a borehole, the screen assembly having one or more screen members discretely arranged with respect to a tubular having an axial passageway, the one or more screen members correspondingly forming one or more flow paths that are discrete from the tubular; and communicating fluid through the one or more screen members to the axial passageway via the one or more flow paths.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] The following descriptions should not be considered limiting in any way. With reference to the accompanying drawings, like elements are numbered alike:

[0007] Figure 1 illustrates a screen assembly installed in a borehole according to one embodiment disclosed herein;

[0008] Figure 2 is a cross-sectional view of the assembly of Figure 1;

[0009] Figure 3 illustrates a screen assembly according to one embodiment disclosed herein;

[0010] Figure 4 is a cross-sectional view of the assembly of Figure 3;

[0011] Figure 5 illustrates a coupling of the screen assembly of Figure 1; and

[0012] Figure 6 is a coupling for a screen assembly according to one embodiment disclosed herein.

DETAILED DESCRIPTION

[0013] A detailed description of one or more embodiments of the disclosed apparatus and method are presented herein by way of exemplification and not limitation with reference to the Figures.

[0014] Referring now to Figures 1 and 2, a screen assembly 10 is illustrated for filtering solids or particulates while enabling the production of desired fluids, e.g., of hydrocarbons, from a subterranean formation via a borehole 12. It is to be appreciated at the outset that for succinctness in discussion the assembly 10 is illustrated as a conglomeration of embodiments including several features that may be used separately or together in any combination. In general, the screen assembly 10 includes one or more discrete screen members 14 arranged circumferentially about a tubular of a tubular string 16, which is, e.g., a production string. By tubular string it is meant one or more tubulars disposed together. The screen members 14 include a filter portion, which can be any desired filtering material, medium, or configuration, such as mesh, slots, wire-wrap, permeable foam, or combinations thereof. In one embodiment, the filtering material is wrapped or disposed about a perforated inner tubular or mini-base pipe to form the screen members 14. It is to of course be appreciated that in other embodiments the screen members 14 can be formed solely from a filter material without use of an inner tubular. The tubular string 16 includes one or more ports or openings (discussed in more detail below) or is otherwise in fluid communication with the screen members 14 for enabling production of fluids filtered by the screen assembly 10.

[0015] It is evident to those of ordinary skill in the art from even a cursory review of the drawings that the screen assembly 10 differs from traditional screens, in which a filter is concentrically wrapped at least partially about a base pipe or other tubular to form a radial flow gap bounded between the screen and the tubular about

which the screen is wrapped. Instead of this traditional arrangement, the screen members 14 are arranged as discrete members that form discrete flow paths therein. By "discrete" it is meant that the screen members 14 each form a closed shape defining a flow path 18 therein that is separate from the other screen members 14 and from the tubular string 16. It is noted that a pattern formed by all of the screen members 14 may encircle the tubular string 16, but that the tubular string 16 is not enclosed within any individual one of the screen members 14. In this way, the flow paths 18 are discrete from and not defined by the tubular string 16. For example, the screen members 14 in Figure 2 are shown in a circular pattern, designated by a dashed line 20, surrounding the tubular string 16, but the tubular string 16 is not enclosed by any individual one of the screen members 14. Of course, screen members in other embodiments could be arranged according to other patterns. It is additionally to be recognized that the screen assembly 10 differs from traditional screens in that it includes a plurality of the discrete screen members 14 at a same longitudinal or axial position within the borehole 12 and/or along the length of the string 16.

[0016] Additionally, by being discrete members, each of the screen members 14 in the illustrated embodiment, and correspondingly each of the flow paths 18, is offset or nonconcentric with respect to the tubular string 16. It is also noted that despite the screen members 14 and the associated flow paths 18 each being nonconcentric with the tubular string 16, the pattern formed by discretely positioning the screen members 14 about the tubular string 16, may be concentric with respect to the tubular string 16. That is, for example, the pattern 20 in Figure 2 is circumferentially and concentrically positioned about the tubular string 16, while the axes of each of the screen members 14, e.g., an axis 22 of an exemplary one of the screen members 14, are each offset from an axis 24 of the tubular string 16.

[0017] The screen members 14 are coupled to the tubular string 16 via couplings 26, which have receptacles 28 configured to receive the screen members 14. The screen members 14 are engagable with the receptacles 28 via threads, ratcheting, grooves, force fitting, welds, etc., or in any other suitable manner. In one embodiment, the receptacles 28 are open on both ends for connecting adjacent ones of the screen members 14, while in other embodiments the receptacles 28 are capped off opposite to their securement with the screen members 14. For example, a representative one of the receptacles 28, designated with the numeral 28a, is secured at one end to a first representative one of the screen members 14, designated with the numeral 14a, and at the opposite end to a second representative one of the screen members, designated with the numeral 14b. Another representative one of the

receptacles 28, designated with the numeral 28b, has a capped end 30 for sealing off the flow path 18 through the receptacle 28b.

[0018] The screen members 14 can be arranged to create a gap 32 between each circumferentially adjacent pair of the screen members 14. In one embodiment, the gaps 32 provide fluid about the screen members 14. Traditional screens are typically spaced some minimum distance from the borehole wall in order to provide sufficient fluid flow into the screen, e.g., during production, and about the screen, e.g., during gravel packing, fracturing, or other borehole treatments or stimulations. Accordingly, in one embodiment, the fluid flow provided by the gaps 32 enables the screen members 14 to be positioned relatively closer to the borehole 12 than a traditional screen could be positioned, thereby enabling the borehole 12 to be more efficiently drilled with a smaller diameter. In another embodiment, the gaps 32 provide for the flow of fluid (e.g., proppant, slurry, injected chemicals, acid, etc.) past, around, or about the screen assembly 10, e.g., for gravel or frac packing, fracturing, or other treatment or stimulation operations.

[0019] Additionally, as shown in Figures 1 and 2, the gaps 32 can be utilized to house and/or protect a control line, cable, instrumentation line, etc. (generally "control line"). The control line can be a hydraulic control line, fiber optic cable, electrical signal conductor, etc., arranged for enabling signal and/or power communication to and/or from the downhole environment. For example, a control line 34a is shown located in one of the gaps 32 between an adjacent pair of the screen members 14 in Figures 1 and 2. The line 34a is generally maintained and protected within its corresponding one of the gaps 32 during run-in, completion, and production. Even though the line 34a is generally protected, it remains open to downhole fluids, thereby enabling borehole fluids and downhole operations to be monitored by the line 34a and/or via sensors attached thereto, if desired. As another example, a control line 34b is illustrated passing through one of the screen members 14, thereby providing protection to the control line 34b. A clip, adhesive, fastener, or other device or mechanism could be used for holding the control lines 34a and/or 34b in their respective areas.

[0020] It is also to be appreciated that the gaps 32 could be used for holding or providing for a shunt tube or other tool or piece of equipment to be located and/or passed by the screen assembly 10. Furthermore, ones of the screen members 14 could be used as shunt tubes to enable the conveyance of proppant, gravel, or slurry

downhole. In one embodiment, one or more of the screen members 14 is replaced by a similarly shaped and sized blank tubular (e.g., not including a filtering material, perforations, or other openings in its circumferential surface) that is receivable in the receptacles 28 of the couplings 26 (the blank tube generally resembling any one of the screen members 14 and thus sufficiently represented in the drawings, although it is understood that the blank tube or shunt tube could take other forms). For example, in one embodiment, the blank tubular is used as a shunt tube to convey slurry or proppant to the borehole 12 or as a protective conduit for housing control lines, sensors, or other equipment. For example, in one embodiment, the screen assembly 10 is modified such that seven of the screen members 14 are included as described above, while an eighth is replaced by a section of blank pipe for protecting control lines, enabling slurry or other media to be conveyed downhole, etc.

[0021] The screen members 14 of the embodiment of Figures 1 and 2 are shown having a circular cross-section. It is to of course be appreciated that the screen members 14 could take any other desired shape, e.g., polygonal, irregular, crescent or kidney-bean (e.g., to follow the contours of the tubular string 16), etc. It is also to be appreciated that the screen members 14 can be arranged in any desired pattern about the tubular string 16 and that they do not need to follow the circular pattern 20. Moreover, size of the gaps 32 and/or spacing between the screen members 14 does not need to be consistent. For example, the screen members 14 in Figures 1 and 2 are evenly, symmetrically, and/or regularly spaced about the circumference of the tubular string 16. In other embodiments, the spacing between adjacent ones of the screen members 14 could be irregular or inconsistent. In some embodiments the pattern formed by the screen members 14 is asymmetrical, i.e., the screen members 14 wrap around only a portion of the circumference of the tubular string 16, e.g., an assembly 36 in Figure 3 discussed below. The pattern formed by the members 14 can be concentrically or eccentrically included about the tubular string 16.

[0022] As noted above, the screen assembly 36 includes the screen members 14 arranged in an asymmetric pattern about the tubular string 16. By this it is meant that the screen members 14 of the assembly 36 are not evenly spaced and positioned about the tubular string 16, but instead are grouped together at one side of the tubular string 16. A coupling 38 is included for securing the screen members 14 of the assembly 36 to the string 16. The ends of the screen members 14 opposite from the coupling 38 are illustrated as being open, although it is to be appreciated that these ends would be connected into another coupling or screen member, capped off, etc. Additionally, the ends of the screen members 14 are shown tapered or having reduced diameter than the body of the screen members 14, which can assist

in securing the screen members 14 in the receptacles of the couplings 26 and/or 38. The tapered ends may be caused by the aforementioned inner tubulars or base pipes of the screen members 14, e.g., a base pipe 40, extending out from a filter portion 42 wrapped thereon. It is to of course be appreciated that the description of the assembly is generally application to those of the assembly 10 and that components and features of the assembly 36 can be used with or for the assembly 10, and vice versa.

[0023] As shown in cross-section in Figure 4, the coupling 38 is positioned with respect to one or more ports or openings 44 in the tubular string 16, thereby providing fluid communication between the flow paths 18 and an axial passage 46 of the string 16. The coupling 38 also includes a valve 48 having a valve member 50 that is movable within a valve chamber 52 in order to selectively enable fluid communication between the flow paths 18 and the axial passageway 46. In the illustrated embodiment, the valve member 50 is controlled hydraulically via a control line 54 in fluid communication with the chamber 52. That is, pressure can be communicated via the control line 54 to hold the valve member 50 in the closed configuration shown in Figure 4. Upon relieving the pressure in the control line 54, pressure from the downhole fluid entering the flow paths 18 through the screen members 14 will force the member 50 toward the line 54, uncovering or opening the ports 44 and enabling production of the fluid through the axial passageway 46 of the string 16. It is to be appreciated that the chamber 52 and the valve member 50 can be in communication with all of the screen members 14 of the assembly 36 (e.g., the member 50 resembling a sliding sleeve or arcuate member), selected ones or groups of the screen members 14, or each of the screen members 14 could be provided separately with a valve member (e.g., the member 50 being generally cylindrical in shape). It is additionally to be appreciated that a valve member, e.g., a sliding sleeve, can be positioned within the axial passage 46 in order to selectively enable fluid communication. Additionally, the valve member 50 or any other valve member can be actuated mechanically, e.g., via a shifting tool or spring, electrically, e.g., via a motor or electromagnet, or in any other manner known in the art or otherwise. In one embodiment, a sliding sleeve having a seat is provided to receive a ball or plug dropped downhole and shifted by pressuring against the plug and seat in order to selectively open the ports 44.

[0024] Figure 5 shows one of the couplings 26 without the rest of the screen assembly 10. From the view of Figure 5 it can be appreciated that one or more ports

56 in the couplings 26 can be positioned with respect to ports, e.g., the ports 44, in the string 16, similar to the coupling 38 in order to enable fluid communication between the flow paths 18 and the axial passageway 46. Additionally, a valve, for example, any of the valves discussed above with respect to the assembly 36, could be arranged with the coupling 26 to selectively enable fluid communication through the screen assembly 10. One of the ports 56 could be provided for each of the screen members 14, or multiple ones of the screen members 14 could be in fluid communication with single ones of the ports 56 via grooves or the like within the coupling 26.

[0025] Figure 6 illustrates a coupling 58 that also enables fluid communication between the flow paths 18 of the screen members 14 and the axial passageway 46 of the string 16. Specifically, the coupling 58 includes receptacles 60 adapted to receive the screen members 14 and that terminate in ports 62. The coupling 58 can be secured between two sections of the string 16, e.g., at an end 64 (and an opposite end, hidden from view behind the receptacles 60), such that the ports 62 open directly into axial passageway 46 of the string 16. The end 64 could be threaded, force fit, welded, or secured to the string 16 in some other manner. Alternatively, the ports 62 could be aligned with ports in the string 16, e.g., resembling the ports 44.

[0026] With knowledge that the filterable surface area of a cylindrical screen is measured as pi times diameter times length, the total filterable surface area of the screen members 14 of the assembly 10 can be set to equal or approximate that of a traditional screen of a given length by modifying the number and diameter of the screen members 14. For example, there are eight of the screen members 14 in the illustrated embodiments, thus, by setting the diameter of each of the screen members 14 to be one-eighth that of a traditional screen, the total filterable surface area of the screen assembly 10 would approximate that of the tradition screen, assuming constant length. In this way, for example, eight of the screen members 14, each having a one inch diameter, would approximate the same total filterable surface area as a traditional screen eight inches in diameter having the same length. Of course, any other number of the screen members 14 and/or diameters of the screen members 14 could be utilized and the size of screen members in the same assembly could also vary.

[0027] While the invention has been described with reference to an exemplary embodiment or embodiments, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the scope of the invention. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the invention without departing

from the essential scope thereof. Therefore, it is intended that the invention not be limited to the particular embodiment disclosed as the best mode contemplated for carrying out this invention, but that the invention will include all embodiments falling within the scope of the claims. Also, in the drawings and the description, there have been disclosed exemplary embodiments of the invention and, although specific terms may have been employed, they are unless otherwise stated used in a generic and descriptive sense only and not for purposes of limitation, the scope of the invention therefore not being so limited. Moreover, the use of the terms first, second, etc. do not denote any order or importance, but rather the terms first, second, etc. are used to distinguish one element from another. Furthermore, the use of the terms a, an, etc. do not denote a limitation of quantity, but rather denote the presence of at least one of the referenced item.

CLAIMS

What is claimed is:

1. A screen assembly, comprising:

one or more screen members that correspondingly form one or more flow paths, the one or more flow paths discrete from a tubular with which the one or more screen members are associated, but in fluid communication with an axial passageway of the tubular.

2. The screen assembly of claim 1, wherein the one or more screen members includes a plurality of screen members arranged in a symmetric pattern about the tubular.

3. The screen assembly of claim 1, wherein the one or more screen members includes a plurality of screen members arranged in an asymmetric pattern about the tubular.

4. The screen assembly of claim 1, wherein the fluid communication is provided by a port in the tubular.

5. The screen assembly of claim 4, further comprising a valve that selectively enables the fluid communication.

6. The screen assembly of claim 5, wherein the valve is hydraulically actuated.

7. The screen assembly of claim 1, further comprising one or more couplings configured for mounting the one or more screen members to tubular.

8. The screen assembly of claim 7, wherein the one or more couplings includes one or more receptacles corresponding to and separately receiving each of the one or more screen members.

9. The screen assembly of claim 8, further comprising a blank tube, wherein the one or more receptacles includes a plurality of receptacles at least one of which receives the blank tube.

10. The screen assembly of claim 9, wherein the blank tube is a shunt tube.

11. The screen assembly of claim 7, wherein the one or more couplings includes a port opening into the axial passageway of the tubular.

12. The screen assembly of claim 1, further comprising a control line.

13. The screen assembly of claim 12, wherein the control line is located through at least one of the one or more screen members.

14. The screen assembly of claim 12, wherein the control line is located in at least one of one or more gaps located adjacent to the one or more screen members.

15. The screen assembly of claim 1, wherein the one or more screen members includes a base pipe surrounded by a filter portion.

16. The screen assembly of claim 1, wherein the screen assembly is positioned within a borehole for enabling the production of fluids from the borehole.

17. A screen assembly, comprising:

a plurality of screen members arranged at a same longitudinal position along a tubular, each of the screen members having a discrete closed shape that forms one of a plurality of discrete flow paths corresponding to the plurality of screen members.

18. A method of using a screen assembly, comprising:

positioning the screen assembly in a borehole, the screen assembly having one or more screen members discretely arranged with respect to a tubular having an axial passageway, the one or more screen members correspondingly forming one or more flow paths that are discrete from the tubular; and

communicating fluid through the one or more screen members to the axial passageway via the one or more flow paths.

19. The method of claim 18, wherein the communicating includes selectively opening a valve disposed between the one or more flow paths and he axial passageway of the tubular.

20. The method of claim 19, wherein the communicating includes gravel packing, frac packing, hydraulic fracturing, stimulation of the borehole, treatment of the borehole, or a combination including at least one of the foregoing.

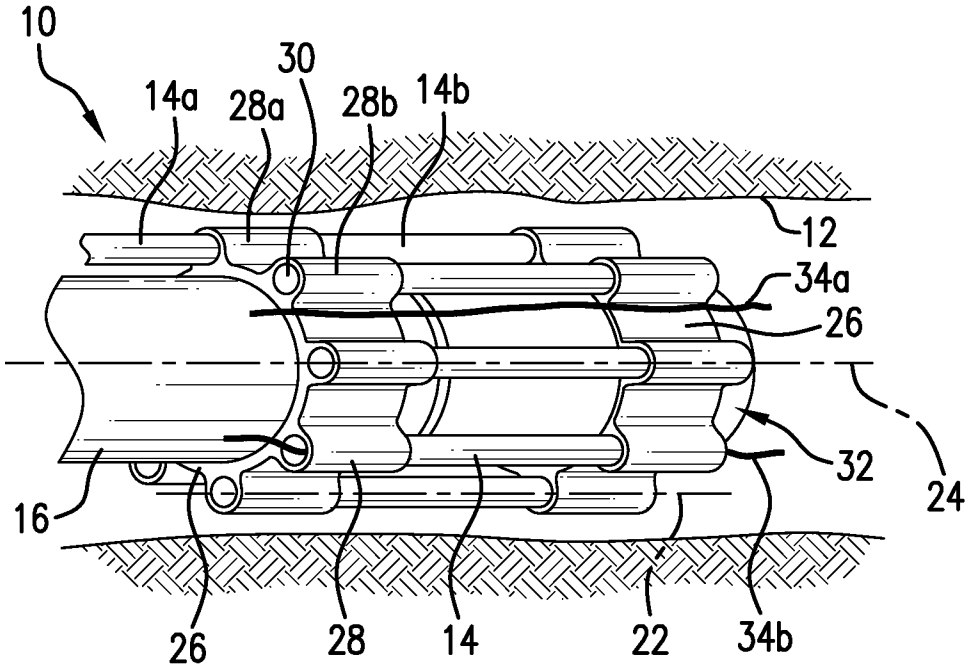


FIG.1

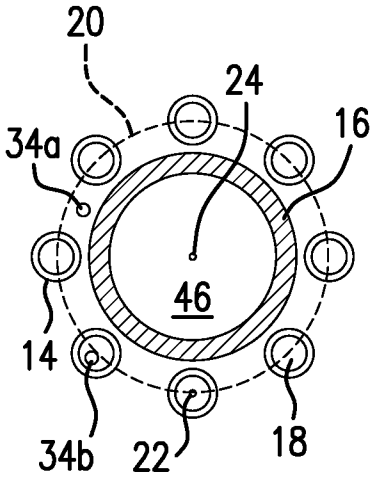


FIG.2

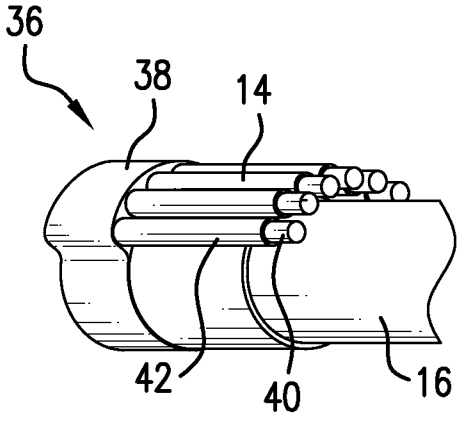


FIG.3

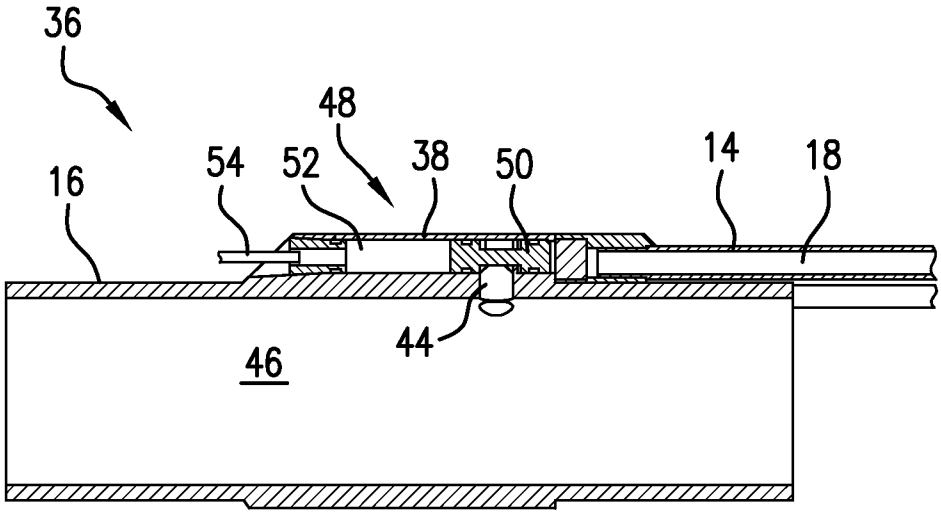


FIG.4

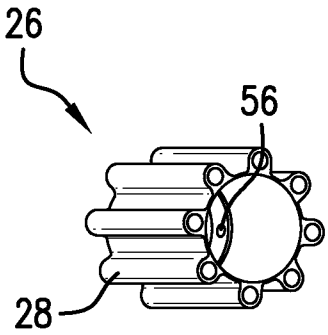


FIG.5

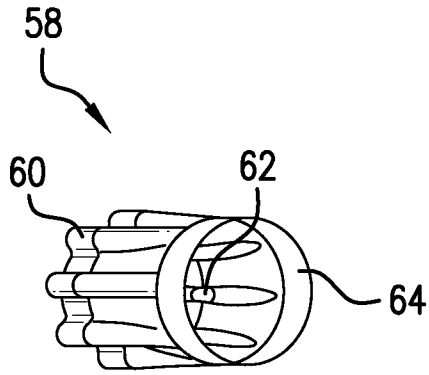


FIG.6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2014/031940

A. CLASSIFICATION OF SUBJECT MATTER

E21B 43/08(2006.01)i, E21B 43/10(2006.01)i, E03B 3/18(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 43/08; E21B 43/12; F16K 17/00; E03B 3/18; E21B 43/00; B21D 39/03; E21B 43/10

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: screen, flow path, tubular, valve, coupling, and control line

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2011-0036565 A1 (HOLDERMAN et al.) 17 February 2011 See abstract, paragraphs [0045]-[0055], and figures 2-5B.	1-4,7-8,11-18
Y		5-6,9-10,19-20
Y	US 2011-0011586 A1 (DUSTERHOFT et al.) 20 January 2011 See abstract, paragraphs [0061],[0069]-[0072], and figures 4A,6.	5-6,19-20
Y	US 2009-0008084 A1 (DYBEVIK et al.) 08 January 2009 See abstract, paragraphs [0033],[0035], and figures 1,5.	9-10
A	US 2011-0042096 A1 (NUTLEY et al.) 24 February 2011 See abstract, paragraphs [0082]-[0087], and figures 1-3.	1-20
A	US 2012-0227823 A1 (VEIT, JAN) 13 September 2012 See abstract, paragraphs [0026]-[0028], and figures 1-2E.	1-20

☐ 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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"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
11 July 2014 (11.07.2014)	**14 July 2014 (14.07.2014)**

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. +82-42-472-7140

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

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/US2014/031940

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