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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))

[Continued on next page]

(54) Title: COMPLETION TOOL, STRING COMPLETION SYSTEM, AND METHOD OF COMPLETING A WELL

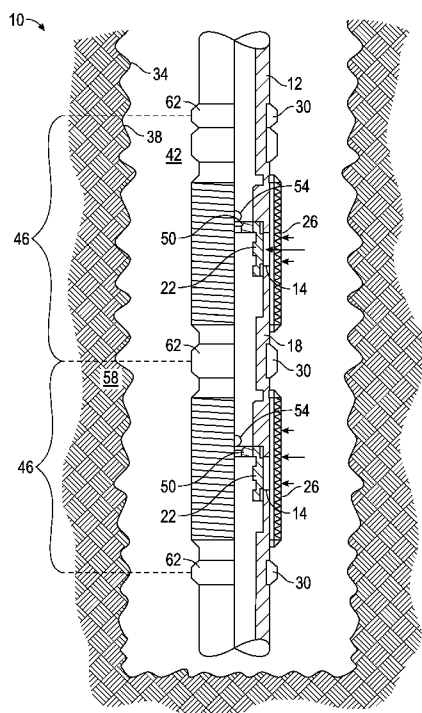


FIG. 1

(57) Abstract: A completion system includes, a tool string having, a plural-
ity of packers configured to isolate a plurality of zones along a borehole that
the tool string is positioned within. A plurality of ports along the tool string
are configured to be selectively opened and a plurality of screens in operable
communication with the plurality of ports are configured to filter fluid flow-
ing between the zones and an inside of the tool string through the plurality of
ports. The tool string is also configured to be run into the borehole, the plur-
ality of packers set, the plurality of ports selectively opened, and fluid to
flow between the plurality of zones and an inside of the tool string without
intervention.



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- *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*
- Published:**
- *with international search report (Art. 21(3))*

COMPLETION TOOL, STRING COMPLETION SYSTEM, AND METHOD OF COMPLETING A WELL

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Application No. 14/332955 filed on July 16, 2014, which is incorporated herein by reference in its entirety.

BACKGROUND

[0002] Completing a well is typically a time consuming project that requires many steps. Some of these steps include setting packers, shifting valves, treating zones of a formation, packing gravel, and cementing annular spaces, for example. Most of these steps involve running one or more tools into the borehole. These interventions consume resources and extend the time before production can begin. As such, those that work in the industry are always interested in systems and methods that improve efficiency of their operations.

BRIEF DESCRIPTION

[0003] Disclosed herein is a completion system. The system includes, a tool string having, a plurality of packers configured to isolate a plurality of zones along a borehole that the tool string is positioned within. A plurality of ports along the tool string are configured to be selectively opened and a plurality of screens in operable communication with the plurality of ports are configured to filter fluid flowing between the zones and an inside of the tool string through the plurality of ports. The tool string is also configured to be run into the borehole, the plurality of packers set, the plurality of ports selectively opened, and fluid to flow between the plurality of zones and an inside of the tool string without intervention.

[0004] Further disclosed herein is a method of completing a well. The method includes, running a tool string into a borehole, isolating a plurality of zones along the borehole with the tool string, selectively opening ports in the tool string, establishing fluidic communication between an inside of the tool string and the plurality of zones through the selectively opened ports, and flowing fluid between the plurality of zones and an inside of the tool string through the opened ports all without intervention.

[0005] Further disclosed herein is a completion tool string. The completion tool string includes, a tubular having: a plurality of ports therethrough, a sleeve in operable communication with each of the plurality of ports configured to at least either occlude or allow fluid flow through the port the sleeve is in operable communication depending upon a

position of the sleeve, a screen in operable communication with each of the plurality of ports configured to filter fluid flowing through the port the screen is in operable communication with, and a plurality of packers in operable communication with the tubular configured to sealingly separate annular spaces defined between the tubular and a borehole the completion string is positionable within into separate zones.

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] FIG. 1 depicts a quarter cross sectional view of a completion tool string disclosed herein; and

[0008] FIG. 2 depicts a quarter cross sectional view of an alternate completion tool string disclosed herein.

DETAILED DESCRIPTION

[0009] 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.

[0010] Referring to Figure 1, an embodiment of a completion tool string disclosed herein is illustrated at 10. The completion tool string 10 includes a tubular 12 having a plurality of ports 14 through walls 18 thereof. Sleeves 22 are in operable communication with the ports 14 to occlude or allow flow through the ports 14 that each of the sleeves 22 is in communication with depending upon a position of the sleeve 22. Screens 26 are also in operable communication with the ports 14 and are configured to filter fluid flowing through the ports 14 regardless of direction of fluid flow through the ports 14. The screens 26 are initially positioned relative to the ports 14 in one embodiment to filter fluid that flows through the ports 14 without requiring movement of or changes to the screens 26. A plurality of packers 30 are in operable communication with the tubular 12 and configured to sealingly engage the tubular 12 to walls 34 of a borehole 38 within which the tubular 12 is positionable. As such, the packers 30 separate an annular space 42 defined between the tubular 12 and the walls 34 into zones 46 that are longitudinally separated from one another.

[0011] In one embodiment the completion tool string 10 includes a plug seat 50 connected to each of the sleeves 22. As such, plugs 54, shown as balls in the illustrations, can be run through the tubular 12 and selectively or sequentially sealed to each of the seats

50. Once one of the plugs 54 is seated pressure within the tubular 12 can be built against the plug 54 to urge the sleeve 22 to move. In this embodiment the sleeve 22 moves from a position that initially occludes the ports 14 associated therewith to a position that allows flow through the ports 14 associated therewith. The sequencing of seating the plugs 54 can be achieved by positioning the seats 50 pluggable by smaller of the plugs 54 further down the tubular 12 than the larger seats 50. As such, the seats 50 can be sequentially plugged by plugs 54 with ever increasing sizes.

[0012] Once one of the ports 14 is open a formation 58 in one of the zones 46 in fluidic communication with the open port 14 can be treated or produced from. The completion tool string 10 allows all of the foregoing to be carried out with a single run of the tool string 10 into the borehole 38 with no intervention therewithin. Treatments of the formation 58 can include one or more of several possible treatments such as, acid treating or fracturing, for example. Regardless of whether the formation 58 is being treated or fluid is being produced therefrom fluid flowing through the open ports 14 will also flow through the screen 26 in association with the open ports 14 filtering the fluid in the process.

[0013] The setting of the packers 30, to isolate the zones 46 from one another, can be done in a few different ways. For example, the packers 30 can employ swellable members 62 that swell in response to exposure to a target environment. One target environment can be fluids anticipated to be present in the borehole 38 the tubular 12 will be positioned within. In applications where in the borehole 38 is in an open hole of the earth formation 58 such fluid can be oil, water, brine, acid and gas, or combinations of these, for example. As such, the packers 30 would essentially be self-setting in that no additional steps need to be taken beyond positioning the tool string 10 into the borehole 38. Another way to set the packers 30 could be via control lines (not shown) that supply pressurized fluid actuators disposed at each of the packers 30, for example. Alternately the full tool string 10 can be pressured up (i.e. without requiring one of the plugs 54), to set the packers 30. Still other embodiments could use hydrostatic pressure within the borehole 38 to set the packers 30. Referring to Figure 2, an alternate embodiment of a completion tool string disclosed herein is illustrated at 110. The tool string 110 has similarities to the tool string 10 and as such primarily the differences between the two will be discussed hereunder. Like the tool string 10 the tool string 110 includes the ports 14 through a tubular 112 that are coverable by the movable sleeves 22. And the sleeves 22 are movable in response to pressure built against the plugs 54 sealed on the seats 50. The tool string 110 differs in that not all of the screens 26A and 26B have the ports 14 positioned longitudinally adjacent thereof. Instead, a passageway 116 runs through

the tubular 112 thereby fluidically connecting a longitudinally displaced one of the screens 26B to the ports 14. Such an arrangement allows for fluid flow between more than one of the screens 26A, 26B for each one of the ports 14. This allows for a reduction in the number of the sleeves 22 and the ports 14 that are required in comparison to the number of the screens 26A, 26B that are employed.

[0014] 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:

1. A completion system, characterized by:
a tool string 10 having;
a plurality of packers 30 configured to isolate a plurality of zones 46 along a borehole 38 the tool string 10 is positioned within;
a plurality of ports 14 along the tool string 10 configured to be selectively opened;
and
a plurality of screens 26 in operable communication with the plurality of ports 14 configured to filter fluid flowing between the zones 46 and an inside of the tool string 10 through the plurality of ports 14, the tool string 10 being configured to be run into the borehole 38, the plurality of packers 30 set, the plurality of ports 14 selectively opened, and fluid to flow between the plurality of zones 46 and an inside of the tool string 10 without intervention.
2. The completion system of claim 1, wherein the plurality of packers 30 are self-setting.
3. The completion system of claim 1, wherein the plurality of packers 30 set by swelling a member into engagement with walls of the borehole 38.
4. The completion system of claim 1, wherein the plurality of ports 14 have sleeves 22 a position of which determines whether a port 14 associated with a sleeve 22 is open or closed.
5. The completion system of claim 4, wherein the sleeves 22 are movable from closed to open in response to pressuring up within the tool string 10.
6. The completion system of claim 5, wherein the pressuring up is against a plug 54 selectively positioned at the sleeves 22.
7. The completion system of claim 1, wherein screens 26 filter fluid flowable through the plurality of ports 14.
8. The completion system of claim 1, wherein flow through more than one of the plurality of screens 26 flows through ports 14 opened by one of the plurality of sleeves 22.
9. The completion system of claim 1, wherein each of the plurality of screens 26 is in operable communication with one of the plurality of sleeves 22.
10. The completion system of claim 1, wherein the tool string 10 is configured to complete within an open borehole 38.
11. The completion system of claim 1, wherein the completion system is configured to selectively treat formations in the zones 46.

12. The completion system of claim 1, wherein the formation treatment includes acid treating and fracturing.

13. The completion system of claim 1, wherein the plurality of packers 30 are set by hydrostatic pressure.

14. The completion system of claim 1, wherein the plurality of screens 26 are initially positioned to filter fluid that flows through the plurality of ports 14.

15. A method of completing a well, characterized by:
running a tool string 10 into a borehole 38;
isolating a plurality of zones 46 along the borehole 38 with the tool string 10;
selectively opening ports 14 in the tool string 10;
establishing fluidic communication between an inside of the tool string 10 and the plurality of zones 46 through the selectively opened ports 14; and
flowing fluid between the plurality of zones 46 and an inside of the tool string 10 through the opened ports 14 all without interventions.

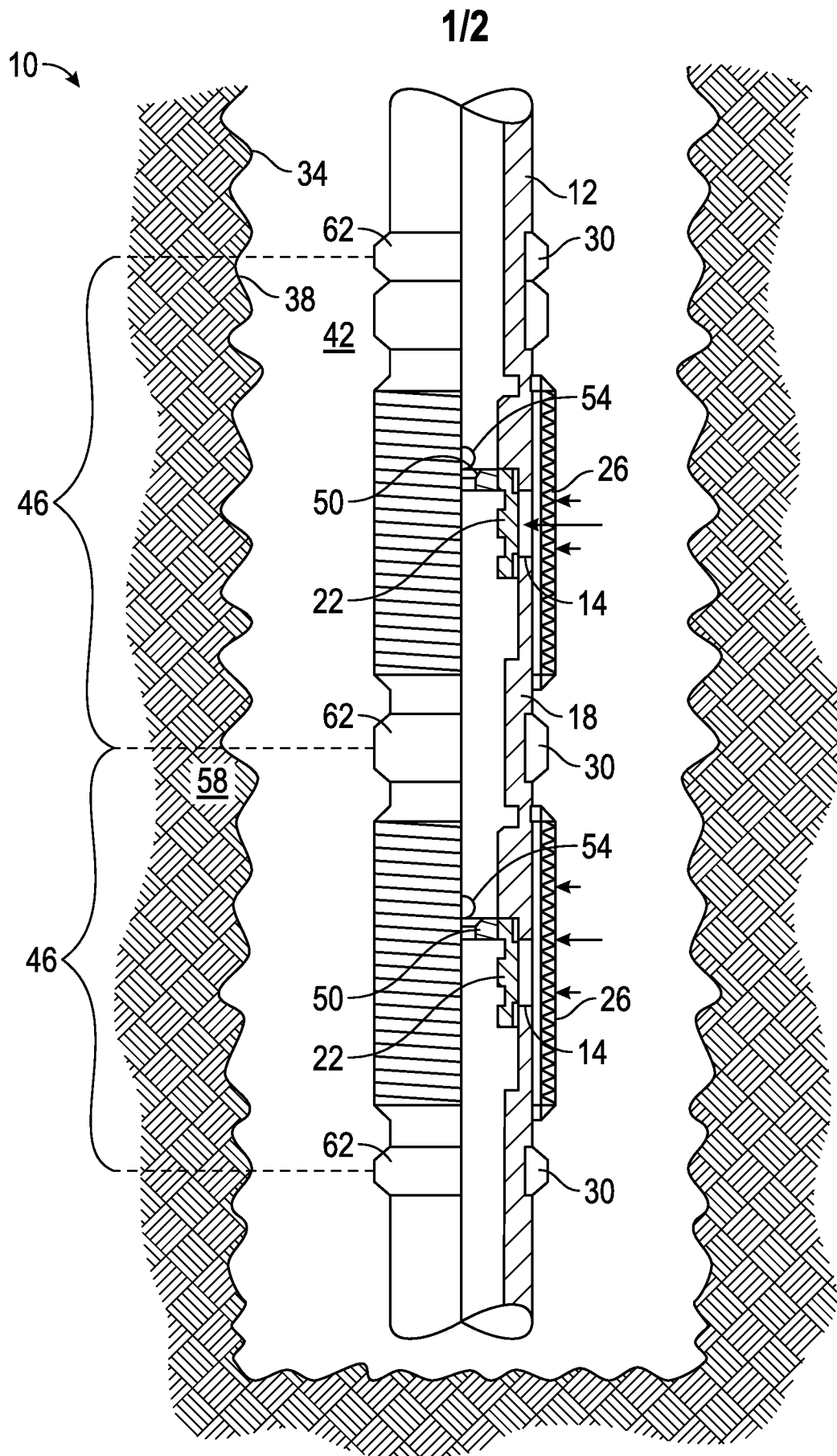


FIG. 1

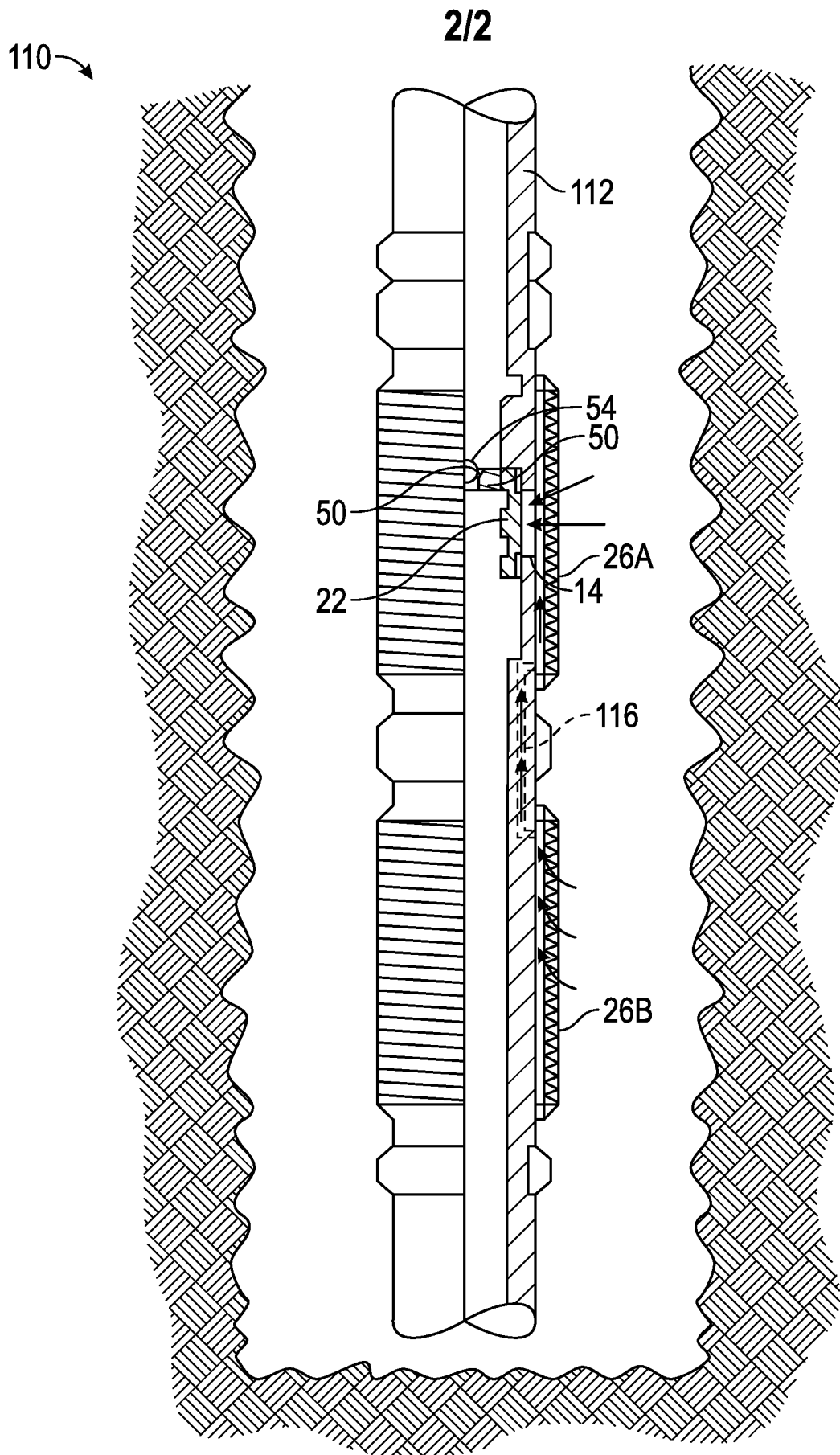


FIG. 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2015/035533**A. CLASSIFICATION OF SUBJECT MATTER****E21B 17/00(2006.01)i, E21B 17/18(2006.01)i, E21B 43/08(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 17/00; E21B 43/04; E21B 43/00; E21B 33/124; E21B 33/12; B32B 37/02; E21B 17/18; E21B 43/08

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: completion, string, packer, borehole, port, screen, sleeve, hydrostatic pressure

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2002-0079099 A1 (HURST et al.) 27 June 2002 See abstract, paragraphs [0023], [0035], [0046], claims 1, 16, 37, 38, 43, and figure 4.	1,2,4,7-10,14,15
Y		3,5,6,11-13
Y	WO 2008-051250 A2 (HALLIBURTON ENERGY SERVICES, INC.) 02 May 2008 See abstract, claim 1, and figure 3.	3
Y	US 6619397 B2 (COON et al.) 16 September 2003 See abstract, column 2, lines 52-56, and figure 1.	5,6
Y	US 4372384 A (KINNEY, CHARLES W.) 08 February 1983 See abstract, column 6, lines 15-19, claim 13, and figure 1.	11,12
Y	US 7681651 B2 (LOUGHLIN, MICHAEL J.) 23 March 2010 See abstract and claim 9.	13

☐ 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

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Date of mailing of the international search report

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2015/035533

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