(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 2 212 518 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
04.01.2017 Bulletin 2017/01

(21) Application number: **08852389.9**

(22) Date of filing: **06.11.2008**

(51) Int Cl.:
E21B 43/10 *(2006.01)*

(86) International application number:
PCT/GB2008/051035

(87) International publication number:
WO 2009/066097 (28.05.2009 Gazette 2009/22)

(54) **COMPLETION ARRANGEMENT**

FERTIGSTELLUNGSANORDNUNG

DISPOSITIF D'ACHÈVEMENT

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MT NL NO PL PT RO SE SI SK TR

(30) Priority: **23.11.2007 GB 0722995**

(43) Date of publication of application:
04.08.2010 Bulletin 2010/31

(73) Proprietor: **Swellfix UK Limited**
Chandler's Ford,
Eastleigh
Hampshire SO53 3LG (GB)

(72) Inventors:
- **SIMONIAN, Sam**
  F-75001 Paris (FR)
- **BOYLE, Colin**
  Elstree, Hertfordshire (GB)
- **CARTER, Neale**
  Elstree, Hertfordshire (GB)

(74) Representative: **Docherty, Andrew John et al**
Marks & Clerk LLP
Aurora
120 Bothwell Street
Glasgow G2 7JS (GB)

(56) References cited:
EP-A- 0 697 501
EP-A- 0 713 951
WO-A-2005/042916
WO-A-2007/094900
GB-A- 2 416 551

EP 2 212 518 B1

Description

[0001] The present invention relates to a completion arrangement and particularly, to a completion arrangement for a hydrocarbon (e.g. oil or gas) and/or an injection (e.g. water or gas) well.

[0002] When an oil/gas well is drilled, extraction equipment is inserted into an oil/gas reservoir from which oil/gas will be produced to the surface. A bore is drilled into the oil/gas reservoir and production tubing is introduced into the bore. The oil/gas well has then to be "completed", which entails running a completion section into the well to enable extraction of hydrocarbons from the reservoir for transfer to the surface via the production tubing. It is generally desired that the completion section is ideally located at, or extends into, the bottom (or total depth) of the well.

[0003] A number of "completion" devices exist, for example, "openhole completions", i.e. where a packer is provided on tubing above an "openhole" (an openhole being an uncased portion of a well bore), or "inflow control devices", i.e. a tubing section provided with devices to control flow of fluid from the reservoir to the interior of the tubing section in a producing well and control flow of fluid from the tubing section to the reservoir in an injection well.

[0004] In current completion techniques, when the completion is "run-in" to the well, it is the weight of the completion string that urges the completion to the end of the well.

[0005] However, such techniques are problematic in that the completion may get stuck due to entrained rock and debris accumulated at the head of the completion. Additionally, there may be "burrs" in the openhole section of the well caused by the drilling process, and the completion may also become stuck when it encounters these "burrs".

[0006] Under the current techniques, if the completion becomes stuck as described above, then remedial actions (such as "jarring" the completion string) are taken to free the completion in an attempt to insert the completion section further into the well bore. Unfortunately, these remedial actions are not always successful, which leads to the well being completed as is or side-tracked. The problem of the completion becoming stuck is a particular problem in long horizontal wells.

[0007] WO 2008/043985 describes drilling a lower completion into a pre-drilled wellbore with casing liner. A casing liner is a tubular section that conventionally is 'pushed' into the pre-drilled hole to total depth. Once to total depth, the casing liner is cemented into place by pumping cement into the space between the reservoir rock and the casing liner (tubular section). The cement is required for structural integrity and to hold the casing liner in place. In order for hydrocarbons to reach the production tubing to flow to the surface, it is necessary that the casing liner be perforated using perforating charges to connect the production tubing space to the reservoir rock.

[0008] GB 2416551 discloses the drilling of a wellbore using a drill string having a first non-porous portion, a second porous portion and a drill bit. GB 2416551 also discloses a downhole filter having openings with outer widths less than the inner widths so that sand or other particulates which are prevented from passing through the openings will tend to be retained on the outside of the filter.

[0009] WO 2005/042916 discloses a method of running a bore-lining tubing string into a bore which comprises running a tubing string, typically a liner string, into a bore while agitating the string. The agitation of the string reduces the friction between the string and the bore wall and thus facilitates the translation of the string into the bore. The agitation may also take place while the tubing is being cemented in the bore. Pressure pulses may be applied to fluid in the bore, which fluid may be cement slurry.

[0010] EP 0713951 discloses a method and apparatus for drilling and completing a bore hole. Generally, the method comprises the steps of positioning a workstring in the well, with the workstring having attached thereto a bottom hole assembly. The bottom hole assembly may contain a bit for rotary drilling a bore hole; and, a drilling motor, operably associated with the bit, for rotating said drilling means. The method further includes the steps of circulating a fluid in the workstring so that the motor rotates the bit means; and, drilling the bore hole through a target reservoir. In one disclosed embodiment in EP 0713951, the workstring string is a production string, and the production string is attached to an isolation safety valve member for isolating the well and the bore hole from pressure.

[0011] EP 0697501 discloses an integrated drilling and evaluation system for drilling, logging and testing a well which comprises a drill string, a drill bit carried on a lower end of the drill string for drilling a well bore, logging while drilling means included in the drill string for identifying subsurface zones of formations of interest, packer means carried on the drill string above the drill bit for sealing a zone or formation of interest below the packer means, and a fluid testing means included in the drill string for controlling the flow of well fluid from the zone or formation of interest into the drill string. The system allows one or more subsurface zones or formations of interest in a well to be drilled, logged and tested without the necessity of removing the drill string from the well.

[0012] WO 2007/094900 discloses a method of completing a well. The well may be a producing well or an injection well. In one embodiment disclosed in WO 2007/094900, the method includes identifying technical issues associated with a well; selecting a technology to address each technical issue; defining criteria for each selected technology to determine when to deploy the selected technology in the well, wherein each selected technology remains dormant until the criteria are met; and integrating the technologies into a well completion profile

stored in. memory and utilized in the deployment of the technologies into the well. The method provides the ability to proactively address technical issues to reduce workovers and interventions for a well.

[0013] The present invention seeks to provide for a completion arrangement having advantages over known such completions.

[0014] According to an aspect of the present invention, there is provided a completion arrangement for a drilled hydrocarbon well bore comprising: a completion section arranged to be coupled to production tubing, and having means to allow hydrocarbons to pass therein from reservoir rock in which the well bore is formed, said means also arranged to serve as flushing portals, whereby drilling fluid introduced into said production tubing is arranged to flow via said means into a space between said production tubing and said well bore and circulate in said space; and impacting formations, operable by being drivingly moveable relative to the drilled well bore, wherein one, or both, of arranging said means to permit circulation of said drilling fluid in said space and operation of said impacting formations removes obstructing material from the drilled well bore, for return to surface by way of said space, during insertion of the completion arrangement into the well bore.

[0015] An advantage of the present invention is that debris around the completion arrangement during an insertion process can be removed by: (i) flushing drilling fluid through said means which, during production, are arranged to allow hydrocarbons to pass into the production tubing from reservoir rock in which the well bore is formed, but which, during the insertion process, allow drilling fluid to enter a space around the production tubing; and (ii) driving the impacting formations. Thus, with the above two features, the completion section is less likely to become stuck when being "run-in" to the well.

[0016] In this particular invention the lower completion can be set into the openhole section without cementing. Once the well is put into production, the hydrocarbon from the reservoir rock is drawn into the space created by the openhole packers. The hydrocarbon then flows from the space, through nozzles in the flow restrictors into the production tubing and then on to the surface. If this particular arrangement was to be cemented, then connection between the production tubing and the reservoir will be required via perforating charges. However, in the present invention, cementing is not required and the stability of the openhole section is maintained by the strength of the reservoir rock.

[0017] As mentioned, cementing is not required for this invention since the type of lower completion serves a different purpose - this is an openhole completion with openhole packers and flow restrictors.

[0018] The invention is further advantageous in that it enhances completion deployment and allows longer completions to be run, thereby providing completion capabilities for extended reach applications.

[0019] The impacting formations are operable to crush, cut, abrade, scrape, pound or grind material and formations in the well bore.

[0020] Also, said means to allow hydrocarbons to pass therein from reservoir rock in which the well bore is formed may comprise flow restrictors having at least one nozzle.

[0021] Preferably, said impacting formations comprise a drill bit or ream-in shoe.

[0022] Conveniently, said impacting formations are operable by rotating said production tubing, to which said impacting formations are coupled via said completion section.

[0023] If required, the completion arrangement further comprises a motor coupled between said completion section and said impacting formations and arranged to control operation of said impacting formations.

[0024] Further, said motor comprises a mud motor operable by means of drilling fluid supplied thereto through said production tubing and completion section.

[0025] Preferably, said drilling fluid further serves to lubricate said impacting formations.

[0026] According to another aspect of the present invention, there is provided production tubing for a hydrocarbon well, comprising a completion arrangement as described above.

[0027] According to a further aspect of the present invention, there is provided a method of completing a drilled hydrocarbon well bore, comprising the steps of: inserting a completion arrangement into said drilled well bore, the completion arrangement comprising a completion section having means for allowing hydrocarbons to pass therein from reservoir rock in which the well bore is formed, said means also arranged to serve as flushing portals whereby drilling fluid introduced into the completion section via production tubing is arranged to flow via said means into a space between said completion arrangement and said well bore and circulate in said space ; and at least one of introducing drilling fluid into said completion arrangement for flow via said means into said space and/or driving said impacting formations so as to move relative to the drilled well bore to remove obstructing material from the drilled well bore during insertion of the completion arrangement into the well bore.

[0028] Preferably, said driving step comprises rotating said production tubing to drive said impacting formations.

[0029] If required, the method further comprises the step of: locating, between said completion section and said impacting formations, a motor; and wherein said driving step comprises activating said motor by means of fluid pumped to said motor via production tubing coupled to said completion section such that said motor can operate said impacting formations.

[0030] The present invention is described further hereinafter, by way of example only, with reference to the accompanying drawings in which:

Fig. 1 illustrates a cross-sectional side view of an oil/gas well or an injection well;

Fig. 2 illustrates a cross-sectional side view of the well of Fig. 1 into which the present invention is being introduced;

Fig. 3 illustrates a cross-section side view of the well of Fig. 1 with the present invention located partially along the well length;

Fig. 4 illustrates a cross-section side view of the well of Fig. 1 with a particular arrangement of the present invention located partially along the well length;

Fig. 5 illustrates a cross-section side view of the well of Fig. 1 with the present invention located at total depth; and

Fig. 6 illustrates a cross-section side view of the well of Fig. 1 with an alternative arrangement of the present invention being introduced to the well.

[0031] As mentioned, Fig. 1 illustrates an oil/gas well or injection well 10. The well 10 comprises a well bore 12 which extends from the surface 14 to oil/gas bearing rock 16. Part of the well bore 12 is lined with a production casing 18 to support the walls of the well bore 12 and prevent collapse of the well bore 12. The part of the well bore 12 which extends into the oil/gas bearing rock 16 comprises a so-called openhole section 20 which is not lined with production casing.

[0032] Fig. 2 illustrates the same oil/gas well 10, but with extraction equipment partially introduced into the well in a "running-in" process, i.e. the process whereby extraction equipment is delivered to the oil/gas producing region of the well. This equipment comprises production tubing 22 which is located within the production casing 18 and which is formed of a series of tubing sections connected together by means of couplers 24 arranged to couple adjacent sections of tubing sections together. The extraction equipment further comprises a completion section 26 coupled to an end of the production tubing 22 and which is arranged, upon well completion, to reside in the portion of the well bore 18 (i.e. the openhole section 20) extending into the oil/gas bearing rock 16. The completion section 26 is arranged such that fluid can permeate from the surrounding oil/gas bearing rock into an interior section of the completion section 26 such that the fluid can be transferred to the surface 14 via the production tubing 22. Vice versa for an injection well: the injected fluid is pumped from surface into the production tubing 22 and permeates through the completion section 26 into the reservoir rock 16.

[0033] In addition to the production tubing 22 and the completion section 26, the illustrated embodiment of the completion arrangement of the invention includes a drill bit 28 coupled to an end of the completion section 26 remote from the end coupled to the production tubing 22. The drill bit 28 is located at the "front" face of the completion section 26, i.e. the face of the completion section 26 which is foremost with respect to its direction of travel into the openhole section 20.

[0034] Fig. 3 illustrates the same oil/gas well 10 as Figs. 1 and 2. The features illustrated in Fig. 3 which correspond to features already described in relation to Figs. 1 and 2 are denoted by like reference numerals.

[0035] The illustration of Fig. 3 differs from that of Fig. 2 in that the production tubing 22 extends further into the well bore 12. In Fig. 2, the completion section 26 and drill bit 28 are located within the production casing 18 of the lined section of the well bore 12. However, in Fig. 3, the completion section 26 and drill bit 28 have been inserted further so as to extend into the openhole section 20 of the well bore 12.

[0036] The completion section 26 preferably comprises a number of different combinations of extraction devices, valves, sensors, measurements, mechanical and swellable packers etc. In a particular arrangement as illustrated in Fig. 4, which shows a detailed view of the completion section 26 to illustrate the features thereof, the completion section 26 is made up of openhole swellable packers 200 (for openhole compartmentalisation) and Inflow Control devices ("flow restrictors" 202) which serve two purposes: (i) during the "running in" procedure, drilling fluid 204 is pumped from surface down to the drill bit 28 (or ream-in shoe) to circulate and lubricate the completion section 26 during deployment; and (ii) during a production phase, hydrocarbons can enter the completion section 26 from reservoir rock surrounding the completion section 26, via the flow restrictors 202 and pass therefrom to the surface via production tubing 22 attached to the completion section 26. Since the flow restrictor 202 is formed with a plurality of nozzles 206 arranged to allow drilling fluid 204 to be injected through the production tubing 22 into a space 208 (which may be annular) around production tubing 22, this aids in a lubricating process to ease the passage of the completion section 26 into the well bore. Should the lubrication process fail, or be inadequate to remove debris, etc. and the completion section 26 becomes stuck, the completion section 26 can be rotated by means of surface control (or by a downhole mud motor - see Fig. 5 and the description relating thereto). However the rotational capability is secondary to the fact that drilling fluid is being flushed across the entire completion section 26, rather than merely at the drill bit 28. By efficiently flushing and lubricating across the entire lower completion, this may reduce the need to rotate the drill bit 28. Debris is carried along the space 208 to surface and since the flow restrictors 200 are passing fluid from the production tubing 22 into the space 208, this aids in the flushing process.

[0037] The illustrations of Figs. 2, 3 and 4 are merely schematic "snapshots" of the process of introducing extraction equipment into the well, and the progress of the extraction equipment on its route to the position as illustrated in Fig. 5.

[0038] Turning now to Fig. 5 in detail, there is illustrated the same oil/gas well 10 as in Figs. 1 to 4. Again, features

corresponding to those already described are denoted by like reference numerals.

[0039] Here, the completion section 26 and drill bit 28 have reached total depth, i.e. the maximum extent to which the bore has previously been drilled. Once the completion section 26 and drill bit 28 have reached the total depth, the well 10 is effectively "complete" and an oil/gas extraction process can commence without limitation that might occur due to incomplete insertion of the production tubing and completion section.

[0040] The lubrication process has been described above. Now the operation of the drill bit 28 found in the illustrated embodiments of the invention will now be described in more detail.

[0041] As described above, in conventional processes where an oil/gas well is "completed", the extraction equipment (including a completion section) is introduced into the well bore, and it is the weight of the completion section and production tubing that urges the completion towards the end of the well (i.e. total depth) and pulls the production tubing behind it. However, and as mentioned above, the presence of "burrs" on the walls of the openhole section of the well which were introduced by the drilling process, or the accumulation of debris in front of the completion section, may cause the completion section to become stuck. Remedial actions (e.g. "jarring") are possible which can free the completion section for further insertion into the well bore, but these are not always effective and the well may therefore have to be completed without the completion section reaching total depth.

[0042] By providing a drill bit 28 at the head of the completion section 26, this allows the completion section 26 to be drilled, or rather reamed into position in the well bore should the lubrication process fail at some point to ease passage of the completion section into the well. Thus, in the illustrations of Figs. 3 to 5 where the completion section 26 and drill bit 28 are in the openhole section 20 of the well bore 12, the drill bit can be operated to, for example, remove "burrs" from the walls of the openhole section 20 and/or to remove debris from in front of the combined drill/completion section for transfer to, and removal at, the surface 14. As noted above, such process is secondary to the main process of providing lubrication by way of drilling fluid 204 passing through nozzles 26 of the flow restrictors 200. Thus, these features aid in the flushing process to carry debris to surface and to efficiently lubricate the space during deployment.

[0043] In a preferable arrangement, the drill bit 28 is rotated by rotating the production tubing 22 at the surface 14 when the drill bit 28 has reached a pre-detemined depth (e.g. when it has entered the openhole section 20). By activating the drill bit, the openhole section 20 is drilled/reamed and this allows the completion section 26 to reach total depth without becoming stuck.

[0044] Another arrangement of the present invention is illustrated in Fig. 6. The same well 10 as illustrated in the previous figures is shown and reference numerals for like features remain the same. However, in the arrangement of Fig. 6, a motor (preferably a mud motor 30 as illustrated) is provided between the completion section 26 and drill bit 28.

[0045] The mud motor 30 is arranged to drive and control operation of the drill bit 28 and eliminates the requirement to rotate the production tubing 22 at surface 14 to operate the drill bit 28.

[0046] It should be appreciated that the drill bit 28 and /or the motor 30 is intended to remain in place once its final depth has been reached.

[0047] The mud motor 30 operates by means of fluid pumped from the surface through the production tubing 22 (denoted by arrows A). This fluid activates the mud motor 30 which, in turn, operates the drill bit 28. The drill bit 28 preferably comprises a number of nozzles 32 to allow the drilling fluid to exit a face of the drill bit 28. After the drilling fluid has exited through the nozzles 32, and through nozzles 206 in the flow restrictor 200, it can lubricate the drill bit 28 and carry the debris from the face of the drill bit 28 back through the space between the production tubing 22 and the walls of the openhole section 20 and between the production tubing 22 and the production casing 28 to the surface 14 (this is indicated by arrows B).

[0048] Advantages of the present invention have been described above although the present invention is particularly advantageous when used in the completion of horizontal wells.

Claims

1. A method of completing a drilled hydrocarbon well bore (12), comprising the steps of:

inserting a completion arrangement into said drilled well bore (12), the completion arrangement comprising:

a completion section (26) having means (202) for allowing hydrocarbons to pass therein from reservoir rock (16) in which the well bore (12) is formed, said means (202) also arranged to serve as flushing portals whereby drilling fluid introduced into the completion section (26) via production tubing (22) is arranged to flow via said means (202) into a space (208) between said completion arrangement and said well bore (12) and circulate in said space (208); and impacting formations (28) coupled to an end of the completion section (26) ; and

at least one of introducing drilling fluid into said completion arrangement for flow via said means (202) into said space (208) and driving said impacting formations (28) so as to move relative to the drilled well bore (12) to remove obstructing

material from the drilled well bore (12) during insertion of the completion arrangement into the well bore.

2. A method according to Claim 1, wherein said driving step comprises rotating said production tubing (22) to drive said impacting formations (28).

3. A method according to Claim 1, further comprising the step of: locating a motor (30) between said completion section (26) and said impacting formations (28); wherein said driving step comprises activating said motor (30) by means of fluid pumped to said motor (30) via production tubing (22) coupled to said completion section (26) such that said motor (30) can operate said impacting formations (28).

4. A method according to Claim 1, 2 or 3, comprising introducing drilling fluid into said completion arrangement for flow via said means (202) into said space (208) to remove obstructing material from the drilled well bore (12), and then permitting hydrocarbons to flow from said space (208) via said means (202) to be produced to surface (14) via production tubing (22).

5. A method according to any preceding Claim, comprising both introducing drilling fluid into said completion arrangement for flow via said means (202) into said space (208) and driving said impacting formations (28) so as to move relative to the drilled well bore (12) to remove obstructing material from the drilled well bore (12) during insertion of the completion arrangement into the well bore (12).

6. A method according to any preceding Claim, wherein the impacting formations (28) comprise a drill bit and/or a ream-in shoe.

7. A completion arrangement for a drilled hydrocarbon well bore (12) comprising:

a completion section (26) arranged to be coupled to production tubing (22) and having means (202) to allow hydrocarbons to pass therein from reservoir rock (16) in which the well bore (12) is formed, said means (202) also arranged to serve as flushing portals, whereby drilling fluid introduced into said production tubing (22) is arranged to flow via said means (202) into a space (208) between said production tubing (22) and said well bore (12) and circulate in said space (208); and
impacting formations (28) coupled to an end of the completion section (26) and being operable by being drivingly moveable relative to the drilled well bore (12),
wherein one, or both, of arranging said means (202) to permit circulation of said drilling fluid in said space (208) and operation of said impacting formations (28) removes obstructing material from the drilled well bore (12), for return to surface (14) by way of said space (208), during insertion of the completion arrangement into the well bore (12).

8. An arrangement according to Claim 7, wherein said means (202) to allow hydrocarbons to pass therein from reservoir rock (16) in which the well bore (12) is formed comprise flow restrictors (202) having at least one nozzle (206).

9. An arrangement according to Claims 7 or 8, wherein said impacting formations comprise (28) a drill bit and/or a ream-in shoe.

10. An arrangement according to any one or more of the preceding claims, wherein said impacting formations (28) are operable by rotating said production tubing (22), to which said impacting formations (28) are coupled via said completion section (26).

11. An arrangement according to any one or more of the preceding claims, further comprising a motor (30) coupled between said completion section (26) and impacting formations (28) and arranged to control operation of said impacting formations (28).

12. An arrangement according to Claim 11, wherein said motor (30) comprises a mud motor operable by means of drilling fluid supplied thereto through said production tubing (22) and completion section (26).

13. An arrangement according to any one or more of the preceding claims, wherein said drilling fluid further serves to lubricate said impacting formations (28).

Patentansprüche

1. Verfahren zum Fertigstellen eines gebohrten Kohlenwasserstoffbohrlochs (12) umfassend die Schritte:

Einführen einer Fertigstellungsanordnung in das gebohrte Bohrloch (12), wobei die Fertigstellungsanordnung umfasst:

einen Fertigstellungsabschnitt (26) mit Mitteln (202) zum Ermöglichen, dass Kohlenwasserstoffe durch die selben aus Speichergestein (16) strömen, in dem das Bohrloch (12) gebildet ist, wobei die Mittel (202) auch als Spülungsportale ausgebildet sind, wodurch das in den Fertigstellungsabschnitt (26) durch eine Förderleitung (22)

eingeführte Bohrfluid so ausgebildet ist, dass es durch die Mittel (202) in einen Raum (208) zwischen der Fertigstellungsanordnung und dem Bohrloch (12) fließt und in dem Raum (208) zirkuliert; und
Schlaganordnungen (28), welche mit einem Ende des Fertigstellungsabschnitts (26) gekoppelt sind; und
mindestens eines von Folgenden: das Einführen eines Bohrfluids in die Fertigstellungsanordnung, damit es durch die Mittel (202) in den Raum (208) fließen kann, und das Antreiben der Schlaganordnungen (28) so dass diese relativ zum gebohrten Bohrloch (12) bewegt werden, um ein verstopfendes Material aus dem gebohrten Bohrloch (12) während des Einführens der Fertigstellungsanordnung in das Bohrloch zu entfernen.

2. Verfahren nach Anspruch 1, wobei der Schritt des Antreibens das Drehen der Förderleitung (22) umfasst, um die Schlaganordnungen (28) anzutreiben.

3. Verfahren nach Anspruch 1, ferner umfassend den Schritt des: Positionierens eines Motors (30) zwischen dem Fertigstellungsabschnitt (26) und den Schlaganordnungen (28); wobei der Schritt des Antreibens das Aktivieren des Motors (30) mittels eines Fluids umfasst, welches zum Motor (30) durch eine Förderleitung (22) gepumpt wird, welche mit dem Fertigstellungsabschnitt (26) gekoppelt ist, sodass der Motor (30) die Schlaganordnungen (28) antreiben kann.

4. Verfahren nach Anspruch 1, 2 oder 3, umfassend das Einführen eines Bohrfluids in die Fertigstellungsanordnung, zum Fließen durch die Mittel (202) in den Raum (208), um verstopfendes Material aus dem gebohrten Bohrloch (12) zu entfernen, und dann das Ermöglichen, dass Kohlenwasserstoffe vom Raum (208) durch die herzustellenden Mittel (202) über die Förderleitung (22) zur Oberfläche (14) strömen.

5. Verfahren nach einem der vorhergehenden Ansprüche, umfassend sowohl das Einführen des Bohrfluids in die Fertigstellungsanordnung zum Fließen durch die Mittel (202) in den Raum (208) als auch das Antreiben der Schlaganordnungen (28), sodass diese sich relativ zu dem gebohrten Bohrloch (12) bewegen, um das verstopfende Material aus dem gebohrten Bohrloch (12) während des Einführens der Fertigstellungsanordnung in das Bohrloch (12) zu entfernen.

6. Verfahren nach einem der vorhergehenden Ansprüche, wobei die Schlaganordnungen (28) einen Bohrmeißel und/oder einen Räumerschuh umfassen.

7. Fertigstellungsanordnung für ein gebohrtes Kohlenwasserstoffbohrloch (12), umfassend:

einen Fertigstellungsabschnitt (26), welcher zum Koppeln mit der Förderleitung (22) ausgebildet ist, und welcher Mittel (202) aufweist, zum Ermöglichen, dass Kohlenwasserstoffe durch den selben aus Speichergestein (16) strömen, in dem das Bohrloch (12) gebildet ist, wobei die Mittel (202) auch als Spülungsportale ausgebildet sind, wodurch das in die Förderleitung (22) eingeführte Bohrfluid so ausgebildet ist, dass es durch die Mittel (202) in einen Raum (208) zwischen der Förderleitung (22) und dem Bohrloch (12) fließt und in dem Raum (208) zirkuliert; und Schlaganordnungen (28), welche mit einem Ende des Fertigstellungsabschnitts (26) gekoppelt sind, und welche so ausgebildet sind, dass sie relativ zum gebohrten Bohrloch (12) antriebsmäßig bewegbar sind;
wobei eines oder beides von Anordnen der Mittel (202), um die Zirkulation des Bohrfluids in dem Raum (208) zu ermöglichen, und Betreiben der Schlaganordnungen (28), das Entfernen des verstopfenden Materials aus dem gebohrten Bohrloch (12) ermöglichen, damit dieses durch den Raum (208), während des Einführens der Fertigstellungsanordnung in das Bohrloch (12), zur Oberfläche (14) zurückkehren kann.

8. Anordnung nach Anspruch 7, wobei die Mittel (202) zum Ermöglichen, dass Kohlenwasserstoffe durch die selben aus Speichergestein (16) strömen können, in dem das Bohrloch (12) gebildet ist, Durchflussbegrenzer (202) umfassen, welche mindestens eine Düse (206) aufweisen.

9. Anordnung nach Anspruch 7 oder 8, wobei die Schlaganordnungen einen Bohrmeißel und/oder einen Räumerschuh umfassen (28).

10. Anordnung nach einem oder mehreren der vorgehenden Ansprüche, wobei die Schlaganordnungen (28) antreibbar sind, indem die Förderleitung (22) gedreht wird, mit der die Schlaganordnungen (28) über die Fertigstellungsanordnung (26) verbunden sind.

11. Anordnung nach einem oder mehreren der vorgehenden Ansprüche, ferner umfassend einen Motor (30), welcher zwischen dem Fertigstellungsabschnitt (26) und den Schlaganordnungen (28) gekoppelt ist, und so ausgebildet ist, um den Betrieb der Schlaganordnungen (28) zu steuern.

12. Anordnung nach Anspruch 11, wobei der Motor (30) einen Schlammotor umfasst, welcher mittels eines Bohrfluids betrieben werden kann, welches durch

die Förderleitung (22) und den Fertigstellungsabschnitt (26) demselben zugeführt werden kann.

13. Anordnung nach einem oder mehreren der vorgehenden Ansprüche, wobei das Bohrfluid ferner zum Schmieren der Schlaganordnungen (28) verwendet wird.

Revendications

1. Procédé d'achèvement d'un puits de forage pétrolier foré (12), comprenant les étapes consistant à :

insérer un dispositif d'achèvement dans ledit puits de forage foré (12), le dispositif d'achèvement comprenant :

une section d'achèvement (26) présentant des moyens (202) permettant de laisser passer des hydrocarbures dans celle-ci à partir d'une roche-réservoir (16) dans laquelle est formé ledit puits de forage (12), lesdits moyens (202) étant également configurés pour servir de portails de rinçage grâce auxquels du fluide de forage introduit dans la section d'achèvement (26) via un tube de production (22) est configuré pour circuler via lesdits moyens (202) jusque dans un espace (208) situé entre ledit dispositif d'achèvement et ledit puits de forage (12) et pour circuler dans ledit espace (208) ; et
des formations percutantes (28) couplées à une extrémité de la section d'achèvement (26) ; et
au moins une étape parmi les étapes consistant à introduire du fluide de forage dans ledit dispositif d'achèvement pour qu'il circule via lesdits moyens (202) jusque dans ledit espace (208) et entraîner lesdites formations percutantes (28) de manière à ce qu'elles se déplacent par rapport au puits de forage foré (12) afin de retirer un matériau obstructif du puits de forage foré (12) pendant une insertion du dispositif d'achèvement dans le puits de forage.

2. Procédé selon la revendication 1, dans lequel ladite étape d'entraînement comprend une étape consistant à faire tourner ledit tube de production (22) afin d'entraîner lesdites formations percutantes (28).

3. Procédé selon la revendication 1, comprenant en outre l'étape consistant à: positionner un moteur (30) entre ladite section d'achèvement (26) et lesdites formations percutantes (28) ; dans lequel ladite étape d'entraînement comprend une étape consistant à activer ledit moteur (30) au moyen d'un fluide pompé vers ledit moteur (30) via un tube de production (22) couplé à ladite section d'achèvement (26) de telle manière que ledit moteur (30) peut faire fonctionner lesdites formations percutantes (28).

4. Procédé selon l'une quelconque des revendications 1, 2 ou 3, comprenant une étape consistant à introduire du fluide de forage dans ledit dispositif d'achèvement afin qu'il circule via lesdits moyens (202) jusque dans ledit espace (208) afin de retirer un matériau obstructif du puits de forage foré (12), et permettre ensuite à des hydrocarbures de circuler à partir dudit espace (208) via lesdits moyens (202) afin d'être produites vers la surface (14) via le tube de production (22).

5. Procédé selon l'une quelconque des revendications précédentes, comprenant à la fois les étapes consistant à introduire du fluide de forage dans ledit dispositif d'achèvement afin qu'il circule via lesdits moyens (202) jusque dans ledit espace (208) et à entraîner lesdites formations percutantes (28) de manière à ce qu'elles se déplacent par rapport au puits de forage foré (12) afin de retirer le matériau obstructif du puits de forage foré (12) pendant une insertion du dispositif d'achèvement dans le puits de forage (12).

6. Procédé selon l'une quelconque des revendications précédentes, dans lequel les formations percutantes (28) comprennent un trépan et/ou un sabot aléseur.

7. Dispositif d'achèvement pour un puits de forage pétrolier foré (12), comprenant :

une section d'achèvement (26) configurée de manière à être couplée au tube de production (22) et présentant des moyens (202) destinés à laisser passer des hydrocarbures dans celle-ci à partir d'une roche-réservoir (16) dans laquelle est formé le puits de forage (12), lesdits moyens (202) étant également configurés pour servir de portails de rinçage, grâce auxquels du fluide de forage introduit dans ledit tube de production (22) est configuré pour circuler via lesdits moyens (202) jusque dans un espace (208) situé entre ledit tube de production (22) et ledit puits de forage (12) et pour circuler dans ledit espace (208) ; et
des formations percutantes (28) couplées à une extrémité de la section d'achèvement (26) et pouvant fonctionner en étant mobile par entraînement par rapport au puits de forage foré (12), dans lequel une étape, ou les deux étapes, parmi l'étape de configuration desdits moyens (202) afin de permettre une circulation dudit fluide de forage dans ledit espace (208) et l'étape

d'utilisation desdites formations percutantes (28) retire(nt) du matériau obstructif du puits de forage foré (12), pour le renvoyer vers la surface (14) en passant par ledit espace (208), pendant une insertion du dispositif d'achèvement dans le puits de forage (12).

8. Dispositif selon la revendication 7, dans lequel lesdits moyens (202) destinés à laisser entrer des hydrocarbures à partir d'une roche-réservoir (16) dans laquelle est formé le puits de forage (12) comprennent des limiteurs de débit (202) présentant au moins une buse (206).

9. Dispositif selon la revendication 7 ou 8, dans lequel lesdites formations percutantes (28) comprennent un trépan et/ou un sabot aléseur.

10. Dispositif selon l'une quelconque ou plusieurs des revendications précédentes, dans lequel lesdites formations percutantes (28) peuvent être utilisées en faisant tourner ledit tube de production (22), auquel sont couplées lesdites formations percutantes (28), via ladite section d'achèvement (26).

11. Dispositif selon l'une quelconque ou plusieurs des revendications précédentes, comprenant en outre un moteur (30) couplé entre ladite section d'achèvement (26) et lesdites formations percutantes (28) et configuré pour commander un fonctionnement desdites formations percutantes (28).

12. Dispositif selon la revendication 11, dans lequel ledit moteur (30) comprend un moteur à boue pouvant fonctionner au moyen du fluide de forage fourni à celui-ci par l'intermédiaire dudit tube de production (22) et de la section d'achèvement (26).

13. Dispositif selon l'une quelconque ou plusieurs des revendications précédentes, dans lequel ledit fluide de forage sert en outre à lubrifier lesdites formations percutantes (28).

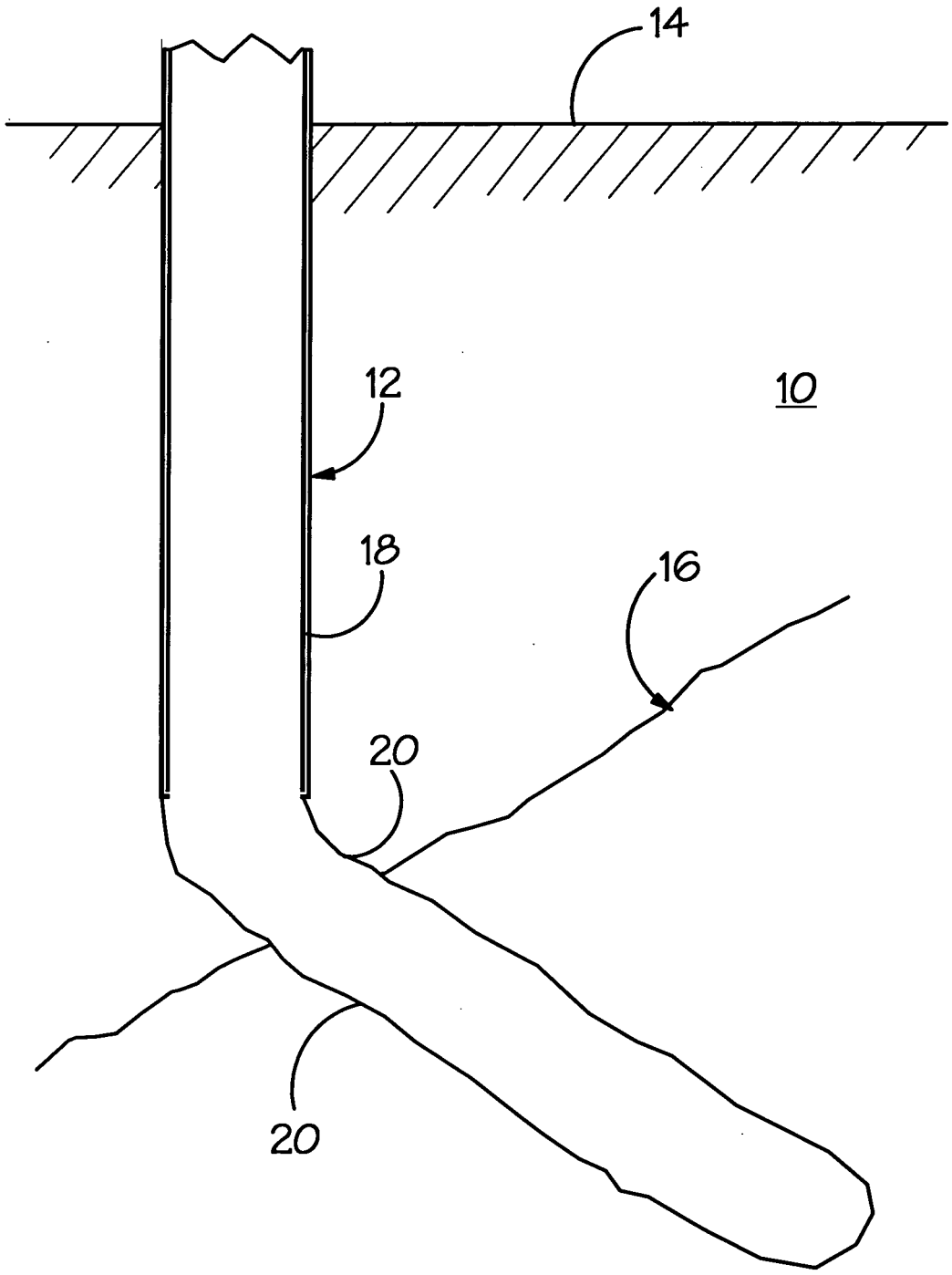

FIG.1.

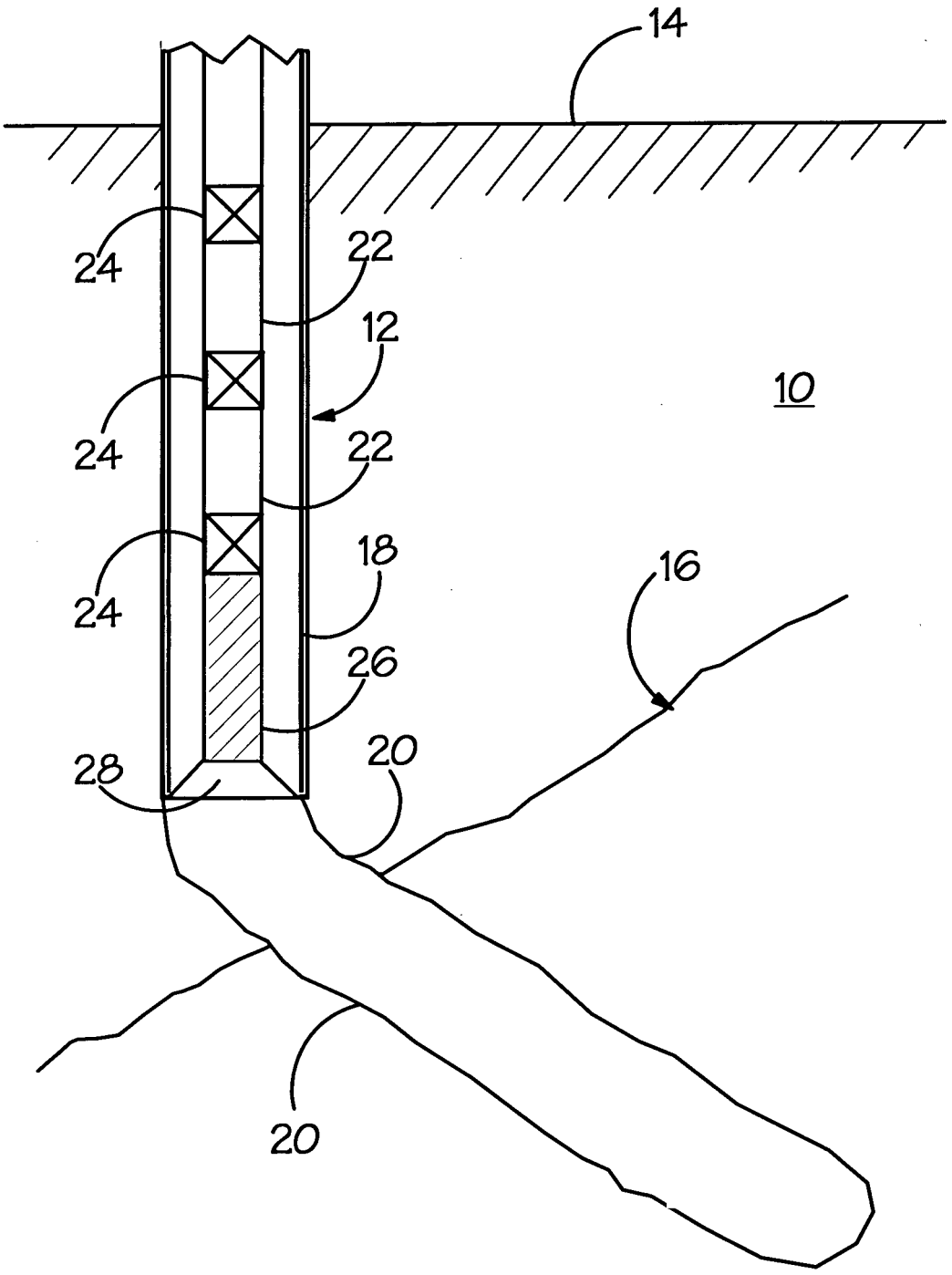

FIG.2.

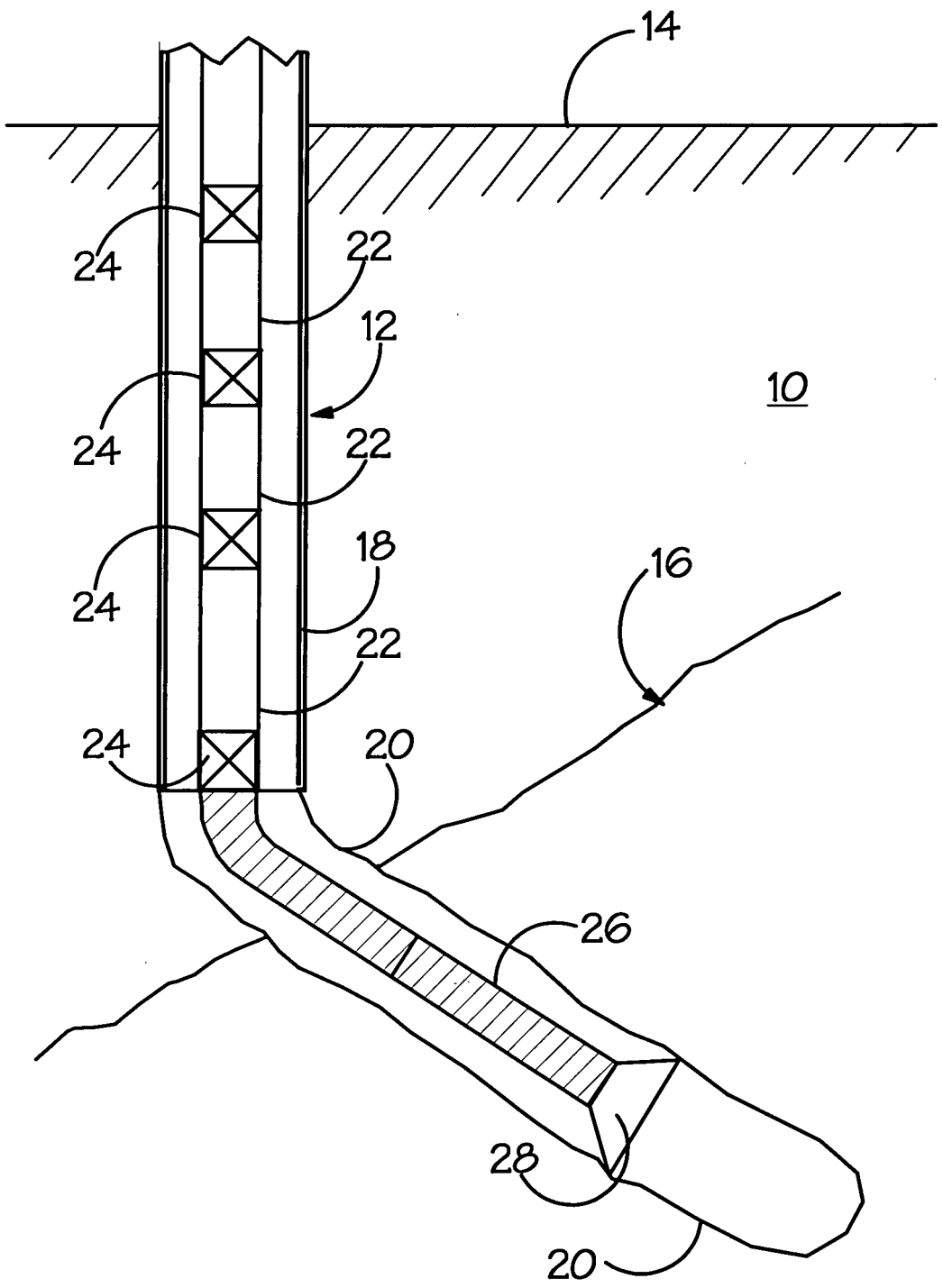

FIG.3.

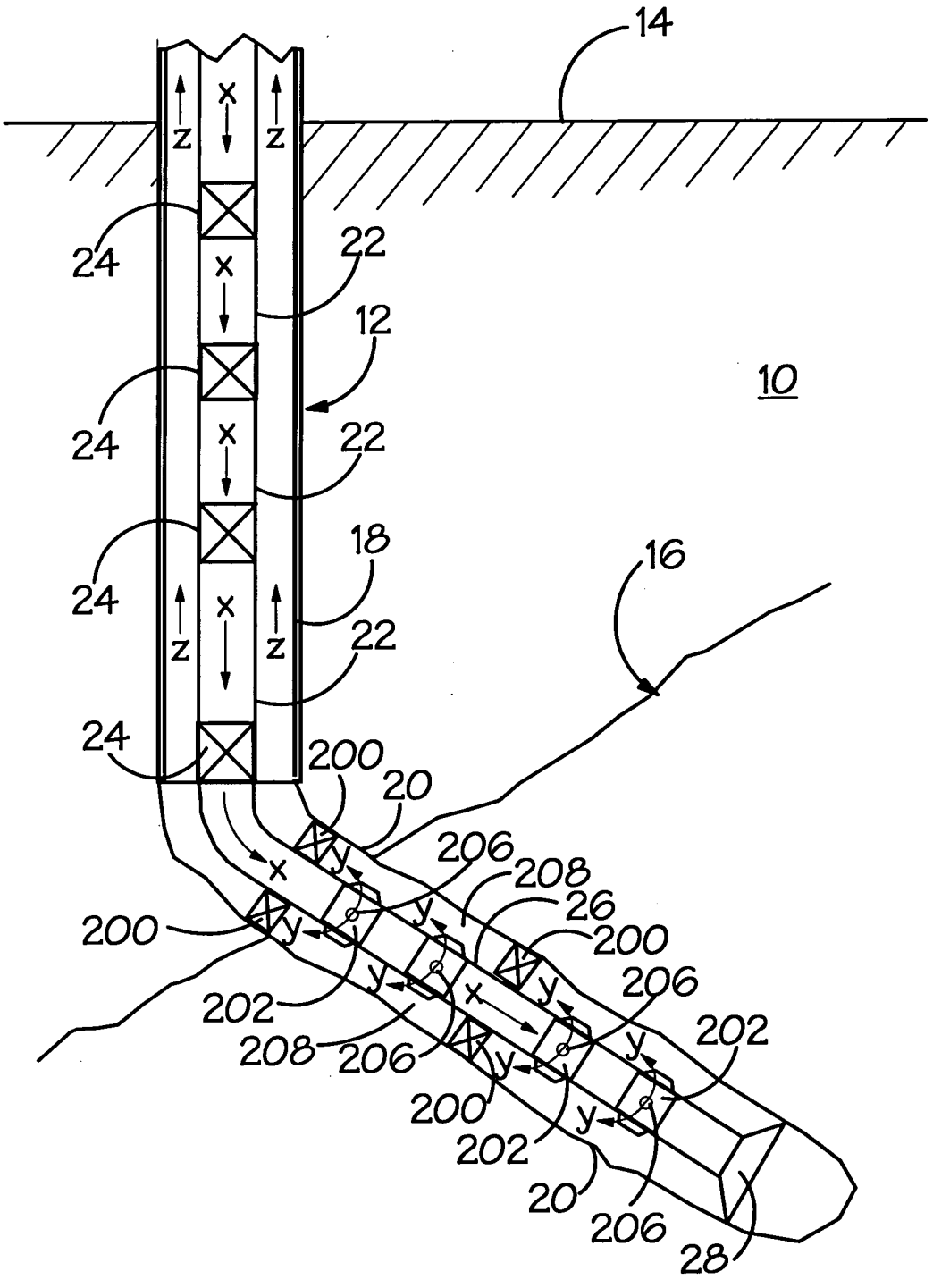

FIG.4.

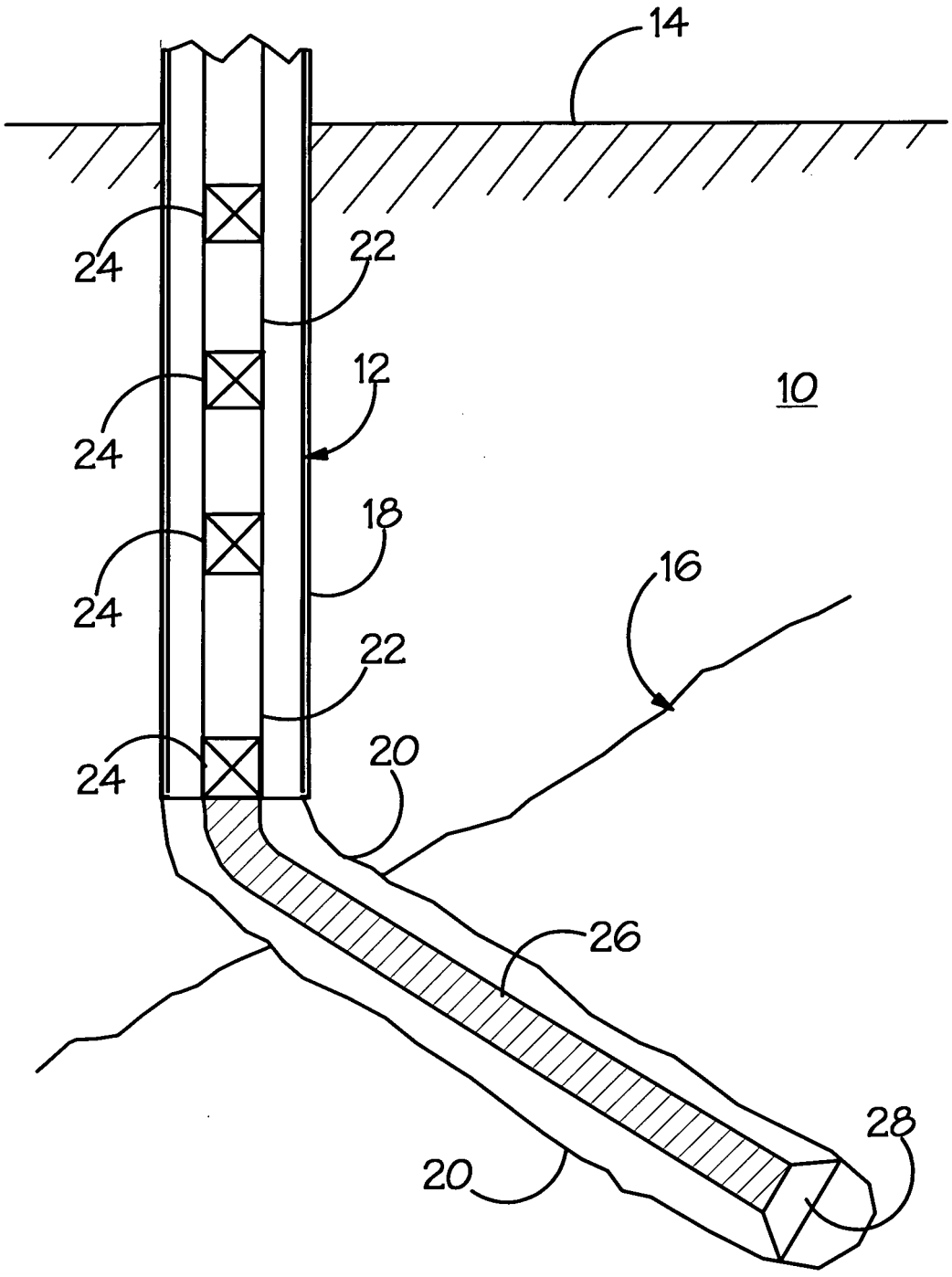

FIG.5.

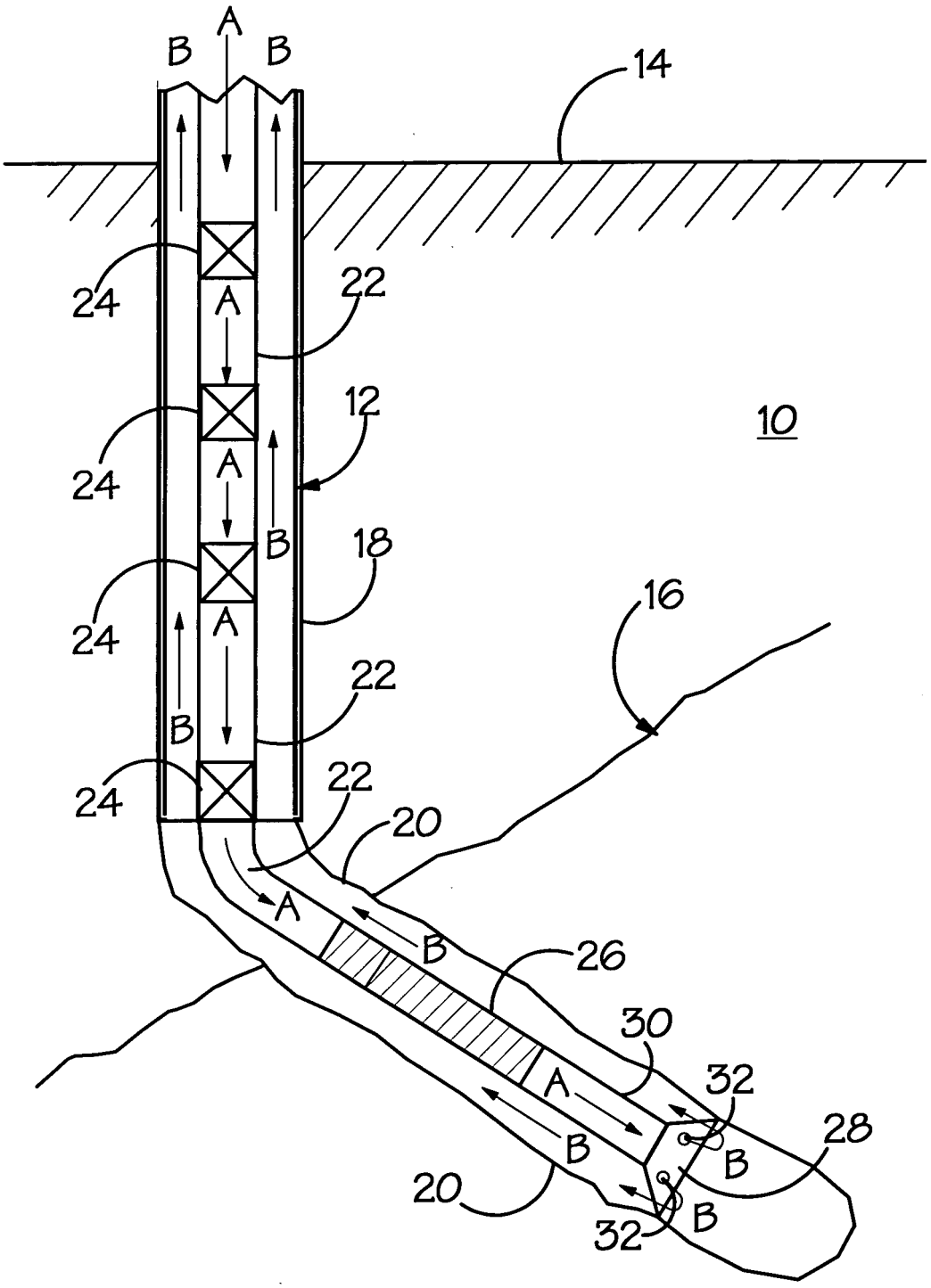
A
B
B
14
24
22
A
12
10
24
A
B
18
24
A
16
22
B
24
22
20
A
B
26
30
A
32
28
B
B
20
B
32

FIG.6.

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- WO 2008043985 A **[0007]**
- GB 2416551 A **[0008]**
- WO 2005042916 A **[0009]**
- EP 0713951 A **[0010]**
- EP 0697501 A **[0011]**
- WO 2007094900 A **[0012]**