



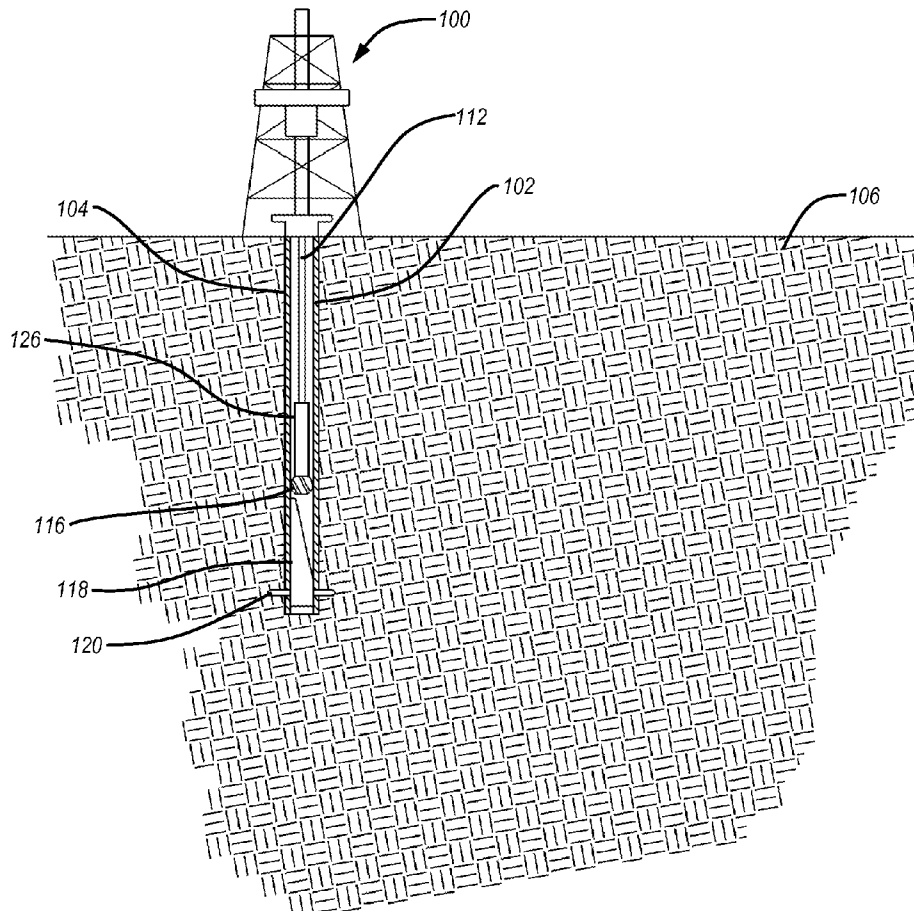
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(19) **United States**(12) **Patent Application Publication**
Utter et al.(10) **Pub. No.: US 2014/0360723 A1**(43) **Pub. Date: Dec. 11, 2014**(54) **PROTECTIVE SHEATH THROUGH A CASING WINDOW**(71) Applicant: **Smith International, Inc.**, Houston, TX (US)(72) Inventors: **Robert D. Utter**, Sugar Land, TX (US);
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James L. Land, Spring, TX (US)(21) Appl. No.: **14/297,212**(22) Filed: **Jun. 5, 2014****Related U.S. Application Data**

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E21B 29/00 (2006.01)(52) **U.S. Cl.**CPC **E21B 7/046** (2013.01); **E21B 29/002** (2013.01)USPC **166/298**; 175/402(57) **ABSTRACT**

Systems, assemblies, and methods are described which relate to drilling a lateral borehole from a primary wellbore. A primary wellbore may have a casing therein. A window may be milled in the casing using a casing bit. The casing bit may pass through the window and into the surrounding formation. A protective sheath coupled to the casing bit may also extend through the window. The casing bit and protective sheath may remain in place while a drill bit slides through the protective sheath. The drill bit may drill through the casing bit and drill the formation to extend the lateral borehole. An anchor may be used to secure the protective sheath and/or casing bit in place. The drill bit may be included in a single trip assembly with the casing bit and protective sheath.



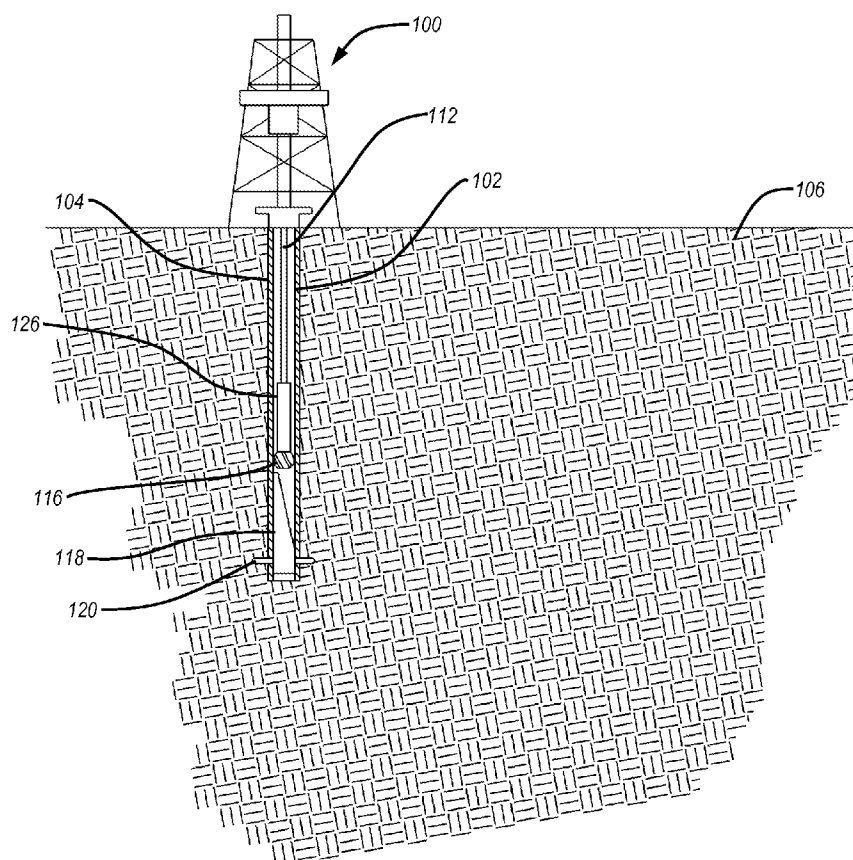


Fig. 1

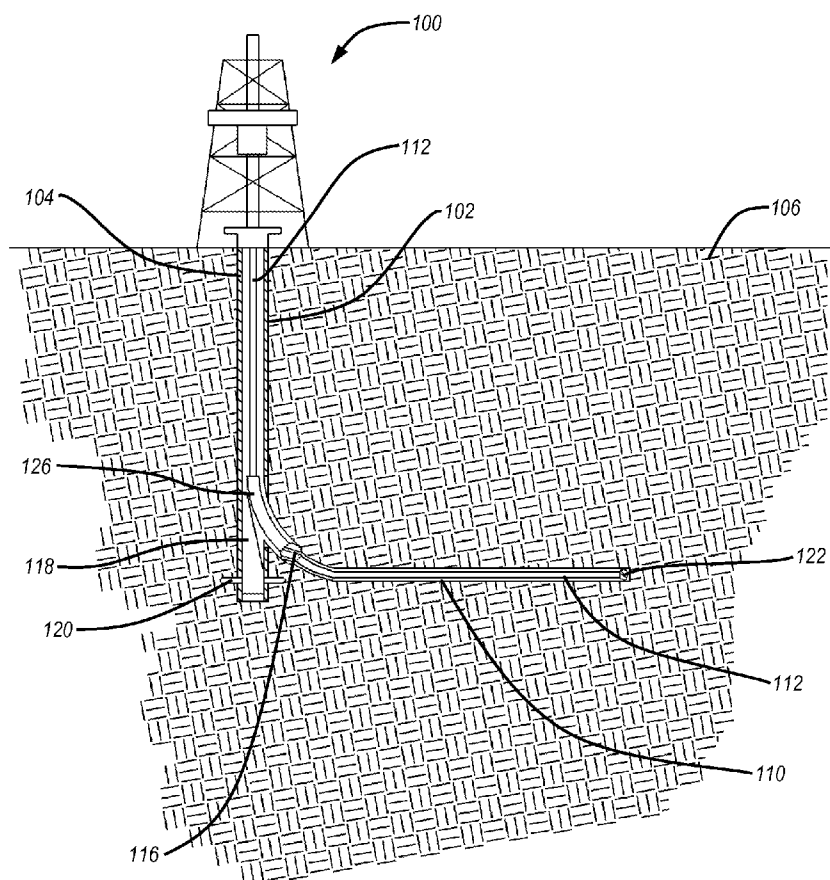


Fig. 2

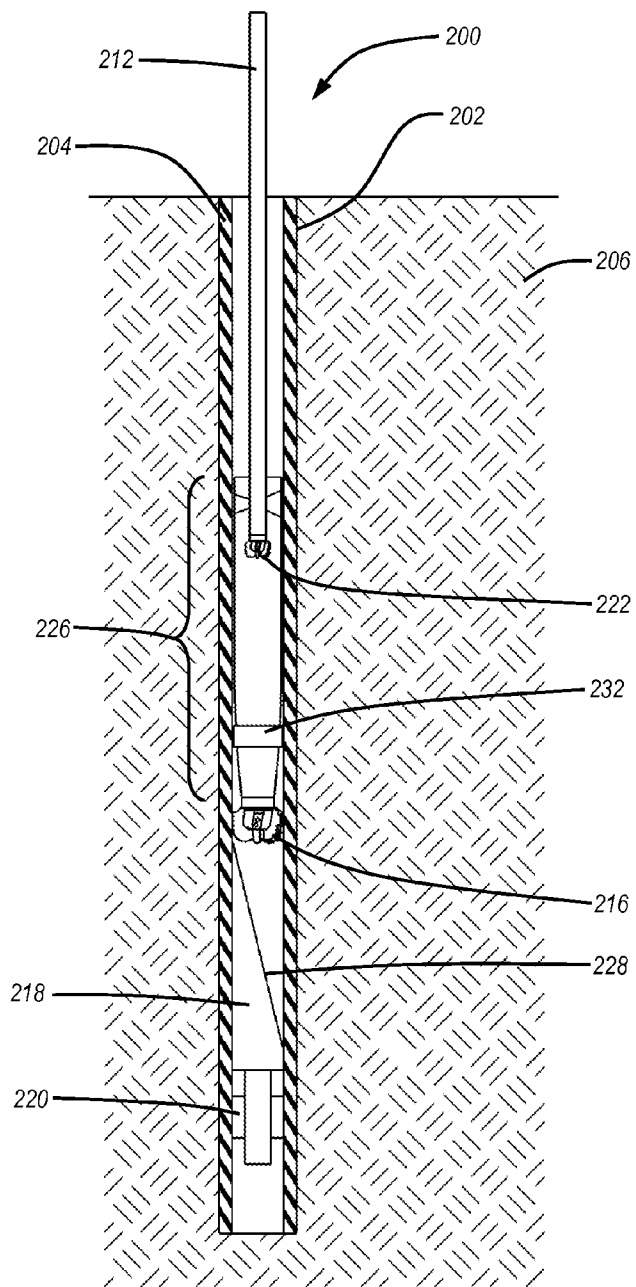


Fig. 3

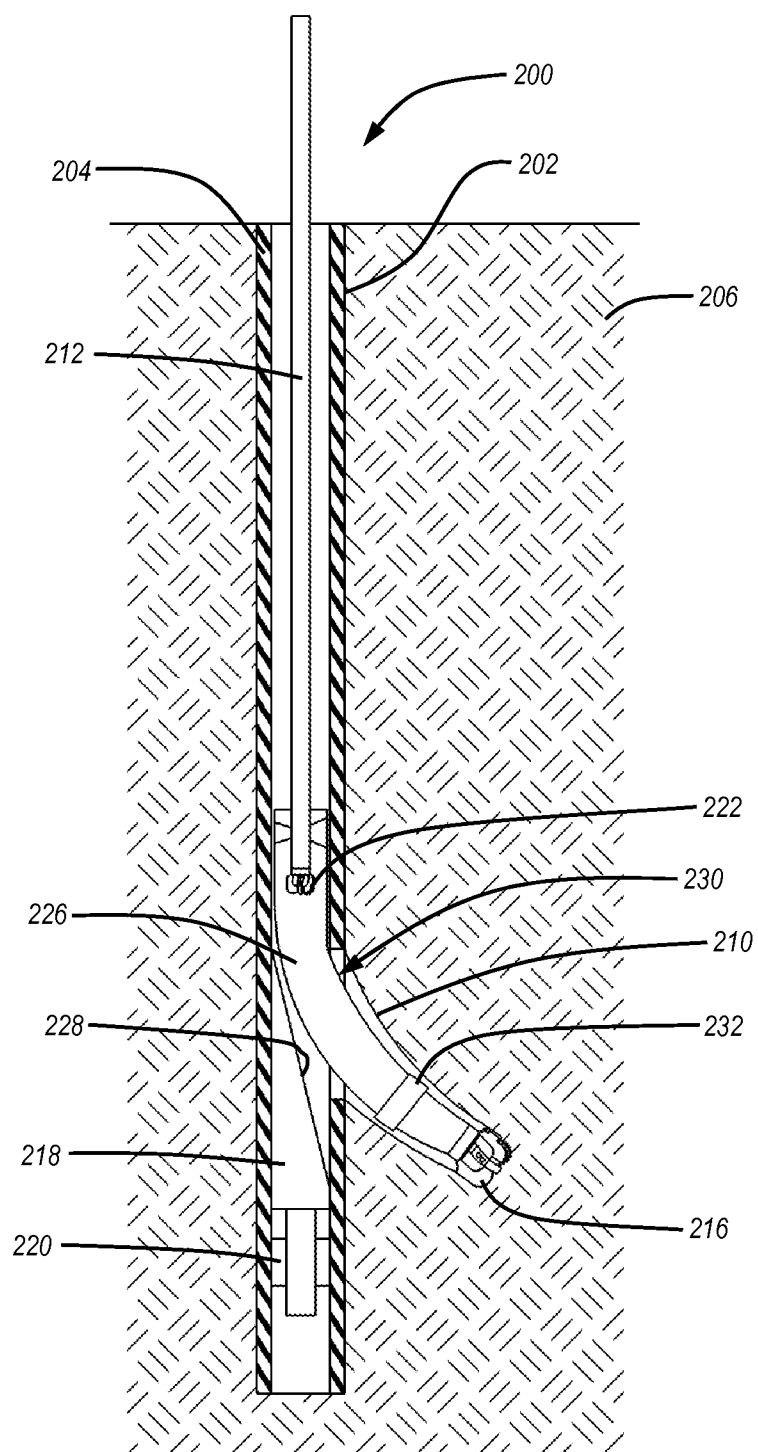


Fig. 4

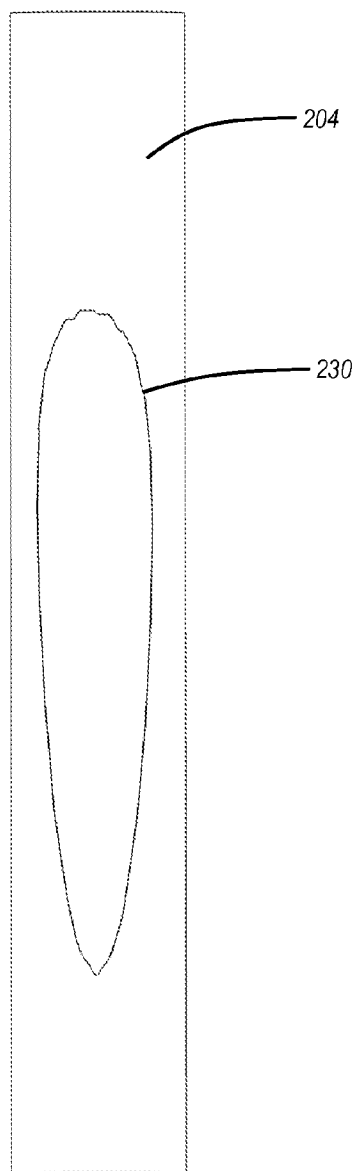


Fig. 5

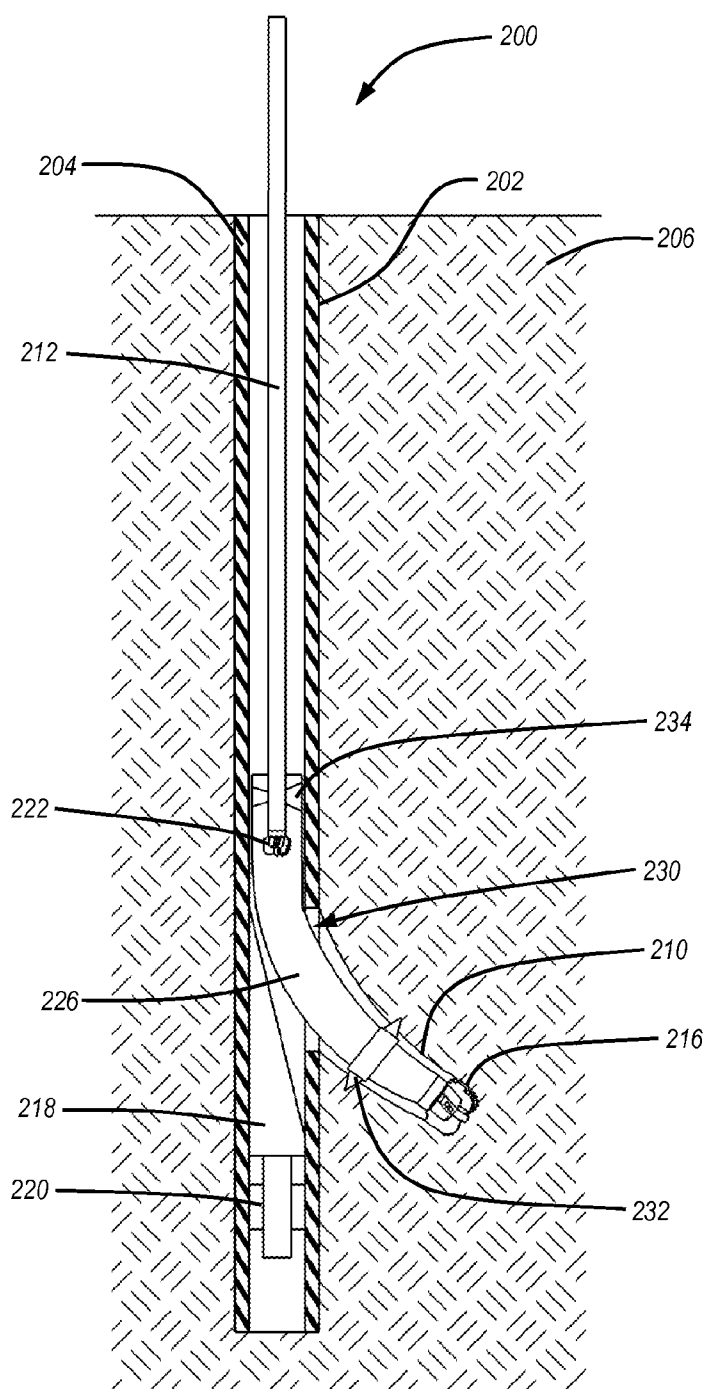


Fig. 6

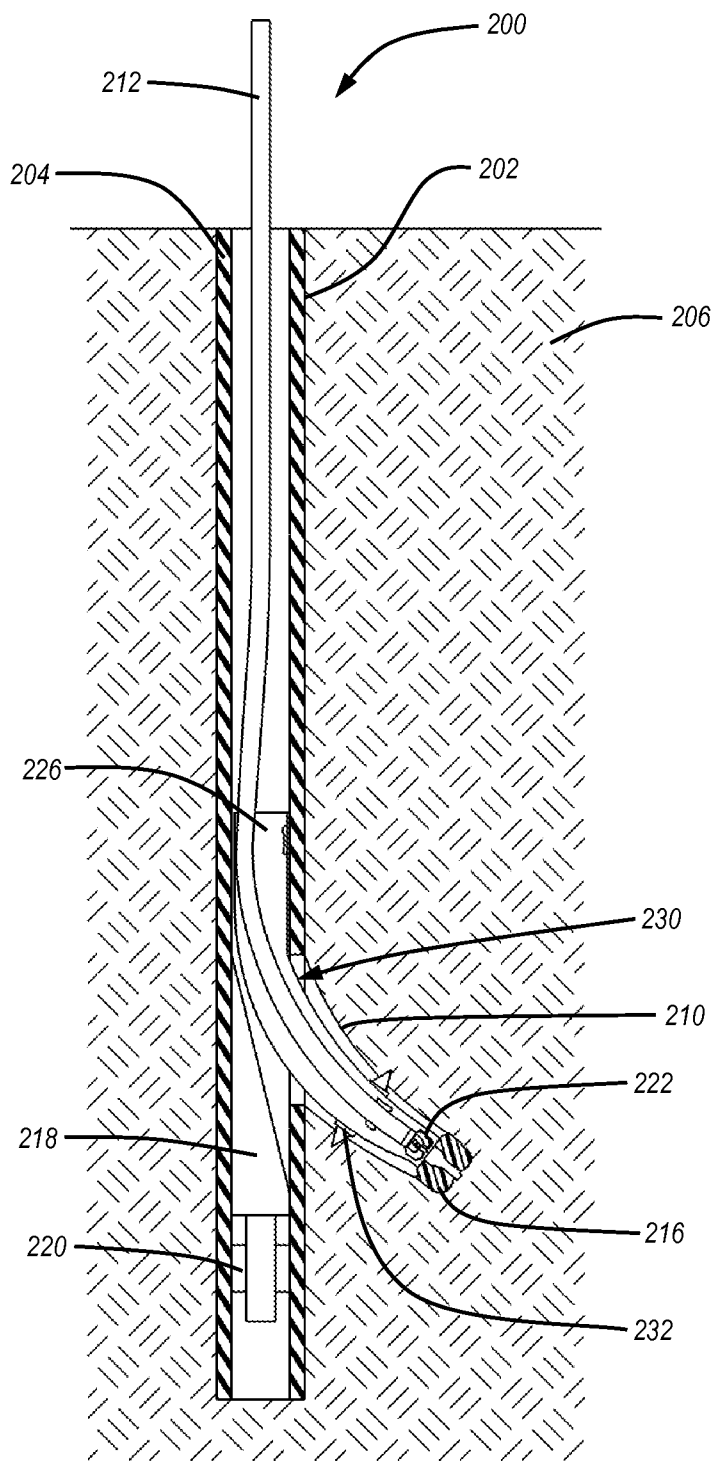


Fig. 7

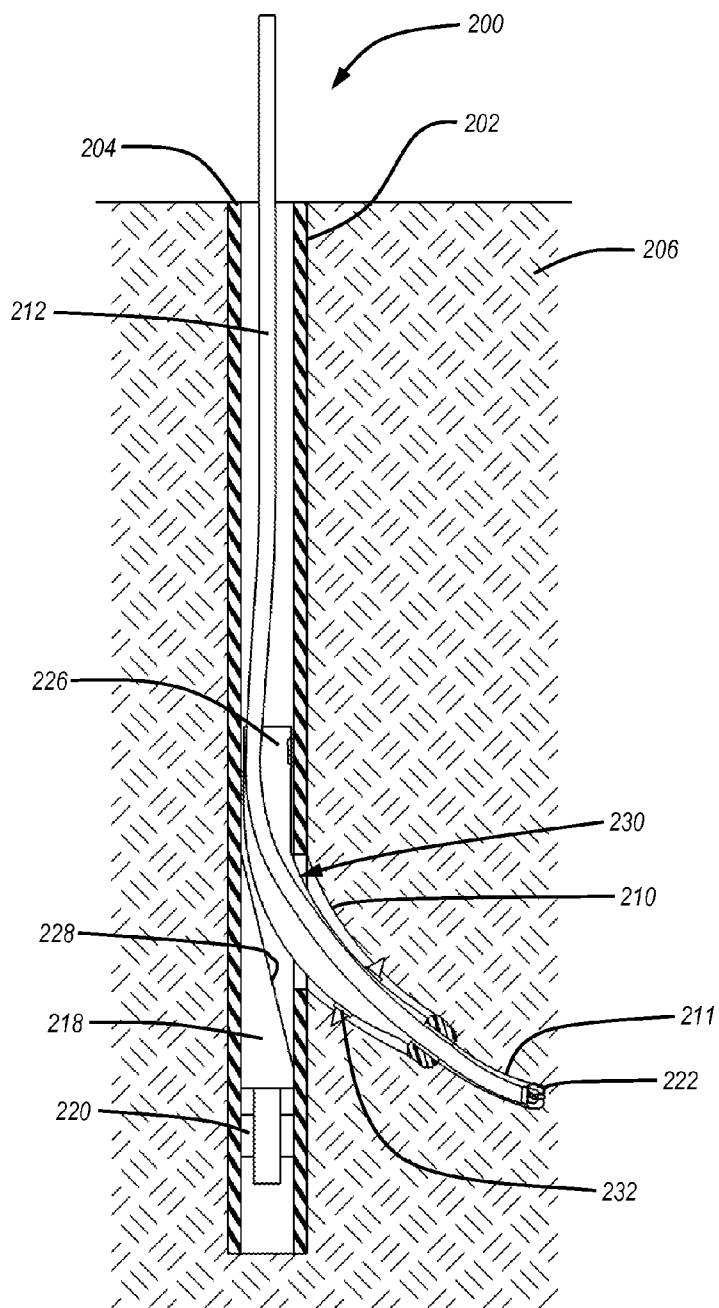


Fig. 8

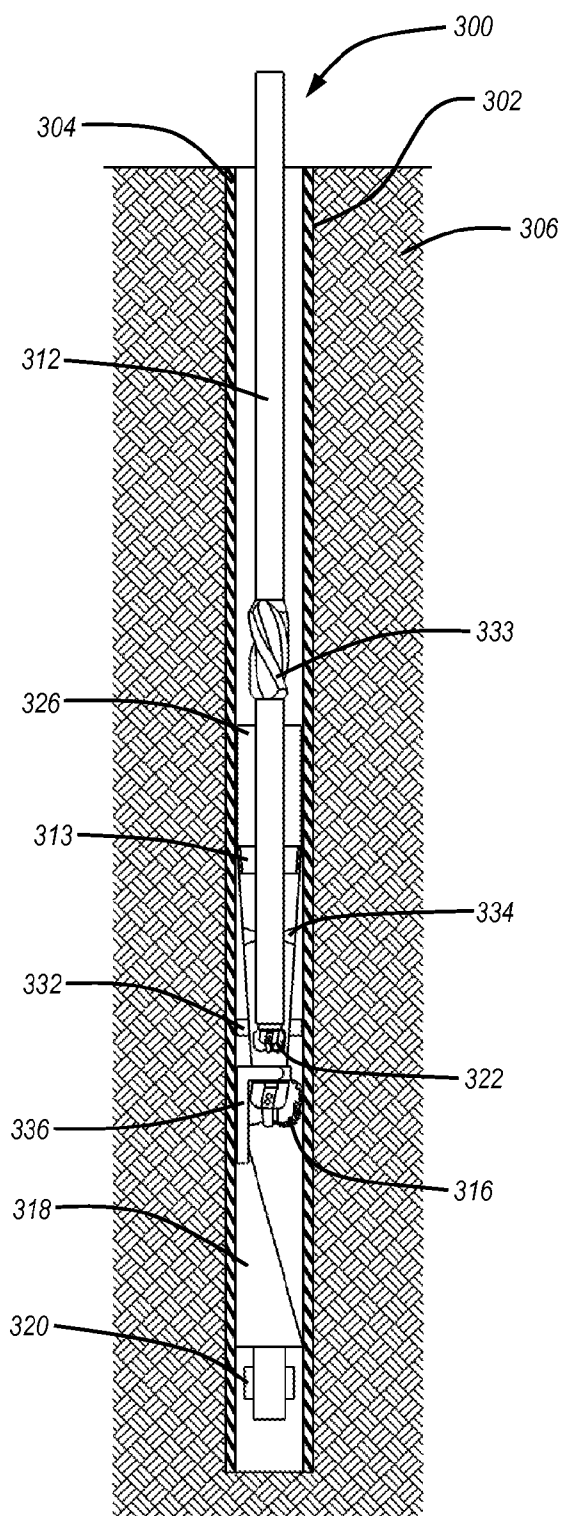


Fig. 9

PROTECTIVE SHEATH THROUGH A CASING WINDOW

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of, and priority to, U.S. Patent Application Ser. No. 61/832,564 filed on Jun. 7, 2013 and entitled "Protective Sheath Through a Casing Window," which application is incorporated herein by this reference in its entirety.

BACKGROUND

[0002] In exploration and production operations for natural resources such as hydrocarbon-based fluids (e.g., oil and natural gas), a vertical wellbore may be drilled into an earthen formation. If the wellbore comes into contact with a fluid reservoir, the fluid may then be extracted. If the wellbore doesn't contact the fluid reservoir, or as the resources in a reservoir are depleted, it may be useful to create additional wellbores to access additional resources. For instance, a new wellbore may be drilled at the site of an additional fluid reservoir.

[0003] In some cases, however, directional drilling may be used in lieu of creating a new, vertical wellbore. In directional drilling, a lateral or deviated borehole may be formed and may branch off an existing wellbore. The lateral borehole may extend laterally at a desired trajectory suitable for reaching a particular site. In creating the lateral borehole, a whipstock may be employed in a method referred to as sidetracking.

[0004] Whipstocks have a ramped surface providing a travel path for a bit coupled to a drill string. To create the lateral borehole, the whipstock can be set at a desired depth and the ramped surface oriented to provide a particular drilling trajectory. The whipstock may be located at an openhole or cased portion of a wellbore. When the wellbore is cased, a milling assembly may be used to mill through, and form a window in, the casing. Upon forming the window, the milling assembly may be removed and a drilling assembly may be tripped into the wellbore to extend the lateral borehole through the casing window.

SUMMARY OF THE DISCLOSURE

[0005] Assemblies, systems and methods of the present disclosure may relate to the drilling of a lateral borehole from a primary wellbore. In one example system, a method includes positioning a drilling assembly within a primary wellbore. The drilling assembly may include a casing bit coupled to a protective sheath. The casing bit may be used to mill a window in casing of the primary wellbore, and the protective sheath may be extended through the window. The drill string and drill bit may be guided through the protective sheath and through the window, and the drill bit may be used to drill a lateral borehole.

[0006] In another example embodiment, a drilling assembly may include a casing bit coupled to a protective sheath. A drill string may also be coupled to, and inside, the protective sheath. The drill string may include drill bit.

[0007] According to another example embodiment, a drilling system may be used to form a window in a casing of a primary wellbore and to drill a lateral borehole off the primary wellbore. The drilling system may include a drillable casing bit configured to mill the window in the casing. A

protective sheath may be coupled to the drillable casing bit. The drilling system may also include an anchor used to anchor the protective sheath and restrict the protective sheath from moving axially, rotationally, or both. A drill string may be coupled to an interior of the protective sheath. The drill string may include a drill bit configured to drill through the drillable casing bit and through formation around the primary wellbore. A fastener may releasably couple the drill string to the protective sheath.

[0008] This summary is provided solely to introduce some features and concepts that are further developed in the detailed description. Other features and aspects of the present disclosure will become apparent to those persons having ordinary skill in the art through consideration of the ensuing description, the accompanying drawings, and the appended claims. This summary is therefore not intended to identify key or essential features of the claimed subject matter, nor is it intended to be used as an aid in limiting the scope of the claims.

BRIEF DESCRIPTION OF DRAWINGS

[0009] In order to describe various features and concepts of the present disclosure, a more particular description of certain subject matter will be rendered by reference to specific embodiments which are illustrated in the appended drawings. Understanding that these drawings depict only some example embodiments and are not to be considered to be limiting in scope, nor drawn to scale for all embodiments, various embodiments will be described and explained with additional specificity and detail through the use of the accompanying drawings in which:

[0010] FIG. 1 schematically illustrates an example system for drilling a lateral borehole, the system including a casing bit for drilling a window into a casing of a primary wellbore to begin formation of the lateral borehole, in accordance with one embodiment of the present disclosure;

[0011] FIG. 2 schematically illustrates the system of FIG. 1 following commencement of drilling of the lateral borehole using the casing bit, and including extension of the lateral borehole using a drill bit drilling through the casing bit, in accordance with an embodiment of the present disclosure;

[0012] FIG. 3 illustrates a partial cross-sectional view of an example system for drilling a lateral borehole, the system including a casing bit for drilling a window in a wellbore casing, a drill string coupled to the casing bit, and an interior drill bit, in accordance with one embodiment of the present disclosure;

[0013] FIG. 4 illustrates a partial cross-sectional view of the system of FIG. 3, the casing bit and a portion of the drill string having passed through a window of the wellbore casing, in accordance with one embodiment of the present disclosure;

[0014] FIG. 5 schematically illustrates an example window formed in the wellbore casing of FIG. 4;

[0015] FIG. 6 illustrates a partial cross-sectional view of the system of FIGS. 3 and 4, the casing bit and drilling assembly being anchored to the earthen formation, in accordance with one embodiment of the present disclosure;

[0016] FIG. 7 illustrates a partial cross-sectional view of the system of FIGS. 3, 4 and 6, the interior drill bit having been detached and extended through the protective sheath towards the casing bit, in accordance with an embodiment of the present disclosure;

[0017] FIG. 8 illustrates a partial cross-sectional view of the system of FIG. 7, with the interior drill bit extending the lateral borehole following drilling through the casing bit, in accordance with another embodiment of the present disclosure; and

[0018] FIG. 9 illustrates a partial cross-sectional view of another example system for drilling a lateral borehole, the system including an interior drill bit adjacent the casing bit, and including a deflection assembly coupled to the casing bit, in accordance with another embodiment of the present disclosure.

DETAILED DESCRIPTION

[0019] In accordance with some aspects of the present disclosure, embodiments herein relate to systems and assemblies for drilling a lateral borehole. More particularly, embodiments disclosed herein may relate to drilling systems, assemblies and methods for drilling a lateral borehole off a cased, primary wellbore. Example drilling systems and assemblies may include a casing bit and a drill bit. The casing bit may be coupled to a drill string element which may be coupled to, or may include, a protective sheath. Upon milling a window in a casing of the cased, primary wellbore, the protective sheath can pass through the window. The drill bit may also pass through the window. As the drill bit passes through the window, the protective sheath may restrict and potentially prevent the drill bit from contacting the casing or a surrounding formation until the drill bit drills through or is otherwise removed from the casing bit.

[0020] Referring now to FIGS. 1 and 2, schematic diagrams are provided of an example drilling system 100 that may utilize systems, assemblies and methods in accordance with one or more embodiments of the present disclosure. FIG. 1 shows an example primary wellbore 102 which is, in this embodiment, a cased wellbore. The cased wellbore shown in FIG. 1 includes a casing 104 which may extend along all or a portion of the length of the primary wellbore 102. The casing 104 may be used for any number of reasons. For instance, the casing 104 may be production casing that is cemented or otherwise secured in place to isolate the primary wellbore 102 from the surrounding formation 106, and/or to provide structural support along the length of the primary wellbore 102. In other embodiments, the casing 104 may include additional or other casing, including intermediate casing, surface casing, conductor casing, liner, or other component.

[0021] In the particular embodiment illustrated in FIG. 1, the drilling system 100 may be provided and may include components to allow drilling of a lateral borehole (e.g., lateral borehole 110 of FIG. 2) which branches off the primary wellbore 102. The lateral borehole may be drilled using a drill string 112 to rotate one or more drill bits. In the particular example embodiment of FIG. 1, the drill string 112 may be coupled to a protective sheath 126, which in turn may be coupled to a casing bit 116. The casing bit 116 may mill or otherwise configured to mill into the casing 104, and to form a window or opening therein. During formation of the window, the casing bit 116 may drill partially into the formation 106 to initiate a lateral borehole. In some embodiments, the casing bit 116 may also be used after full formation of the window to continue drilling the lateral borehole.

[0022] More particularly, some embodiments of the present disclosure contemplate use of a drill string 112 that can transmit torque and axial loads, and which can transfer such forces to the protective sheath 126. The protective sheath 126 may

ultimately transfer such forces to the casing bit 116. The drill string 112 may therefore include any number of structures to facilitate such use for the formation and/or extension of a lateral borehole. For instance, the drill string 112 may include a tubular member. As an example, the tubular member of the drill string 112 may include coiled tubing with a downhole motor, jointed/segmented tubing, a liner, casings (e.g., as part of a casing-while-drilling system), or other components, or some combination thereof, to be capable of carrying transmitted loads to the protective sheath 126 and ultimately to the casing bit 116. Of course, the drill string 112 may include or be coupled to any number of different components or structures. In some embodiments, the drill string 112 may include, or be coupled to, multiple sections of jointed pipe, a motor, stabilizers, or other components. An example motor may include a positive displacement motor (e.g., a mud motor or progressive cavity motor), a turbine or turbodrill motor, an electrical motor, some other type of motor, or a combination of the foregoing. The drill string 112 may also include directional drilling and/or measurement equipment. As an example, the drill string 112 may include a steerable drilling assembly to control the direction of drilling of the lateral borehole within the formation 106. A steerable drilling assembly may include various types of directional control systems, including rotary steerable systems referred to as push-the-bit or point-the-bit systems, or any other type of rotary steerable or directional control system. In some embodiments, components coupled to the drill string 112 may be part of a bottomhole assembly for drilling the lateral borehole into the formation 106.

[0023] To further facilitate drilling of the lateral borehole, the drilling system 100 may include, or be used with, a deflection member 118. The deflection member 118 may include a whipstock or any other structure that may be used to facilitate formation of the window in the casing 102 or the lateral borehole. In this particular embodiment, the deflection member 118 may include an inclined surface. The inclined surface may be generally planar, although in other embodiments the inclined surface may be concave (e.g., to accommodate a rounded casing bit 116, drill string 112, etc.), have multiple tiers of differing inclines, or be otherwise configured.

[0024] In operation, the drill string 112 and casing bit 116 may be tripped into the wellbore until they engage with the deflection member 118. The inclined surface of the deflection member 118 may direct the casing bit 116 towards the interior surface of the casing 104. In some embodiments, the deflection member 118 may be anchored or otherwise maintained at a desired position, depth, and orientation in order to deflect the casing bit 116 at a desired location and azimuthal orientation. When at the desired location and azimuthal orientation, the casing bit 116 may mill a window for drilling of a lateral borehole.

[0025] A set of one or more anchors 120, packers, or other components may be used to anchor the deflection member 118 at an axial position and azimuthal orientation within the primary wellbore 102. The one or more anchors 120 and/or other components may define a setting assembly for engaging the sidewalls of the casing 104 in the primary wellbore 102. In one embodiment, the anchors 120 may be expandable. For instance, hydraulic fluid may be used to expand the anchors 120 from a retracted position to the expanded position shown in FIG. 1. In other embodiments, however, the anchors 120 that can be set in other manners. For instance, the anchors 120 may expand or be set mechanically, using spring-loaded com-

ponents, through directed explosive charges, or in other manners. Regardless of the particular manner in which the anchors 120 operate, the anchors 120 optionally have a sufficient ratio of the expanded diameter relative to the retracted diameter, thereby facilitating engagement with a sidewall of a casing 104 or primary wellbore 102, to potentially allow use in wellbores having any number of different sizes. In other embodiments, the anchors 120 may be modified, or even eliminated and replaced by other suitable components usable to secure the deflection member 118 in place.

[0026] The drilling system 100 may also include still other or additional components. By way of example, and as discussed in greater detail herein, the casing bit 116 may be used primarily for milling through the casing 104. Upon milling through the casing 104, and potentially through a portion of the formation 106, the casing bit 116 may stop rotating and/or stop advancing. As shown in FIG. 2, a drill bit 122 may then be used to extend the lateral borehole 110.

[0027] More particularly, the drill bit 122 of FIG. 2 may be coupled to the drill string 112 of FIG. 1. The drill string 112 may be used to rotate and advance the protective sheath 126 and the casing bit 116 to form the window in the casing 104. In FIG. 1, however, the drill string 112 and drill bit 122 may be coupled to an interior of the protective sheath 126 using a fastener. The fastener may secure the drill string 112 and/or drill bit 122 relative to the protective sheath 126, and allow axial and rotational loads to be transmitted between the drill string 112 and the protective sheath 126. Upon release of the fastener, however, the rotational and axial forces on the drill bit 122 and drill string 112 may allow movement independent of the protective sheath 126. Consequently, the drill string 112 and drill bit 122 may be moved through the protective sheath 126 and can potentially drill through the casing bit 116. For purposes of this disclosure, a casing bit 116 which may be drilled through by a drill bit 122 may be referred to as a “drillable casing bit”. After drilling through the casing bit 116, which may be a drillable casing bit, the drill bit 122 can move into and potentially extend the lateral borehole 110.

[0028] The particular structure, components, and method of use of the drilling system 100 may be varied in any number of manners. For instance, the length of the protective sheath 126 may be varied. Optionally, the length and size of the protective sheath 126 may be sized based on particular conditions within the primary wellbore 102 or based on components of the drilling system 100. For instance, as discussed herein, the protective sheath 126 may be coupled to the drill string 112 during a milling operation for forming a window in the casing 104. Thereafter, however, the drill string 112 may be detached from the protective sheath 126 to allow a lateral borehole 110 to be formed or extended. According to at least some embodiments, including the embodiment shown in FIG. 2, the length of the protective sheath 126 may allow the protective sheath 126 to extend at least from a top of the deflection member 118 to a position beyond the window milled in the casing 104. As a result, when the drill bit 122 passes through the interior of the protective sheath 126, the protective sheath 126 may restrict the drill bit 122 from contacting the deflection member 118 and/or the casing 104.

[0029] If a protective sheath 126 extends from a top of the deflection member 118 and fully through the window in the casing 104, the particular length of the protective sheath 126 may vary depending on a variety of factors. Example factors may include the length of an inclined surface of the deflection member 118, a diameter of the primary wellbore 102, a diam-

eter of the casing bit 116, and the like. In other embodiments, the length of the protective sheath 126 may be selected to give a tolerance to positioning of the protective sheath 126. In such an embodiment, the length may be extended to allow the protective sheath 126 to start a few feet above the top of the deflection member 118 and extend fully to a position a few feet beyond the milled window in the casing 104. In any such embodiments, and for illustration only, an example protective sheath 126 may have a length of between 5 ft. (1.5 m) and 100 ft. (30.5 m). In another embodiment, the length of the protective sheath 126 may be between 15 ft. (4.6 m) and 60 ft. (18.3 m). In still another embodiment, the length of the protective sheath 126 may be between 20 ft. (6.1 m) and 40 ft. (12.2 m). For instance, the protective sheath 126 may be 30 ft. (9.1 m) in some embodiments. Of course, in other embodiments, the length of the protective sheath 126 may be greater than 100 ft. (305 m) or less than 5 ft. (1.5 m.). Further, the length may of course also be varied if the location of the protective sheath 126 is varied. For instance, if the protective sheath 126 extends through the window in the casing 104, but doesn't extend fully to the top of the deflection member 118, the protective sheath 126 may be shortened.

[0030] When the protective sheath 126 extends from the top of the deflection member 118 fully through the casing 104, and optionally an added distance in either or both directions, the protective sheath 126 may house the drill bit 122 and protect the drill bit 122 from damage that could otherwise result from the drill bit 122 contacting either the deflection member 118 or the casing 104. Moreover, protecting the drill bit 122 in this manner may further allow a different bit (i.e., drill bit 122) to drill the lateral borehole 110 than the bit (i.e., casing bit 116) used to mill the window in the casing 104. The drill bit 122 may not exhibit the wear caused to the casing bit 116 by the casing and/or may be designed for cutting into the formation 106. Such factors, along with reduced damage to the drill bit 122 due to protection provided by the protective sheath 126, may increase the drilling efficiency and life of the drill bit 122.

[0031] Protection of the drill bit 122 from damage caused by the casing 104 and/or deflection member 118 are only some of the features of the protective sheath 126. In other embodiments, for instance, the drilling system 100 may include motors, stabilizers, or other components (e.g., as part of a bottomhole assembly). These additional components may also be protected against damage. Further, particularly for the casing 104, the window may have jagged or uneven edges and the protective sheath 126 may protect against interference with the edges of the window. Further still, upon removal of the drill bit 122 and drill string 112 from the primary wellbore 112, the lateral borehole 110 may be re-entered for performing additional operations. The protective sheath 126 may be left in place (and potentially anchored in place). As a result, components used to perform the additional operations may be tripped into the wellbore 102 and into the lateral borehole 110 while being guided by the protective sheath 126. For instance, completion components (e.g., packers) may be run into the lateral borehole 110, and may pass through the protective sheath 126 which protects the components from damage or interference.

[0032] Turning now to FIGS. 3-8, various partial, cross-sectional views are provided to illustrate another example embodiment of a drilling system 200 in accordance with another aspect of the present disclosure. In particular, FIGS. 3-8 illustrate various stages of drilling a lateral borehole 210

off of a primary wellbore **202**, while also providing a protective sheath **226** for protecting and guiding a drill bit **222** used to form or extend the lateral borehole **210**.

[0033] More particularly, FIGS. 3-8 illustrate a primary wellbore **202** formed in a formation **206**. The primary wellbore **202** may be formed in any suitable manner. In this particular embodiment, for instance, the primary wellbore **202** is shown as a cased wellbore and has a casing **204** therein. The casing **204** may generally be a tubular structure adjacent the interior, peripheral walls of the primary wellbore **202**. In some embodiments, the casing **204** may be cemented or otherwise secured in place within the primary wellbore **202**.

[0034] Under some circumstances, a lateral, deviated, or branched borehole (e.g., lateral borehole **210** in FIGS. 4 and 6-8) may be drilled. The lateral bore hole **210** may extend within the formation **206** and at an angle from the primary wellbore **202**. For instance, the primary wellbore **202** may be oriented generally vertically, and the lateral borehole **210** can be formed to extend therefrom at a particular trajectory. Of course, it should be appreciated by a person having ordinary skill in the art in view of the disclosure herein that the primary wellbore **202** may also not be vertical, and that the degree of deviation of the lateral borehole **210** from the primary wellbore **202** can be varied in a number of manners. Indeed, the angles of the primary wellbore **202** and lateral borehole **210** may extend at any possible angle relative to each other and/or the surface. Thus, while a lateral borehole **210** may be formed to extend in a generally horizontal direction, that direction may or may not be about perpendicular relative to the primary wellbore **202** or parallel relative to a surface of the formation **206**. In other embodiments, other trajectories are obtained, and the lateral borehole **210** may curve along its path to obtain the desired end trajectory or desired target.

[0035] In order to drill and extend the lateral borehole **210**, a deflection member **218** may be tripped into the primary wellbore **202**. FIGS. 3-8 somewhat schematically illustrate a side view of the example deflection member **218**, which in this embodiment is shown as a whipstock. Generally speaking, the deflection member **218** may include, or be coupled to, anchors **220** that may be used to set the deflection member **218** at a desired position and orientation. When tripping the deflection member **218** into the primary wellbore **202**, the anchors **220** may be in a retracted state (not shown). With the anchors **220** retracted, the deflection member **218** may move axially and/or rotationally within the primary wellbore **202**.

[0036] Once the deflection member **218** reaches a desired depth, the deflection member may be oriented and secured in place in the primary wellbore **202** using the anchors **220**. In some embodiments, the anchors **220** are part of a setting assembly and may expand to engage against the interior wall of the casing **204**. Such engagement may create a frictional or interference fit to secure the deflection member **218** in place by resisting axial and/or rotational movement within the primary wellbore **202**. The anchors **220** may be expandable in any number of manners. For instance, in some embodiments the anchors **220** may be hydraulically actuated. In other embodiments the anchors **220** may be mechanically or otherwise expanded and/or retracted. Additionally, while the anchors **220** are shown as engaging the casing **204**, the anchors **220** optionally may be aligned with an uncased, or openhole, portion of the wellbore **202**. In such an embodiment, the anchors **220** may expand to engage the formation **206** directly, and potentially may cut into, or pierce, the formation **206** to secure the deflection member **218** in place.

[0037] The deflection member **218** may be used to direct the path of a drilling assembly used to drill a lateral borehole off the primary wellbore **202**. In one embodiment, such as where the deflection member **218** is a whipstock, the deflection member **218** may include a ramped surface **228**. When anchoring the deflection member **218** in place, the ramped surface **228** may be positioned at a desired orientation configured to guide the drilling assembly along a particular trajectory. As shown in FIG. 3, due to the ramped surface **228**, a width of the deflection member **218** may increase from an upper end towards a lower end. As a result, as a drilling assembly that includes the drill string **212**, protective sheath **226**, and casing bit **216** is moved downward into the primary wellbore **202**, the ramped surface **228** can urge the drilling assembly radially outwardly, away from a central axis of the primary wellbore **202**, and against the casing **204**, and ultimately into the formation **206**. As shown in FIG. 4, for instance, the casing bit **216** can generally follow the incline of the ramped surface **228** and engage the casing **204**. Upon contacting the casing **204**, the casing bit **216** can mill an opening therein. The opening, which is referred to herein as a "window" **230**, may be gradually formed as the casing bit **216** moves along the ramped surface **228** and through the casing **204**. As a result, the window **230** may have a generally elongated shape. FIG. 5, for instance, illustrates a side view of the exterior of the casing **204** with the window **230** formed therein.

[0038] As shown in FIG. 5, when the window **230** is formed, the window **230** may not have a perfectly smooth periphery, but instead may include one or more jagged or uneven edges. As discussed herein, a drill bit, mill, or other cutting element may pass through the window **230** to form a lateral borehole **210**. If unprotected, the drill bit, mill, or other cutting element may catch on the jagged edges of the window **230**, or otherwise contact the edges of the window **230**. The edges of the window **230** could also interfere with other components of a drilling assembly (e.g., drill string, motor, stabilizer, etc.), or with completion or other components which re-enter the lateral borehole after removal of a drill string. Such engagement or interference can potentially damage the components, make entry into the lateral borehole **210** difficult, or reduce the effectiveness and/or useful life of a downhole system or bottomhole assembly.

[0039] Furthermore, the properties of the casing **204** may significantly differ from that of the surrounding formation **206**. For instance, the casing **204** may be formed of a metal (e.g., steel), while the formation **206** may be formed of one or more types of rock or other materials. In some cases, a cutting element or bit structure suited for cutting the formation **206** may not be as efficient at milling the window **230**, or may be more easily damaged by the casing **204**. Embodiments herein, including the drilling system **200** of FIGS. 3-8, relate to an example embodiment that may be used to effectively mill a window in a casing **204**, while also protecting a cutting element or bit that may be used to form or extend a lateral borehole **210**.

[0040] More particularly, and returning now to FIGS. 3 and 4, the drilling system **200** may include two or more bits, each of which may have multiple cutting structures or elements. In this particular embodiment, the drilling system **200** includes a casing bit **216** as a first bit, and a drill bit **222** as a second bit. The casing bit **216** may be primarily configured for use in milling a window **230** in the casing **204**, while the drill bit **222**

may be primarily configured for use in cutting, shearing, impacting, or otherwise extending the lateral borehole 210 in the formation 206.

[0041] In this particular embodiment, the casing bit 216 is shown as being coupled to a protective sheath 226 which may in turn be coupled to, and optionally suspended from, a drill string 212. The drill string 212 may include jointed pipe, casing-while-drilling ("CWD"), or other types of drill string elements, or any combination thereof. Torque and axial thrust may be applied to the drill string 212 and transferred to the protective sheath 226, which may in turn transfer such torque and motion to the casing bit 216.

[0042] The drill string 212 may optionally be used to convey drilling mud or another fluid. Such fluids may, for instance, pass through an interior of the drill string 212. The fluid may be used in connection with a hydraulic motor or drive system (not shown) to rotate the drill string 212, or a component thereof, as well as the protective sheath 226 and the casing bit 216. In some embodiments, the drilling mud or other fluid may enter the protective sheath 226, and the casing bit 216 may include one or more openings therein to allow fluid to pass therethrough. Such a fluid may then also act as a coolant on an exterior of the casing bit 216 and/or a jet nozzle to flush cuttings away from the face of the casing bit 216. The drilling fluid may facilitate cutting of the casing 204 and/or formation 206, reduce wear of the casing bit 216, and prolong the life or effectiveness of the casing bit 216.

[0043] As discussed herein, the protective sheath 226 and casing bit 216 may be lowered toward the deflection member 218 by using the drill string 212. The ramped surface 228 of the deflection member 218 may push the casing bit 216 into the casing 204 where the window 230 may be formed by rotation of the casing bit 216 as weight-on-bit is applied thereto. FIG. 3 illustrates the casing bit 216 prior to formation of the window 230, while FIG. 4 illustrates the casing bit 216 after milling of the window 230. Also shown in FIG. 4 is the start of a lateral borehole 210 branching from the primary wellbore 202.

[0044] While the casing bit 216 may be primarily used to mill the window 230 in the casing 204, the casing bit 216 may also cut, to at least some extent, into the formation 206. Indeed, in some embodiments, the casing bit 216 may partially cut into the formation 206 before the window 230 is at its full size. In at least some embodiments, the cutting of the formation 206 may stop at about the same time as completion of the window 230. In other embodiments such as that shown in FIG. 4, the casing bit 216 may continue to cut into the formation 206 even after the window 230 is fully formed. In such an embodiment, the amount of additional cutting performed using the casing bit 216 may vary. For instance, the length of the lateral borehole 210 may vary from a few inches or centimeters to many feet or meters by the time an operator ceases using the casing bit 216 to drill a portion of the lateral borehole 210.

[0045] When the drilling of the formation 206 using the casing bit 216 is stopped, the casing bit 216 may be removed. In other embodiments, however, the casing bit 216 may potentially be left within the lateral borehole 210. As an example, the illustrated embodiment depicts an additional anchor 232 coupled to the protective sheath 226. When the anchor 232 is in a retracted state as shown in FIGS. 3 and 4, the protective sheath 226 and the casing bit 216 may advance within the lateral borehole 210. In contrast, by expanding or activating the anchor 232, the anchor 232 may engage or grip

the formation 206 and restrict, if not prevent, axial and/or rotational movement of the protective sheath 226 and/or casing bit 216. FIG. 6 illustrates an example embodiment in which the anchor 232 has been expanded to engage the formation 206 and restrict movement of the casing bit 216 and protective sheath 226. The particular manner in which the anchor 232 operates may vary. For instance, hydraulic fluid may be used to hydraulically expand the anchor 232. In another embodiment, the anchors 232 may be mechanically, explosively, or otherwise activated.

[0046] Optionally, a controller (e.g., a programmable or electronic controller) may be used to facilitate activation. For instance, if an operator of the drilling system 200 determines that the window 230 has been completed and the length of the lateral borehole 210 is sufficient to allow the anchor 232 to engage the formation 206, a control signal may be provided in a wireless, physical, conductive, or other manner, or using some combination of the foregoing. The control signal may open a valve which can allow hydraulic fluid passing within the protective sheath 226 to then expand the anchor 232. Alternatively, a control signal may activate a motor to mechanically expand the anchor 232, release a spring-loaded element, ignite a directed explosive charge, or otherwise expand the anchor 232. Moreover, while the anchor 232 may be controlled by an operator, in other embodiments the control may be automatic. For instance, a controller of the anchor 232 may be programmed to activate at a particular location, and one or more sensors (e.g., measurement-while-drilling tools, logging-while-drilling tools, smart drill collars, etc.) may provide positioning information to the controller to sense when the conditions for activating the anchor 232 are present.

[0047] When the casing bit 216 is secured in place within the lateral borehole 210, a second bit, which is illustrated as a drill bit 222 in FIG. 6, may then be used to extend the lateral borehole 210. In FIG. 6, for instance, the drill bit 222 is also coupled to the drill string 212. More particularly, the drill bit 222 may be coupled to a distal end portion of the drill string 212, and optionally be located inside the protective sheath 226 that is also coupled to the drill string 212. The illustrated drilling system 200 may be intended for use as a single trip drilling assembly, so that milling of the window 230 and drilling of the lateral borehole 210 may occur in a single trip. In some embodiments, the deflection member 218 and anchor 220 may also be set in a single trip so that setting of the anchor, milling of the window 230, and drilling of the lateral borehole 210 may occur in a single trip.

[0048] In at least some embodiments, the drill bit 222 or drill string 212 may be fixed at a particular location within the protective sheath 226 in a manner that allows the drill bit 222 to advance within the primary wellbore 202 and/or lateral borehole 210 at about the same rate as the protective sheath 226. In this particular embodiment, for instance, a fastener 234 may selectively couple the drill string 212 at a particular axial location within the protective sheath 226. Of course, in other embodiments, the fastener 234 may directly couple the drill bit 222 to the protective sheath 226.

[0049] Regardless of how or where located, the fastener 234 may provide a connection that allows rotational and axial forces on the drill string 212 to be transferred to the protective sheath 226. Indeed, as described herein, while fixed to the protective sheath 226, the drill string 212 or drill bit 222 may have a rotation that is about synchronous with the rotation of the casing bit 216 and/or protective sheath 226. In the illus-

trated embodiment, for instance, the fastener **234** may effectively lock the drill bit **222** to the drill string **212**. When locked, the fastener **234** may allow rotational movement (i.e., torque) and axial thrust (i.e., weight-on-bit) on the drill string **212** to be transmitted to the protective sheath **226**. Thus, the protective sheath **226** and drill string **212** may have about the same rotation and axial movement. When the anchor **232** is activated to restrict rotation of the drill string **212** and/or the casing bit **216**, the rotation of both the casing bit **216** and drill bit **222** may stop. In other embodiments, however, the drill bit **222** may rotate independently of the protective sheath **226** and/or casing bit **216**. For instance, the fastener **234** may be coupled to the drill string **212**. A motor or other element of a bottomhole assembly associated with the drill bit **222** may allow the drill bit **222** to rotate at a rate that is faster or slower relative to rotation of the drill string **212**, protective sheath **226**, or casing bit **216**.

[0050] At about the time the casing bit **216** is anchored in place, or sometime thereafter, the drill string **212** may be allowed to rotate and move axially relative to the protective sheath **226** and the casing bit **216**. Such independent rotation and axial movement may occur using any number of mechanisms. For instance, the fastener **234** may be deactivated or selectively released. As an example, the fastener **234** may include a hydraulically activated release. Depending on the design of the release, when hydraulic pressure is supplied or cut-off, the fastener **234** may release, allowing the drill bit **222** and drill string **212** to move independently of the protective sheath **226**. In another embodiment, a ball, dart, or other obstruction element may be inserted into the drill string **212** and may land on a seat. Pressure may build behind the seat and obstruction element to break one or more shear pins of the fastener **234**. In other embodiments, a spring-loaded release, or other mechanical system may be activated to detach the drill string **212** and/or drill bit **222** relative to the protective sheath **226**. Any such deactivation or release may be controlled by an operator, or may be automatic. For instance, mud-pulse telemetry, pressure pulses, rotational speed signals, wired drill pipe connections, wireless signals, active or passive RFID tags, or other mechanisms may be used to convey a signal from an operator on the surface to a downhole controller. In another embodiment, a controller may include a sensor that measures rotation of the protective sheath **226**. When the rotation stops or drops below a particular threshold, the fastener **234** may deactivate to release the drill string **212** or the drill bit **222**.

[0051] In another embodiment, the fastener **234** may include a sacrificial element. For a drive system using a motor, drilling mud or another fluid may be used to rotate the drill string **212** and/or the drill bit **222**. Optionally, the drilling mud or other fluid can be supplied to a motor associated with the drill bit **222** anchoring the protective sheath **234**; however, such rotation may also occur while the casing bit **216** is in use and un-anchored. If the rotations of the drill bit **222** and the casing bit **216** are synchronous (or the rotations of the corresponding drill string **212** and protective sheath **226**), the sacrificial element of the fastener **234** may also rotate synchronously and remain in place. Restricting rotation of the protective sheath **226**, however, may not stop the drill bit **222** or drill string **212** from rotating. Instead, a drive force may continue to be applied to the drill string **212** and/or drill bit **222**. The drive force may apply a torque that ultimately causes the sacrificial element to break and fail, thereby releasing the drill string **212** and drill bit **222** from the protective sheath

226. The drill string **212** and drill bit **222** may then be able to rotate and move axially within the interior of the drill string **212**.

[0052] The fastener **234** may be located at any suitable location, and the drill bit **222** may therefore be fastened at any suitable location along the length of the protective sheath **226**. In the embodiment illustrated in FIG. 6, the drill bit **222** is shown as being fixed at location that is in an upper end portion of the protective sheath **226**. In some embodiments, upon anchoring of the protective sheath **226**, the drill bit **222** may still be located within the primary wellbore **202**. Such an embodiment is, however, merely illustrative. In other embodiments (e.g., the embodiment shown in FIG. 9), the drill bit **222** may be anchored at a location more proximate the casing bit **216**, such that as the casing bit **216** is anchored in place, the drill bit **222** may already be located at least partially within the lateral borehole **210**.

[0053] Regardless of the distance at which the drill bit **222** is positioned relative to the casing bit **216**, when the fastener **234** is released and the drill bit **222** can move axially along the protective sheath **226**, the drill bit **222** may pass through the window **230** prior to drilling or extending a length of the lateral borehole **210**. As discussed herein, the window **230** may be surrounded by edges of the casing **204** that can potentially damage the drill bit **222**, whether on account of the material of the casing **204**, the shape of the edges around the window **230**, or other factors. In accordance with some embodiments of the present disclosure, the protective sheath **226** may shield the drill bit **222** and the drill string **212** from contacting the edges of the window **230** or potentially any part of the casing **204** or deflection member **218**.

[0054] More particularly, as discussed herein, the protective sheath **226** may be anchored in place and may extend from the interior of the primary wellbore **202**, through the window **230**, and into the lateral borehole **210**. The protective sheath **226** may, at its outer surface, potentially contact the deflection member **218** and/or casing **204**. The drill bit **222** and drill string **212**, however, may be located within the protective sheath **226**. Thus, as the drill bit **222** moves from a location within the primary wellbore **202** (FIG. 6) through the window **230** and to the lateral borehole **210** (FIG. 7), the drill bit **222** may be shielded from direct contact with the deflection member **218** and/or the edges of the window **230**.

[0055] The protective sheath **226** may be formed in any number of different manners. For instance, as discussed herein, the protective sheath **226** may include a tubular member coupled to (e.g., suspended from) a portion of the drill string **212**. Optionally, the protective sheath **226** may have the same or different properties relative the drill string **212**, casing **204**, or other components of the drilling system **200**. In some embodiments, the protective sheath **226** may be configured to bend or flex, may be jointed, or otherwise structured. The protective sheath **226** may also be part of a bottomhole assembly, or a separate component coupled to a bottomhole assembly associated with the drill bit **222**. An example protective sheath **226** may include CWD components to allow the protective sheath **226** to form a casing extending through the window **230** and into the lateral borehole **210**. In such an embodiment, the anchor **232** may cement or otherwise fix a casing within the lateral borehole **210**. In at least some embodiments, the protective sheath **226** may include a joint to facilitate bending and assist in forming a channel to guide the

drill bit 222 into the lateral borehole 210. In some embodiments, the protective sheath 226 may include expandable casing.

[0056] The protective sheath 226 may provide other uses other than protecting the drill bit 222 as the drill bit 222 moves through the window 230. As discussed herein, a deflection member 218 may be used to orient the drill string 212 at a desired trajectory. The drill string 212 may also restrict the drill bit 222 and drill string 214 from contacting the deflection member 218. The protective sheath 226 may, however, generally define the path from the primary wellbore 202 to the lateral borehole 210, and can thus act as a guide to the drill bit 222. In particular, the drill bit 222 and drill string 212 may be sized to allow the drill bit 222 to move within the protective sheath 226, which may act as a slide through which the drill bit 222 may move towards the casing bit 216 and ultimately to the distal end of the lateral borehole 210 as shown in FIG. 7. When anchored, the protective sheath 226 may also remain in place during not only lateral drilling of the lateral borehole 210 using the drill bit 222, but also potentially during re-entry of other components, including completion or other intervention components.

[0057] When the drill bit 222 reaches the end of the protective sheath 226, the casing bit 216 may obstruct further movement of the drill bit 222. In some embodiments, however, the casing bit 216 and drill bit 222 may be coordinated to allow the drill bit 222 to drill through the casing bit 216. For instance, the casing bit 216 may be a drillable casing bit and/or have an optional opening therein. When the opening is included, the opening may be used to center the drill bit 222 and/or to allow the drill bit 222 to more efficiently begin drilling through the casing bit 216. In some embodiments, the opening may have a size and/or length configured to allow the casing bit 216 to effectively mill the window 230 and start the lateral borehole 210, while also minimizing or reducing the amount of material through which the drill bit 222 may drill through to reach the exterior of the casing bit 216. In at least some embodiments, the interior of the casing bit 216 may be formed of a material that is different than at least some materials on an exterior of the casing bit 216. As an example, superhard or superabrasive materials (e.g., polycrystalline diamond, tungsten carbide, metal borides, etc.), or cutters having such materials, may be located on the exterior of the casing bit 216, while the interior of the casing bit 216 may have a different, and relatively softer, material (e.g., steel, iron, etc.). The drill bit 222 may be formed in any suitable manner for cutting through the interior of the casing bit 216 as well as through rock or other materials of the formation 206. In some embodiments, the interior of the casing bit 216 may be configured to allow the drill bit 222 to drill through the casing bit 216 at least nearly as efficiently as through the formation 206.

[0058] When the drill bit 222 has drilled through the casing bit 216, the drill bit 222 may then be at the distal end of the lateral borehole 210. In such an embodiment, by continuing to drive the drill bit 222 by applying weight-on-bit (e.g., using axial loading on the drill string 212), the lateral borehole 210 may be extended. As shown in FIG. 8, for instance, the drill bit 222 may be used to form an extended length 211 of the lateral borehole 210. In some embodiments, such as where the drill bit 222 is smaller than the casing bit 216, the extended length 211 of the lateral borehole 210 may also have a reduced size (e.g., width or diameter).

[0059] The above description of certain embodiments, including the embodiments illustrated in FIGS. 3-8, contains certain specific elements that are intended to be illustrative only, and may be varied in any number of manners. For instance, while the drilling system 200 described herein has been described as enabling a single trip operation, such an embodiment is merely illustrative. In other embodiments, for instance, a drilling system 200 may include a protective sheath 226 and a casing bit 216 to mill a window in a casing 204, but may not include a drill bit 222. Instead, an entirely separate assembly may be tripped into the primary wellbore 202 and guided by the protective sheath 226 to extend a lateral borehole 210.

[0060] Further, a deflection member 218 as described herein may have any number of other constructions. For instance, a ramped surface 228, or a portion thereof, may have an incline between 0.5° and 15° relative to a longitudinal axis of the primary wellbore 202. More particularly, the ramped surface 228 may have an incline with lower and upper limits that include any of 0.5°, 1°, 1.5°, 2°, 2.5°, 3°, 3.5°, 4°, 5°, 7.5°, 10°, 12.5°, 15°, or any value therebetween. For instance, at least a portion of the ramped surface 228 may be inclined at an angle of between 2° and 5° relative to the longitudinal axis of the primary wellbore 202. In still another embodiment, the ramped surface may be inclined at 3°. In still other embodiments, the ramped surface 228, or a portion thereof, may have an angle of less than 0.5°, or greater than 15°, relative to the longitudinal axis of the primary wellbore 202. In some embodiments, the angle of the ramped surface 228 may be an average angle of incline over multiple different stages having different inclines.

[0061] The deflection member 218 may be tripped into the primary wellbore 202 separate from the drill string 212. In other embodiments, however, the drill string 212 and deflection member 218 may be part of the same drilling assembly to allow for single trip setting of the deflection member 218, milling of the window 230, drilling of the lateral borehole 210, or some combination thereof.

[0062] FIG. 9, for instance, illustrates an example embodiment of a drilling system 300 that may be used for single trip drilling of a lateral borehole. In the drilling system 300 of FIG. 9, the drilling system 300 may also be used to anchor a deflection member 318 and mill a window in a casing 304 in the same, single trip.

[0063] Many of the components of the drilling system 300 may be similar in various regards to components described in embodiments described elsewhere herein, or illustrated in FIGS. 1-8. Accordingly, to avoid unnecessarily obscuring aspects of the disclosure, certain details will not be repeated relative to the drilling system 300, but should instead be understood to be equally applicable to the embodiment shown in FIG. 9. Indeed, each embodiment disclosed herein is intended to include components and features that may be interchanged with features and components of other embodiments disclosed herein.

[0064] In the embodiment shown in FIG. 9, the drilling system 300 may be used to form a lateral borehole off of a primary wellbore 302 that includes a casing 304 therein. The drilling system 300 may itself include a deflection member 318, a casing bit 316, and a drill bit 322 coupled together using a drill string 312, protective sheath 326, fasteners 334, connectors 336, or other components that allow single trip installation and/or use.

[0065] The deflection member 318 may include a whipstock or any other components suitable for deflecting the casing bit 316 against the casing 304 for formation of a window. In this embodiment, the deflection member 318 includes a setting assembly having one or more expandable anchors 320. The expandable anchors 320 are illustrated in a retracted state in which a width of the anchors 320 may be less than the interior diameter of the casing 304, thereby allowing the deflection member 318 to be inserted into, or retracted from, the primary wellbore 302.

[0066] The deflection member 318 is further illustrated as including a connector 336. In general, the connector 336 may couple the deflection member 318 to the casing bit 316. The connector 336 may have sufficient structural strength and integrity to maintain the deflection member 318 coupled to the casing bit 316 when tripped into the primary wellbore 302, but may be structured to break or release at a desired time or location. For instance, when the anchors 320 are expanded, the casing bit 316 may begin to rotate. When the deflection member 318 is fixed at an axial and/or rotational position, the rotation of the casing bit 316 may generate a torque or other force causing the connector 336 to fail. When the connector 336 fails, the deflection member 318 may become detached from the casing bit 316. It will be appreciated by a person having ordinary skill in the art, however, that the connector 336 may be used to decouple the deflection member 318 from the casing bit 316 or drill string 312 in any number of manners, and need not be or include a sacrificial element. Indeed, in some embodiments, the connector 336 may be selectively couplable to allow decoupling from, and re-coupling between, the deflection member 318 and the casing bit 316.

[0067] Upon separation of the deflection member 318 from the casing bit 316, the drill string 312 may be used to advance the casing bit 316 within the primary wellbore 302. Advancing the casing bit 316 may cause the casing bit 316 to move toward, and mill a window into, the casing 304. As discussed herein, when the casing bit 316 has milled a window, and optionally cut at least a portion of the formation 306 to start a lateral borehole, use of the casing bit 316 may be discontinued. The casing bit 316 may also be secured at an axial and/or rotational position in using an anchor 332 or other securement device (either directly or, as shown in FIG. 9, by coupling the anchor 332 to the protective sheath 326). Thereafter, the drill bit 322 may be advanced within the protective sheath 326 towards the casing bit 316. The drill bit 322 may drill through the casing bit 316 and then into the formation 306 to extend the lateral borehole.

[0068] The protective sheath 326 may protect the drill bit 322 and/or the drill string 312 against contact with the casing 304 (e.g., at the edges of the window in the casing 304); however, the protective sheath 326 may also provide other uses. For instance, the protective sheath 326 may protect other components of the drilling system 300. For instance, a bottomhole assembly including the drill bit 322 may include a stabilizer 333 or other components (e.g., mud motor, drill collars, sensors, jars, tractors, conveyors, vibration tools, etc.). The stabilizer 333 and other components may also pass through the protective sheath 326 to be protected from contact with the casing 304 or the deflection member 318. In other embodiments, completion or other components may enter the primary wellbore 302 following removal of the drill string 312, and can pass through the protective sheath 326 to be protected against damage from the deflection member 318 and/or the casing 304.

[0069] As discussed herein, the drill string 312 may be coupled to a protective sheath 326. The protective sheath 326 may provide a slide or guide for the drill bit 322 to allow the drill bit 322 to move through a window in the casing 304 without directly contacting the casing 304. In another embodiment, the protective sheath 326 may be separable from the drill string 312 (e.g., using fasteners 334). In one example embodiment, the protective sheath 326 may include components of a CWD system. Optionally, a joint 313 may couple components of the protective sheath 326 to each other. The joint 313 may be a CWD joint, and can be used to couple CWD or other component of the protective sheath 326, to facilitate bending or flexure of the protective sheath 326, or for any number of other purposes.

[0070] The drill bit 322 may be directly or indirectly coupled to the drill string 312, protective sheath 326, or casing bit 316 so as to be part of the same drilling assembly, and to allow single trip drilling of the lateral borehole. The fastener 334, which is shown as coupling the drill string 312 to the protective sheath 326, may be used to make such a connection. Optionally, the fastener 334 may include a sacrificial element, hydraulic release, or other type of connector to allow selective decoupling of the drill bit 322 from the protective sheath 326.

[0071] The particular location of the fastener 334 and/or location of a connection of the drill bit 322 can be varied. Relative to the embodiment in FIGS. 3-8, for instance, the drill bit 322 is shown as being fastened in a distal end portion near the casing bit 316. In one embodiment, the drill bit 322 may be generally aligned in a longitudinal direction with the anchor 332, or potentially nearer the casing bit 316 than the anchor 332. In such an embodiment, as the casing bit 316 mills a window in the casing 304, and is anchored to the formation 306, the protective sheath 326 may guide and protect the drill bit 322 through the window even before the fastener 334 is selectively released to decouple the drill bit 322 or drill string 312 from the protective sheath 326. When decoupled, the drill bit 322 may be used to independently drill within the lateral borehole, and can potentially drill through the casing bit 316 and/or into the formation 306 to form or extend the lateral borehole. In some embodiments, the drill bit 332 may be a fixed cutter, roller cone, impregnated diamond, or other drilling bit. In some embodiments, the drill bit 332 may have a fixed outer or gauge diameter. In other embodiments, the drill bit 332 may be an expandable drill bit. Similarly, the casing bit 316 may have a fixed diameter or may be expandable.

[0072] In the description herein, various relational terms are provided to facilitate an understanding of various aspects of some embodiments of the present disclosure. Relational terms such as "bottom," "below," "top," "above," "back," "front," "left," "right," "rear," "forward," "up," "down," "horizontal," "vertical," "clockwise," "counterclockwise," "upper," "lower," "uphole," "downhole," and the like, may be used to describe various components, including their operation and/or illustrated position relative to one or more other components. Relational terms do not indicate a particular orientation for each embodiment within the scope of the description or claims. For example, a component of a bottomhole assembly that is described as "below" another component may be further from the surface while within a vertical wellbore, but may have a different orientation during assembly, when removed from the wellbore, or in a deviated borehole. Accordingly, relational descriptions are intended solely

for convenience in facilitating reference to various components, but such relational aspects may be reversed, flipped, rotated, moved in space, placed in a diagonal orientation or position, placed horizontally or vertically, or similarly modified. Certain descriptions or designations of components as “first,” “second,” “third,” and the like may also be used to differentiate between identical components or between components which are similar in use, structure, or operation. Such language is not intended to limit a component to a singular designation. As such, a component referenced in the specification as the “first” component may be the same or different than a component that is referenced in the claims as a “first” component.

[0073] Furthermore, while the description or claims may refer to “an additional” or “other” element, feature, aspect, component, or the like, it does not preclude there being a single element, or more than one, of the additional element. Where the claims or description refer to “a” or “an” element, such reference is not to be construed that there is just one of that element, but is instead to be inclusive of other components and understood as “at least one” of the element. It is to be understood that where the specification states that a component, feature, structure, function, or characteristic “may,” “might,” “can,” or “could” be included, that particular component, feature, structure, or characteristic is provided in some embodiments, but is optional for other embodiments of the present disclosure. The terms “couple,” “coupled,” “connect,” “connection,” “connected,” “in connection with,” and “connecting” refer to “in direct connection with,” or “in connection with via one or more intermediate elements or members.” Components that are “integral” or “integrally” formed include components made from the same piece of material, or sets of materials, such as by being commonly molded or cast from the same material, or commonly machined from the same piece of material stock. Components that are “integral” should also be understood to be “coupled” together.

[0074] Although various example embodiments have been described in detail herein, those skilled in the art will readily appreciate in view of the present disclosure that many modifications are possible in the example embodiments without materially departing from the present disclosure. Accordingly, any such modifications are intended to be included in the scope of this disclosure. Likewise, while the disclosure herein contains many specifics, these specifics should not be construed as limiting the scope of the disclosure or of any of the appended claims, but merely as providing information pertinent to one or more specific embodiments that may fall within the scope of the disclosure and the appended claims. The various embodiments discussed herein may be used in combination, and various features disclosed in one embodiment are intended to be usable in connection with other embodiments disclosed herein.

[0075] A person having ordinary skill in the art should realize in view of the present disclosure that equivalent constructions do not depart from the spirit and scope of the present disclosure, and that various changes, substitutions, and alterations may be made to embodiments disclosed herein without departing from the spirit and scope of the present disclosure. Equivalent constructions, including functional “means-plus-function” clauses are intended to cover the structures described herein as performing the recited function, including both structural equivalents that operate in the same manner, and equivalent structures that provide the same function. It is the express intention of the applicant not

to invoke means-plus-function or other functional claiming for any claim except for those in which the words ‘means for’ appear together with an associated function. Each addition, deletion, and modification to the embodiments that falls within the meaning and scope of the claims is to be embraced by the claims.

[0076] While embodiments disclosed herein may be used in oil, gas, or other hydrocarbon exploration or production environments, such environments are merely illustrative. Systems, tools, assemblies, methods, milling systems, and other components of the present disclosure, or which would be appreciated in view of the disclosure herein, may be used in other applications and environments. In other embodiments, milling tools, deflection elements, methods of milling and drilling, or other embodiments discussed herein, or which would be appreciated in view of the disclosure herein, may be used outside of a downhole environment, including in connection with other systems, including within automotive, aquatic, aerospace, hydroelectric, manufacturing, other industries, or even in other downhole environments. The terms “well,” “wellbore,” “borehole,” and the like are therefore also not intended to limit embodiments of the present disclosure to a particular industry. A wellbore or borehole may, for instance, be used for oil and gas production and exploration, water production and exploration, mining, utility line placement, or myriad other applications.

[0077] Certain embodiments and features may have been described using a set of numerical values that may provide lower and upper limits. It should be appreciated that ranges including the combination of any two values are contemplated unless otherwise indicated, and that a particular value may be defined by a range having the same lower and upper limit. All numbers, percentages, ratios, measurements, or other values stated herein are intended to include not only the stated value, but also other values that are about or approximately the stated value, as would be appreciated by one of ordinary skill in the art encompassed by embodiments of the present disclosure. A stated value should therefore be interpreted broadly enough to encompass values that are at least close enough to the stated value to perform a desired function or achieve a desired result. The stated values include at least experimental error and variations that would be expected by a person having ordinary skill in the art, as well as the variation to be expected in a suitable manufacturing or production process. A value that is about or approximately the stated value and is therefore encompassed by the stated value may further include values that are within 5%, within 1%, within 0.1%, or within 0.01% of a stated value.

[0078] The Abstract at the end of this disclosure is provided to allow the reader to quickly ascertain the general nature of some embodiments of the present disclosure. It is submitted with the understanding that it will not be used to interpret or limit the scope or meaning of the claims.

What is claimed is:

1. A method for drilling a lateral borehole from a cased, primary wellbore, comprising:
 - positioning a drilling assembly within a primary wellbore, the drilling assembly including a casing bit coupled to a protective sheath;
 - milling a window in a casing of the primary wellbore with the casing bit;
 - extending the protective sheath through the window;
 - guiding a drill string and drill bit through the protective sheath and through the window; and

- drilling a lateral borehole using the drill bit.
2. The method recited in claim 1, the casing bit being a drillable casing bit, wherein drilling the lateral borehole including:
- drilling through the casing bit using the drill bit.
3. The method recited in claim 1, further comprising:
- anchoring the protective sheath following extending the protective sheath through the window.
4. The method recited in claim 3, wherein anchoring the protective sheath includes anchoring the protective sheath to restrict at least one of axial or rotational movement of the protective sheath.
5. The method recited in claim 1, wherein the protective sheath is a casing while drilling joint coupled to the drill string.
6. The method recited in claim 1, wherein milling the window in the casing further includes using the casing bit to initiate drilling of the lateral borehole.
7. The method recited in claim 1, wherein the drill string is coupled to an interior of the protective sheath.
8. The method recited in claim 7, wherein drilling the lateral borehole includes releasing the drill string from the protective sheath.
9. The method recited in claim 1, further comprising:
- anchoring a deflection member within the primary wellbore; and
 - deflecting the casing bit into the casing using the deflection member.
10. The method recited in claim 1, wherein extending the protective sheath includes positioning the protective sheath partially through the window.
11. A drilling assembly, comprising:
- a casing bit;
 - a protective sheath coupled to the casing bit; and
 - a drill string coupled to an interior of the protective sheath, the drill string including a drill bit.
12. The drilling assembly recited in claim 11, further comprising:
- an anchor coupled to the protective sheath.

13. The drilling assembly recited in claim 11, the casing bit being a drillable casing bit and configured to mill through casing of a wellbore.

14. The drilling assembly recited in claim 11, further comprising:

- a fastener selectively coupling the drill string to the protective sheath.

15. The drilling assembly recited in claim 14, the fastener including a sacrificial element.

16. The drilling assembly recited in claim 11, further comprising:

- a deflection member releasably coupled to the casing bit.

17. The drilling assembly recited in claim 16, further comprising:

- an anchor coupled to the deflection member.

18. A drilling system for forming a window in a casing of a primary wellbore and drilling a lateral borehole off the primary wellbore, comprising:

- a drillable casing bit configured to mill a window in casing of a primary wellbore;
- a protective sheath coupled to the drillable casing bit;
- an anchor configured to anchor the protective sheath and restricting at least one of axial or rotational motion of the protective sheath;
- a drill string coupled to, and within the protective sheath, the drill string including a drill bit configured to drill through the drillable casing bit and through formation around the primary wellbore; and
- a fastener releasably coupling the drill string to the protective sheath.

19. The drilling system recited in claim 18, the anchor being selectively expandable to anchor the protective sheath within the formation.

20. The drilling system recited in claim 18, further comprising:

- a deflection member releasably coupled to at least one of the drillable casing bit or the protective sheath.

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