(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
19 December 2013 (19.12.2013)

WIPO | PCT

(10) International Publication Number
WO 2013/187902 A1

(51) International Patent Classification:
E21B 43/04 (2006.01)

(21) International Application Number:
PCT/US2012/042472

(22) International Filing Date:
14 June 2012 (14.06.2012)

(25) Filing Language: English

(26) Publication Language: English

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM,

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(54) Title: METHOD FOR MAKING WINDOWS IN OIL WELL CASING

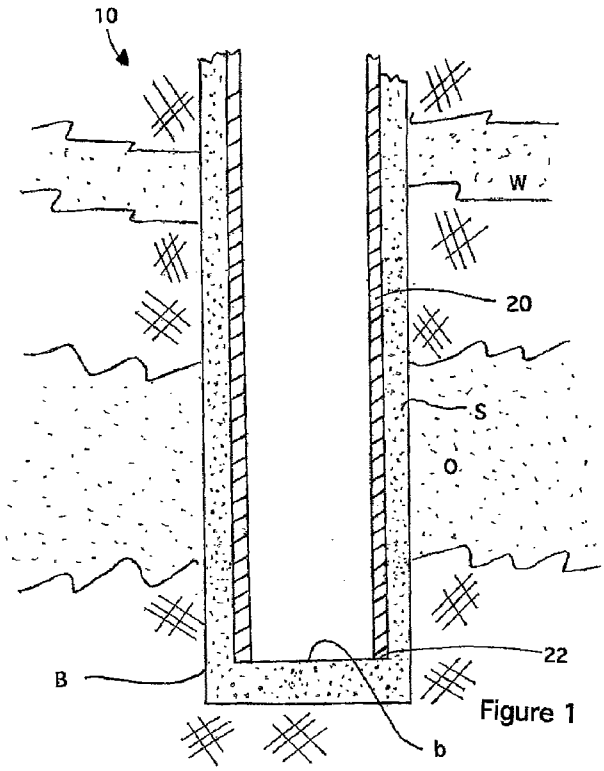

Figure 1

(57) Abstract: A method for making gravel filters in oil well bores. The first step involves ascertaining the location of a producing formation adjacent to a cemented casing in a well bore. Then, a portion of the casing adjacent to the producing formation is cut, enlarging the bore adjacent to the producing formation. Subsequently, a sufficient amount of gravel is deposited in the enlarged portion of the bore to create an effective filter for a producing tube with a screen at its distal end. The distal end is positioned adjacent to the cemented bottom of the well bore. The method maximizes the diameter of the gravel deposited by delivering it exteriorly of the screen of the producing tube and through the annular space defined and sealed between the screen and the casing.

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TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— *of inventorship (Rule 4.17(iv))*

Published:

— *with international search report (Art. 21(3))*

I. TITLE: *METHOD FOR MAKING WINDOWS IN OIL WELL CASING*

II. TECHNICAL FIELD

1. Field of the Invention.

[001] The present invention relates to a method for making gravel filters in oil well bores, particularly in those oil well bores where there are water veins near oil producing formations.

III. BACKGROUND ART

2. Other Related Applications.

[002] The present application is a continuation-in-part of pending (allowed) U.S. patent application serial No.13/024,036, filed on **February 9, 2011**, which is hereby incorporated by reference, and which in turn is a continuation in part of pending U.S. patent application serial No. 12/508,088 filed on July 23, 2009 (now abandoned) which is incorporated by reference.

[003] Some producing formations tapped by oil well installations have sandy characteristics that require the creation of gravel filters adjacent to the producing formation. The present methods typically gun the casing to make holes that connect the producing tube with a gravel filter that is defined by the inner surface of the well bore and the outer surface of the casing. This results in a very limited and thin gravel filter that is susceptible to getting clogged thereby frequently interrupting the operation of the well. The method is also not very precise.

[004] Several methods for making gravel filters in oil well bores have been used in the past. None of them, however, have the flexibility and precision, nor the effectiveness (from its larger size), of the present method. Additionally, this method can be used in new and old oil wells, including those where the gun method was used. The precision characteristics of the present method are quite desirable in oil wells with water veins in relative proximity to the oil producing formation.

[005] Applicant believes that the closest reference corresponds to U.S. patent No. 3,850,246 issued to Despujols for a gravel packing method and apparatus. However, it differs from the present invention because the gravel is delivered through and out of the screen, necessitating additional sealing members **48**, **50**, and **52**. Also, the diameter size of the gravel is severely limited by the constraints of the passages through which the gravel is passed.

[006] Other documents describing the closest subject matter provide for a number of more or less complicated features that fail to solve the problem in an efficient and economical way. None of these patents suggest the novel features of the present invention.

IV. SUMMARY OF THE INVENTION

[007] It is one of the main objects of the present invention to provide a method for making windows in oil wells that permits a user to use gravel of different diameters.

[008] It is another object of this invention to provide such a method with minimum obstruction to the passage of gravel.

[009] It is yet another object of this invention to provide such a device that is inexpensive to manufacture and maintain while retaining its effectiveness.

[010] Further objects of the invention will be brought out in the following part of the specification, wherein detailed description is for the purpose of fully disclosing the invention without placing limitations thereon.

V. BRIEF DESCRIPTION OF THE DRAWINGS

[011] With the above and other related objects in view, the invention consists in the details of construction and combination of parts as will be more fully understood from the following description, when read in conjunction with the accompanying drawings in which:

[012] With the above and other related objects in view, the invention consists in the details of construction and combination of parts as will be more fully understood from the following description, when read in conjunction with the accompanying drawings in which:

Figure 1 represents an elevational cross-sectional view of an oil well bore **B** with a new (unused) casing **20** and a cemented bottom. A producing formation and a water vein above it are also represented to show typical characteristics in an oil well.

Figure 2 shows an elevational representation similar to the one shown in the previous figure with a section mill tool positioned to start cutting through the casing.

Figure 3 illustrates another elevational view similar to the previous figures with the blades cutting through the casing.

Figure 4 is a representation of an elevational view of the well's bore with the tool section milling the casing.

Figure 5 shows a cross-sectional view of the well's bore except for the underreamer tool for which the cross-section is not shown. The underreamer is shown enlarging the bore in a predetermined location.

Figure 6 shows an elevational view of the well's bore with a tool forming a gravel-packed filter between the enlarged portion of the bore and the casing.

Figure 7 represents another elevational view of the well's bore shown in the previous figures with a producing tube in place that includes a screen through which the filtered sand with oil is passed.

Figure 8 shows an elevational view of a conventional oil well as it exists in the prior art.

Figure 9 is a partial cross-sectional representation of setting tool **50** taken along line 9-9 in figure 6.

Figure 10 is a cross-sectional view of setting tool **50** taken along line 10-10 in figure 6.

VI. DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[013] Referring now to the drawings, where the present invention is generally referred to with numeral **10**, it can be observed that it basically includes casing **20** that extends coaxially inside bore **B** that includes a cemented bottom **b**, as it is typically found in new oil well installations. Bore **B** typically passes through water formations **W** and oil producing formations **O**. The space **S** between casing **20** and bore **B** is typically cemented to keep casing **20** in place. The lowermost end **22** of casing **20** is typically brought against bottom **b**. Several tools are then inserted in casing **20** and lowered to the required locations and finally the producing casing is installed.

[014] In old oil well installations, a filter has been previously made with a gun perforator that caused holes **23** to be made through casing **20** at predetermined locations, as shown in figure 8. The explosives used penetrate through cemented space **S**. The present invention can also be used to repair these conventional operating oil well installations.

[015] The first step in the present method is to ascertain the location where the window for the filter is to be made or where the repair is to take place. Once this is determined, a section milling tool is lowered to that location and casing **20** is cut, creating an interruption. The cutting takes place with precision that is not possible with the gunning method. In this manner, a user can avoid water formations **W**. Casing **20** is kept in place since the annular space between casing **20** and the surface of bore **B** has been cemented, as it is conventionally done in the industry. A section milling tool, like the one described in U.S. patent No. 6,920,923, can be used to perform this function. A section milling tool is used to cut casing **20** and concentrates its blades' action on this operation.

[016] The next step, after withdrawing the section milling tool **30**, is the lowering of the underreamer **40** to the location where the window was formed. An underreamer, like the one described in Applicant's U.S. patent No. 5,896,940, can be used for this step. The underreamer enlarges the diameter of the bore at a location adjacent to where window **25** was formed as it can be seen in figure 5.

[017] After retrieving underreamer **40**, a setting tool **50** is lowered and a mix of gravel and a fluid is pumped radially through openings **53a** and **53b**, as seen in figure 6. The fluid can be water or other suitable liquid conventionally used to carry granular material, such as gravel, in oil well installations. Gravel **G** and fluid (not shown) are delivered downwardly through tube **52**, as best seen in figure 9. Tube **52** is bifurcated, in the embodiment shown in figures 9 through 10, with inclined tubes **52a** and **52b** extending radially outwardly with respective openings **53a** and **53b**. Openings **53a** and **53b** are positioned in setting tool **50** above screen **62** when the former is operationally engaged to producing tube **60**. The lower surfaces **55a** and **55b** are reinforced with thicker walls to withstand the abrasive action of the gravel and fluid. Sealing units **61** are not deployed when gravel **G** is delivered from above screen **62** and passes between screen **62** and casing **20**.

[018] This permits a user to deliver gravel of the largest possible diameter, if required, without risking undesirable internal obstructions. The fluid also passes through and is collected back through holes **64** of screen **62**.

The fluid travels back under pressure through returning tube **67**, leaving the gravel **G** in place. Once a sufficient amount of the gravel mix **70** is pumped in the enlarged portion of the well, setting tool **50** is retrieved and producing tube

60 is installed. The result is a considerably larger volume of gravel filter **80** with an extended life, as best seen in figure 7.

[019] Producing tube **60** includes a screen **62** with through holes **64** cooperatively smaller than the diameter of the granular material constituting the annular filter to prevent this material from entering producing tube **60**. Different types of producing tubes **60** are conventionally used.

[020] One of the advantages of the present method for creating a gravel filter is its precision. A user can control the dimensions of the window or windows to be built in casing **20**. The range of the sizes of the gravel is maximized, providing more flexibility to the user. The present methods for building gravel filters involve gunning a portion of casing **20** with unpredictable locations and dimensions for the holes. The use of the present method permits a user to build filters that are more reliable and track the intended specifications.

[021] The foregoing description conveys the best understanding of the objectives and advantages of the present invention. Different embodiments may be made of the inventive concept of this invention. It is to be understood that all matter disclosed herein is to be interpreted merely as illustrative, and not in a limiting sense.

VII. INDUSTRIAL APPLICABILITY

[022] It is apparent from the previous paragraphs that an improvement of the type for such a method is quite desirable in oil producing installations and particularly in the construction of effective gravel filters.

VIII. CLAIMS

What is claimed is:

1. A method for making gravel filters in oil wells having a casing coaxially mounted within a well bore and defining a space between said bore and said casing that is cemented to keep said casing in place, comprising the steps of:

A) ascertaining the location, at the cemented casing in an oil well bore, adjacent to a producing formation where a gravel filter is to be built;

B) cutting a portion of said casing adjacent to said producing formation;

C) enlarging said bore's diameter where said portion was cut to create an enlarged annular space by removing the cemented space adjacent to said portion and beyond the bore's initial diameter;

D) lowering and installing a producing tube having a distal end with an intake screen and being coaxially disposed within said casing and positioning said intake screen substantially adjacent to said casing portion which was removed;

E) depositing an effective amount of gravel through said enlarged annular space and said gravel being delivered from above said screen at a first predetermined distance from said

portion and exteriorly thereof between said screen and said casing, and the largest diameter of said gravel being limited by the separation between said casing and said screen; and

F) sealing unit located in said space between said screen and said casing at a second predetermined distance above said portion and below said first predetermined distance and said sealing unit being set after said gravel is deposited so that said sealing unit seals said annular space between said screen and said casing.

2. The method set forth in claim 1 wherein said step of depositing an effective amount of gravel includes the use of a setting tool with a central tube ending with at least two connected inclined tubes defining respective openings in said setting tool for the delivery of said gravel and fluid.

3. The method set forth in claim 2 wherein said inclined tubes are reinforced to withstand the abrasive action of said gravel and fluid.

4. The method set forth in claim 3 wherein the steps of cutting said casing and enlarging said bore's diameter is performed with a section mill and an underreamer.

5. The method set forth in claim 4 wherein the gravel is selected for predetermined diameters in accordance with the characteristics of said producing formation.

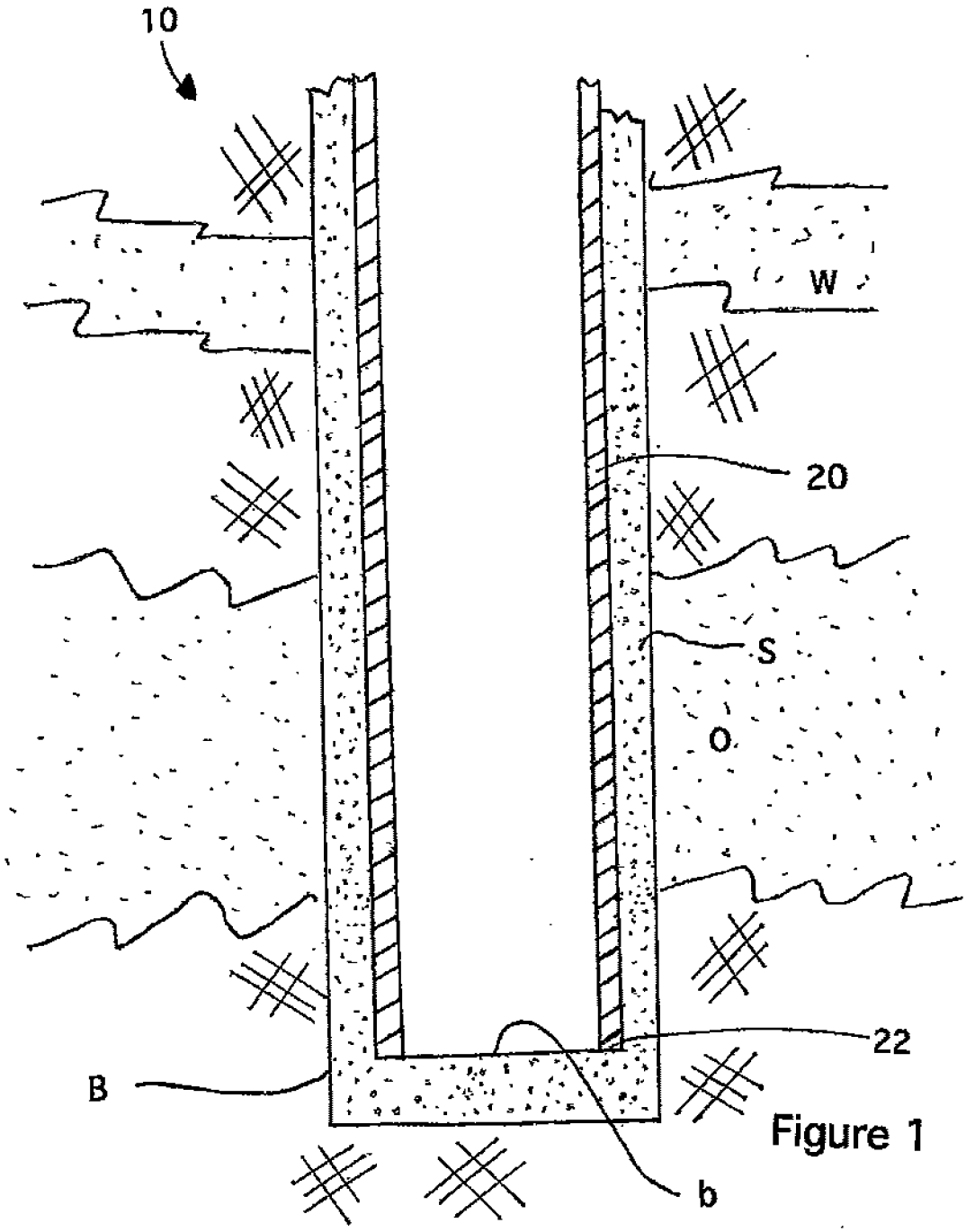

Figure 1

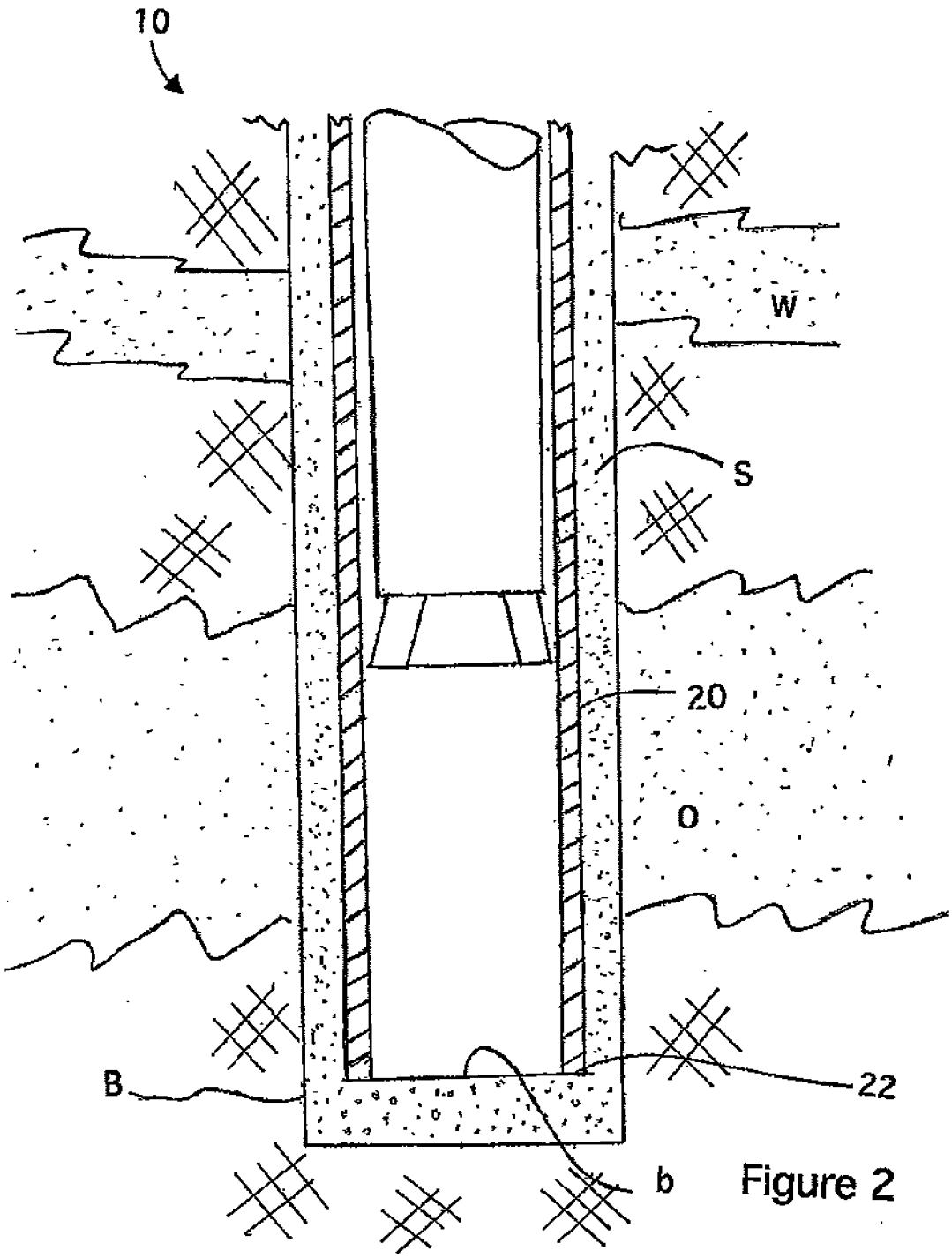

Figure 2

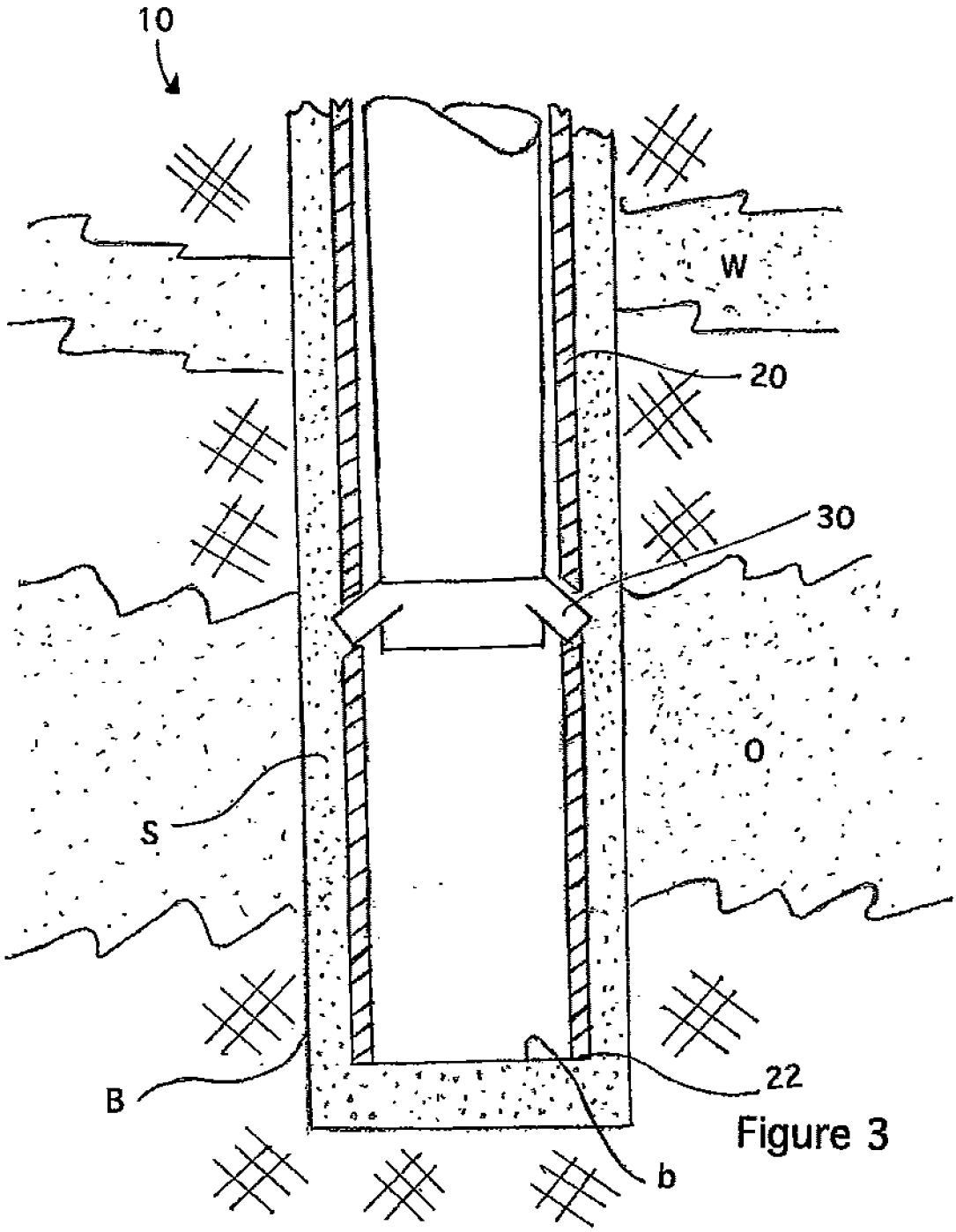

Figure 3

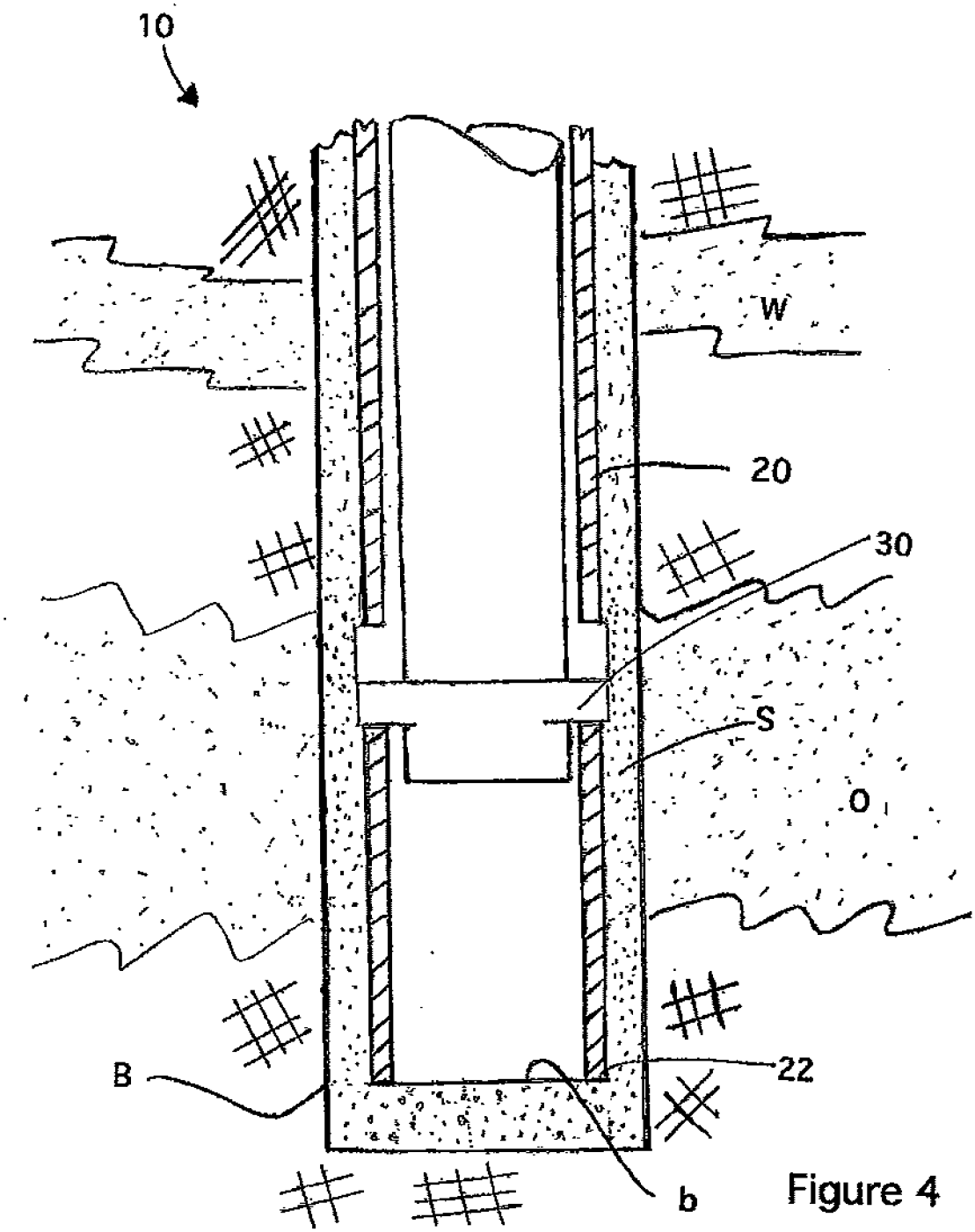

Figure 4

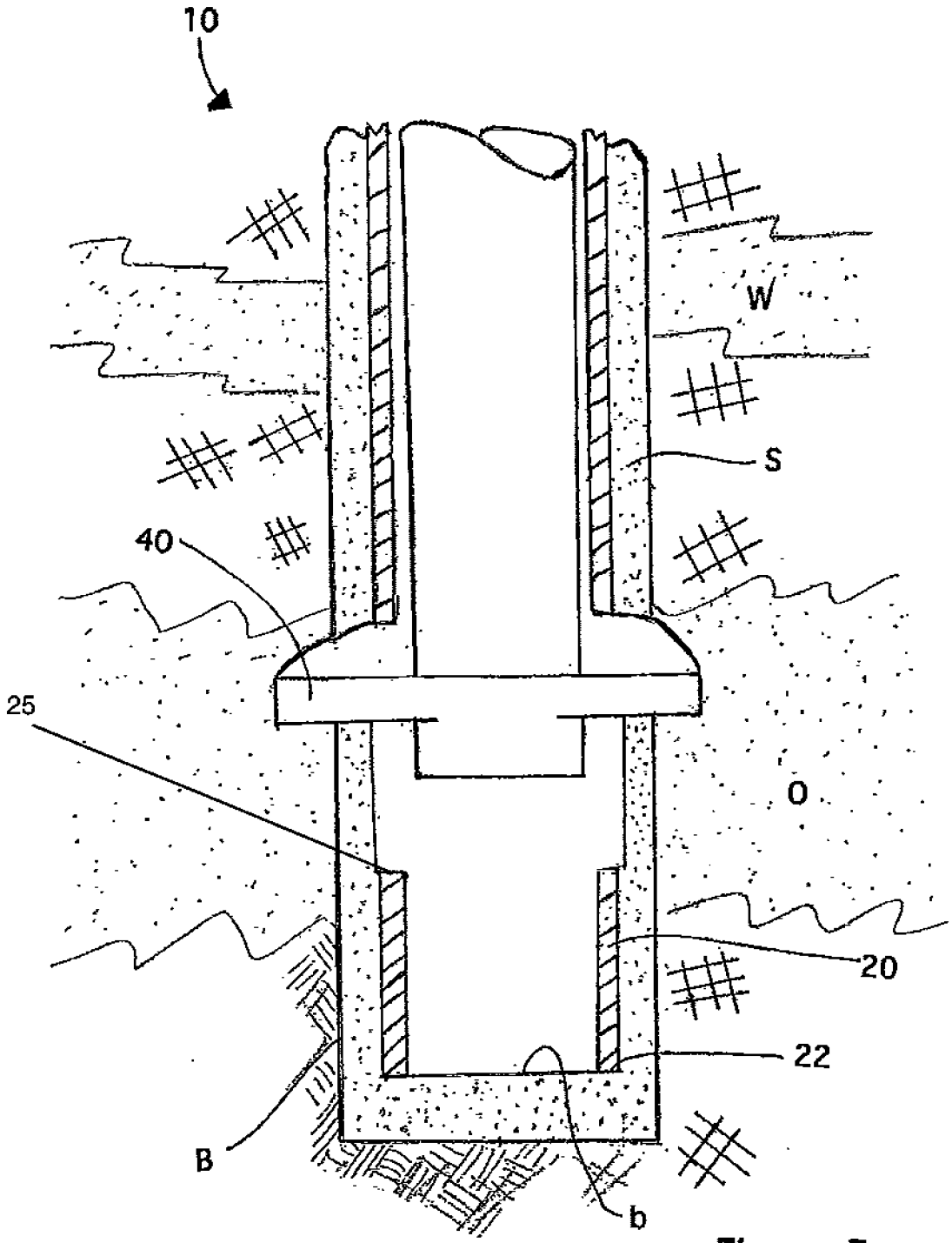

Figure 5

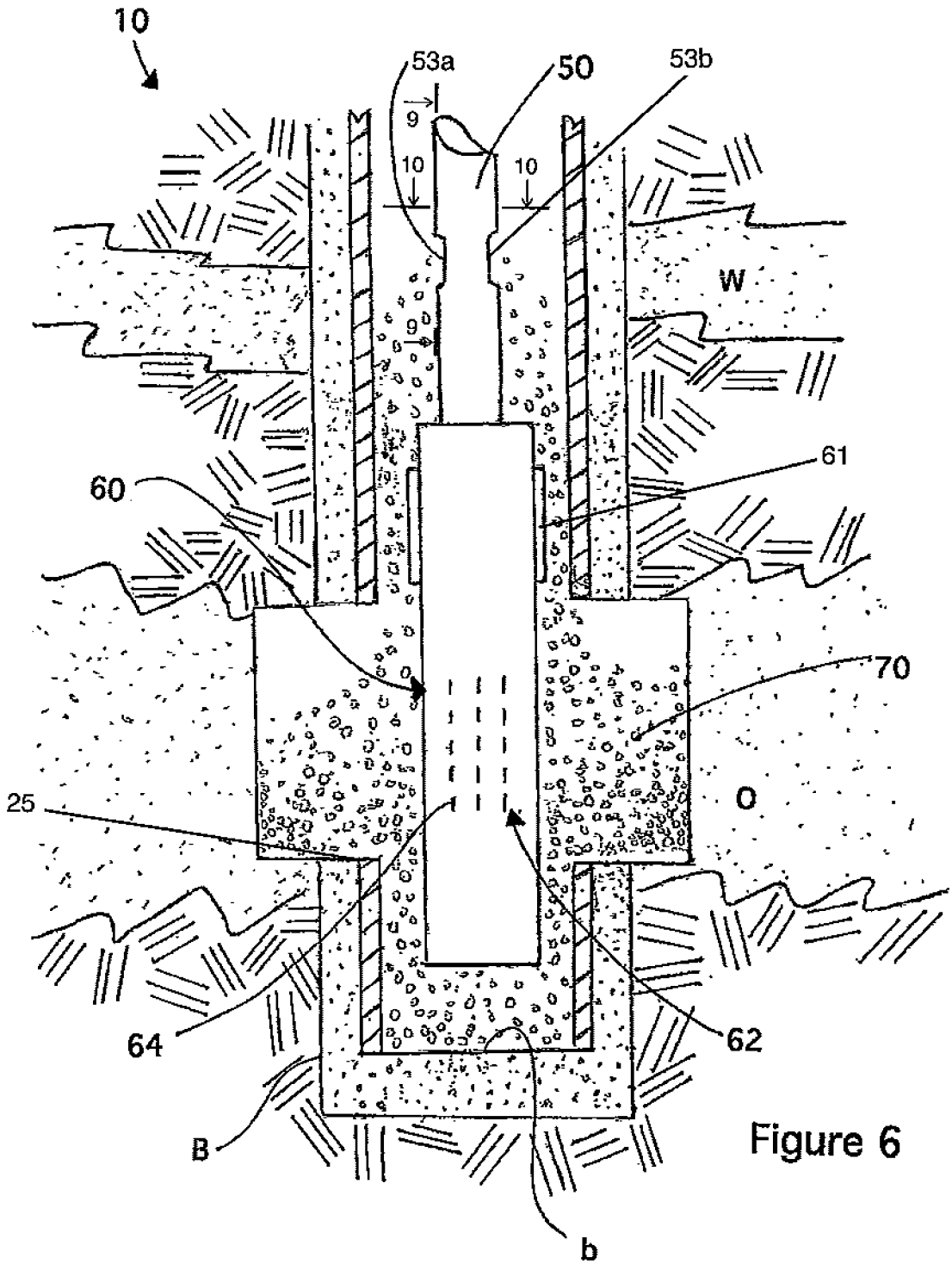

Figure 6

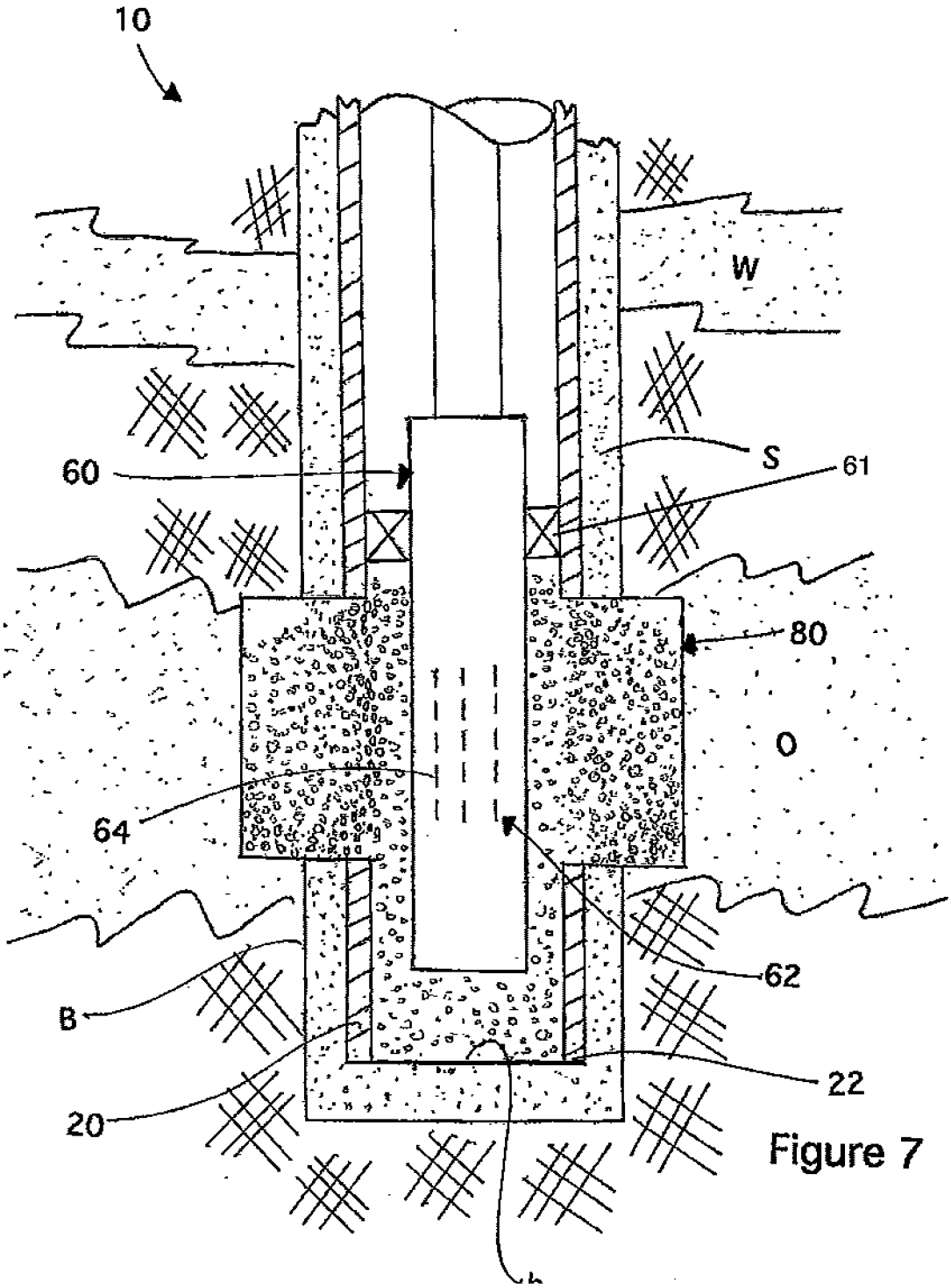

Figure 7

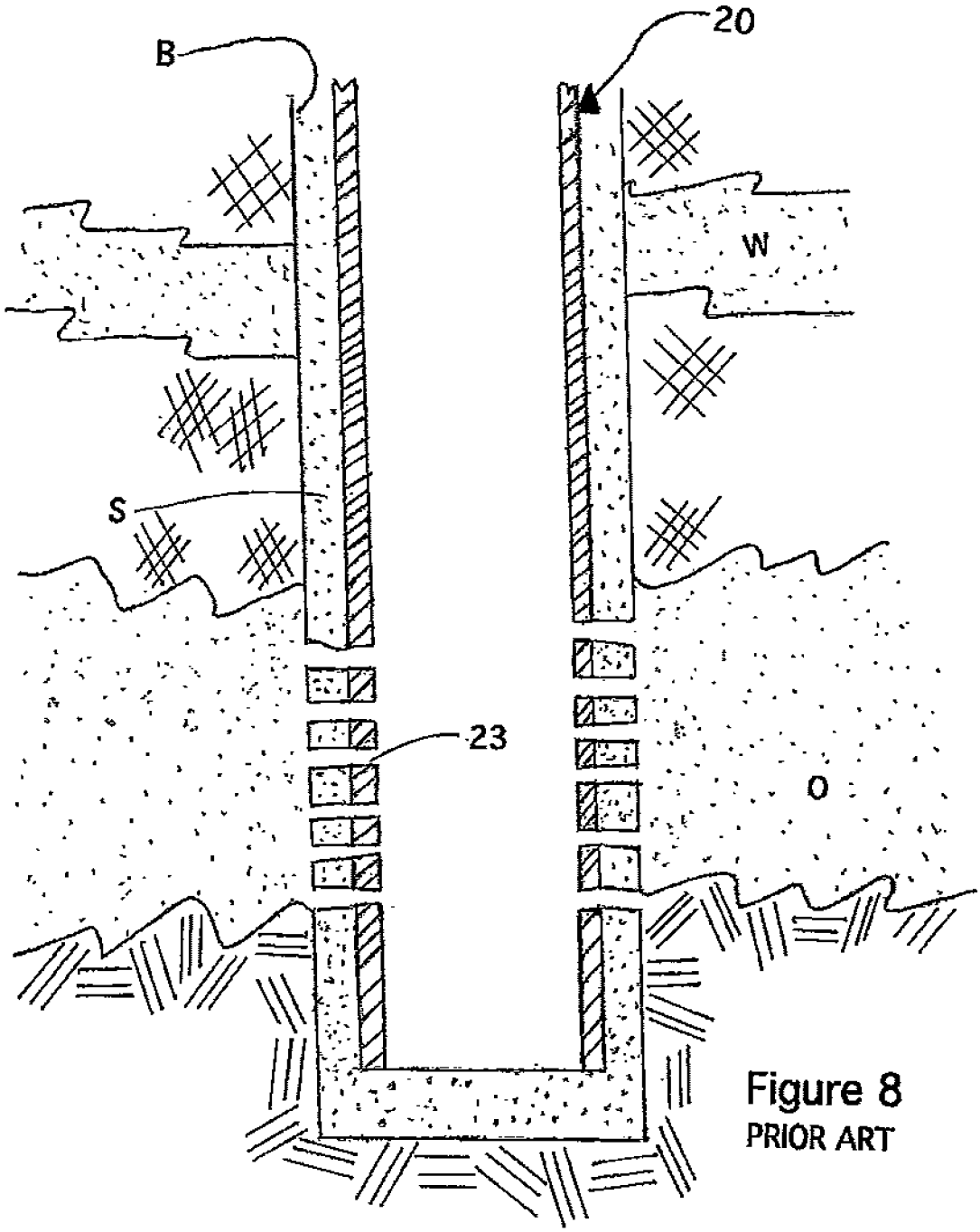

Figure 8
PRIOR ART

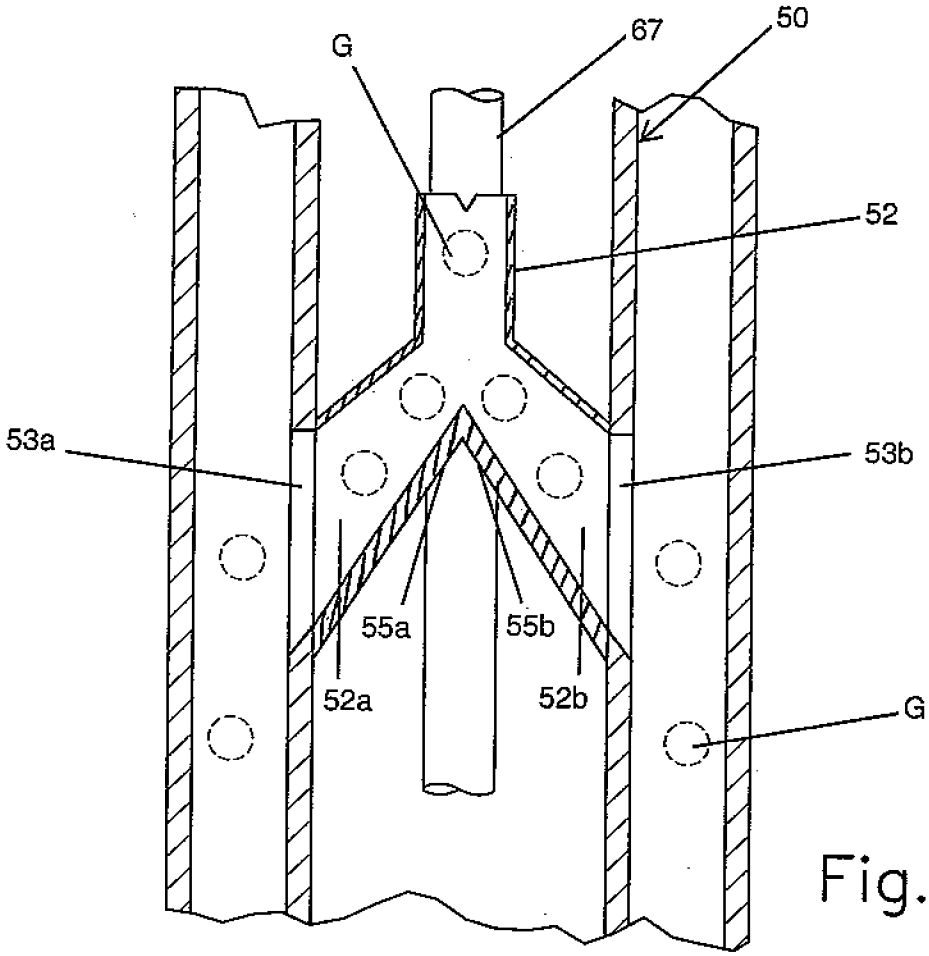

Fig. 9

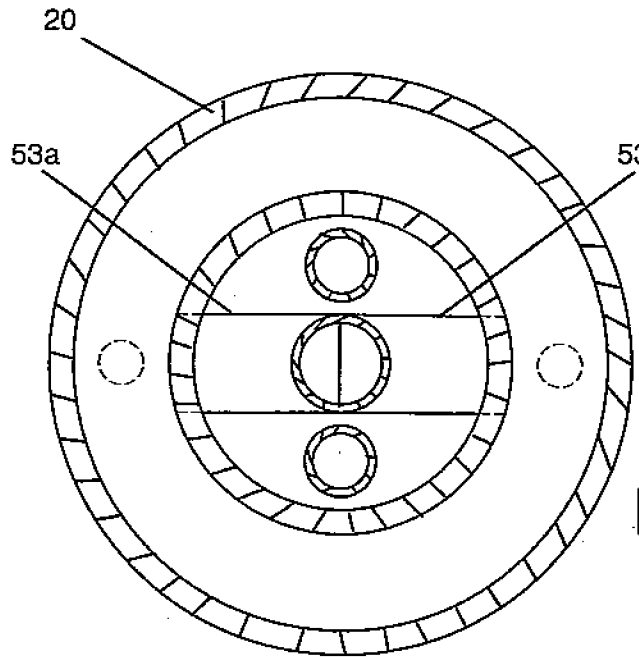

Fig. 10

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2012/042472

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - E21B 43/04 (2012.01)
USPC - 166/278
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)
IPC(8) - E21B 29/00, 43/04 (2012.01)
USPC - 166/51, 227, 278, 297; 175/263; 507/200

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)
PatBase, Google Patent

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 2011/0017450 A1 (PIETROBELLI ET AL) 27 January 2011 (27.01.2011) entire document	1 --- 2-5
Y	US 7,363,974 B2 (WANG et al) 29 April 2008 (29.04.2008) entire document	2-5
A	US 5,255,741 A (ALEXANDER) 26 October 1993 (26.10.1993) entire document	1-5
P, A	US 8,225,870 B1 (PIETROBELLI et al) 24 July 2012 (24.07.2012) entire document	1-5

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

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

Date of the actual completion of the international search	Date of mailing of the international search report
06 August 2012	21 SEP 2012
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Authorized officer: Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

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