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(54) Hydraulic Disconnect

(57) A disconnect apparatus (100) includes a lower housing (102), an upper housing (104) having a collet mechanism (106) configured to couple the upper housing to the lower housing, a retainer sleeve (124) disposed within the upper housing and/or the lower housing, the retainer sleeve (126) configured to move longitudinally within the lower housing and/or the upper housing between a first position and a second position in response to a pressure differential applied across the retainer sleeve; wherein in the first position at least a portion of the retainer sleeve is disposed radially inward of the collet mechanism (106) and in the second position the retainer sleeve (124) is disposed axially above or below the collet mechanism (106), and a biasing mechanism (126) coupled to an end of the retainer sleeve (124). A method of disconnecting a tool from a tubular string includes applying a differential pressure across a sleeve (124) and disengaging a collet mechanism (106) with a housing.

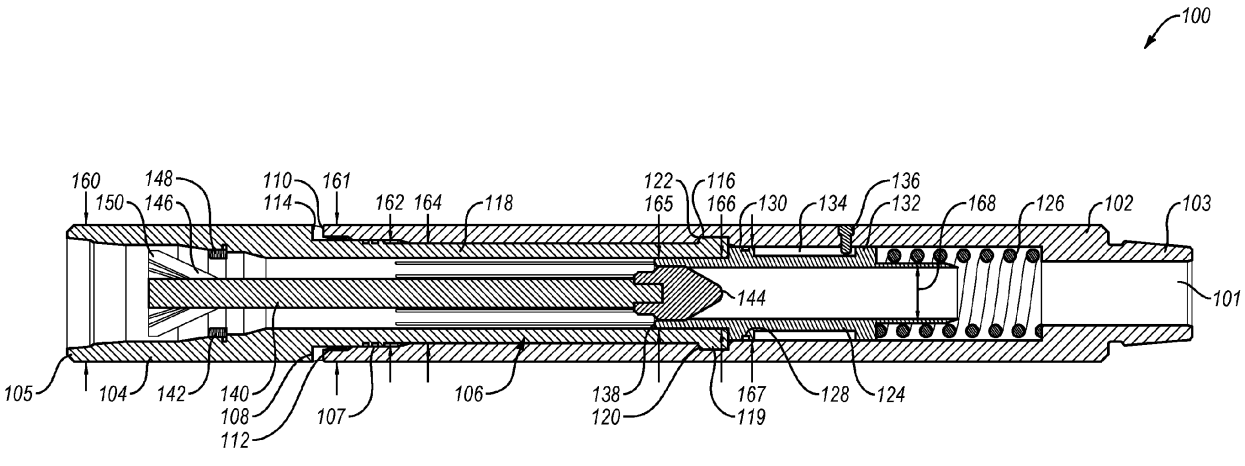

Fig. 1

EP 2 772 608 A1

Description

BACKGROUND

[0001] Downhole tools or assemblies for use in a variety of downhole applications are often disposed in a borehole on a tubing string. Such tools and assemblies may then provide any of numerous operations, including drilling, casing milling, sidetracking, well abandonment procedures, and the like. To complete the operation, the tubing string may be tripped into the borehole. Upon completion of the operation, the tubing string and the attached tools or assemblies may be tripped out of the borehole and recovered.

[0002] In some instances, the tool or assembly may be designed to remain downhole. For instance, a whipstock may be tripped into a wellbore for a planned or unplanned departure, and anchored in place. The tubing string delivering the whipstock may be released from the whipstock and then tripped out of the hole. In other cases, a tool or assembly may become stuck in the hole. To allow disconnection between the tubing string and the downhole tool or assembly, he tubing string may be connected to the tool or assembly by a disconnect device. The disconnect device can be actuated to release the tool or assembly to allow withdrawal of the tubing string from the borehole, while the tool remains downhole. A disconnect device may also allow for reconnection with the tool or assembly in the event retrieval of the tool becomes possible.

SUMMARY

[0003] In one aspect, embodiments disclosed herein relate to a disconnect apparatus including a lower housing, and a retainer sleeve disposed within the lower housing and configured to move longitudinally within the lower housing. The retainer sleeve may include a seating surface configured to receive an obstruction device, a spring coupled to a lower end of the retainer sleeve, and an upper housing configured to removably engage the lower housing. The upper housing may include a retainer disposed therein configured to engage and retain an obstruction device within, or connected to, the upper housing. The obstruction device may be a dart.

[0004] In another aspect, embodiments disclosed herein relate to a disconnect apparatus including a lower housing, an upper housing having a collet mechanism configured to couple the upper housing to the lower housing, a retainer sleeve disposed within at least one of the upper housing and the lower housing, and a biasing mechanism coupled to an end of the retainer sleeve. The retainer sleeve may be configured to move longitudinally between a first position and a second position in response to a pressure differential applied across the retainer sleeve. The retainer sleeve may move within the lower housing and/or the upper housing. When in the first position, at least a portion of the retainer sleeve may be disposed radially inward of the collet mechanism and in the second position the retainer sleeve may be disposed axially above or below the collet mechanism. This disconnect apparatus may further comprise a float valve disposed in the retainer sleeve, the float valve operable between an open position and a closed position. The biasing mechanism may bias the retainer sleeve into the first position.

[0005] In another aspect, embodiments disclosed herein relate to methods that include applying a differential hydraulic pressure across a retainer sleeve of a disconnect apparatus, the disconnect apparatus having an upper housing and a lower housing coupled to the upper housing, and a retainer sleeve disposed in at least one of the upper housing or the lower housing. The retainer sleeve may be moved from a first position to a second position in response to the differential pressure, and a tensile load may be applied to the upper housing. Engagement of a collet mechanism of the upper housing may be released from a retaining groove formed in an inner surface of the lower housing. The method may further comprise recoupling the upper housing with the lower housing, the recoupling including: disposing the collet mechanism in the lower housing and engaging a lower end surface of the collet mechanism with an upper end surface of the retainer sleeve; applying an axial load to the upper housing to move the collet mechanism and the retainer sleeve axial downward; engaging the collet mechanism with the retaining groove of the lower housing; and moving the retainer sleeve axial upward until at least a portion of the retainer sleeve is disposed radially inward of the collet mechanism.

[0006] This summary is provided to introduce a selection of concepts that are further described below in the detailed description. This summary is 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 claimed subject matter.

BRIEF DESCRIPTION OF DRAWINGS

[0007]

FIG. 1 is a cross-sectional view of a disconnect apparatus in a first position in accordance with some embodiments disclosed herein.

FIG. 2 is a cross-sectional view of the disconnect apparatus of FIG. 1 in a second position in accordance with some embodiments disclosed herein.

FIG. 3 is a cross-sectional view of the disconnect apparatus of FIG. 1 in a third position in accordance with some embodiments disclosed herein.

FIG. 4 is a cross-sectional view of another disconnect apparatus in accordance with some embodiments disclosed herein.

FIG. 5 is a cross-sectional view of a disconnect apparatus with a float valve in an open position in accordance with some embodiments disclosed herein.

FIG. 6 is a cross-sectional view of the disconnect apparatus of FIG. 4 with the float valve in a closed position in accordance with some embodiments disclosed herein.

DETAILED DESCRIPTION

[0008] Embodiments disclosed herein relate generally to systems, apparatuses, assemblies, and methods for disconnecting a downhole tool or assembly. Specifically, some embodiments disclosed herein relate to an apparatus and method for disconnecting a drill string, remedial string, or other tubular string from a downhole tool or assembly. More specifically, some embodiments disclosed herein relate to disconnecting a tubular string from a downhole tool or assembly using hydraulic pressure applied through or around the tubular string.

[0009] Referring to FIG. 1, a cross-sectional view of an example disconnect apparatus 100 having a throughbore 101 in a first position is shown in accordance with some embodiments of the present disclosure. Disconnect apparatus 100 may include a lower housing 102 having a central throughbore and an upper housing 104 having a central throughbore. The upper housing 104 may be configured to removably engage the lower housing 102 in some embodiments. The lower housing 102 may be configured to couple to or engage with a tool or assembly (e.g., a bottomhole assembly). For example, a lower end of the lower housing 102 may include a pin member 103 for threadingly engaging a box member (not shown) of a tool or assembly. Similarly, an upper end of the upper housing 104 may include a box member 105 for receiving and engaging a pin member (not shown) of a section of tubing string (not shown). Of course, in other embodiments, the pin member 103 may be replaced by a box member and/or the box member 105 may be replaced by a pin member. The pin member 103 and/or box member 105 may also be replaced by other connection mechanisms.

[0010] As shown in FIG. 1, the upper housing 104 may include a retention mechanism for removably securing the upper housing 104 to the lower housing 102. In one embodiment, as shown, the retention mechanism may include a collet mechanism 106 formed in a lower end of the upper housing 104, as discussed in more detail herein. One having ordinary skill in the art will appreciate in view of the disclosure herein that the collet mechanism 106 may be integrally formed with the upper housing or may be a separate component coupled to the upper housing by any means known in the art, for example, threadingly engaged, bolted, or otherwise mechanically fastened, welded, brazed, adhesively coupled, or combinations of the foregoing.

[0011] As shown, an outer diameter 160 of an upper end of the upper housing 104 may be approximately equal to an outer diameter 161 of at least a portion of the lower housing 102. An outer diameter 162 of a lower end or middle portion of the upper housing 104 may, in some embodiments, be approximately equal to or less than an inner diameter 164 of the lower housing 102. A shoulder 108 formed between the outer diameter 160 of the upper end and the outer diameter 162 of the middle or lower end of the upper housing 104 may be configured to abut an upper end surface 110 of the lower housing 102.

[0012] In some embodiments, the lower housing 102 may include a plurality of splines 112 formed or located on an inner surface of the lower housing 102. As shown in FIG. 1, the plurality of splines 112 may be formed or located proximate an upper end of the lower housing 102, although the plurality of splines 112 may be located at other locations along the lower housing 102. The upper housing 104 may also include a plurality of splines 114 formed on an outer surface of middle or lower end of upper housing 104. The plurality of splines 114 may be configured to engage the plurality of splines 112 of the lower housing 102. In some embodiments, the splines 112, 114 may be corresponding straight splines. The splines 112, 114 may further be configured to engage the lower housing 102 and the upper housing 104 during rotation of a tubular string (e.g., a drill string connected to the box member 105) to transmit torque between the tubing string (not shown) and the tool or assembly (not shown) which may be coupled to the lower end of the disconnect apparatus 100 (e.g., to pin member 103). In some embodiments, ends of each of the plurality of splines 112, 114 may be tapered along the length of each spline 112, 114 to allow for the splines 112, 114 to align and engage as the upper housing 104 is coupled to the lower housing 102. One of ordinary skill in the art will appreciate in view of the disclosure herein that when the splines 112, 114 are included in the disconnect apparatus 100, the number of splines 112,114 may vary without departing from the scope of embodiments disclosed herein. In certain embodiments, one or more seals 107, may be disposed between the upper housing 104 and the lower housing 102 to facilitate formation of a fluid-tight connection between the upper housing 104 and the lower housing 102. In some embodiments, the seals 107 may include O-rings, T-seals, lip seals, gaskets, U-cups, diaphragms, sealing disks, elastomer sleeves, C-rings, X-rings, or other sealing components, or some combination thereof, proximate the splines 112, 114.

[0013] In some embodiments, the collet mechanism 106 may be configured to engage a circumferential groove 116 formed on the inner surface of the lower housing 102. The collet mechanism 106 may include a plurality of collet fingers 118 circumferentially arranged and extending distally from the upper housing 104. Each collet finger 118 may terminate with a radially outwardly extending protrusion 119 configured to engage the circumferential groove 116. In one embodiment, the circumferential groove 116 may be a single groove formed along

an entire circumference of the inner surface of the lower housing 102. In other embodiments, the circumferential groove 116 may include a number of discrete grooves, and the size and number of grooves may correspond with the size and number of individual collet fingers.

[0014] As shown, an upper surface 120 of the radially outwardly extending protrusion 119 of each collet finger 118 may be angled radially downward. The upper surface 120 may be configured to engage an upper surface 122 of the circumferential groove 116. The upper surface 122 of the circumferential groove 116 may be angled to correspond to the angled upper surface 120 of the radially outwardly extending protrusion 119. One of ordinary skill in the art will understand in view of the disclosure herein that the geometry of the cooperating surfaces 120, 122 of the radially outwardly extending protrusion 119 and the circumferential groove 116, respectively, may be selected so as to provide a releasable engagement between the collet mechanism 106 and the lower housing 102 at a predetermined tensile load. In other words, the geometry of the cooperating surfaces 120, 122 may be selected such that the collet mechanism 106 disengages from the lower housing 102 when a predetermined tensile load is applied to the tubing string (not shown) coupled to the upper housing 104.

[0015] Disconnect apparatus 100 may further include a retainer sleeve 124 disposed at least partially within the lower housing 102. The retainer sleeve 124 may be configured to move longitudinally within the lower housing 102. A biasing mechanism such as a spring 126 may be disposed axially below the retainer sleeve 124. An outer diameter 165 of an upper end of the retainer sleeve 124 may be approximately equal to or less than an inner diameter 166 of a lower end of the collet mechanism 106. Thus, when the radially outwardly extending protrusion 119 of the collet mechanism 106 is engaged with the circumferential groove 116 of the lower housing 102, at least a portion of the retainer sleeve 124 may be disposed radially inward of the at least a portion of the collet mechanism 106. In one embodiment, the spring 126 may bias the retainer sleeve 124 in an upward direction such that at least a portion of the retainer sleeve 124 may be disposed radially inward of the collet mechanism 106. An outer surface of the upper end of the retainer sleeve 124 may be configured to contact an inner surface of the lower end of the collet mechanism 106 to restrict, and potentially prevent, the collet mechanism 106 from disengaging the circumferential groove 116 under an applied tensile load.

[0016] A medial portion of the retainer sleeve 124 is shown in FIG. 1 as having an outer diameter 167 approximately equal to or less than the inner diameter 164 of the lower housing 102. Thus, the outer surface of the medial portion of the retainer sleeve 124 may be, in some embodiments, configured to contact the inner surface of the lower housing 102. In some embodiments, a seal 128 may be disposed between the medial portion of the retainer sleeve 124 and the inner surface of the lower housing 102. For example, an O-ring, T-seal, lip seal, gasket, U-cup, diaphragm, sealing disk, elastomer sleeve, C-ring, X-ring, or other sealing component, or some combination thereof, may be disposed in a groove 130 formed in the outer surface of the medial portion of the retainer sleeve 124. A lower end of the retainer sleeve 124 may have an outside diameter 168 smaller than at least a portion of the outer diameter 167 of the medial portion of the retainer sleeve 124, thereby forming a shoulder 132 between the medial portion and the lower end of the retainer sleeve 124. The lower end of the retainer sleeve 124 may be at least partially inserted in the spring 126 in some embodiments (or around the spring 126 in other embodiments) and an upper end of the spring 126 may abut the shoulder 132 of the retainer sleeve 124.

[0017] A longitudinal groove 134 may be formed in the medial portion of the retainer sleeve 124. In at least some embodiments, the longitudinal groove 134 may be configured to receive a retainer sleeve screw 136 extending radially inward from the lower housing 102. As shown in FIG. 1, the retainer sleeve screw 136 may be coupled to the lower housing 102 and extend radially inward from the inner surface of the housing 102. The retainer sleeve screw 136 may be threadingly engaged with a port extending from the outer surface to the inner surface of the lower housing 102 or may be coupled to the housing by any other means now or hereafter known in the art. In one embodiment, the boundaries of the groove 134 (e.g., shoulder 132) may define the limits of a path for an interior portion of the sleeve screw 136. The boundaries may restrict movement of the sleeve screw 136, and the groove 134 may thus limit axial movement of the retainer sleeve 124 in one or more directions.

[0018] The upper end of the retainer sleeve 124 may, in some embodiments, include a seating surface 138 configured to receive an obstruction device such as a ball or dart 140. The seating surface 138 may simply be an inner surface of the upper end of the retainer sleeve 124. In other embodiments, the seating surface 138 may include a separate seat coupled to the upper end of the retainer sleeve 124 or disposed within a throughbore of the retainer sleeve 124.

[0019] In certain embodiments, the upper housing 104 may also include a retainer 142 disposed within the throughbore of the upper housing 104 and coupled to an inner surface of the upper housing 104 proximate an upper end or the middle portion of the upper housing 104. The retainer 142 may be configured to receive and engage a portion of the ball, dart 140, or other obstruction device. For example, in an embodiment where the obstruction device is dart 140, as shown in FIG. 1, a nose portion 144 of the dart 140 may be configured to engage the seating surface 138 of the retainer sleeve 124, while a tail portion 146 of the dart 140 may be configured to engage the retainer 142 of the upper housing 104.

[0020] In one embodiment, the retainer 142 may include a ring 148 coupled to the inner surface of the upper housing 104. In this embodiment, the tail portion 146 of

the dart 140 may include a tail collet mechanism 150 configured to engage the ring 148. When the upper housing 104 is disconnected from the lower housing 102, the dart 140 may be retained in the upper housing 104. In other embodiments, the obstruction device may be a ball. In such embodiments, the ball may be configured to engage the seating surface 138 of the retainer sleeve 124. Thus, when the upper housing 104 is disconnected from the lower housing 102, the ball may stay downhole.

[0021] An example operation of the disconnect apparatus 100 is now described with reference to FIGS. 1-3. As shown in FIG. 1, the components of the disconnect apparatus 100 in a first position may be initially coupled (e.g., the upper housing 104 coupled to the lower housing 102). In this coupled position, the collet mechanism 106 may be engaged with the lower housing 102, and spring 126 may bias the retainer sleeve 124 into a first position where at least a portion of the retainer sleeve 124 is disposed radially inward of the collet mechanism 106 to restrict, and potentially prevent, the collet mechanism 106 from disengaging from the lower housing 102. Splines 112, 114 may be engaged so as to provide transmission of torque. In this first position-which may also be referred to as a "connected" or "coupled", the disconnect apparatus 100 may provide full torque, tension, and flow through capabilities.

[0022] To disconnect the upper housing 104 from the lower housing 102, an obstruction device (e.g., dart 140) may be dropped downhole through the tubing string (not shown). The dart 140 may pass into the throughbore 104 and the nose portion 144 of the dart 140 may engage the seating surface 138 of the retainer sleeve 124. As fluid is pumped downhole behind the dart 140, the hydraulic pressure may build and create a pressure differential across the seating surface 138. This pressure differential may move the retainer sleeve 124 against the spring 126, thereby compressing the spring 126, as shown in FIG. 2. The hydraulic pressure may move the retainer sleeve 124 a selected distance until the portion of the retainer sleeve 124 disposed radially inward of the collet mechanism 106 is moved to a position axially below the collet mechanism 106. Once the retainer sleeve 124 is no longer positioned radially inward of the collet mechanism 106, a tensile load applied to the tubing string (not shown) sufficient to overcome the engagement of the cooperating surfaces 120, 122 of the radially outwardly extending protrusion 119 and the surfaces around the circumferential groove 116 may move the collet fingers 118 radially inward, thereby disengaging the collet mechanism 106 from the lower housing 102. FIG. 2 illustrates the disconnect apparatus 100 in a second position in which the collet mechanism 106 may be disengaged from the lower housing. FIG. 3 illustrates the disconnect apparatus 100 in a third position in which the collet mechanism 106 has disengaged the lower housing 102, and in which the upper housing 104 has been disconnected from the lower housing 102.

[0023] Additionally, when the retainer sleeve 124 moves axially downward a selected distance with the dart 140 seated in the seating surface 138, the tail portion 146 of the dart 140 may engage the retainer 142 in the upper housing 104. Specifically, the tail collet mechanism 150 of the dart 140 may engage the ring 148 of the retainer 142. As the tubing string (not shown) is pulled from the borehole, the upper housing 104 coupled to the tubular string may be removed from the lower housing 102 and the dart 140 may be retained in the upper housing 104 as it is removed. Moreover, as the upper housing 104 and dart 140 are removed, the biasing force of the spring 126 may move the retainer sleeve 124 back to its first position. The retainer sleeve screw 136 and groove 130 may limit the axial upward movement of the retainer sleeve 124, and upon reaching an upper position, the dart 140 may separate from the seating surface 138. Although the collet mechanism 106 may no longer be disposed in the lower housing 102, the retainer sleeve 124 may return to the first position and be disposed radially inward of the circumferential groove 116.

[0024] To reconnect the upper housing 104 with the lower housing 102, the upper housing 102 may be lowered into the borehole. The collet mechanism 106 may be inserted into the lower housing 102. As the upper housing 104 is lowered or moved into contact with the lower housing 102, the splines 112, 114 of the lower and upper housings 102, 104 may engage. The tapered ends of the splines 112, 114 may help orient and align the upper housing 104 with the lower housing 102. Because an outer diameter of the radially outwardly extending protrusions 120 of the circumferentially arranged collet fingers 118 may be greater than the inside diameter 164 of the lower housing 102, as the collet mechanism 106 contacts the inner surface of the lower housing 102, the collet fingers 118 flex radially inward.

[0025] The upper housing 104 with collet mechanism 106 may move downward until the lower end surface of the collet mechanism 106 contacts the upper end surface of the retainer sleeve 124. As the upper housing 104 is lowered more, the retainer sleeve 124 may move downward, thereby compressing the spring 126 until the retainer sleeve 124 is moved to a position longitudinally below the circumferential groove 116. The radially outwardly extending protrusions 120 of the collet fingers 118 may then be axially aligned with the circumferential groove 116, which allows the collet fingers 118 to flex back radially outward engaging the protrusions 120 with the circumferential groove 116. As the collet fingers 118 flex back radially outwardly, the lower end surface of the collet mechanism 106 may no longer be in contact with the upper end surface of the retainer sleeve 124, allowing the spring 126 to move the retainer sleeve 124 upward to a position where at least a portion of the retainer sleeve 124 is radially inward of the collet mechanism 106 (*see* FIG. 1). The portion of the retainer sleeve 124 radially inward of the collet mechanism locks the radially outward engaging protrusions 120 in the circumferential groove 116, thereby coupling the upper housing 104 with the

lower housing 102.

[0026] The disconnect apparatus 100 may be disconnected from a tubular string again as discussed above. Thus, a disconnect apparatus 100 may be used to couple and decouple a drill string from a tool or assembly. The upper housing 104 may be recoupled with the lower housing 102 and maintain torque, tensile, and flow through capabilities of the tubular string. Moreover, in some embodiments, connection and disconnection may occur even in the absence of a mechanical rotational lock or other similar device, by using hydraulic pressure and axially-directed forces.

[0027] Turning now to FIG. 4, another embodiment of a disconnect apparatus 200 is shown in accordance with an additional embodiment of the present disclosure. The disconnect apparatus 200 may include various components that are the same as, or similar to, those of the disconnect apparatus 100 of FIGS. 1-3. Accordingly, to avoid obscuring aspects of the disconnect apparatus 200, some same or similar components will not be described. Thus, one skilled in the art will appreciate in view of the disclosure herein that components of FIGS. 1-3 (e.g., seals, splines, grooves, retainers, etc.) may be fully incorporated into the embodiment of FIG. 4.

[0028] FIG. 4 illustrates a cross-sectional view of a partially-disassembled hydraulic disconnect 200. More particularly, an obstruction device such as a dart 240 is shown as being outside of an upper housing 204 and lower housing 202 of the hydraulic disconnect 200; however, the dart 240 or other obstruction device (e.g., a ball) may be inserted into the upper housing 204 and/or lower housing 202 as described herein.

[0029] An upper end of the upper housing 204 may include a box member 205 for receiving and engaging a pin member (not shown) of a corresponding section of tubing string (not shown). In a similar manner, the lower housing 204 may include a pin member 203 for threadingly engaging a box member (not shown) of a corresponding tool or assembly (not shown). In FIG. 4, the lower housing 204 includes a cross-over section 211 at the lower end thereof, and the cross-over section 211 may include the pin member 203.

[0030] The upper housing 204 may be configured to removably engage the lower housing 202 in some embodiments. For instance, the upper housing 204 may include a retention mechanism for removably securing the upper housing 204 to the lower housing 202. In one embodiment, as shown, the retention mechanism may include a collet mechanism 206 formed in a lower end of the upper housing 204, as discussed in more detail herein. One having ordinary skill in the art will appreciate in view of the disclosure herein that the collet mechanism 206 may be integrally formed with the upper housing or may be a separate component coupled to the upper housing by any means known in the art, for example, threadingly engaged, bolted, or otherwise mechanically fastened, welded, brazed, adhesively coupled, or some combination of the foregoing.

[0031] In some embodiments, the collet mechanism 206 may be configured to engage a circumferential groove 216 formed on the inner surface of the lower housing 202. The collet mechanism 206 may include a plurality of collet fingers 218 circumferentially arranged and extending distally from the upper housing 204. Each collet finger 218 may terminate with a radially outwardly extending protrusion 219 configured to engage the circumferential groove 216. In one embodiment, the circumferential groove 216 may be a single groove formed along an entire circumference of the inner surface of the lower housing 202. In other embodiments, the circumferential groove 216 may include a number of discrete grooves, and the size and number of grooves may correspond with the size and number of individual collet fingers 218.

[0032] One of ordinary skill in the art will understand in view of the disclosure herein that the geometry of cooperating surfaces of the radially outwardly extending protrusions 219 of the upper housing 204, and the corresponding circumferential groove 216 of the lower housing 202 may be selected so as to provide a releasable engagement between the collet mechanism 206 and the lower housing 202 at a predetermined tensile load. In other words, the geometry may be selected such that the collet mechanism 206 disengages from the lower housing 202 when a predetermined tensile load is applied to the tubing string (not shown) coupled to the upper housing 204.

[0033] The disconnect apparatus 200 may further include a retainer sleeve 224 disposed at least partially within the lower housing 202 (*e.g.*, within the cross-over section 211 of the lower housing 202). The retainer sleeve 224 may be configured to move longitudinally within the lower housing 202. A biasing mechanism such as a spring 226 may be disposed within the lower housing 202. In the illustrated embodiment, the spring 226 may also encircle a portion of the retainer sleeve 224 and is enclosed in a chamber formed between a shoulder of the lower housing 202 and a shoulder of the retainer sleeve 224. An outer diameter of an upper end of the retainer sleeve 224 (*e.g.*, a portion in which the openings 241 are formed) may be approximately equal to or less than an inner diameter of a lower end of the collet mechanism 206. Thus, when the radially outwardly extending protrusion 219 of the collet mechanism 206 is engaged with the circumferential groove 216 of the lower housing 202 as shown in FIG. 4, at least a portion of the retainer sleeve 224 may be disposed radially inward of the at least a portion of the collet mechanism 206. In one embodiment, the spring 226 may bias the retainer sleeve 224 in an upward direction such that at least a portion of the retainer sleeve 224 may be disposed radially inward of the collet mechanism 206. An outer surface of the upper end of the retainer sleeve 224 may be configured to contact an inner surface of the lower end of the collet mechanism 206 to restrict, and potentially prevent, the collet mechanism 206 from disengaging the circumferential groove 216 under an applied tensile load. In other embodiments,

the retainer sleeve 224 may be biased axially upward and nevertheless be axially downward relative to the collet mechanism 206. For instance, the portion of the retention sleeve 224 in which the openings 241 are formed may be a separate component, rather than a portion of the retention sleeve 224.

[0034] The portion of the retention sleeve 224 where the openings 241 are located-or a separate component coupled to the retention sleeve 224, may be configured to facilitate repeated operation and use of the collet mechanism 206. For instance, debris may be located within a downhole environment, and the debris may become lodged between collet fingers 218. In such case, it may be difficult to compress the collet fingers 218 to either connect or disconnect the upper housing 204. The openings 241 formed within the retention sleeve 224 may be generally aligned with the collet mechanism 206, and may act as a debris or junk catch. Debris may then flow through the slots in the collet mechanism 206, through the openings 241, and into the retention sleeve 224. The debris may then not obstruct compression of the collet fingers 218.

[0035] In accordance with at least some embodiments, the lower housing 202 and/or the retainer sleeve 224 may include one or more components for providing facilitating operation of the spring 226. For instance, FIG. 4 illustrates an embodiment in which the lower housing 202 may include a plug 235. The plug 235 may be threadingly engaged or otherwise coupled within a port of the lower housing 202, and configured to restrict, and potentially prevent, the oil or another fluid from escaping the lower housing 202. In at least some embodiments, the oil or other fluid within the lower housing 202 may be a lubricant for the spring 226. Appropriate seals may be provided to contain the fluid within the lower housing 202. For instance, seals 233 within a shoulder 232, or piston may restrict fluid leakage at a lower end of the retention sleeve 224. Other appropriate seals may also be used along the chamber in which the spring 226 is located.

[0036] In at least some embodiments, the retainer sleeve 224 may include or be coupled to a stop 231. In FIG. 4, the stop 231 may include a stop ring protruding radially outward from a portion of the retainer sleeve 224. The outer diameter of the stop 231 may be larger than an inner diameter of a portion of the lower housing 202 (e.g., the inner diameter at shoulder 227). Consequently, as the retainer sleeve 224 moves axially within the lower housing 202, the stop 231 may restrict, and potentially prevent, the retainer sleeve 224 from moving axially upward once the stop 231 engages the corresponding shoulder 227 of the lower housing 202.

[0037] In one embodiment, the position at which the stop 231 engages the shoulder 227 limits upward movement of the retainer sleeve 224 while another component may limit downward movement. For instance, as will be appreciated in view of the disclosure herein, an upper end or medial portion of the retainer sleeve 224 may, in some embodiments, include a seating surface 238 configured to receive an obstruction device such as a ball or dart 240. The seating surface 238 may simply be an inner surface of the retainer sleeve 224. In other embodiments, the seating surface 238 may include a separate seat coupled to the upper end of the retainer sleeve 224 or disposed within a throughbore of the retainer sleeve 224.

[0038] When the dart 140 is inserted into the upper housing 204 and advanced toward the lower housing 202, the hydraulic pressure behind the dart 244 may cause the nose 244 of the dart 240 to engage the seating surface 238 of the retaining sleeve 224. The pressure behind the dart 240 can then build, causing the dart 240 and retaining sleeve 224 to move axially downward and compress the spring 226.

[0039] In certain embodiments, the upper housing 204 may also include a retainer 242 disposed within the throughbore of the upper housing 204 and coupled to an inner surface of the upper housing 204. The retainer 242 may be configured to receive and engage a portion of the ball, dart 240, or other obstruction device. For example, in an embodiment where the obstruction device is dart 240, as shown in FIG. 4, a nose portion 244 of the dart 240 may be configured to engage the seating surface 238 of the retainer sleeve 224, while a tail portion 246 of the dart 240 may be configured to engage the retainer 242 of the upper housing 204. When the tail portion 246 of the dart 240 engages the retainer 242, further downward axial movement of the dart 240 and/or retaining sleeve 224 may be limited and potentially prevented.

[0040] An example operation of the disconnect apparatus 200 is now described. Such operation is generally similar the manner described above for disconnect apparatus 100 of FIGS. 1-3. The components of the disconnect apparatus 200 in a first position may be initially coupled (e.g., the upper housing 204 coupled to the lower housing 202). In this coupled position, the collet mechanism 206 may be engaged with the lower housing 202, and spring 226 may bias the retainer sleeve 224 into a first position. In the first position a portion of the retainer sleeve 224 may be disposed radially inward of the collet mechanism 206 to restrict, and potentially prevent, the collet mechanism 206 from disengaging from the lower housing 202.

[0041] To disconnect the upper housing 204 from the lower housing 202, an obstruction device (e.g., dart 240) may be dropped downhole through the tubing string (not shown). The dart 240 may pass into the throughbore and the nose portion 244 of the dart 240 may engage the seating surface 238 of the retainer sleeve 224. As fluid is pumped downhole behind the dart 240, the hydraulic pressure may build and create a pressure differential across the seating surface 238. The dart 240 may include one or more swab cups 245 that may also facilitate building up of pressure, or pumping of the dart 240 downhole through the tubing string (not shown). This pressure differential may move the retainer sleeve 224 against the spring 226, thereby compressing the spring 226. The hydraulic pressure may move the retainer sleeve 224 a se-

lected distance until the portion of the retainer sleeve 224 disposed radially inward of the collet mechanism 206 (or some other component) is moved to a position axially below the collet mechanism 206. Once the retainer sleeve 224 or other component is no longer positioned radially inward of the collet mechanism 206, a tensile load applied to the tubing string (not shown) sufficient to overcome the engagement of the radially outwardly extending protrusions 219 with the surfaces of the upper lower housing 202 which define the groove 216 may move the collet fingers 218 radially inward, thereby disengaging the collet mechanism 206 from the lower housing 202.

[0042] Additionally, when the retainer sleeve 224 moves axially downward a selected distance with the dart 240 seated in the seating surface 238, the tail portion 246 of the dart 240 may engage the retainer 242 in the upper housing 204. As the tubing string (not shown) is pulled from the borehole, the upper housing 204 coupled to the tubing string may be removed from the lower housing 202 and the dart 240 may be retained in the upper housing 204 as it is removed. Moreover, as the upper housing 204 and dart 240 are removed, the biasing force of the spring 226 may move the retainer sleeve 224 back to its first position. The stop 231 may limit the axial upward movement of the retainer sleeve 224, and upon reaching an upper position, the dart 240 may separate from the seating surface 238. Although the collet mechanism 206 may no longer be disposed in the lower housing 202, the retainer sleeve 224 may return to the first position and be disposed radially inward of the circumferential groove 216.

[0043] To reconnect the upper housing 204 with the lower housing 202, the upper housing 202 may be lowered into the borehole. The collet mechanism 206 may be inserted into the lower housing 202. Because an outer diameter of the radially outwardly extending protrusions 220 of the circumferentially arranged collet fingers 218 may be greater than the inside diameter 264 of the lower housing 202, as the collet mechanism 206 contacts the inner surface of the lower housing 202, the collet fingers 218 flex radially inward.

[0044] The upper housing 204 with collet mechanism 206 may move downward until the lower end surface of the collet mechanism 206 contacts the upper end surface of the retainer sleeve 224. As the upper housing 204 is lowered more, the retainer sleeve 224 may move downward, thereby compressing the spring 226 until the retainer sleeve 224 is moved to a position axially below the circumferential groove 216. The radially outwardly extending protrusions 220 of the collet fingers 218 may then be axially aligned with the circumferential groove 216, which allows the collet fingers 218 to flex back radially outward engaging the protrusions 220 with the circumferential groove 216. As the collet fingers 218 flex radially outwardly, the lower end surface of the collet mechanism 206 may no longer be in contact with the upper end surface of the retainer sleeve 224, allowing the spring 226 to move the retainer sleeve 224 upward to a position where at least a portion of the retainer sleeve 224 is radially inward of the collet mechanism 206. The portion of the retainer sleeve 224 radially inward of the collet mechanism may lock the radially outward engaging protrusions 220 in the circumferential groove 216, thereby coupling the upper housing 204 with the lower housing 202.

[0045] The disconnect apparatus 200 may be disconnected from a tubular string again as discussed above. Thus, a disconnect apparatus 200 may be used to selectively couple and decouple a tubular string from a tool or assembly. The upper housing 204 may be recoupled with the lower housing 202 and maintain torque, tensile, and flow through capabilities of the tubular string. Moreover, in some embodiments, connection and disconnection may occur even in the absence of a mechanical rotational lock or other similar device, by using hydraulic pressure and axially-directed forces.

[0046] Referring now to FIG. 5, a cross-sectional view of a disconnect apparatus 300 having a throughbore 301 is shown in accordance with additional embodiments of the present disclosure. Disconnect apparatus 300 may include a lower housing 302 having a central throughbore and an upper housing 304 having a central throughbore. The lower housing 302 may be configured to couple to or engage with a tool or assembly (e.g., a bottomhole assembly). For example, a lower end of the lower housing 302 may include a pin member 303 for threadedly engaging a box member (not shown) of a tool or assembly. Similarly, an upper end of the upper housing 304 may include a box member 305 for receiving and engaging a pin member (not shown) of a section of tubing string (not shown). Of course other connection mechanisms may also be utilized, as would be appreciated by one of skill in the art in view of the disclosure herein.

[0047] The upper housing 304 may include a retention mechanism for removably securing the upper housing 304 to the lower housing 302. In one embodiment, as shown, the retention mechanism may include a collet mechanism 306 at a lower end of the upper housing 304. One of ordinary skill in the art will appreciate in view of the disclosure herein that the collet mechanism 306 may be integrally formed with the upper housing 304 or may be a separate component coupled to the upper housing 304 by any means known in the art, for example, threadedly engaged, bolted, or otherwise mechanically fastened, welded, brazed, adhered, coupled in some other manner, or some combination of the foregoing.

[0048] The collet mechanism 306 may function similarly to the collect mechanism 106 of FIG. 1. Accordingly, the collet mechanism 306 may be configured to engage a circumferential groove 316 formed on an inner surface of the lower housing 302. The collet mechanism 306 may include a plurality of collet fingers 318 circumferentially arranged and extending downwardly from the upper housing 304. Each collet finger 318 may include one or more radially outwardly extending protrusions 319 configured to engage the circumferential groove 316. In one

embodiment, the circumferential groove 316 may be a single groove formed along the full circumference of the inner surface of the lower housing 302. In other embodiments, the circumferential groove 316 may include a number of discrete grooves in which the size and number of grooves optionally corresponds with the size and number of individual collet fingers 318.

[0049] As shown, an upper surface 320 of the radially outwardly extending protrusion 319 of each collet finger 320 may be angled radially downward. The upper surface 320 may be configured to engage an upper surface 322 of the circumferential groove 316. The upper surface 322 of the circumferential groove 316 may be angled to correspond to the angled upper surface 320 of the radially outwardly extending protrusion 319. One of ordinary skill in the art will understand in view of the disclosure herein that the geometry of the cooperating surfaces 320, 322 of the radially outwardly extending protrusion 319 and the circumferential groove 316, respectively, may be selected so as to provide a releasable engagement between the collet mechanism 306 and the lower housing 302 at a predetermined or other tensile load. In other words, the geometry of the cooperating surfaces 320,322 may facilitate disengaging the collet mechanism 306 from the lower housing 302 when a predetermined tensile load is applied to the tubing string (not shown).

[0050] Disconnect apparatus 300 may further include a retainer sleeve 324 disposed and retained within the upper housing 304 and configured to move axially within the upper housing 304. A biasing mechanism, for example, spring 326, may be disposed axially above the retainer sleeve 324 in the upper housing 304. As shown, a lower end of the spring 326 may abut an upper end surface of retainer sleeve 324.

[0051] An outer diameter of a lower end end of the retainer sleeve 324 may be approximately equal to or less than an inner diameter of a lower end of the collet mechanism 306. Thus, when the radially outwardly extending protrusion 319 of the collet mechanism 306 is engaged with the circumferential groove 316 of the lower housing 302, at least a portion of the retainer sleeve 324 may be disposed radially inward of the at least a portion of the collet mechanism 306. In one embodiment, the spring 326 may bias the retainer sleeve 324 in a downward direction such that at least a portion of the retainer sleeve 306 may be disposed radially inward of the collet mechanism 306. An outer surface of the lower end of the retainer sleeve 324 may be configured to contact an inner surface of the lower end of the collet mechanism 306 to prevent the collet mechanism 306 from disengaging the circumferential groove 316 under an applied tensile load.

[0052] As shown, the upper housing 304 may include a shoulder 380 formed between a first inside diameter of the upper housing 304 proximate an upper end of the upper housing 304 and a smaller second inside diameter of the upper housing 304 proximate a middle portion 313 of the upper housing 304. The retainer sleeve 324 optionally has a shoulder 382 formed on an outer surface between a first outside diameter proximate the lower end of the retainer sleeve 324 and a larger second outside diameter proximate the upper end of the retainer sleeve 324. The shoulder 380 of the upper housing 304 may be configured to engage the shoulder 382 of the retainer sleeve 324 when the retainer sleeve 324 is in a first position. Thus, the shoulder 380 of the upper housing may limit the axial movement of the retainer sleeve 324 in a downward direction.

[0053] An outer diameter of the upper end of the upper housing 304 may be approximately equal to an outer diameter of the lower housing 302. An outer diameter of a lower end 311 or middle portion 313 of the upper housing 304 may be approximately equal to or less than an inner diameter of the lower housing 302. A shoulder 308 formed between the outer diameter of the upper end and the outer diameter of the middle portion 313 or lower end 311 of the upper housing 304 may be configured to abut an upper end surface 310 of the lower housing 302.

[0054] The lower housing 302 may include a plurality of splines (not shown) formed on an inner surface 315 of the lower housing 302 proximate an upper end of the lower housing 302. The upper housing 304 may include a plurality of splines (not shown) formed on an outer surface 317 of middle portion 313 or lower end 311 of upper housing 304 and configured to engage the plurality of splines (not shown) of the lower housing 302. In some embodiments, the splines may be corresponding straight splines. The splines may be configured to engage the lower housing 302 and the upper housing 304 during rotation of the tubing string (not shown) to transmit torque between the tubing string (not shown) and the tool or assembly (not shown) coupled to the lower end of the disconnect apparatus 300. In some embodiments, ends of each of the plurality of splines may be tapered along the length of each spline to allow for the splines to align and engage as the upper housing 304 is coupled to the lower housing 302. One of ordinary skill in the art will appreciate in view of the disclosure herein that the number of splines may vary without departing from the scope of embodiments disclosed herein. In certain embodiments, one or more seals 307, may be disposed between the upper housing 304 and the lower housing 302. For instance, the one or more seals 307 may be proximate the splines and may create a fluid-tight coupling between the upper housing 304 and the lower housing 302.

[0055] The retainer sleeve 324 may include a float valve 370 disposed in a central throughbore 372 of the retainer sleeve 324. The float valve 370 may be operable between an open position and a closed position. In one embodiment, the float valve 370 may be a flapper type float valve coupled to an inner surface of the retainer sleeve 324. The float valve 370 may be biased toward a first position in which the float valve 370 closes the central throughbore 372 of the retainer sleeve 324 (*see* FIG. 6). In a second position, the float valve 370 may be open which allows fluid flow through the central throughbore

372 (*see* FIG. 5). Thus, when a hydraulic pressure is applied to the float valve 370 sufficient to overcome the bias of the float valve 370, the float valve 370 is moved to a second or open position, as shown in FIG. 5. For example, when drilling mud or fluid is pumped downhole, the hydraulic pressure may open the float valve 370, and when there is less or potentially no fluid circulation down through the disconnect apparatus 300, the float valve 370 may close.

[0056] In one embodiment, a groove 371 may be formed in an inner surface of the retainer sleeve 324 and configured to house the float valve 370 in the second position, such that the central throughbore 372 is unobstructed allowing full fluid flow therethrough. The float valve 370 may be disposed near the upper end of the retainer sleeve 324, as shown in FIG. 5, or may be disposed proximate the medial portion 313 or lower end 311 of the retainer sleeve 324.

[0057] An example operation of the disconnect apparatus 300 is now described with reference to FIGS. 5 and 6. The disconnect apparatus 300 in a first position may be initially coupled. For instance, the upper housing 304 may be coupled to the lower housing 302. In this coupled position, the collet mechanism 306 may engage the lower housing 302, and spring 326 may bias the retainer sleeve 324 into a first position. When the retainer sleeve 324 is in the first position, the collet mechanism 306 may be restricted, and potentially prevented, from disengaging from the lower housing 302. Splines (not shown) of the upper housing 304 and lower housing 302 may be engaged so as to provide transmission of torque. In this first, coupled or connected position, the disconnect apparatus 300 may provide full torque and tension capabilities.

[0058] To disconnect the upper housing 304 from the lower housing 302, the fluid flow downhole may be reversed. Specifically, fluid may be pumped downhole into the annular area between the outer diameter of the disconnect apparatus 300 and the borehole 309 and flowed back up through the disconnect apparatus 300 from the bottom. Because hydraulic pressure may not be applied to the upper end of the float valve 370, the float valve 370 may move to the first or closed position, as shown in FIG. 6. Thus, the float valve 370 may close or seal the throughbore 372 of the retainer sleeve 324, thereby sealing the throughbore 301 of the disconnect apparatus 300.

[0059] The reverse fluid flow may create a pressure differential across the float valve 370 in the retainer sleeve 324. When the pressure applied below the float valve 370 overcomes a spring force of spring 326, the retainer sleeve 324 may move axially upward, thereby compressing spring 326. The retainer sleeve 324 may be configured to move a selected distance such that, in a second position, the position of the retainer sleeve 324 is axially upward of the collet mechanism 306. Specifically, in the second position, the retainer sleeve 324 may not be disposed radially inward of the collet mechanism 306. A tensile load may then be applied to the tubing string (not shown) and the upper housing 304 to release the collet mechanism 306 from the circumferential groove 316. In other words, the tensile load applied would be sufficient to overcome the engagement of the cooperating surfaces 320, 322 of the radially outwardly extending protrusion 319 and the circumferential groove 316. As the tubular string and upper housing 304 are moved upward using an axially-directed force, the collet fingers 318 move or flex radially inward, thereby disengaging the collet mechanism 306 from the lower housing 302.

[0060] To reconnect the upper housing 304 with the lower housing 302, the upper housing 302 may be lowered into the borehole. The collet mechanism 306 may then be inserted into the lower housing 302. As the upper housing 304 is lowered or moved into contact with the lower housing 302, the splines (not shown) of the lower and upper housings 302, 304 may engage. Tapered ends of the splines (not shown) may help orient and align the upper housing 304 with the lower housing 302. Because an outer diameter of the radially outwardly extending protrusions 320 of the circumferentially arranged collet fingers 318 may be greater than the inside diameter of the lower housing 302, as the collet mechanism 306 contacts the inner surface of the lower housing 302, the collet fingers 318 may flex radially inward.

[0061] The flow of fluid downhole may be reversed, as described above, to maintain the float valve 370 in the first or closed position, as shown in FIG. 6. By maintaining the float valve in the closed position as the upper housing 304 is run downhole, the retainer sleeve 324 remains in second position, axially upward of the collet mechanism 306 and compressing spring 326. This allows the collet fingers 318 of the collet mechanism 306 to move or flex radially inward as described herein. Once the radially outwardly extending protrusions 320 of the collet fingers 318 are axially aligned with the circumferential groove 316, the collet fingers 318 may flex radially outward engaging the protrusions 320 with the circumferential groove 316. In some embodiments, the collect fingers 318 are biased toward a radially outward extended position. The fluid flow downhole may then be stopped (e.g., pumps pumping the fluid downhole may be shut off), which may allow the retainer sleeve 324 to move back to its first position due to the spring force of the spring 326. The retainer sleeve 324 in the first position may block inwardly-directed flexing of the collet fingers 318, thereby securing engagement of the collet mechanism 306 with the circumferential groove 316 of the lower housing 302, and securely connecting the upper housing 304 to the lower housing 302.

[0062] The disconnect apparatus 300 may be disconnected from a tubular string again as discussed herein. Thus, the disconnect apparatus 300 may be used to repeatedly couple and decouple a tubular string from a tool or assembly. The upper housing 304 may be recoupled with the lower housing 302 and maintain torque and tensile capabilities of the tubular string.

[0063] As used herein, relational terms such as "inner"

and "outer", "up" and "down", "upper" and "lower", "upward" and "downward", "above" and "below", "top" and "bottom", "inner" and "outer", "distal" and "proximal" and other like terms as used herein refer to relative positions to one another and are not intended to denote a particular direction or spatial orientation. 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."

[0064] Although only a few example embodiments have been described in detail above, those skilled in the art will readily appreciate that many modifications are possible in the example embodiments without materially departing from a hydraulic disconnect as described herein. Accordingly, all such modifications are intended to be included within the scope of this disclosure. In the claims, means-plus-function clauses are intended to cover the structures described herein as performing the recited function and not only structural equivalents, but also equivalent structures. Thus, although a nail and a screw may not be structural equivalents in that a nail employs a cylindrical surface to secure wooden parts together, whereas a screw employs a helical surface, in the environment of fastening wooden parts, a nail and a screw may be equivalent structures. It is the express intention of the applicant not to invoke 35 U.S.C. § 112, paragraph 6 for any limitations of any of the claims herein, except for those in which the claim expressly uses the words 'means for' together with an associated function.

Claims

1. A disconnect apparatus, comprising:

a lower housing;
a retainer sleeve disposed within the lower housing and configured to move axially within the lower housing, the retainer sleeve having a seating surface configured to receive an obstruction device;
a spring coupled to the retainer sleeve; and
an upper housing configured to removably engage the lower housing.

2. The disconnect apparatus of claim 1, wherein the upper housing includes a collet mechanism disposed on a lower end thereof.

3. The disconnect apparatus of claim 2, wherein the lower housing includes a circumferential groove formed on an inner surface of the lower housing, the circumferential groove being configured to receive the collet mechanism.

4. The disconnect apparatus of claim 3, wherein the retainer sleeve is configured to be disposed radially inward of the collet mechanism in a first position, and/or

5. The disconnect apparatus of claim 3, wherein the retainer sleeve is configured to be disposed axially below the collet mechanism in a second position.

6. The disconnect apparatus of claim 5, wherein in the second position, the spring is compressed.

7. The disconnect apparatus of any one of the preceding claims, wherein the upper housing includes a retainer disposed therein configured to engage and retain an obstruction device such as a dart within, or connected to, the upper housing.

8. The disconnect apparatus of any one of the preceding claims, wherein the lower housing includes a plurality of splines formed on an inner surface of an upper end configured to engage a plurality of splines formed on an outer surface of the upper housing.

9. The disconnect apparatus of any one of the preceding claims, further comprising a seal disposed radially between the upper housing and the lower housing when the upper housing is connected to the lower housing.

10. A method for operating a hydraulic disconnect device, comprising:

applying a differential hydraulic pressure across a retainer sleeve of a disconnect apparatus, the disconnect apparatus having an upper housing and a lower housing coupled to the upper housing, the retainer sleeve disposed in at least one of the upper housing or the lower housing, wherein applying the differential hydraulic pressure moves the retainer sleeve from a first position to a second position;
applying a tensile load to the upper housing; and
releasing engagement of a collet mechanism of the upper housing from a retaining groove formed in an inner surface of the lower housing.

11. The method of claim 10, wherein applying the differential hydraulic pressure across the retainer sleeve includes engaging an obstruction device with the retainer sleeve.

12. The method of claim 11, further comprising engaging at least a portion of the obstruction device in a retainer disposed in the upper housing.

13. The method of claim 11 or 12, further comprising coupling the obstruction device with the upper housing and removing the upper housing from the lower housing.

14. The method of any of claims 10 to 13, wherein the applying the differential hydraulic pressure across the retainer sleeve includes closing a float valve disposed in the retainer sleeve.

15. The method of claim 14, wherein the applying the differential hydraulic pressure across the retainer sleeve includes flowing a fluid through a central throughbore of the retainer sleeve from a bottom of the disconnect apparatus.

16. The method of any of claims 10 to 15, further comprising recoupling the upper housing with the lower housing, the recoupling including:

disposing the collet mechanism in the lower housing and engaging a lower end surface of the collet mechanism with an upper end surface of the retainer sleeve;
applying an axial load to the upper housing to move the collet mechanism and the retainer sleeve axial downward;
engaging the collet mechanism with the retaining groove of the lower housing; and
moving the retainer sleeve axial upward until at least a portion of the retainer sleeve is disposed radially inward of the collet mechanism.

17. A disconnect apparatus, comprising:

a lower housing;
an upper housing having a collet mechanism configured to couple the upper housing to the lower housing;
a retainer sleeve disposed within at least one of the upper housing or the lower housing, the retainer sleeve configured to move axially within the at least one of the lower housing and upper housing between a first position and a second position in response to a pressure differential applied across the retainer sleeve, wherein in the second position the retainer sleeve is disposed axially below the collet mechanism; and
a biasing mechanism coupled to the retainer sleeve and biasing the retainer sleeve in an axial direction.

18. The disconnect apparatus of claim 17, further comprising a float valve disposed in the retainer sleeve, the float valve operable between an open position and a closed position.

19. The disconnect apparatus of claim 17 or claim 18, wherein the biasing mechanism biases the retainer sleeve into the first position.

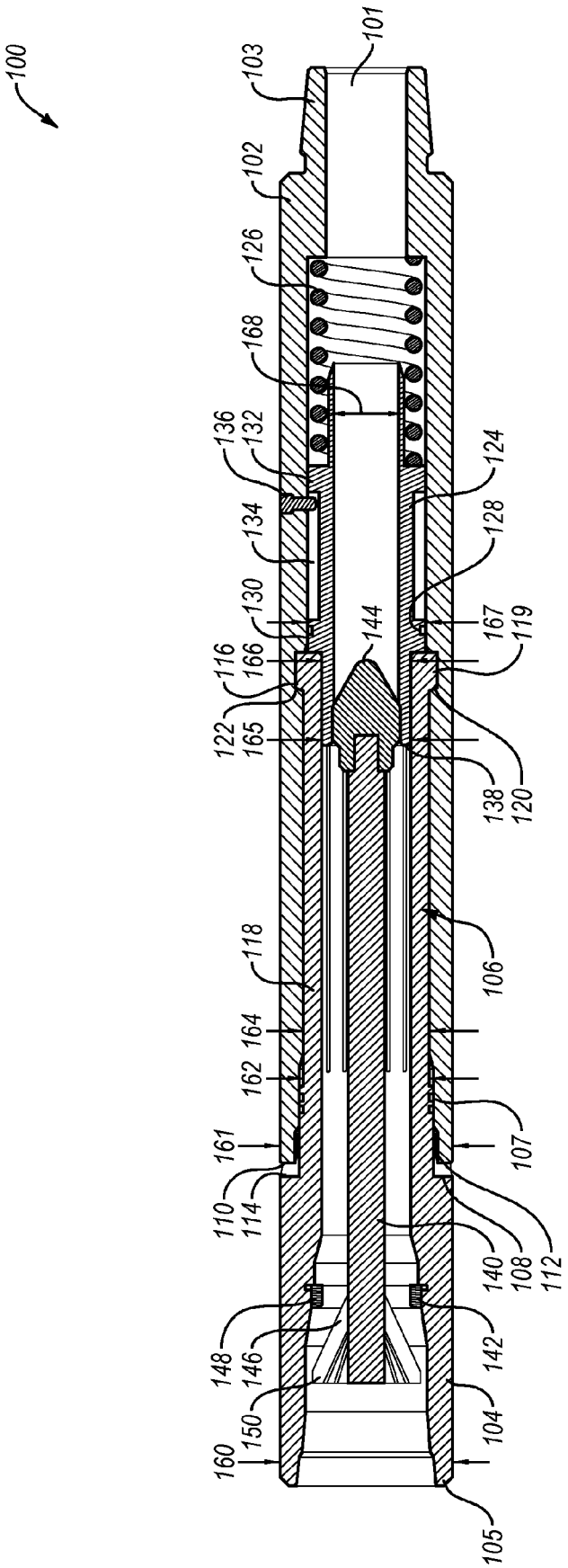
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Fig. 1

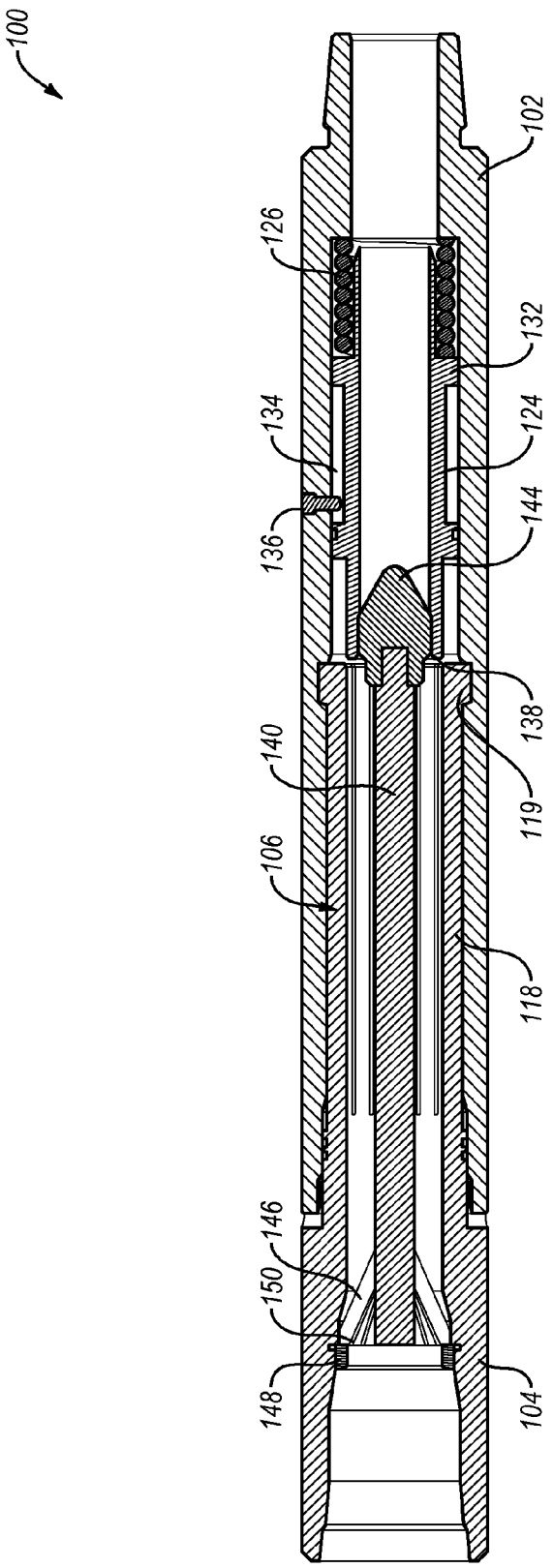
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Fig. 2

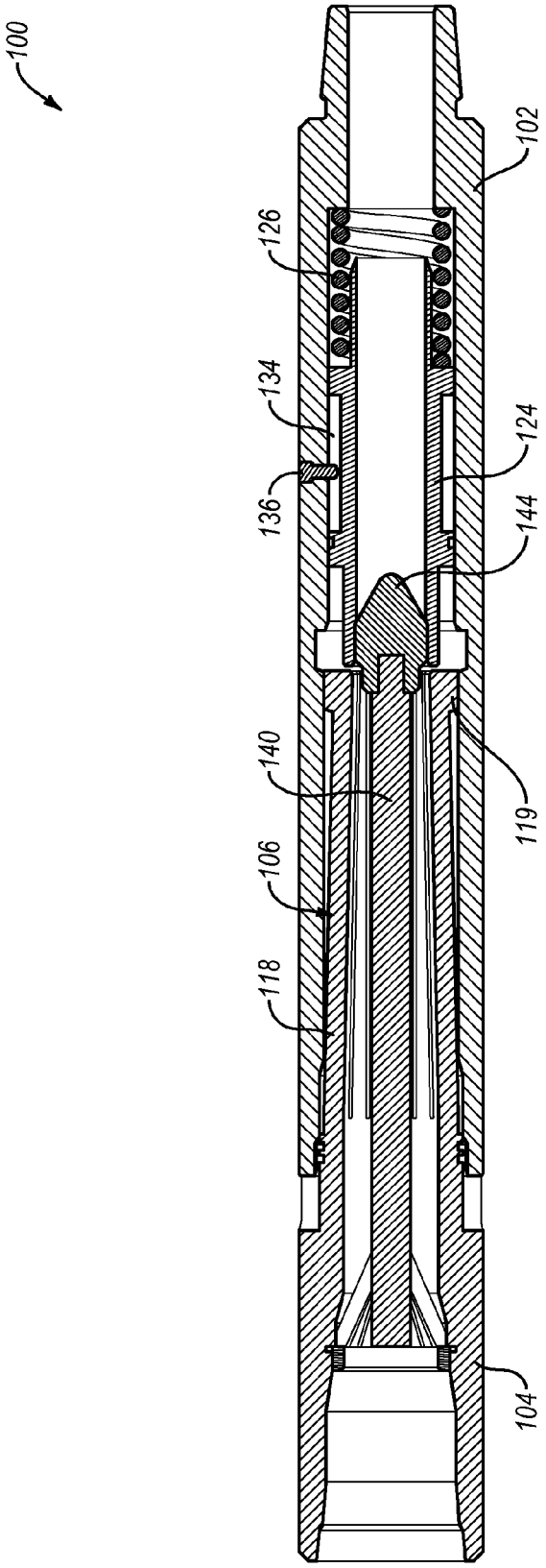

Fig. 3

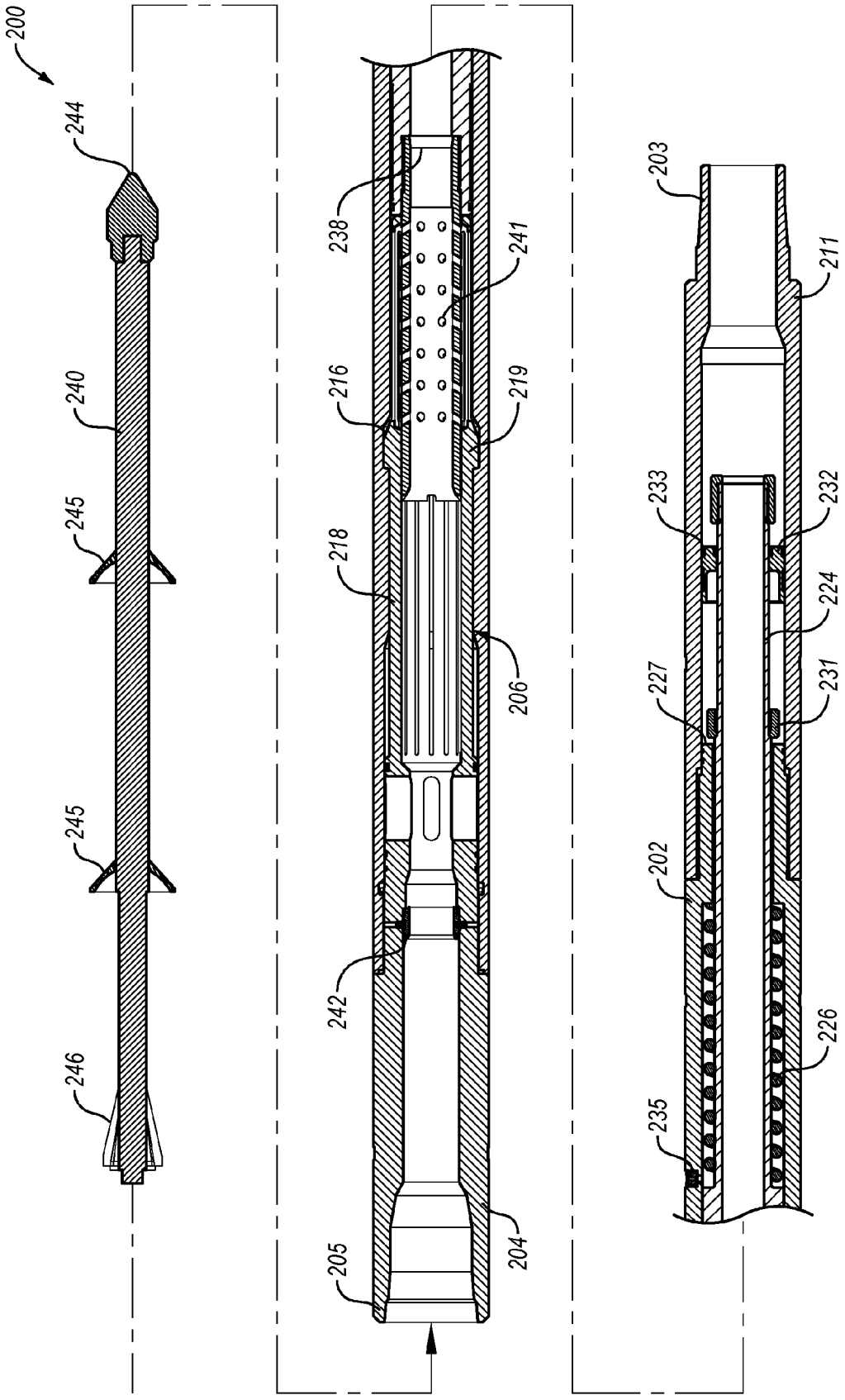
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Fig. 4

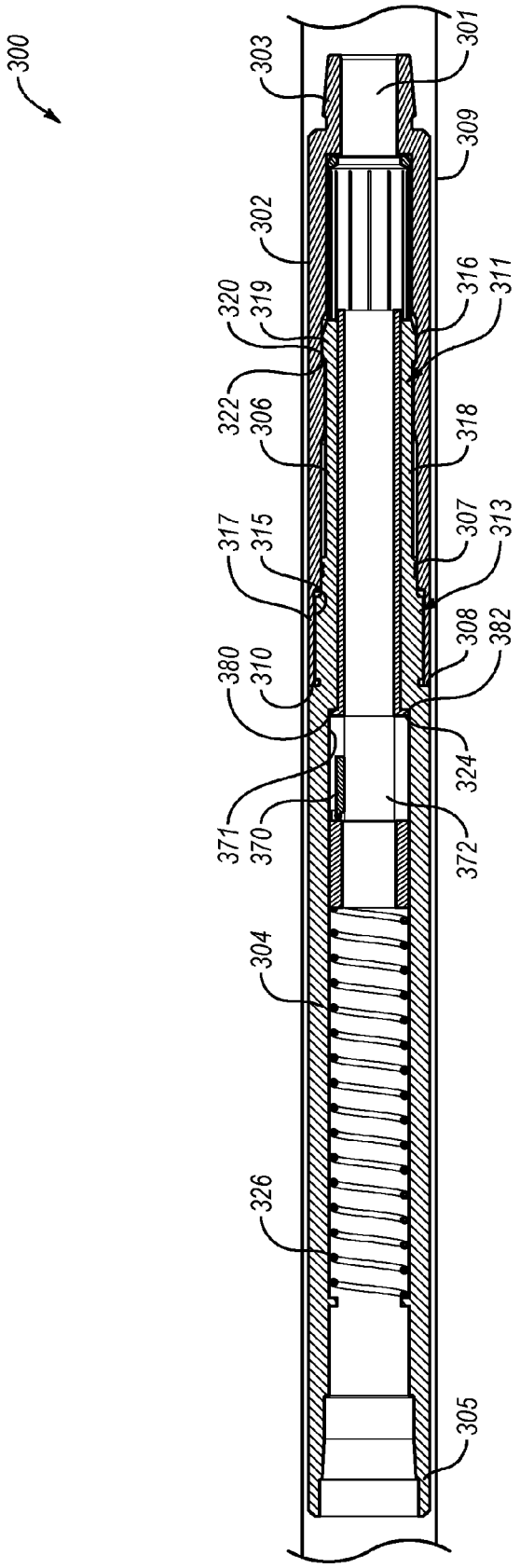
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Fig. 5

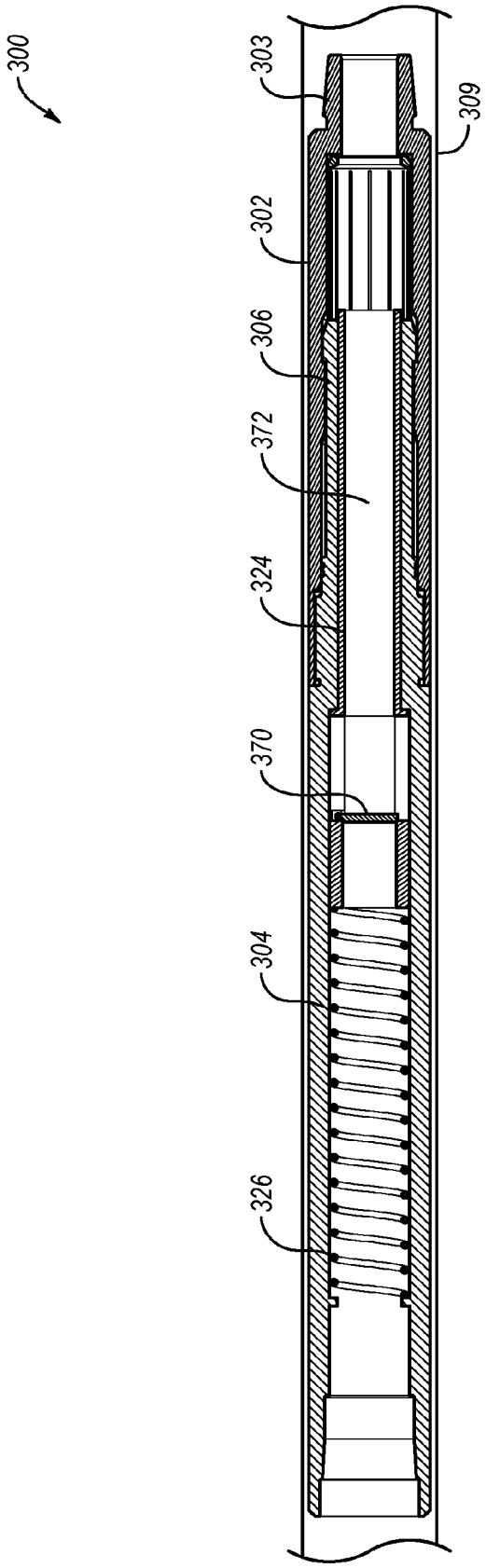

Fig. 6

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EUROPEAN SEARCH REPORT

Application Number
EP 13 18 9423

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X A	US 2009/280912 A1 (BUCHANAN ALASTAIR [NO] ET AL) 12 November 2009 (2009-11-12) * paragraphs [0028] - [0030]; figures 1-7 * -----	1 2-9	INV. E21B17/06
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	24 July 2014	Manolache, Iustin

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