

INTEGRATED DEBRIS CATCHER AND PLUG SYSTEM

BACKGROUND

[0001] In the oil and gas industry, once casing is placed into a wellbore, certain portions of the wellbore may need to be isolated. A plug, such as, *e.g.*, a bridge plug, may be placed down into the wellbore to isolate the desired portion. However, operations that may continue in the wellbore uphole of the plug may produce significant amounts of debris and junk. Debris catchers, such as junk baskets, are often placed above the plug to catch the junk and debris such that when the plug needs to be removed, the debris may be removed first, enabling easier retrieval of the plug.

10 [0002] Traditionally, the plug is set in one downhole trip using a setting tool run from the surface. The setting tool must be brought back to the surface and the junk basket attached, which is then set in an additional downhole trip. Each downhole trip costs time and, likewise, money. What is needed is a debris catcher and plug system that does not experience the drawbacks of existing debris catchers and plug systems.

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BRIEF DESCRIPTION

[0003] Reference is now made to the following descriptions taken in conjunction with the accompanying drawings, in which:

20 [0004] FIG. 1 is a schematic illustration of an offshore oil and gas platform during the installation of an integrated debris catcher and plug system according to principles of the disclosure;

[0005] FIG. 2A is a section view illustrating one stage of deployment of an integrated debris catcher and plug system according to principles of the disclosure running inhole during downhole deployment;

25 [0006] FIG. 2B is a section view illustrating another stage of downhole deployment of the integrated debris catcher and plug system according to principles of the disclosure as the plug is being set in the wellbore;

[0007] FIG. 2C is a section view illustrating yet another stage of downhole deployment of the integrated debris catcher and plug system according to principles of the disclosure as force is applied uphole to disengage the debris catcher from the plug;

30 [0008] FIG. 2D is a section view illustrating still another stage of downhole deployment of the integrated debris catcher and plug system according to principles of the disclosure as a downhole setting device begins to disengage from the debris catcher;

[0009] FIG. 2E is a section view illustrating another stage of downhole deployment of the integrated debris catcher and plug system according to principles of the disclosure showing the downhole setting device disengaged from the debris catcher and being pulled uphole;

5 [0010] FIG. 2F is a section view illustrating an initial stage of retrieval of the debris catcher of the integrated debris catcher and plug system according to principles of the disclosure; and

[0011] FIG. 2G is a section view illustrating a next stage of retrieval of the debris catcher of the integrated debris catcher and plug system according to principles of the disclosure.
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DETAILED DESCRIPTION

[0012] In the drawings and descriptions that follow, like parts are typically marked throughout the specification and drawings with the same reference numerals, respectively.

15 The drawn figures are not necessarily to scale. Certain features of the disclosure may be shown exaggerated in scale or in somewhat schematic form and some details of certain elements may not be shown in the interest of clarity and conciseness. The present disclosure may be implemented in embodiments of different forms. Specific embodiments are described in detail and are shown in the drawings, with the understanding that the present
20 disclosure is to be considered an exemplification of the principles of the disclosure, and is not intended to limit the disclosure to that illustrated and described herein. It is to be fully recognized that the different teachings of the embodiments discussed herein may be employed separately or in any suitable combination to produce desired results.

[0013] Unless otherwise specified, use of the terms “connect,” “engage,” “couple,”
25 “attach,” or any other like term describing an interaction between elements is not meant to limit the interaction to direct interaction between the elements and may also include indirect interaction between the elements described.

[0014] Unless otherwise specified, use of the terms “up,” “upper,” “upward,”
“uphole,” “upstream,” or other like terms shall be construed as generally toward the surface
30 of the formation; likewise, use of the terms “down,” “lower,” “downward,” “downhole,” or other like terms shall be construed as generally toward the bottom, terminal end of a well, regardless of the wellbore orientation. Use of any one or more of the foregoing terms shall not be construed as denoting positions along a perfectly vertical axis. Unless otherwise

specified, use of the term “subterranean formation” shall be construed as encompassing both areas below exposed earth and areas below earth covered by water such as ocean or fresh water.

[0015] Previous embodiments of plugs and debris catchers have required multiple
5 downhole trips – a trip to set the plug and at least one additional trip to set the debris catcher. Some embodiments have deployed a system wherein a downhole end of the debris catcher has an opening, such as a flap, flapper, or similar type opening, such that a downhole power unit extends through the downhole end of the debris catcher to engage and set the plug. What is proposed is a debris catcher and plug system that may be installed in a single downhole trip
10 wherein the base of the debris catcher is non-opening and remains securely closed and in place once the plug and debris catcher have been set into the wellbore.

[0016] Referring initially to FIG. 1, there is shown a plug 170 and debris catcher 110 being installed from an offshore oil and gas platform that is schematically illustrated and generally designated 100. A semi-submersible platform 102 is centered over submerged oil
15 and gas formations 104, 106 located below sea floor 108. A subsea conductor 112 extends from deck 114 of platform 102 to sea floor 108. A wellbore 116 extends from sea floor 108 and traverse formations 104, 106. Wellbore 116 includes a casing 118 that is supported therein by cement 122. Casing 118 has two sets of perforations 124, 126 in the intervals proximate formations 104, 106.

[0017] A tubing string 128 extends from wellhead 132 to a location below formation 106 but above formation 104 and provides a conduit for production fluids to travel to the surface. A pair of packers 134, 136 provides a fluid seal between tubing string 128 and casing 118 and directs the flow of production fluids from formation 106 to the interior of tubing string 128 through, for example, a slotted liner. Disposed within tubing string 128 is a
25 wireline 138 used to convey a tool system including at least a downhole setting device, such as downhole power unit (DPU) 180, debris catcher 110, and plug 170, such as e.g., a bridge plug. Even though downhole power unit 180, debris catcher 110, and plug 170 are depicted as being deployed on a wireline, it is to be understood by those skilled in the art that downhole power unit 180, debris catcher 110, and plug 170 could be deployed on other types
30 of conveyances and downhole setting devices, including, but not limited to a slickline, coiled tubing, jointed tubing, a downhole robot or the like, without departing from the principles of the present disclosure.

[0018] As will be described in more detail below, a particular implementation of downhole power unit 180 includes an elongated housing, a motor disposed in the housing and a sleeve connected to a rotor of the motor. The sleeve is a rotational member that rotates with the rotor. A moveable member such as the above-mentioned moveable shaft is received
5 within the threaded interior of the sleeve. Operation of the motor rotates the sleeve which causes the moveable shaft to move longitudinally. Accordingly, when downhole power unit 180 is operably coupled with debris catcher 110 and plug 170 and the moveable member is activated, longitudinal movement is imparted to the debris catcher 110 and plug 170.

[0019] Even though FIG. 1 depicts a vertical well, it should be understood by those
10 skilled in the art that the debris catcher 110 and plug 170 of the present disclosure are equally well-suited for use in deviated wells, inclined wells, horizontal wells, multilateral wells and the like. As such, the use of directional terms such as above, below, upper, lower, upward, downward and the like are used in relation to the illustrative embodiments as they are depicted in the figures, the upward direction being toward the top of the corresponding figure
15 and the downward direction being toward the bottom of the corresponding figure. Likewise, even though FIG. 1 depicts an offshore operation, it should be understood by those skilled in the art that the through tubing bridge plug and junk basket of the present disclosure is equally well-suited for use in onshore operations. Also, even though FIG. 1 depicts a cased wellbore, it should be understood by those skilled in the art that the through tubing bridge plug and
20 junk basket of the present disclosure is equally well-suited for use in open hole operations.

[0020] Referring now to FIG. 2A, there is shown one embodiment of an integrated debris catcher and plug deployment system 200 (hereinafter deployment system 200) for deploying a debris catcher 210 engaged with a plug 270 using a downhole setting device 280. In one embodiment, the plug 270 and debris catcher 210 may be deployed in a single
25 downhole trip using downhole setting device 280, which in some embodiments may be a downhole power unit. In the example embodiment, the debris catcher 210 includes a debris catching sleeve 220. The debris catching sleeve 220, among other features, may include an extension sleeve 222, an upper running sleeve 224, and a lower running sleeve 226. While only a single extension sleeve 222 has been illustrated, those skilled in the art understand that
30 multiple extension sleeves 222 may be used (e.g., coupled together in one embodiment) to accommodate various different volumes of debris. The lower running sleeve 226 extends downhole and sits within an opening in plug 270. The debris catcher 210 further includes a running tool 240 positioned within the lower running sleeve 226 that engages with the plug

270. In one embodiment (e.g., as shown in FIG. 2D), the uphole end of the running tool 240 engages with a locking ring within the upper running sleeve 224 to form a collection base of the debris catcher 210.

[0021] The running tool 240 includes one or more shear features 248 configured to set plug 270, but shear and release the running tool 240 from the plug 270 (e.g. as shown in FIG. 2C) when the plug is set and the running tool 240 is being drawn uphole. The running tool 240 is coupled with an extension rod 282 of downhole setting device 280 by a coupling rod 242. An alignment pin 246 is positioned near and extends from an uphole end of coupling rod 242. The alignment pin 246 aligns the coupling rod 242 with a downhole end of the extension rod 282.

[0022] A collet 284 is positioned axially about and extends from the downhole end of the extension rod 282. The downhole end of the collet 284, in the illustrated embodiment, engages an axial groove 244 of the coupling rod 242. During the downhole deployment, as shown in FIG. 2A, the collet is positioned within a reduced diameter bore 228 of the upper running sleeve 224. In this configuration, the reduced diameter bore 228 keeps the collet 284 from disengaging from the axial groove 244. Positioned axially about the coupling rod 242 is a locking ring 250. In one embodiment, the locking ring 250 is configured to engage the uphole end of the running tool 240. In one embodiment, the running tool 240 includes, at its uphole end, no-go shoulder 241 which prevent the running tool 240 from moving uphole of the upper running sleeve 224, for example as is shown in FIG. 2D.

[0023] In the illustrated embodiment, an uphole end of the extension sleeve 222 includes a catch profile 230. The catch profile 230 may engage with a retrieval tool for future retrieval of the debris catcher 210. In the illustrated embodiment of FIG. 2A, the catch profile 230 is not in use.

[0024] Referring now to FIG. 2B, there is shown a section view of the deployment system 200 as the plug 270 is being set in the wellbore to seal off a downhole portion of the wellbore. Downhole force is applied by the downhole setting device 280 to set the plug 270. Tensile force, in this embodiment, is applied until the locking ring 250 meets with and engages the running tool 240. At this stage of the deployment, the plug 270 is set within the wellbore, and at the same time the debris catcher remains engaged with the plug 270.

[0025] Referring now to FIG. 2C, there is shown a section view of the deployment system 200 as tensile force is applied to begin retraction of the downhole setting device 280 from the plug 270. As the running tool 240 is drawn uphole, the uphole force causes the one

or more shear features 248 to shear thereby disengaging the running tool 240, and as such, the debris catcher 200, from the plug 270. In one embodiment, the one or more shear features 248 include shear pins which removably couple plug 270 with the running tool 240. As further tensile force is applied, the running tool 240 is drawn uphole and into locking ring 250. At this stage of downhole deployment, the collet 284 remains engaged in the reduced diameter bore 228 and seated in the axial groove 244. Accordingly, the extension rod 282 of the downhole setting device 280 remains engaged with the coupling rod 242.

[0026] Referring now to FIG. 2D, there is shown a section view of the deployment system 200 as the setting device 280 begins to disengage from the debris catcher 210. As additional uphole force is applied to retract the downhole setting device 280, the coupling rod 242 is further drawn uphole, which also draws the running tool 240 uphole and further engaging the locking ring 250. When the locking ring 250 is fully engaged with the running tool 240, the running tool becomes the base of the debris catcher 210. As tensile force is continuously applied, the collet 284 is drawn out of the reduced diameter bore, which allows the collect to extend radially outward and disengage from the axial groove 244. At this point, the extension rod 282 of the downhole setting device 280 may disengage from the coupling rod 242.

[0027] FIG. 2E is a section view illustrating the downhole setting device 280 substantially disengaged from the debris catcher 210. As tensile force is continuously applied, the collet 284 disengages from the reduced diameter bore 228 such that downhole setting device 280 is substantially disconnected from the debris catcher 210 and may be drawn uphole for removal from the wellbore. The debris catcher 210 is held atop the plug 270 by gravity to catch any debris caused by uphole activity. As is illustrated, the uphole end of the running tool 240 engages with a locking ring within the upper running sleeve 224 to form a collection base of the debris catcher 210.

[0028] FIG. 2F is a section view illustrating a first stage of retrieval of the debris catcher 210 from the wellbore. Such a configuration would exist after the debris catcher 210 has served its purpose, and thus is at least partially or substantially filled with debris, and must be withdrawn from the wellbore. FIG. 2F illustrates a retrieval tool 290 approaching the debris catcher 210. The retrieval tool 290, in the embodiment shown, includes an engagement member 292. The engagement member 292, as shown, is configured to engage the catch profile 230 in the inner diameter of the uphole end of the debris catcher 210.

[0029] FIG. 2G is a section view illustrating retrieval of the debris catcher 210 of the integrated debris catcher and plug system according to principles of the disclosure. The retrieval tool 286, and more specifically the engagement member 292, is shown engaged in the catch profile 230 of the debris catcher 210. Once the retrieval tool is fully engaged in the catch profile 230, uphole force may be applied to the downhole setting device 280 to retrieve the debris catcher 210 for removal from the wellbore. At this stage, the plug 270 would remain within the wellbore, and may be retrieved by conventional methods.

[0030] Various aspects of the disclosure can be claimed including the apparatuses, systems, and methods disclosed herein. Aspects disclosed herein include:

10 [0031] A. A debris catcher for use within a wellbore, comprising: a debris catching sleeve; a running tool coupled to the debris catching sleeve, the running tool including an uphole end and a downhole end, and further wherein the uphole end of the running tool is configured to slide to engage a downhole end of the debris catching sleeve and form a collection base of the debris catcher; and a coupling rod attached to the uphole end of the running tool, the coupling rod configured to engage a downhole setting device.

15 [0032] B. A debris catching system for use within a wellbore, comprising: a plug; and a debris catcher, the debris catcher comprising: a debris catching sleeve; a running tool coupled to the debris catching sleeve, the running tool including an uphole end and a downhole end, and further wherein the uphole end of the running tool is configured to slide to engage a downhole end of the debris catching sleeve and form a collection base of the debris catcher; and a coupling rod attached to the uphole end of the running tool, the coupling rod configured to engage a downhole setting device; wherein the plug is removably coupled with the downhole end of the running tool during downhole deployment of the debris catching system.

25 [0033] C. A method of setting a debris catcher into a wellbore, the method comprising: providing an integrated debris catcher and plug deployment system, the integrated debris catcher and plug deployment system including: a debris catcher, the debris catcher including: a debris catching sleeve, the debris catching sleeve including an extension sleeve, an upper running sleeve and a lower running sleeve, wherein the upper running sleeve includes a reduced diameter bore configured to engage a collet of a downhole setting device; a running tool coupled to the debris catching sleeve, the running tool including an uphole end and a downhole end, and further wherein the uphole end of the running tool is configured to slide to engage a downhole end of the debris catching sleeve and form a collection base of the

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debris catcher; and a coupling rod attached to the uphole end of the running tool, the coupling rod configured to engage the downhole setting device; a plug removably coupled with the downhole end of the running tool by one or more shear features configured to set the plug, and shear and release the running tool from the plug when being drawn uphole; deploying the
5 integrated debris catcher and plug deployment system downhole using the downhole setting device.

[0034] Each of aspects A, B, and C can have one or more of the following additional elements in combination:

[0035] Element 1: wherein the debris catching sleeve includes an extension sleeve, an
10 upper running sleeve and a lower running sleeve, and further wherein the upper running sleeve includes a reduced diameter bore configured to engage a collet of the downhole setting device;

[0036] Element 2: wherein the coupling rod further includes an axial groove for receiving the collet when the collet is located in the reduce diameter bore;

15 **[0037]** Element 3: wherein a downhole end of the upper running sleeve includes a locking ring, wherein the locking ring is configured to engage the uphole end of the running tool;

[0038] Element 4: wherein the running tool is positioned within the lower running sleeve, and further wherein a downhole end of the lower running sleeve is configured to
20 insert into an uphole end of the plug;

[0039] Element 5: wherein the running tool is positioned within the lower running sleeve, and further wherein a downhole end of the lower running sleeve is configured to insert into an uphole end of the plug;

25 **[0040]** Element 6: wherein the running tool includes one or more shear features configured to set a plug, and shear and release the running tool from the plug when being drawn uphole;

[0041] Element 7: wherein the coupling rod includes an alignment pin configured to align with an opening in a downhole end of an extension rod of the downhole setting device;

30 **[0042]** Element 8: wherein an uphole end of the debris catching sleeve includes a catch profile, the catch profile configured to engage an associated engagement member of a retrieval tool; and

[0043] Element 9: wherein deploying the integrated debris catcher and plug deployment system downhole includes: applying a downhole force to deploy the debris

catcher downhole until the plug engages a selected portion of the wellbore and the locking ring engages the uphole end of the running tool; applying an uphole force to the downhole setting device, wherein the uphole force shears the running tool from the plug and draws the running tool uphole; and maintaining the uphole force on the downhole setting device until
5 the collet disengages from the reduced diameter bore, disengaging the downhole setting device from the running tool and drawing the downhole setting device uphole.

[0044] Those skilled in the art to which this application relates will appreciate that other and further additions, deletions, substitutions and modifications may be made to the described embodiments.