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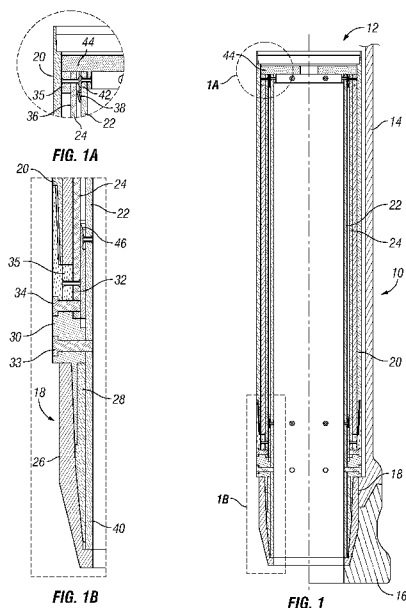
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(54) Title: TELESCOPING CORE BARREL



(57) Abstract: A coring assembly (10) comprises a shoe (18) and a tubular body (20) having a first end coupled to the shoe. An inner sleeve (22) is releasably coupled to the shoe and has a first end (40) disposed within the shoe and a second end (42) that is slidably engaged with the tubular body. A middle sleeve (24) is slidably engaged with the tubular body and releasably coupled to the shoe. At least a portion of the middle sleeve is disposed within an annulus defined by the inner sleeve and the tubular body.

TELESCOPING CORE BARREL

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to U.S. Patent Application Serial No. 61/676,011, titled Telescoping Core Barrel, which was filed July 26, 2012. This priority application is hereby incorporated by reference in its entirety into the present application, to the extent that it is not inconsistent with the present application.

BACKGROUND

[0002] This disclosure relates generally to methods and apparatus for acquiring cores from subterranean formations. More particularly, this disclosure relates to methods and apparatus for mitigating the effects of core jamming by utilizing a telescoping core barrel to acquire a core from a subterranean formation.

[0003] Formation coring is a well-known process for obtaining a sample of a subterranean formation for analysis. In conventional coring operations, a specialized drilling assembly is used to obtain a cylindrical sample of material, or “core,” from the formation so that the core can be brought to the surface. Once at the surface, the core can be analyzed to reveal formation data such as permeability, porosity, and other formation properties that provide information as to the type of formation being drilled and/or the types of fluids contained within the formation.

[0004] As a core is being drilled, it is received within an elongated tubular receptacle, known as a barrel. As the core moves into the barrel it can become stuck, or “jammed,” in the barrel, and prevent additional core from moving into the barrel. Once a jam occurs, the drilled core is subjected to increased compressive loads until the coring operation is stopped. Often, the increased compressive loads can damage the core before the coring operation can be stopped. Thus, in many instances, a core jam can result in an insufficient length of core being obtained and/or damage the core that can compromise the desired analysis. Therefore, in conventional coring operations, when a core jam is detected, the coring operation is halted and the tools are brought back to the surface. This can be especially costly in deep wells where it may take several hours to retrieve the coring tools from the bottom of the well.

[0005] Thus, there is a continuing need in the art for methods and apparatus for acquiring cores that overcome these and other limitations of the prior art.

BRIEF SUMMARY OF THE DISCLOSURE

[0006] A coring assembly comprises a shoe and a tubular body having a first end coupled to the shoe. An inner sleeve is releasably coupled to the shoe and has a first end disposed within the shoe and a second end that is slidably engaged with the tubular body. A middle sleeve is slidably engaged with the tubular body and releasably coupled to the shoe. At least a portion of the middle sleeve is disposed within an annulus defined by the inner sleeve and the tubular body.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] For a more detailed description of the embodiments of the present disclosure, reference will now be made to the accompanying drawings, wherein:

[0008] Figure 1 is partial sectional view of an exemplary coring assembly including a telescoping core barrel.

[0009] Figure 1A is a detailed view of the upper end of the coring assembly of Figure 1.

[0010] Figure 1B is a detailed view of the lower end of the coring assembly of Figure 1.

[0011] Figure 2 is a partial sectional view of the coring assembly of Figure 1 shown in a first position wherein the inner and middle sleeves are coupled to the shoe.

[0012] Figure 3 is a partial sectional view of the coring assembly of Figure 1 shown in a second position wherein the inner sleeve is moved axially relative to the shoe.

[0013] Figure 4 is a partial sectional view of the coring assembly of Figure 1 shown in a third position where the inner sleeve and the middle sleeve are moved axially relative to the shoe.

DETAILED DESCRIPTION

[0014] It is to be understood that the following disclosure describes several exemplary embodiments for implementing different features, structures, or functions of the invention. Exemplary embodiments of components, arrangements, and configurations are described below to simplify the present disclosure; however, these exemplary embodiments are provided merely as examples and are not intended to limit the scope of the invention. Additionally, the present disclosure may repeat reference numerals and/or letters in the various exemplary embodiments and across the Figures provided herein. This repetition is for the purpose of simplicity and clarity and does not in itself dictate a relationship between the various exemplary embodiments

and/or configurations discussed in the various figures. Moreover, the formation of a first feature over or on a second feature in the description that follows may include embodiments in which the first and second features are formed in direct contact, and may also include embodiments in which additional features may be formed interposing the first and second features, such that the first and second features may not be in direct contact. Finally, the exemplary embodiments presented below may be combined in any combination of ways, i.e., any element from one exemplary embodiment may be used in any other exemplary embodiment, without departing from the scope of the disclosure.

[0015] Additionally, certain terms are used throughout the following description and claims to refer to particular components. As one skilled in the art will appreciate, various entities may refer to the same component by different names, and as such, the naming convention for the elements described herein is not intended to limit the scope of the invention, unless otherwise specifically defined herein. Further, the naming convention used herein is not intended to distinguish between components that differ in name but not function. Additionally, in the following discussion and in the claims, the terms "including" and "comprising" are used in an open-ended fashion, and thus should be interpreted to mean "including, but not limited to." All numerical values in this disclosure may be exact or approximate values unless otherwise specifically stated. Accordingly, various embodiments of the disclosure may deviate from the numbers, values, and ranges disclosed herein without departing from the intended scope. Furthermore, as it is used in the claims or specification, the term "or" is intended to encompass both exclusive and inclusive cases, i.e., "A or B" is intended to be synonymous with "at least one of A and B," unless otherwise expressly specified herein.

[0016] Referring initially to Figure 1, coring assembly 10 includes an inner barrel assembly 12 that is disposed within an outer barrel 14 and a coring bit 16, which is coupled to the outer barrel 14. In operation, the outer barrel 14 and coring bit are disposed in a wellbore and rotated so that the coring bit 16 cuts a core of material from the formation. As the core of material is cut, it moves through the coring bit 16 and into the inner barrel assembly 12. The inner barrel assembly 12 is not rotationally coupled to the outer barrel 14 or coring bit 16 so that the inner barrel assembly 12 can remain rotationally stationary as the core is being drilled.

[0017] The inner barrel assembly 12 includes a shoe assembly 18, a tubular body 20, an inner sleeve 22, and a middle sleeve 24. The inner sleeve 22 and middle sleeve 24 are releasably coupled to the shoe assembly 18 and are operable to telescope relative to each other and the

tubular body 20 once released from the shoe assembly 18. As will be discussed in detail to follow, the telescoping sleeves 22, 24 allow for up to three core jams to occur without interrupting the coring process. The sleeves 22, 24 can be manufactured from a metal, plastic, or composite material.

[0018] At the beginning of the coring process, the inner sleeve 22 and middle sleeve 24 are releasably coupled to the shoe assembly 18. The shoe assembly 18 includes a lower shoe 26 that houses a core catcher 28 and an upper shoe 30 that is coupled to the tubular body 20 by thread 21. The inner sleeve 22 has a first end 40 that can be releasably coupled to the upper shoe 30 by a frangible member 33. The inner sleeve 22 also has a second end 42 that can be coupled to an end cap 44 that is slidably engaged with the tubular body 20. The middle sleeve 24 has a first end 32 that is releasably coupled to the upper shoe 30 by a frangible member 34. The middle sleeve 24 also has a second end 36 that has a stop member 38 that is coupled to the inner surface of the middle sleeve 24 and extends into the annulus 39 defined by the inner sleeve 22 and the middle sleeve 24. As used in the following discussion and the claims, the term “slidably engaged” means two components that are in contact or a close relationship that allows relative sliding movement between the two components.

[0019] Frangible members 33, 34 may be shear pins, screws, rivets, rings, or a combination thereof that are selected to break and release the sleeve from the shoe assembly once a pre-selected shearing force is applied to the frangible members. In other embodiments, the sleeves 22, 24 may be releasably coupled to the shoe assembly 18 by other releasable members or mechanisms, such as a latch or collet that are configured to release once a predetermined force is applied.

[0020] During coring, once a core jams occurs in the sleeve or the core fills the length of sleeve, continued movement of the coring assembly 10 through the wellbore will generate a longitudinal force that will break the frangible member 33, 34 and release the sleeve 22, 24 from the shoe assembly 18. Once released, the sleeve 22, 24 can move longitudinally relative to the tubular body 20 as more core is drilled.

[0021] The inner sleeve 22 and the middle sleeve 24 are slidably engaged with the tubular body 20 so that as the sleeves telescope they maintain alignment with the tubular body 20. The middle sleeve 24 is slidably engaged with the tubular body 20 via one or more stabilizers 35 that are coupled to the outer surface of the middle sleeve 24. The stabilizers 35 act to maintain the middle sleeve 24 in a position substantially aligned with the centerline of the tubular body

20 and the coring bit 16. The stabilizers 35 can also reduce sliding friction between the middle sleeve 24 and the tubular body 20 and prevent the middle sleeve 24 from becoming stuck within the tubular body 20. The stabilizers 35 can be constructed from metal, plastic, or a composite material.

[0022] The inner sleeve 22 is slidably engaged with the tubular body 20 via the end cap 44 and stop member 46. The stop member 46 extends outward from the inner sleeve 22 into the annulus defined by the inner sleeve 22 and the middle sleeve 24. The stop member 46 is disposed at a location proximate to the first end 40 of the inner sleeve 22 and is slidably engaged with the middle sleeve 24. Thus, the engagement of the end cap 44 with the tubular body 20 combined with the engagement of the stop member 46 with the middle sleeve 24 act to maintain the inner sleeve 22 in a position substantially aligned with the centerline of the tubular body 20 and the coring bit 16. Maintaining the alignment between the inner sleeve 22, the middle sleeve 24, and the tubular body 20 can reduce the likelihood of the core jamming due to misalignment between inner barrel assembly 12 and the coring bit 16.

[0023] The likelihood of core jamming can also be reduced by the first end 40 of the inner sleeve 22 being disposed proximate to the core catcher 28 so that substantially the entire inner surface of the core catcher 28 is initially covered by the inner sleeve 22. When coring operations are commenced, the leading edge of the core has to pass from the interior of the coring bit 16 into the inner sleeve 22. Disposing the first end 40 of inner sleeve 22 as close as possible to coring bit 16 reduces the likelihood that the core can become jammed in the core catcher 26 before entering the inner sleeve 22.

[0024] Referring now to Figure 2, the inner barrel assembly 10 is shown receiving a core 50. Coring bit 16 and outer barrel 14 (not shown) are rotated and advanced through a formation to form core 50. As drilling is started, the leading edge 52 of the core 50 is received in the inner sleeve 22. As drilling continues, the leading edge 52 of the core 50 moves farther into the inner sleeve 22 until the leading edge 52 reaches the top cap 44 or the core 50 becomes jammed in the inner sleeve 22.

[0025] Continued drilling after the core 50 is jammed in inner sleeve 22, or the leading edge 52 contacts the top cap 44, causes the frangible member 33 to break and releases the inner sleeve 22 from the shoe assembly 18. Once released from the shoe assembly 18, the inner sleeve 22 moves longitudinally relative to the middle sleeve 24 and the tubular body 20. The stop member 46 is slidably engaged with the middle sleeve 24 and the top cap 44 is slidably

engaged with tubular body 20 so that the inner sleeve 22 remains centered within the inner barrel assembly 12.

[0026] Referring now to Figure 3, the inner sleeve 22 is shown in a position released from the shoe assembly 18. Continued drilling with coring bit 14 will move the inner sleeve 22 relative to the middle sleeve 24. Once the lower end 40 of the inner sleeve 22 passes the lower end 32 of the middle sleeve 24, the middle sleeve 24 will be exposed to the core 52. As drilling continues, the core 52 moves the inner sleeve 22 relative to the middle sleeve 24 until the core becomes jammed in the middle sleeve 24 or until the stop member 46 on the inner sleeve 22 contacts the stop member 38 on the middle sleeve 24.

[0027] The engagement of the inner sleeve stop member 46 with the middle sleeve stop member 38 or jamming of the core 52 within the middle sleeve 24 acts to longitudinally fix the inner sleeve 22 to the middle sleeve 24. Continued drilling of the core 52 after the inner sleeve 22 and middle sleeve 24 are longitudinally fixed causes frangible member 34 to break and releases the middle sleeve 24 from the shoe assembly 18. Once released from the shoe assembly 18, the inner sleeve 22 and the middle sleeve 24 move longitudinally relative to tubular body 20 as drilling of the core 52 continues.

[0028] Referring now to Figure 4, the inner sleeve 22 and middle sleeve 24 are shown in a position released from the shoe assembly 18. Continued drilling of the core 52 will move the inner sleeve 22 and the middle sleeve 24 relative to tubular body 20. As the middle sleeve 24 moves away from the shoe assembly 18, the tubular body 20 will be exposed to the core 52. As drilling continues, the core 52 moves the inner sleeve 22 and middle sleeve 24 until the inner sleeve 22 reaches the top end of the tubular body 20 or the core 52 jams in the tubular body 20. The coring assembly 10 can then be removed from the formation 50.

[0029] While the disclosure is susceptible to various modifications and alternative forms, specific embodiments thereof are shown by way of example in the drawings and description. It should be understood, however, that the drawings and detailed description thereto are not intended to limit the disclosure to the particular form disclosed, but on the contrary, the intention is to cover all modifications, equivalents and alternatives falling within the spirit and scope of the present disclosure.

What is claimed is:

1. A coring assembly comprising:
 - a shoe;
 - a tubular body having a first end coupled to the shoe;
 - an inner sleeve releasably coupled to the shoe, wherein the inner sleeve has a first end disposed within the shoe and a second end that is slidably engaged with the tubular body; and
 - a middle sleeve slidably engaged with the tubular body and releasably coupled to the shoe, wherein at least a portion of the middle sleeve is disposed within an annulus defined by the inner sleeve and the tubular body.
2. The coring assembly of claim 1, further comprising a stop member coupled to the inner sleeve and operable to limit longitudinal movement of the inner sleeve relative to the middle sleeve.
3. The coring assembly of claim 1, further comprising one or more stabilizers disposed on an outer surface of the middle sleeve and slidably engaged with the tubular body.
4. The coring assembly of claim 1, further comprising a coring bit, wherein the shoe is at least partially disposed within the coring bit.
5. The coring assembly of claim 4, further comprising an outer barrel coupled to the coring bit, wherein the tubular body is disposed within the outer barrel.
6. The coring assembly of claim 4, wherein the shoe comprises a core catcher that is at least partially disposed within the coring bit.
7. The coring assembly of claim 6, wherein the first end of the inner sleeve is at least partially disposed within the core catcher.
8. The coring assembly of claim 1, further comprising:
 - one or more inner sleeve frangible members that releasably couple the inner sleeve to the shoe; and

one or more second frangible members that releasably couple the middle sleeve to the shoe.

9. A coring assembly comprising:

a coring bit;

an outer barrel having a first end coupled to the coring bit;

an inner barrel rotatably disposed within the outer barrel;

a shoe coupled to the inner barrel and at least partially disposed within the coring bit;

a middle sleeve slidably engaged with the inner barrel and releasably coupled to the shoe; and

an inner sleeve releasably coupled to the shoe, wherein the inner sleeve has a first end at least partially disposed within the shoe, a body at least partially disposed within the middle sleeve, and a second end slidably engaged with the inner barrel.

10. The coring assembly of claim 9, further comprising a stop member coupled to the inner sleeve and operable to limit longitudinal movement of the inner sleeve relative to the middle sleeve.

11. The coring assembly of claim 9, further comprising one or more stabilizers disposed on an outer surface of the middle sleeve and slidably engaged with the inner barrel.

12. The coring assembly of claim 9, wherein the shoe comprises a core catcher that is at least partially disposed within the coring bit.

13. The coring assembly of claim 12, wherein the first end of the inner sleeve is at least partially disposed within the core catcher.

14. The coring assembly of claim 9, further comprising:

one or more inner sleeve frangible members that releasably couple the inner sleeve to the shoe; and

one or more second frangible members that releasably couple the middle sleeve to the shoe.

15. A method for coring comprising:
 - rotating a coring bit in a formation to form a core;
 - receiving the core into an inner sleeve that is coupled to a shoe and has a first end disposed within the coring bit;
 - releasing the inner sleeve from the shoe;
 - moving the inner sleeve longitudinally relative to a middle sleeve that is releasably coupled to the shoe;
 - receiving the core into the middle sleeve;
 - releasing the middle sleeve from the shoe; and
 - moving the middle sleeve longitudinally relative to a tubular body that is coupled to the shoe, wherein the inner sleeve and the middle sleeve are both slidably engaged with the tubular body.
16. The method of claim 15, wherein a stop member is coupled to the inner sleeve and is operable to limit longitudinal movement of the inner sleeve relative to the middle sleeve.
17. The method of claim 15, wherein one or more stabilizers are disposed on an outer surface of the middle sleeve and slidably engaged with the tubular body.
18. The method of claim 15, wherein the shoe comprises a core catcher that is at least partially disposed within the coring bit.
19. The method of claim 15, wherein the first end of the inner sleeve is at least partially disposed within the core catcher.
20. The method of claim 15, wherein the inner sleeve is coupled to the shoe by one or more inner sleeve frangible members and the middle sleeve is coupled to the shoe by one or more second frangible members.

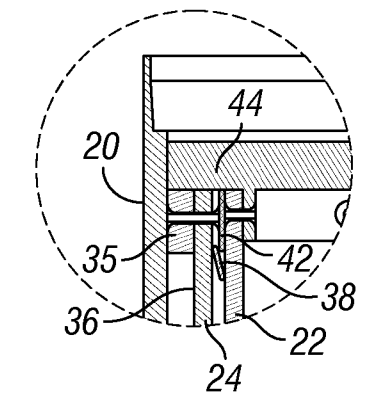


FIG. 1A

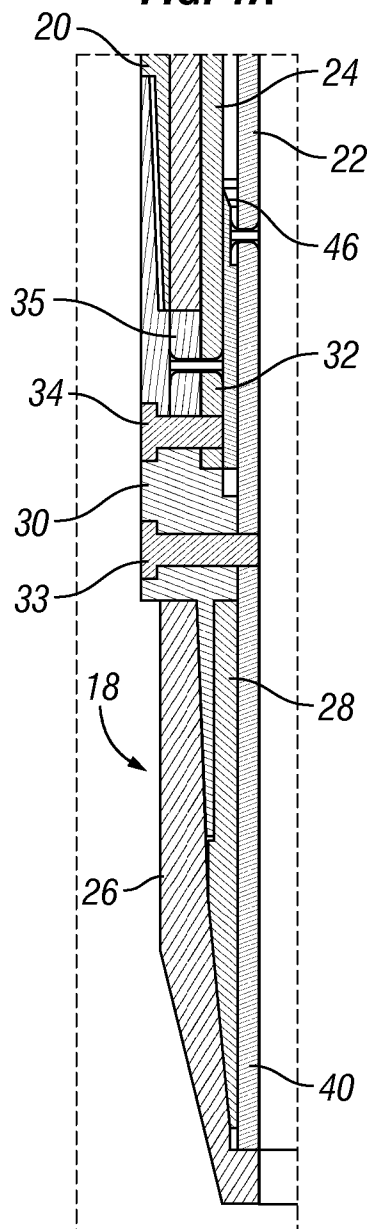


FIG. 1B

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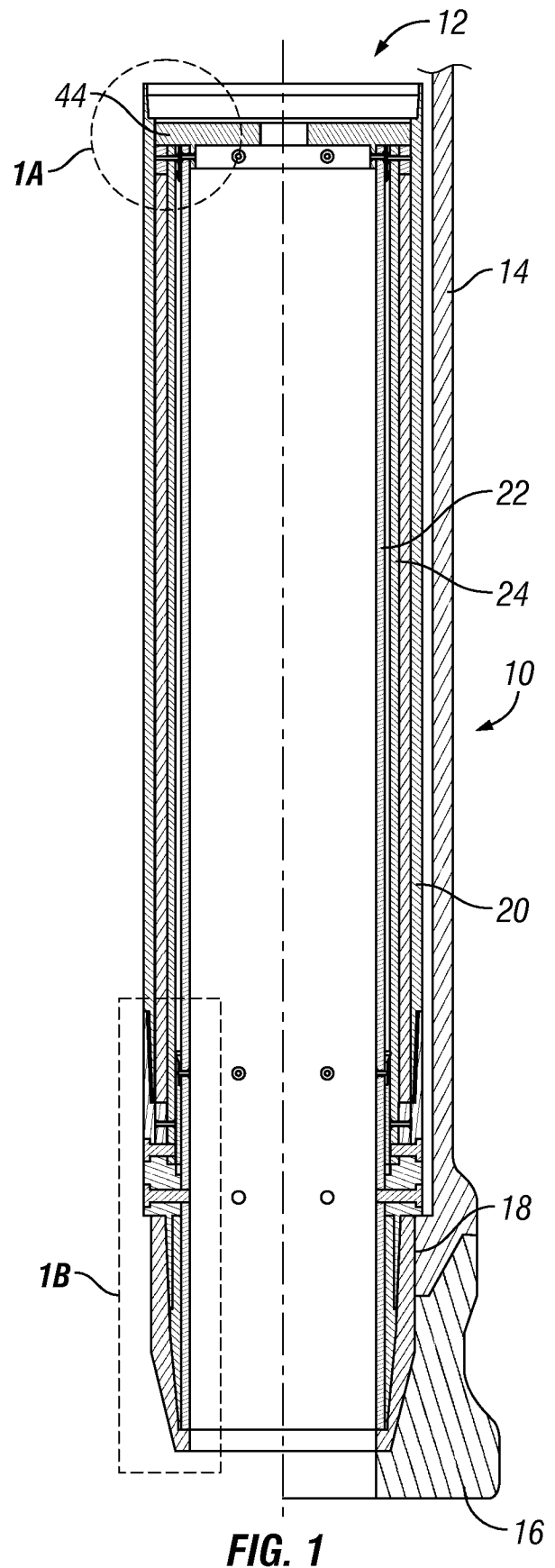


FIG. 1

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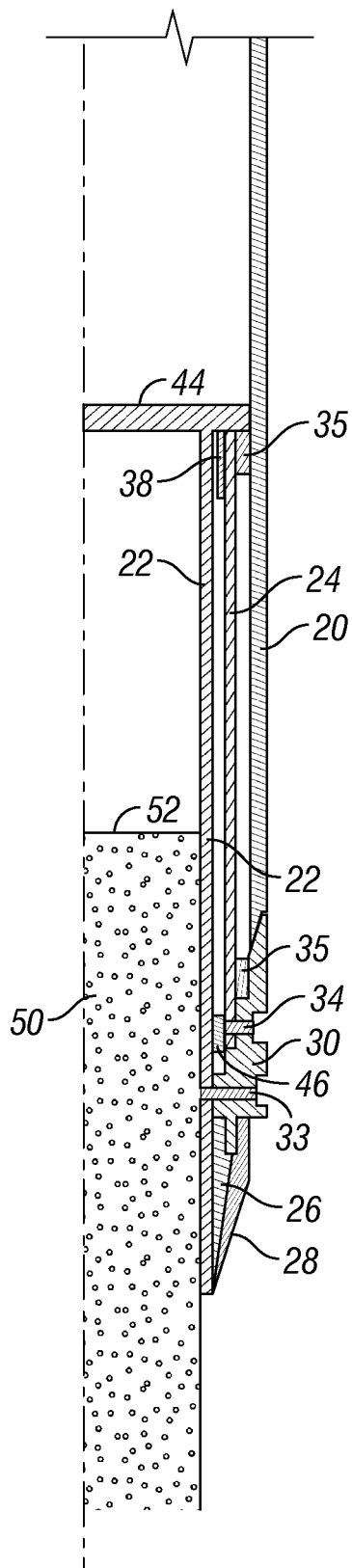


FIG. 2

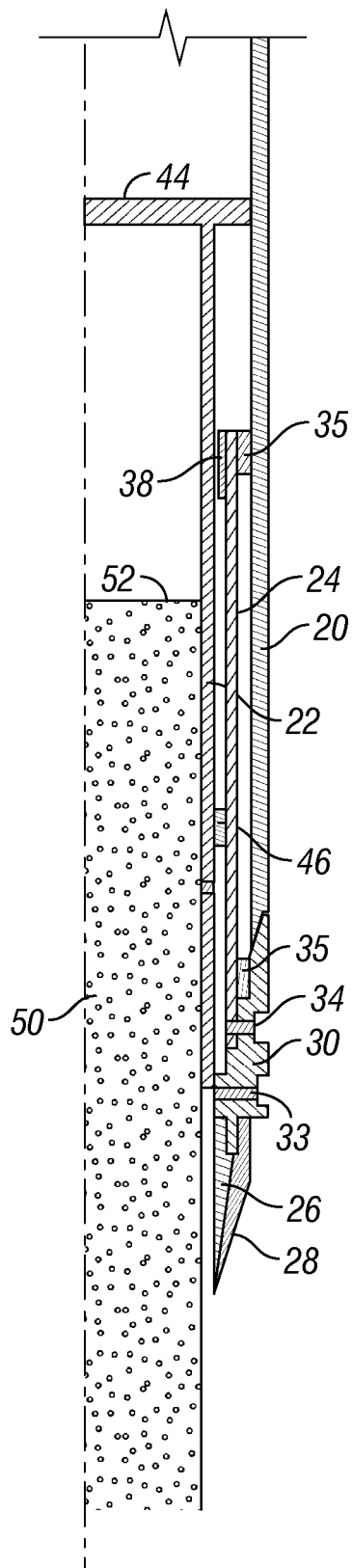


FIG. 3

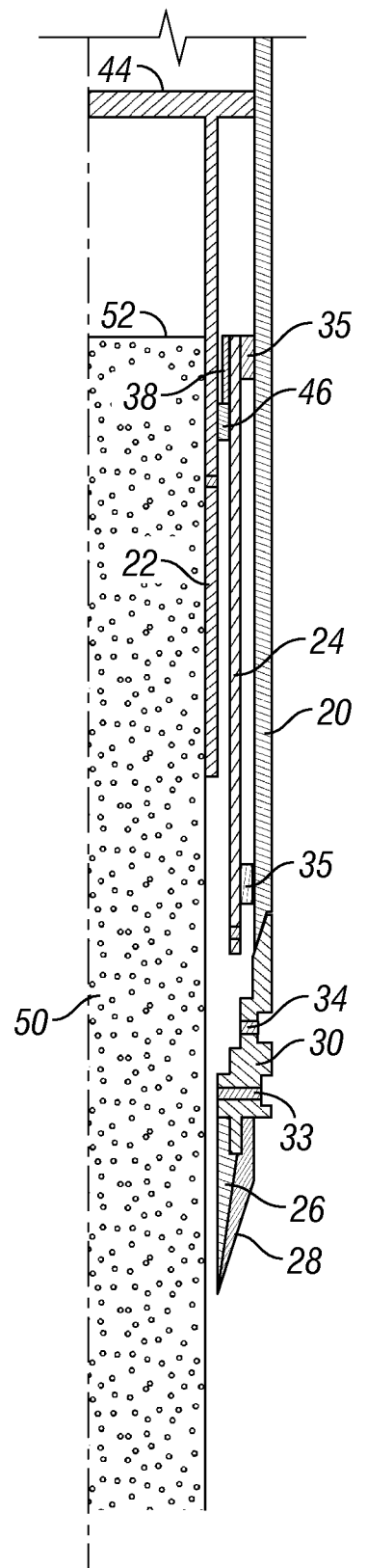


FIG. 4

INTERNATIONAL SEARCH REPORT

International application No
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A. CLASSIFICATION OF SUBJECT MATTER
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ADD.

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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)

EP0-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	WO 94/28281 A1 (BERG EGIL [NO]; TORGRIMSEN TOR [NO]) 8 December 1994 (1994-12-08) abstract figures 1,2 page 2, line 29 - page 4, line 12 -----	1-5, 8-11, 14-17,20
X	US 2 032 423 A (LARSON LEWIS A ET AL) 3 March 1936 (1936-03-03) figures 1-5 page 1, column 1, line 1 - line 6 page 1, column 1, line 21 - line 26 page 1, column 2, line 52 - page 2, column 1, line 8 page 2, column 1, line 43 - line 62 ----- -/--	1-20



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INTERNATIONAL SEARCH REPORT

International application No
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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	SU 1 106 891 A1 (TOMSK POLT I [SU]) 7 August 1984 (1984-08-07) abstract figures 1,2	1-3,6,7, 10-13, 15-19
A	----- US 4 605 075 A (RADFORD STEVEN R [US] ET AL) 12 August 1986 (1986-08-12) abstract figures 1-3 column 3, line 13 - line 27 column 3, line 51 - line 58 column 3, line 64 - line 67 column 4, line 66 - column 5, line 16 column 6, line 31 - line 36 column 6, line 46 - line 51 -----	1-20

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2013/052024

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