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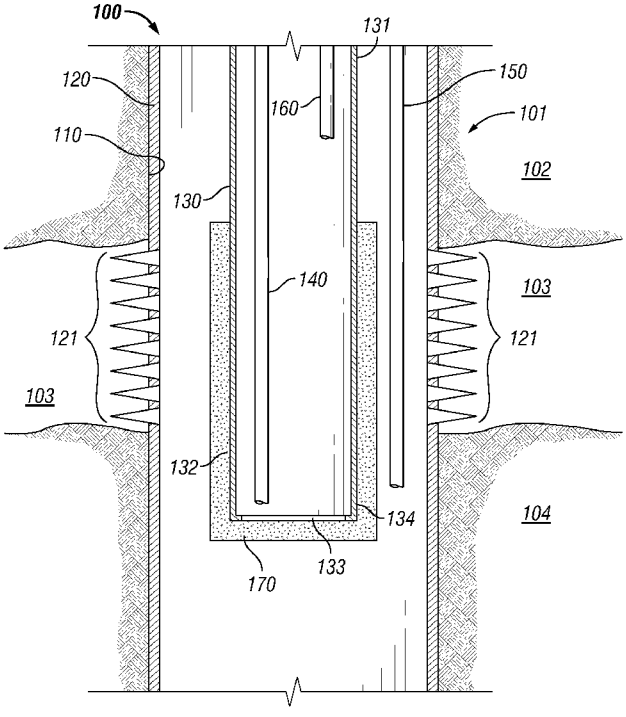
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(54) **Title**: INJECTOR FILL DISPLACEMENT TUBES

FIG. 1



(57) **Abstract**: A well bore system comprising: a well bore (110); a tubular (130) disposed within the well bore (110), wherein the tubular (130) and the well bore (110) define an annulus; a first conduit (140) disposed within the tubular (130); and a second conduit (160) disposed within the annulus and associated methods.

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INJECTOR FILL DISPLACEMENT TUBES

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Application No. 62/019,573, filed July 1, 2014, which is incorporated herein by reference.

BACKGROUND

[0002] The present disclosure relates generally to injector fill displacement tubes. More specifically, in certain embodiments, the present disclosure relates to systems for removing formation sands from well bore systems utilizing injector fill displacement tubes and associated methods.

[0003] Many deepwater waterflood injection wells feature unconsolidated sand reservoirs. These injector wells are often vertical wells, completed with frac & pack technology, and operated at bottom-hole injection pressures larger than the minimum in situ stress. It has been observed that operating these waterflood injectors at fracturing conditions may lead to a loss of the gravel pack sand from the annulus.

[0004] There are several mechanisms that contribute to the loss of the gravel pack sand from the annulus. In some instances, when the injection ceases, reservoir sand may enter the well bore due to well bore storage and cross flow phenomena. In certain instances, gravel in the well bore may be pumped away under fracturing conditions and fluid cross-flow between layers in the completion interval during shut-in may bring in formation sand into the annulus. In addition, since the screens may be designed to filter the gravel pack sand rather than the formation sand, a portion of the formation sand may enter the base pipe of the screen. Once sand enters the base pipe of the screen it may be difficult to remove. The process of pumping away the gravel and filling the well bore with formation sand during shut-ins impacts well injectivity, flow conformance, and can lead to well failures.

[0005] Conventional methods of restoring injection caused by the formation plugging the screen require an intervention. Well intervention with a coil tubing unit is typically used to wash out the well inside the screen. In some cases it may be necessarily to pull and then reinstall the completion in order to wash out the well.

[0006] It is desirable to develop a well bore system better capable of re-establishing injectivity following a shut-in period. It is also desirable to develop a method of unloading formation sands deposited in the well bore, the annular space between the screen and the well bore, and inside the screen to re-establish well injectivity that do not require an intervention.

SUMMARY

[0007] The present disclosure relates generally to injector fill displacement tubes. More specifically, in certain embodiments, the present disclosure relates to systems for removing formation sands from well bore systems utilizing injector fill displacement tubes and associated methods.

[0008] In one embodiment, the present disclosure provides a well bore system comprising: a well bore; a tubular disposed within the well bore, wherein the tubular and the well bore define an annulus; a first conduit disposed within the tubular; and a second conduit disposed within the annulus.

[0009] In another embodiment, the present disclosure provides a well bore system comprising: a well bore; a casing lining the well bore; a tubular disposed within the casing, wherein the tubular and casing define an annulus; a first conduit disposed within the tubular; and a second conduit disposed within the annulus.

[0010] In another embodiment, the present disclosure provides a method comprising: providing a well bore system, wherein the well bore system comprises a well bore; a tubular disposed within the well bore, wherein the tubular and the well bore define an annulus; a first conduit disposed within the tubular; and a second conduit disposed within the annulus; and injecting water into the well bore system.

[0011] In another embodiment, the present disclosure provides a method comprising: providing a well bore system, wherein the well bore system comprises a well bore; a casing lining the well bore; a tubular disposed within the casing, wherein the tubular and casing define an annulus; a first conduit disposed within the tubular; and a second conduit disposed within the annulus; and injecting water into the well bore system.

[0012] In another embodiment, the present disclosure provides a method comprising: providing a well bore system; allowing formation sand to enter the wellbore system; and unloading the formation sand from the well bore system.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] A more complete and thorough understanding of the present embodiments and advantages thereof may be acquired by referring to the following description taken in conjunction with the accompanying drawings.

[0014] Figure 1 is an illustration of a well bore system in accordance with certain embodiments of the present disclosure.

[0015] Figure 2 is an illustration of a well bore system in accordance with certain

embodiments of the present disclosure.

[0016] The features and advantages of the present disclosure will be readily apparent to those skilled in the art. While numerous changes may be made by those skilled in the art, such changes are within the spirit of the disclosure.

DETAILED DESCRIPTION

[0017] The description that follows includes exemplary apparatuses, methods, techniques, and/or 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.

[0018] The present disclosure relates generally to injector fill displacement tubes. More specifically, in certain embodiments, the present disclosure relates to systems for removing formation sands from well bore systems utilizing injector fill displacement tubes and associated methods.

[0019] In certain embodiments, the injector fill displacement tubes of the present disclosure may help unload formation sand that is deposited in the well bore, the annular space between the screen and well bore, and inside the screen. In certain embodiments, the formation sand may have been deposited by the transient or dynamic flow and cross flows through differentially pressure charged (a) layers in a completion interval, (b) reservoirs completely separated (as commingled or selective) in the same well bore, and (c) wells tied to the same flow line that occurs during the shutdown of the injection pressure.

[0020] One difference between the methods and systems of the present disclosure and conventional methods and systems is that the injector fill displacement tubes discussed herein may be permanently installed when the well is completed and thus an intervention may not be required to operate them.

[0021] In certain embodiments, the present disclosure provides a method of applying the pressure and flow rate required to fluidize the material that may be clogging the well and wash it back out of the perforations, thus clearing the conventional path for the injection water. It certain embodiments, the methods and systems described in the present disclosure provide an unblocked pathway or conduit that will run with the original completion and used only when the much larger conventional pathway is blocked.

[0022] Referring now to Figure 1, Figure 1 illustrates a well bore system 100 in accordance with certain embodiments of the present disclosure. Well bore system 100 may comprise any type of well bore system. In certain embodiments, well bore system 100 may

be an on shore or offshore well bore system. In certain embodiments well bore system 100 may comprise well bore 110, casing 120, tubular 130, first conduit 140, and second conduit 150.

[0023] In certain embodiments, well bore 110 may be any type of well bore. In certain embodiments, well bore 110 may a vertical well bore, a horizontal well bore, or a well bore of any angle. In certain embodiments, well bore 110 may be a cased well bore or an open hole well bore. In certain embodiments, well bore 110 may penetrate a subterranean formation 101. In certain embodiments, subterranean formation 101 may comprise a first zone 102, a second zone 103, and a third zone 104. In certain embodiments, first zone 102, second zone 103, and third zone 104 may have different formations characteristics. For example, in certain embodiments, second zone 103 may have a permeability less than or greater than first zone 102 and/or third zone 104. In certain embodiments, first zone 102 may have a permeability less than or greater than or equal to third zone 104.

[0024] In certain embodiments, casing 120 may line well bore 110. In other embodiments, there may be no casing. In certain embodiments, casing 120 may be constructed out of any conventional casing materials. In certain embodiments, casing 120 may be 7 and 3/8" in diameter. In certain embodiments, casing 120 may comprise a plurality of perforations 121. In certain embodiments, the plurality of perforations 121 may each be in a located in a single zone of the subterranean formation or located in multiples zones.

[0025] In certain embodiments, tubular 130 may be disposed within well bore 110 and/or casing 120. In certain embodiments, tubular 130 and well bore 110 and/or casing 120 may define an annulus. In certain embodiments, tubular 130 may comprise any conventional tubular material. In certain embodiments, tubular 130 may be 4" in diameter. In certain embodiments, tubular 130 may comprise bottom a top portion 131 and a bottom portion 132 with an opening 133. In certain embodiments, bottom portion 132 may comprise screen 134. In other embodiments, opening 133 may be covered by screen 134. In certain embodiments screen 134 may comprise any conventional screen materials. In certain embodiments, screen 134 may be capable of preventing gravel pack sand from a gravel pack to enter into tubular 130 while permitting formation fluids to enter into tubular 130. In certain embodiments, screen 134 may be replaced with a filter element or other device capable of preventing gravel pack sand from a gravel pack to enter into tubular 130.

[0026] In certain embodiments, first conduit 140 may be disposed within tubular 130. In certain embodiments, first conduit 140 and tubular 130 may define an annulus. In certain embodiments, first conduit 140 may be an injector fill displacement tube. In certain embodiments first conduit 140 may be constructed out of any conventional injector fill displacement tube materials.

[0027] In certain embodiments, first conduit 140 may facilitate the injection of water into the bottom portion 132 of tubular 130. In certain embodiments, first conduit 140 may facilitate the unloading of formation sands from tubular 130 via bottom portion 132 and/or screen 134.

[0028] In certain embodiments, second conduit 150 may be disposed within the annulus defined by well bore 110 and/or casing 120 and tubular 130. In certain embodiments, second conduit 150 may be an injector fill displacement tube. In certain embodiments second conduit 150 may be may be constructed out of any conventional injector fill displacement tube materials.

[0029] In certain embodiments, second conduit 150 may facilitate the injection of water into the annulus defined by tubular 130 and casing 120. In certain embodiments, second conduit 150 may facilitate the unloading formations sands from the annulus defined by tubular 130 and casing 120.

[0030] In certain embodiments, well bore system 100 may comprise injection port 160. In certain embodiments, injection port 160 may be disposed within the annulus defined by first conduit 140 and tubular 130. In certain embodiments, injection port 160 may facilitate the injection of water into the annulus defined by conduit 140 and tubular 130. In certain embodiments, injection port 160 may be an injector fill displacement tube.

[0031] In certain embodiments, first conduit 140, second conduit 150, and injection port 160 may each be connected to single flow line (not illustrated in Figure 1) to allow for simultaneous injection of fluid into first conduit 140, second conduit 150, and injection port 160. In other embodiments, each of first conduit 140, second conduit 150, and injection port 160 may be connected to separate flow lines (not illustrated in Figure 1) to allow for separate, simultaneous, or sequential injection of fluid into first conduit 140, second conduit 150, and injection port 160.

[0032] In certain embodiments, well bore system 100 may further comprise a gravel pack 170. In certain embodiments, gravel pack 170 may comprise a high rate water pack (HRWP) or frac and pack (FP). In certain embodiments, gravel pack 170 may be

disposed in the annulus defined by the tubular 130 and casing 120 and/or well bore 110. In certain embodiments, gravel pack 170 may surround tubular 130.

[0033] Referring now to Figure 2, Figure 2 illustrates a well bore system 200 in accordance with certain embodiments of the present disclosure. In certain embodiments, well bore system 200 may comprise any combination of characteristics discussed above with respect to well bore system 100. In certain embodiments well bore system 200 may comprise well bore 210, tubular 230, first conduit 240, and second conduit 250. In certain embodiments, not illustrated in Figure 2, well bore system 200 may comprise a casing lining well bore 210.

[0034] In certain embodiments, well bore 210 may share any combination of characteristics discussed above with respect to well bore 110. In certain embodiments, well bore 210 may comprise a plurality of perforations 211. In certain embodiments, well bore 210 may comprise multiple pluralities of perforations 211. In certain embodiments, perforations 211 may share any combination of characteristics discussed above with respect to perforations 111.

[0035] In certain embodiments, tubular 230 may share any combination of characteristics discussed above with respect to tubular 130. In certain embodiments, tubular 230 may comprise one or more screens 234. For example, in certain embodiments, tubular 230 may comprise one, two, three, four, or more screens 234. In certain embodiments, each of the screens 234 may share any combination of characteristics discussed above with respect to screen 134. In certain embodiments, the one or more screens 234 may be disposed on tubular 230 adjacent to the one more perforations 211.

[0036] In certain embodiments, well bore system 200 may comprise one or more gravel packs 270. Gravel packs 270 may comprise any combination of characteristics discussed above with respect to gravel pack 170. In certain embodiments, each of gravel pack 270 may surround tubular 230. In certain embodiments, the one or more gravel packs 270 may cover the one or more screens 234. In certain embodiments, the one or more gravel packs 270 may be adjacent to the one or more perforations 211.

[0037] In certain embodiments, first conduit 240 may share any combination of characteristics discussed above with respect to first conduit 140. In certain embodiments, first conduit 240 may comprise one or more branches 241, one or more openings 243, and one or more check valves 242. As shown in Figure 2, in certain embodiments first conduit 240 may comprise three branches 241. In certain embodiments, first conduit 240 may be

disposed within tubular 230.

[0038] In certain embodiments, the one or more check valves 242 of the one or more branches 241 may allow for the one way flow of fluids through the one or more branches 241. In other embodiments, the one or more check valves 242 may allow for flow both in and out conduit 240 via opening 243. In certain embodiments, each of the openings 243 of the one or more branches 241 may be adjacent to the one or more screens 234 and gravel packs 270. In certain embodiments, each of check valves 242 may be operated to allow the flow to a specific branch 241. In other embodiments, each of check valves 242 may be operated to allow for the separate, simultaneous, or sequential injection of fluid into each of the branches 241.

[0039] In certain embodiments, first conduit 240 may facilitate the unloading of formation sands from tubular 230 via the one or more screens 234.

[0040] In certain embodiments, second conduit 250 may share any combination of characteristics discussed above with respect to second conduit 150. In certain embodiments, second conduit 250 may comprise one or more branches 251, one or more openings 253, and one or more check valves 252. As shown in Figure 2, in certain embodiments second conduit 250 may comprise three branches 251.

[0041] In certain embodiments, the one or more check valves 252 of the one or more branches 251 may allow for the one way flow of fluids through the one or more branches 251. In other embodiments, the one or more check valves 252 may allow for flow both in and out conduit 250 via opening 253. In certain embodiments, each of the openings 253 of the one or more branches 251 may be adjacent to the one or more screens 234 and gravel packs 270. In certain embodiments, each of check valves 252 may be operated to allow the flow to a specific branch 251. In other embodiments, each of check valves 242 may be operated to allow for the separate, simultaneous, or sequential injection of fluid into each of the branches 241.

[0042] In certain embodiments, second conduit 250 may be disposed within the annulus defined by well bore 210 and tubular 230. In certain embodiments, second conduit 250 may facilitate the injection of water into the annulus defined by tubular 230 and wellbore 210. In certain embodiments, second conduit 250 may facilitate the unloading formations sands from the annulus defined by tubular 230 and casing 210 via perforations 211.

[0043] In certain embodiments, first conduit 240 and second conduit 250 may be

connected to single flow line (not illustrated in Figure 2) to allow for simultaneous injection of fluid into first conduit 240 and second conduit 250. In other embodiments, each of first conduit 240 and second conduit 250 may be connected to separate flow lines (not illustrated in Figure 2) to allow for separate or simultaneous injection of fluid into first conduit 240 and second conduit 250.

[0044] In certain embodiments, the present disclosure provides a method comprising: providing a well bore system, wherein the well bore system comprise a well bore; a tubular disposed within the wellbore, wherein the tubular and wellbore define an annulus; a first conduit disposed within the tubular; and a second conduit disposed within the annulus; and injecting water into the well bore system.

[0045] In certain embodiments, the well bore system may comprise any combination of features discussed above with respect to well bore system 100 and/or well bore system 200. In certain embodiments, a portion of the annulus defined by the tubular and casing may be filled with formation sand and/or a portion of the tubular may be filled with formation sand.

[0046] In certain embodiments, providing a well bore system may further comprise allowing formation sand to enter into the production tubing and/or the annulus defined by the production tubular and the wellbore.

[0047] In certain embodiments, injecting water into the well bore system may comprise: injecting water through the first conduit, injecting water through the second conduit, injecting water through the injection port, or any combination thereof. In certain embodiments, water may be injected simultaneously from the first conduit and the second conduit. In other embodiments, water may first be injected into the well bore system through the second conduit first and then from the first conduit. In certain embodiments, injecting water into the well bore system may comprise injecting water into a flowline in fluid communication with the first conduit and/or the second conduit.

[0048] For example, in certain embodiments when both the tubular and the annulus defined by the tubular and casing are filled with formation sand, water may be injected into the second conduit first thereby unloading formation sand from the annulus into the formation through the perforations and then water may be injected into the first conduit thereby unloading formation sand from the tubular into the formation through the perforations. In certain embodiments, water may be continuously injected into the well bore through the second conduit while water is injected into the well bore from the first

conduit.

[0049] In certain embodiments, the present disclosure provides a method comprising: providing a well bore system; allowing formation sand to enter the wellbore system; and unloading the formation sand from the well bore system.

[0050] While the embodiments are described with reference to various implementations and exploitations, it will be understood that these embodiments are illustrative and that the scope of the inventive subject matter is not limited to them. Many variations, modifications, additions and improvements are possible.

[0051] 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.

CLAIMS

1. A well bore system, comprising: a well bore; a tubular disposed within the well bore, wherein the tubular and well bore define an annulus; a first conduit disposed within the tubular; and a second conduit disposed within the annulus.

2. The well bore system of claim 1, further comprising a casing lining the well bore.

3. The well bore system of claim 1 or 2, wherein the first conduit comprises one or more branches.

4. The well bore system of any one of claims 1-3, wherein the first conduit comprises one or more check valves.

5. The well bore system of any one of claims 1-4, wherein the second conduit comprises one or more branches.

6. The well bore system of any one of claims 1-5, wherein the second conduit comprises one or more branches.

7. The well bore system of any one of claims 1-6, further comprising one or more screens.

8. The well bore system of claim 7, wherein the first conduit comprises one or more openings and the one or more openings are adjacent to the one or more screens.

9. The well bore system of any one of claims 1-8, further comprising one or more gravel packs.

10. The well bore system of any one of claims 1-9, further comprising an injection port.

11. The well bore system of any one of claims 1-10, wherein the first conduit and the second conduit are fluidly connected to a single flow line.

12. The well bore system of any one of claims 1-10, wherein the first conduit and the second conduit are fluidly connected to separate flow lines.

13. The well bore system of any one of claims 1-12, further comprising one or more perforations.

14. The well bore system of 13, wherein the second conduit comprises one or more openings and the one or more openings are adjacent to the one or more perforations.

15. A method comprising: providing a well bore system, wherein the well bore system comprises a well bore; a tubular disposed within the well bore, wherein the tubular and the well bore define an annulus; a first conduit disposed within the tubular; and a second conduit disposed within the annulus; and injecting water into the well bore system.

16. The method of claim 15, wherein the well bore system comprises the well bore system of any one of claims 2-14.

17. The method of claim 15 or 16, wherein a portion of the annulus and/or the tubular is filled with formation sand.

18. The method of claim 15 or 16, further comprising allowing formation sand to enter into the annulus and/or the tubular.

19. The method of any one of claims 15-18, further comprising injecting water into the well bore system.

20. The method of claim 19, wherein injecting water into the well bore system comprises injecting water into the first conduit and/or injecting water into the second conduit.

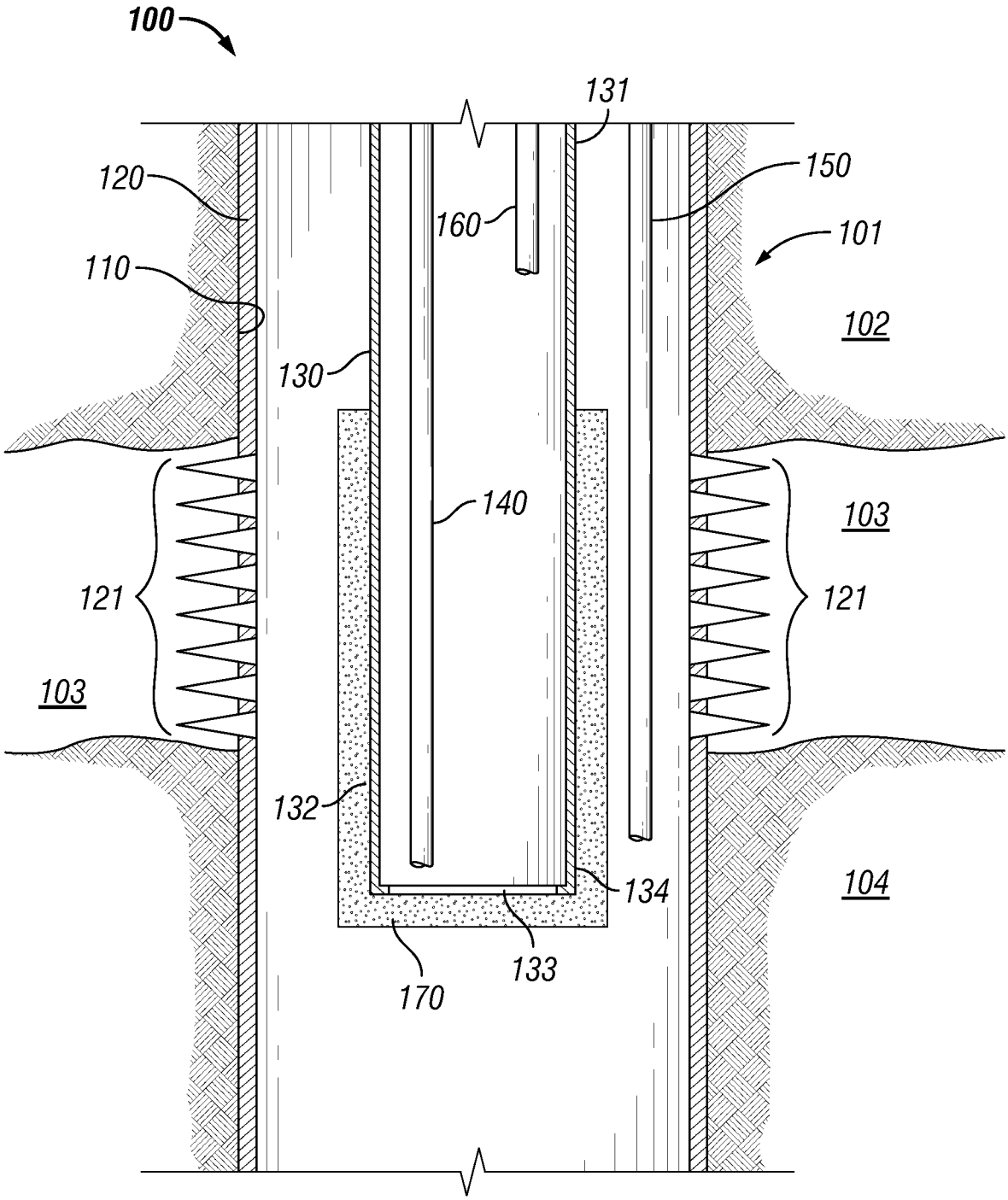

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FIG. 1

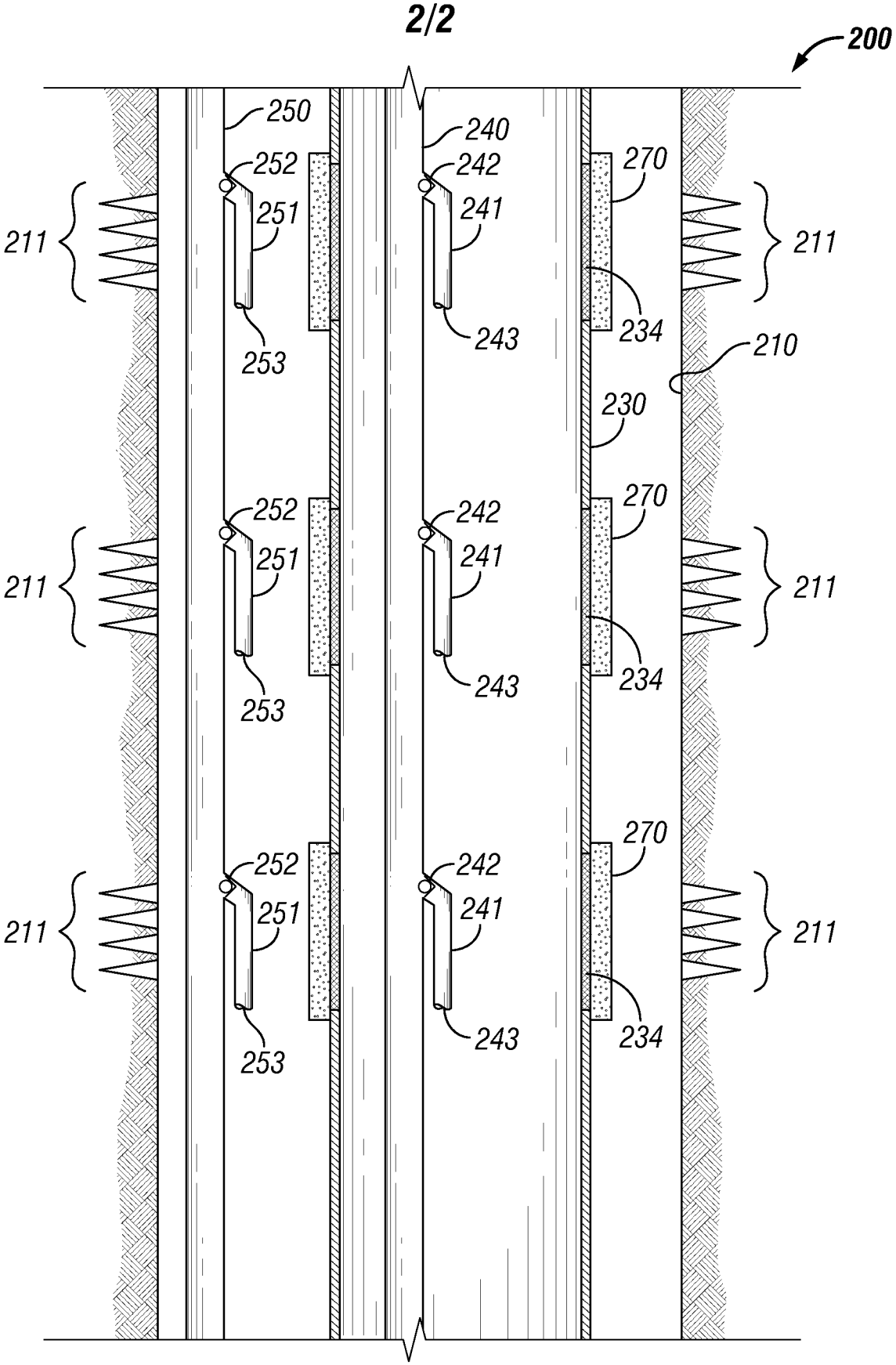

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FIG. 2

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2015/038304

A. CLASSIFICATION OF SUBJECT MATTER
INV. E21B37/08
ADD.

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

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6 073 696 A (ELLIS HARVEY ANDREW [US]) 13 June 2000 (2000-06-13) column 6, line 39 - column 7, line 19 figures 7,8	1-20
X	US 5 865 249 A (GIPSON LARRY J [US] ET AL) 2 February 1999 (1999-02-02) column 3, line 66 - column 4, line 12 column 5, line 16 - line 25 figure 1	1-20
A	US 5 297 631 A (GIPSON THOMAS C [US]) 29 March 1994 (1994-03-29) figure 1	1-20
A	US 5 343 953 A (PATEL DHIRAJLAL C [US] ET AL) 6 September 1994 (1994-09-06) figure 3	1-20

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

☒ See patent family annex.

* Special categories of cited documents :

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Date of the actual completion of the international search	Date of mailing of the international search report
14 September 2015	28/09/2015

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Schneiderbauer, K

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2015/038304

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 6073696 A	13-06-2000	NONE	
US 5865249 A	02-02-1999	CA 2228203 A1 US 5865249 A	11-10-1998 02-02-1999
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