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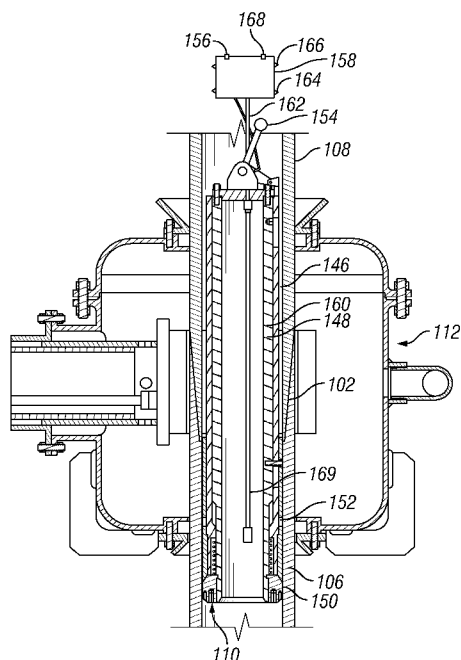


FIG. 3

(57) Abstract: An apparatus may include a body, slips, and a packing element configured to engage an interior of a tubular string. The apparatus may also include an actuator configured to move the slips and packing element into engagement with the interior of the tubular string and a purge opening configured to provide inert gas to an isolated portion of the interior of the tubular string, wherein the isolated portion includes the connection between the first tubular and the second tubular. A method may include providing first and second tubulars, and providing the apparatus described above. The method may also include placing at least a portion of the apparatus inside the first tubular, connecting the second tubular to the first tubular, and activating the actuator to move the slips and packing element into engagement with the interior of the tubular string.



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PLUG APPARATUS AND METHOD

FIELD OF THE INVENTION

[0001] The present invention relates to methods of making up tubulars and more particularly to a plug apparatus and method for use in making up tubulars.

BACKGROUND

5 [0002] For quite some time, hydrocarbon exploration, production, and transportation has involved tubulars (e.g., casing) connected via threads in male and female ends (known as “pin” and “box”) to form a string. Traditionally, such casing stings, drill strings, pipelines, and the like have been formed by “making up” connections by rotating a section to be added relative to the rest of the string. However, such connections may not be as
10 strong as the other portions of the tubular string. Additionally, in some instances, threaded connections may leak to an extent. One alternative to the tubular string is coiled tubing. However, coiled tubing is not appropriate for all applications involving tubulars. Moreover, connecting two sections of coiled tubing has disadvantages.

SUMMARY OF THE INVENTION

15 [0003] According to the present disclosure, an apparatus may include a body, slips connected to the body and configured to engage an interior of a tubular string, and a packing element connected to the body and configured to engage the interior of the tubular string at a location below a connection between a first tubular and a second tubular of the tubular string. The apparatus may also include an actuator configured to move the slips and
20 packing element into engagement with the interior of the tubular string and a purge opening configured to provide inert gas to an isolated portion of the interior of the tubular string, wherein the isolated portion includes the connection between the first tubular and the second tubular.

[0004] According to the present disclosure, a method may include providing a first
25 tubular, providing a second tubular configured to connect to the first tubular to form a tubular string, and providing the apparatus described above. The method may also include placing at least a portion of the apparatus inside the first tubular, connecting the second

tubular to the first tubular, and activating the actuator so as to move the slips and packing element into engagement with the interior of the tubular string.

BRIEF DESCRIPTION OF THE FIGURES

[0005] Figure 1 shows a system for making up a connection between tubulars.

5 [0006] Figure 2 shows a brazing thermal chamber apparatus of the system of Figure 1.

[0007] Figure 3 shows a plug apparatus of the system of Figure 1 within the brazing thermal chamber apparatus of Figure 2.

[0008] Figure 4 shows a running tool apparatus of the system of Figure 1.

DETAILED DESCRIPTION

10 [0009] Generally, the present disclosure describes methods and apparatuses for use in creating a connection that may provide enhanced strength as compared to traditional threaded connections used in hydrocarbon production. Specifically, it is believed that the methods and apparatuses described herein may provide a stronger connection with enhanced sealability due to a metallurgical bond formed between threads. In some
15 instances, the strength of the connection may approach that of the rest of the tubular. Broadly, a method may include providing a first casing or other tubular having threads thereon, providing a second tubular having threads therein, and rotating one tubular relative to the other to form a connection before using a heater to braze the connection. The heater used may provide a bond between the threads that rivals strength provided by a weld
20 in a non-threaded connection, but at a much lower temperature. Due to the lower temperature and the various features described below, such brazing may occur at a well site while remaining safe.

[0010] Referring now to Figure 1, a system 100 for making up a connection 102 (shown in Figure 3) between a first tubular 104 and a second tubular 106 is shown. The
25 system includes a running tool apparatus 108, a plug apparatus 110, and a brazing thermal chamber apparatus 112. The apparatuses may be used individually or collectively to provide the connection 102 between an end portion 114 of the first tubular 104 and an end portion 116 of the second tubular 106, each of which may be hollow and elongated (e.g., casing joints). The end portions 114 and 116 may have threads such that the connection

102 is a threaded connection provided by rotating one tubular relative to the other. In accordance with one aspect of the present disclosure, the second tubular 106 may be rotated about a longitudinal axis such that it spins relative to the first tubular 104 until the tubulars join to form a tubular string (e.g., a casing string).

5 [0011] Generally, the first tubular 104 may be placed in a position where a portion extends downward through a rig floor 118 and into a bore hole 120 and another portion extends upward from the rig floor 118. The first tubular 104 may be held in place by powered slips 122 that prevent rotation as well as axial movement of the first tubular 104. The running tool apparatus 108 may be used to lift and place the second tubular 106 in
10 position to engage the first tubular 104. The end portions 114, 116 of the tubulars 104, 106 may be lined up in close proximity to a heater 124 inside the brazing thermal chamber apparatus 126. This alignment may involve moving the brazing thermal chamber apparatus 126 into place over the end portion 114 of the first tubular 104, and using the running tool apparatus 108 to align and lower the end portion 116 of the second tubular 106 into the
15 brazing thermal chamber apparatus 112. The running tool apparatus 108 may then allow the second tubular 106 to lower and rotate relative to the first tubular 104, thus making up the connection 102 between the tubulars 104, 106, with isolation outside the tubulars 104, 106 being provided by the brazing thermal chamber apparatus 126. Isolation between the interior of the connection 102 and hydrocarbon vapors from the bore hole 120 may be
20 provided with the plug apparatus 110 and certain features of the brazing thermal chamber apparatus 112. The plug apparatus 110 may be at least partially lowered into the first tubular 104 and activated to provide an isolation inside the tubulars 104, 106. The isolated areas may be purged with inert gas before the heater 124 is activated, providing heat to braze the connection 102 between the tubulars 104, 106. The powered slips 122 may then
25 be disengaged and the tubing string, including both tubulars 104, 106, may be lowered a distance before the powered slips 122 are re-engaged and the running tool apparatus 108 is disengaged from the second tubular 106. The second tubular 106 may pass through the thermal chamber 112 as it goes into the bore hole 120. Alternatively, the thermal chamber 112 may at least partly deconstruct to allow passage of the second tubular 106 into the
30 borehole and reconstruct for subsequent connections. In either alternative, the plug apparatus 110 may be removed for subsequent use. The process may then be repeated in

the same manner for one or more additional tubulars (not shown) until the tubular string reaches the desired length.

[0012] Referring now to Figure 2, the brazing thermal chamber apparatus 112 may be used to isolate a section of the exterior of a tubing string from the environment to allow for brazing without the potential undesirables associated with brazing near a bore hole. The brazing thermal chamber apparatus 112 may provide a protective enclosure to isolate a thermal brazing process as related to making the connection 102 (e.g., a casing connection). The brazing thermal chamber apparatus 112 may provide containment of heated gases derived from the thermal brazing.

[0013] The brazing thermal chamber apparatus 112 may provide an enclosure around the connection 102 between the tubulars 104, 106 and the area within the brazing thermal chamber apparatus 112 may be purged with inert gas. While various seals may be present to ensure isolation, the inert gas may be provided at a pressure greater than ambient, providing assurance that ambient fluids do not enter the brazing thermal chamber apparatus 112 during brazing.

[0014] The brazing thermal chamber apparatus 112 may include a housing 126 and the heater 124. The housing 126 may have a first opening 128, a second opening 130, and a purge opening 132. The housing 126 may be configured to contain the end portion 114 of the first tubular 104 and the end portion 116 of the second tubular 106. The first opening 128 may be configured to permit placement of the end portion 114 of the first tubular 104 within the housing 126 during brazing. Thus, a first flared section 129 may be associated with the first opening 128 to assist with such placement. Similarly, the second opening 130 may be configured to permit placement of the end portion 116 of the second tubular 106 within the housing 126 during brazing, and a second flared section 132 may be associated with the second opening 130 to assist with such placement. The housing 126 may include a lower assembly 134 and an upper assembly 136. Various elements and sections of the brazing thermal chamber apparatus 112 may be connected via flanged sections and corresponding bolts or other connectors and optional seals. The elements associated with the thermal chamber apparatus 112 may be circular, rectangular, or any other suitable shape, and may be constructed of materials such as carbon steel or other similar materials capable of focusing heat and keeping energy loss to a minimum.

[0015] The brazing thermal chamber apparatus 112 may also include a plurality of seals configured to allow a positive pressure of inert gas to be provided during brazing of the end portions 114, 116. The positive pressure may remove or prevent entry of hydrocarbons or other undesirable substances during thermal brazing or any time when the heater 124 is activated. For example, a first seal 138 may seal the interface between the first opening 128 and the first tubular 104 and a second seal 140 may seal the interface between the second opening 130 and the second tubular 106. The seals 138, 140 may provide dynamic sealing, allowing for rapid insertion of the second tubular 106 during the thermal brazing process. The seals may be resilient seals or may be configured to retract and extend or otherwise engage and disengage (e.g., via springs). Some degree of flow past the seals may be acceptable, and thus low pressure seals may be used, when positive pressure is present. Regardless of the particular configuration, the brazing thermal chamber apparatus 112 may be designed to provide positive pressure purging to prevent ingress of volatile gasses into the housing 126 and creating an explosive ignition risk. The design of the brazing thermal chamber apparatus 112 may provide rapid cooling of the housing 126. For example cooling to 270°C may occur in 10 minutes or less.

[0016] The purge opening 132 may be configured to provide inert gas (e.g., nitrogen) to the housing 126 before, during, and/or after thermal brazing. The purge opening 132 may be an inlet or an outlet and the dimensions may vary depending upon pipe size and other parameters of a particular site. An additional purge opening 142 may be provided and may also be either an inlet or an outlet. As illustrated, purge opening 132 is an inlet and purge opening 142 is an outlet. Such a configuration may allow for inert gas to be flushed through the housing 126 to purge material (e.g., volatile gas, or heated brazing effluent) from the housing 126.

[0017] The heater 124 may be configured to provide heat to the end portions 114, 116 during brazing. In one aspect of the present disclosure, the heater 124 may be an induction heater. For example, an electric induction heater. In some applications, the heater 124 may be configured to provide heat in the range of 600°C to 900°C. The heater 124 may be configured to fit partially or entirely within the housing 126. To that end, the housing 126 may have an opening 144 for electrical supply and access to the heater 124. The heater 124 may be sized, shaped, or otherwise configured to encircle one or both of the end portions 114, 116 of the tubulars 104, 106. The heater 124 may be connected to a power supply via

a water cooled conductor, secured to the housing 126. The heater 124 may be insulated to maintain electrical isolation.

5 **[0018]** The brazing thermal chamber apparatus 112 may include a control circuit configured to monitor hydrocarbon gas concentration in the housing 126. The control circuit may be configured to shut off brazing of the end portions 114, 116 when the hydrocarbon gas concentration exceeds a predetermined value. Sensors (not shown) with a power supply may be provided with one or more set points and may provide feedback for controlling the brazing process. Thus, the brazing thermal chamber apparatus 112 may provide the ability to sense penetration of various devices for real-time data gathering.

10 **[0019]** The brazing thermal chamber apparatus 112 may be useful in methods of brazing tubulars. For example, methods may include providing the brazing thermal chamber apparatus 112 in any of the forms and variations described above, providing the first tubular 104, and providing the second tubular 106. The end portion 114 of the first tubular 104 may be placed in the first opening 128 of the housing 126 and the end portion
15 116 of the second tubular 106 may be placed in the second opening 130 of the housing 126. Once in place, the heater 124 may be activated so as to cause brazing of a connection 102 between the end portions 114, 116 of the tubulars 104, 106. Brazing may be enhanced by providing a coating on threads or other exposed areas of the end portions 114, 116 prior to activating the heating. The coating of at least a portion of the end portions 114, 116 may
20 include the use of flashing or other materials known in the art of brazing. Coating may precede make-up of the connection 102. Some or all of the length of the connection 102 may be coated to provide a seal. Some exemplary brazing materials may include silver, copper, etc. The particular material used may be selected depending on the specific application.

25 **[0020]** While brazing provides a connection, it may be useful to have a stronger connection than that provided by brazing alone. Thus, when threads are present, the first tubular 104 may be rotated relative to the second tubular 106 to provide the connection 102. Brazing may be initiated after the tubulars 104, 106 are threadedly or otherwise connected such that the brazing enhances the connection 102. Thus, when threaded connections are
30 present, rotating of the first tubular 104 may occur before the heater 124 is activated.

[0021] Circulation of inert gas may be activated before, during, and/or after the brazing, thereby causing circulation through the purge opening. The gas may be compressed using pumps or other means. Some exemplary gases include nitrogen, carbon dioxide, helium, etc. Circulation may be at flow rates sufficient to displace any combustible gas present.

5 [0022] Referring now to Figure 3, the plug apparatus 110 may be used to isolate a section of the interior of a tubing string from the environment to allow for brazing (e.g., within the brazing thermal chamber apparatus 112) without the potential undesirables associated with brazing near a bore hole. The plug apparatus 110 may provide an internal protective enclosure to isolate the thermal brazing process as relates to making the
10 connection 102 (e.g., casing connection). The plug apparatus 110 may provide containment of heated gases derived from the thermal brazing. The plug apparatus 110 may be any pneumatically, manually, or otherwise activated plug or sleeve deployed inside the tubing string to isolate well bore fluids from contacting hot internal surfaces of connections. Preventing well bore fluids from contacting hot surfaces may serve to mitigate the risk of
15 ignition of such well bore fluids.

[0023] The plug apparatus 110 may an isolated portion 146 proximate the connection 102 of the tubulars 104, 106 and the isolated portion 146 may be purged with inert gas. While various seals may be present to ensure isolation, the inert gas may be provided at a pressure greater than ambient, providing assurance that ambient fluids do not enter the
20 isolated portion 146 during brazing. Regardless of the particular configuration, the plug apparatus 110 may be designed to provide positive pressure purging to prevent ingress of volatile gasses into the housing isolated portion 146. The design of the plug apparatus 110 may provide rapid cooling of the isolated portion 146.

[0024] The plug apparatus 110 may include a body 148, slips 150, a packing element
25 152, an actuator 154, and a purge opening 156. The slips 150 may be connected to the body 148 and configured to engage an interior of a tubular string formed by the first tubular 104 and the second tubular 106. The body 148 may be of singular construction and may be an elongated generally tubular member. When the body 148 is of singular construction, one set of slips 150 and packing element 152 may be sufficient to provide the
30 isolated portion 146 (e.g., interior of tubing string above the packing element).

[0025] The body 148 may include an upper portion 158 and a lower portion 160 joined by a tether 162. A second packing element 164 may be connected to the body 148 and configured to engage the interior of the tubular string at a location above the connection 102 between the first tubular 104 and the second tubular 106. When the body 148 includes the upper portion 158 and the lower portion 160, the packing element 152 may be provided in the lower portion 160 and the second packing element 164 may be provided in the upper portion 158. When two packing elements 152, 164 are provided, the isolated portion 146 may be limited to the area between the packing elements 152, 164. Slips may be provided for each of the upper portion 158 and the lower portion 160. Whether structurally independent (e.g., joined by a tether but not by a structural element) or not, upper portion 158 and lower portion 160 may have separate slips and packing elements. When structurally independent, the lower portion 160 may include slips 150 configured to engage the interior of the tubular string at a location below the connection 102 between the first tubular 104 and the second tubular 106 and the upper portion 158 may include additional slips 166 configured to engage the interior of the tubular string at a location above the connection 102 between the first tubular 104 and the second tubular 106.

[0026] The packing element 152 may be connected to the body 148 and configured to engage the interior of the tubular string at a location below the connection 102 between the first tubular 104 and the second tubular 106 of the tubular string. When structurally independent, the lower portion 160 may include the packing element 152 configured to engage the interior of the tubular string at a location below the connection 102 between the first tubular 104 and the second tubular 106 and the upper portion 158 may include the packing element 164 configured to engage the interior of the tubular string at a location above the connection 102 between the first tubular 104 and the second tubular 106. The packing element may be a compressible elastomeric material, Teflon®, or any other material suitable for providing sealing isolation. Thus, the plug apparatus 110 may provide dynamic sealing methods during insertion and locking or setting of the plug apparatus 110 into the interior or bore of the tubulars 104, 106.

[0027] The actuator 154 may be configured to move the slips 150 and packing element 152 into engagement with the interior of the tubular string. The actuator 154 may assist in rapid insertion, extraction, and locking methods for handling the plug apparatus 110. The actuator 154 may be a mechanical device connected to the body 148. Alternatively, or

additionally, the actuator 154 may be pneumatic pressure. Additionally or alternatively, the actuator 154 may be an electrical signal.

[0028] The purge opening 156 may be configured to provide inert gas to an isolated portion 146 of the interior of the tubular string. The isolated portion 146 may include the
5 connection 102 between the first tubular 104 and the second tubular 106. The isolated portion 146 may extend up into the running tool apparatus 108 when only the lower portion 160 is used. Alternatively, when the plug apparatus 110 has the upper portion 158 and the lower portion 160, the isolated portion 146 may be formed by the space confined by the interior of the tubular string and by the upper and lower portions 158, 160 of the plug
10 apparatus 110.

[0029] The purge opening 156 may be an inlet or an outlet and an additional purge opening 168 may be provided and may also be an inlet or an outlet. Thus, the plug apparatus 110 may include a purge inlet and a purge outlet such that inert gas may be flushed through the isolated portion 146.

[0030] The plug apparatus 110 may be provided with sensors to detect temperature, pressure, gas content, etc. Such detected parameters may be communicated through wires or wirelessly. The tether 162 may be present in any of the designs above and may be an armored umbilical useful for sensing devices and gas tubes and for real-time data gathering. Another umbilical 169 may transmit measurements (e.g., temperature) from sensors
20 associated with the plug apparatus 110.

[0031] When mechanical actuation is used, the plug apparatus 110 may have the upper portion 158 and the lower portion 160 and the actuator 154 may include one or more mechanical mechanisms to engage the respective packing elements 164, 152. In such a configuration, pulling the tether 162 may allow for disengagement and retrieval of both
25 portions 158, 160. Such mechanical mechanisms may operate manually using levers or using air pressure.

[0032] When pneumatic actuation is used, the plug apparatus 110 may include only the lower portion 160 and the actuator may not be mechanical as illustrated but may instead involve the use of pressurized nitrogen to energize the packing element 152, and expand
30 the slips 150. In the pneumatic variation, air pressure may activate a piston which activates

a lever, causing the slips and/or seals to move laterally outwards. Lowering of the pressure may reverse the operation and disengage the slips 150 and packing element 152.

5 [0033] When electrical actuation is used, the plug apparatus 110 may include only the lower portion 160 and the actuator may include 2 motors (e.g., solenoid or sealed motor-screw device) to expand and secure the packing element 152 and the slips 150 and may provide electrical pressure sensing of the isolated portion 146. The electrical motor causes the rotation of a lead screw which moves the actuator and causes the seals and/or slips to move laterally (i.e., inward or outward), thus allowing engagement or disengagement of the seals and/or slips.

10 [0034] The plug apparatus 110 may be useful in methods of brazing tubulars. For example, methods may include providing the first tubular 104, providing the second tubular 106 configured to connect to the first tubular 104 to form a tubular string, providing the plug apparatus 110 in any of the forms and variations described above, placing at least a portion of the plug apparatus 110 inside the first tubular 104, connecting
15 the first tubular 104 to the second tubular 106, and activating the actuator 154 so as to move the slips 150 and packing element 152 into engagement with the interior of the tubular string. Placing the plug apparatus 110 inside the first tubular 104 may involve lowering the plug apparatus 110 through the second tubular 106 and at least partially into the first tubular 104 until a position indicator indicates that the plug apparatus 110 is in the
20 desired location.

[0035] The engagement of the slips 150 and packing element 152 may occur either prior to or subsequent to rotating or otherwise providing the connection 102. However, the slips 150 and packing element 152 are preferably set prior to the purging and prior to the thermal brazing. In designs where there are multiple sets of slips and packing elements,
25 some or all of the slips 150, 166 and/or packing elements 152, 164 may be configured to engage the interior of the tubulars 104, 106 before a tubular string is formed by connecting the first tubular 104 and the second tubular 106.

[0036] When a purge inlet and a purge outlet are both present in the plug apparatus 110, methods may include flushing inert gas through the isolated portion 146. Such flushing
30 may occur after the packing element 152 has engaged the interior of the tubular string.

[0037] In versions where the body 148 has the upper portion 158 and the lower portion 160, placing at least a portion of the plug apparatus 110 inside the tubular includes placing at least part of the lower portion 160 inside the first tubular. The method may further include placing the upper portion 158 inside the second tubular 106.

5 [0038] Placement using the various methods may allow for the plug apparatus 110 to be placed so as to provide isolation between the isolated portion 146 and a portion of the interior of the tubular string below the isolated portion 146. In versions with the upper portion 158 and the lower portion 160, the plug apparatus 110 may be placed so as to also provide isolation between the isolated portion 146 and a portion of the interior of the
10 tubular string above the isolated portion 146.

[0039] In some versions, the first tubular 104 and the second tubular 106 may be casing joints and the corresponding tubular string may be a casing string.

[0040] Referring now to Figure 4, the running tool apparatus 108 may be used in conjunction with or separately from the apparatus described above. The running tool
15 apparatus 108 may include a body 170, a purging passage 172 extending through the body 170, an opening 174 in the body 170, and a seal 176. Power for rotation may be provided through hydraulic tongs (not shown) or through a motor (also not shown) in the running tool apparatus 108.

[0041] The body 170 may have a first end 178 configured to engage an elevator and a
20 second end 180 configured to sealingly engage the second tubular 106. The first end 178 may have a profile 182 configured to engage an elevator unit 184. The running tool apparatus 108 may also include a shop lifting plug 186. As illustrated, the shop lifting plug 186 may be disposed proximate the first end 178. The second end 180 may be open. The second end 180 may be configured to rotate relative to the first end 178 about a central
25 longitudinal axis extending from the first end 178 to the second end 180. The body 170 may have a first portion 188 which includes the first end 178 and a second portion 190 which includes the second end 180. Bearings 192 may be provided between the first portion 188 and the second portion 190 such that the second portion 190 is configured to rotate relative to the first portion 188.

[0042] The purging passage 172 may be configured to communicate with the second tubular 106 through the open second end 180.

[0043] The opening 174 in the body 170 may be configured to allow for an umbilical 194 to pass from an exterior of the body 170 through the body 170 and out the second end 180 of the body 170.

[0044] The seal 176 may be configured to prevent flow through the opening 174 when the umbilical 194 is in place. The umbilical 194 and plug apparatus 110 may be provided independent of the running tool apparatus 108. Whether provided separately or jointly with the running tool apparatus 108, the plug apparatus 110 may be configured to pass through the second tubular 106 and sealingly engage the interior of the first tubular 104. Thus, the space above the first tubular 104 may be isolated, allowing for purging and thermal brazing.

[0045] An external seal 196 may be provided at the second end 180 to provide for sealing engagement between the running tool apparatus 108 and the second tubular 106.

[0046] The running tool apparatus 108 may be useful in methods of connecting tubulars. For example, methods may include the running tool apparatus 108 in any of the forms and variations described above, providing the second tubular 106, and connecting the second end 180 of the body 170 to the second tubular 106. The connecting may be done by rotating the second portion 190 of the body 170 when threads are present.

[0047] An additional tubular may be provided and the second tubular 106 may be connected to the additional tubular. The additional tubular may be a subsequently introduced tubular or the additional tubular may be the first tubular 104 already in place in the bore hole 120. When the second portion 190 is configured to rotate relative to the first portion 188, the method may include rotating the second portion 190 relative to the first portion 188 and may provide the connection 102 between the first tubular 104 and the second tubular 106. During this process, the first tubular 104 may be held in place by the powered slips 122 on the rig floor 118 such that rotating the second portion 190 relative to the first portion 188 makes up a threaded connection. Torque and other parameters associated with making up the threaded connection may be determined based on the particular connection.

[0048] Either before or after the connection 102 is provided, the umbilical 194 and the plug apparatus 110 may be provided and the plug apparatus 110 may be lowered into the second tubular 106. The method may also include providing the first tubular 104 and lowering the plug apparatus 110 into the first tubular 104, and, with the plug apparatus 110, sealingly engaging an interior of the first tubular 104. The method may also include connecting the second tubular 106 and the first tubular 104. The method may include purging air from within the second tubular 106 through the purging passage 172. The method may include thermally brazing the connection 102 between the second tubular 106 and the first tubular 104. The method may include providing the brazing thermal chamber apparatus 112 and placing the end portion 116 of the second tubular 106 and the end portion 114 of the first tubular 104 in the brazing thermal chamber apparatus 112 prior to brazing. Brazing may include activating the heater 124 in the brazing thermal chamber apparatus 112. Once brazing occurs, the method may include cooling via circulation through the purging passage 172.

[0049] After optional brazing and optionally cooling are complete, the method may include removing the plug apparatus 110 and disconnecting the second end 180 of the body 170 from the second tubular 106 before repeating the steps with a new tubular.

[0050] The running tool apparatus 108 may provide a means of running a tubular (e.g., casing joint) while plugging the box end to allow for flushing, purging and filling the interior volume, as related to making a tubular connection. The running tool apparatus 108 may provide for tubular rotation during threading operation, as well as vertical displacement during same. The running tool apparatus 108 may provide positive pressure purging to prevent ingress of volatile gases surrounding the tubular on a drilling rig. The running tool apparatus 108 may provide an armored umbilical for sensing devices and gas tubes, for real time data gathering, as connected to an isolation plug. The running tool apparatus 108 may provide an internal slip type latching means for attaching to the tubular, for handling the tubular string weight below. The running tool apparatus 108 may provide rapid insertion, extraction and locking methods for handling of an isolation plug.

[0051] Those of skill in the art will appreciate that many modifications and variations are possible in terms of the disclosed embodiments, configurations, materials, and methods without departing from their scope. For example, rotating a first element relative to a

- second element may involve actual rotation of the first element while the second element is maintained in a static position. However, in some instances, relative rotation of the first element relative to the second element may involve rotation of the second element with or without rotation of the first element. Accordingly, the scope of the claims and their
- 5 functional equivalents should not be limited by the particular embodiments described and illustrated, as these are merely exemplary in nature and elements described separately may be optionally combined.

CLAIMS

1. An apparatus comprising:
 - a body;
 - slips connected to the body and configured to engage an interior of a tubular string;
 - a packing element connected to the body and configured to engage the interior of
 - 5 the tubular string at a location below a connection between a first tubular and a second tubular of the tubular string;
 - an actuator configured to move the slips and packing element into engagement with the interior of the tubular string; and
 - a purge opening configured to provide inert gas to an isolated portion of the interior
 - 10 of the tubular string, wherein the isolated portion includes the connection between the first tubular and the second tubular.
2. The apparatus of claim 1, wherein the purge opening comprises an inlet, the apparatus further comprising a purge outlet such that inert gas may be flushed through the isolated portion.
- 15 3. The apparatus of claim 1, wherein the body comprises an upper portion and a lower portion joined by a tether.
4. The apparatus of claim 3, wherein the lower portion comprises the slips and the slips are configured to engage the interior of the tubular string at a location below the connection between the first tubular and the second tubular, the apparatus
- 20 comprising:
 - a second packing element connected to the body and configured to engage the interior of the tubular string at a location above the connection between the first tubular and the second tubular; and
 - additional slips, wherein the additional slips are configured to engage the interior of
 - 25 the tubular string at a location above the connection between the first tubular and the second tubular;
 - wherein the upper portion comprises the second packing element and the additional slips.

5. The apparatus of claim 1, wherein the packing element comprises an elastomeric material.
6. The apparatus of claim 1, wherein the actuator comprises a mechanical device connected to the body.
- 5 7. The apparatus of claim 1, wherein the actuator comprises pneumatic pressure.
8. The apparatus of claim 1, wherein the actuator comprises an electric signal.
9. A method comprising:
- providing a first tubular;
- providing a second tubular configured to connect to the first tubular to form a
- 10 tubular string;
- providing an apparatus comprising a body, slips connected to the body and configured to engage the interior of the tubular string, a packing element connected to the body and configured to engage the interior of the tubular string at a location below the connection between the first tubular and the second tubular of the tubular string, an
- 15 actuator configured to move the slips and packing element into engagement with the interior of the tubular string, and a purge opening configured to provide inert gas to an isolated portion of the interior of the tubular string, wherein the isolated portion includes the connection between the first tubular and the second tubular;
- placing at least a portion of the apparatus inside the first tubular;
- 20 connecting the second tubular to the first tubular; and
- activating the actuator so as to move the slips and packing element into engagement with the interior of the tubular string.
10. The method of claim 9, wherein the first and second tubular are casing joints and wherein the tubular string is a casing string.
- 25 11. The method of claim 9, wherein the purge opening comprises an inlet, the apparatus further comprising a purge outlet such that inert gas may be flushed through the isolated portion, the method comprising flushing inert gas through the isolated portion.

12. The method of claim 9, wherein the body comprises an upper portion and a lower portion joined by a tether, and wherein placing at least a portion of the apparatus inside the first tubular comprises placing at least part of the lower portion inside the first tubular.
- 5 13. The method of claim 9, wherein the lower portion comprises the slips and the slips are configured to engage the interior of the tubular string at a location below the connection between the first tubular and the second tubular, wherein the apparatus comprises
- 10 a second packing element connected to the body and configured to engage the interior of the tubular string at a location above the connection between the first tubular and the second tubular, and additional slips, wherein the additional slips are configured to engage the interior of the tubular string at a location above the connection between the first tubular and the second tubular and wherein the upper portion comprises the second packing element and the additional slips, the method comprising:
- 15 placing the upper portion inside the second tubular.
14. The method of claim 9, wherein the apparatus is placed so as to provide isolation between the isolated portion and a portion of the interior of the tubular string below the isolated portion.
- 20 15. The method of claim 14, wherein the apparatus is placed so as to provide isolation between the isolated portion and a portion of the interior of the tubular string above the isolated portion.

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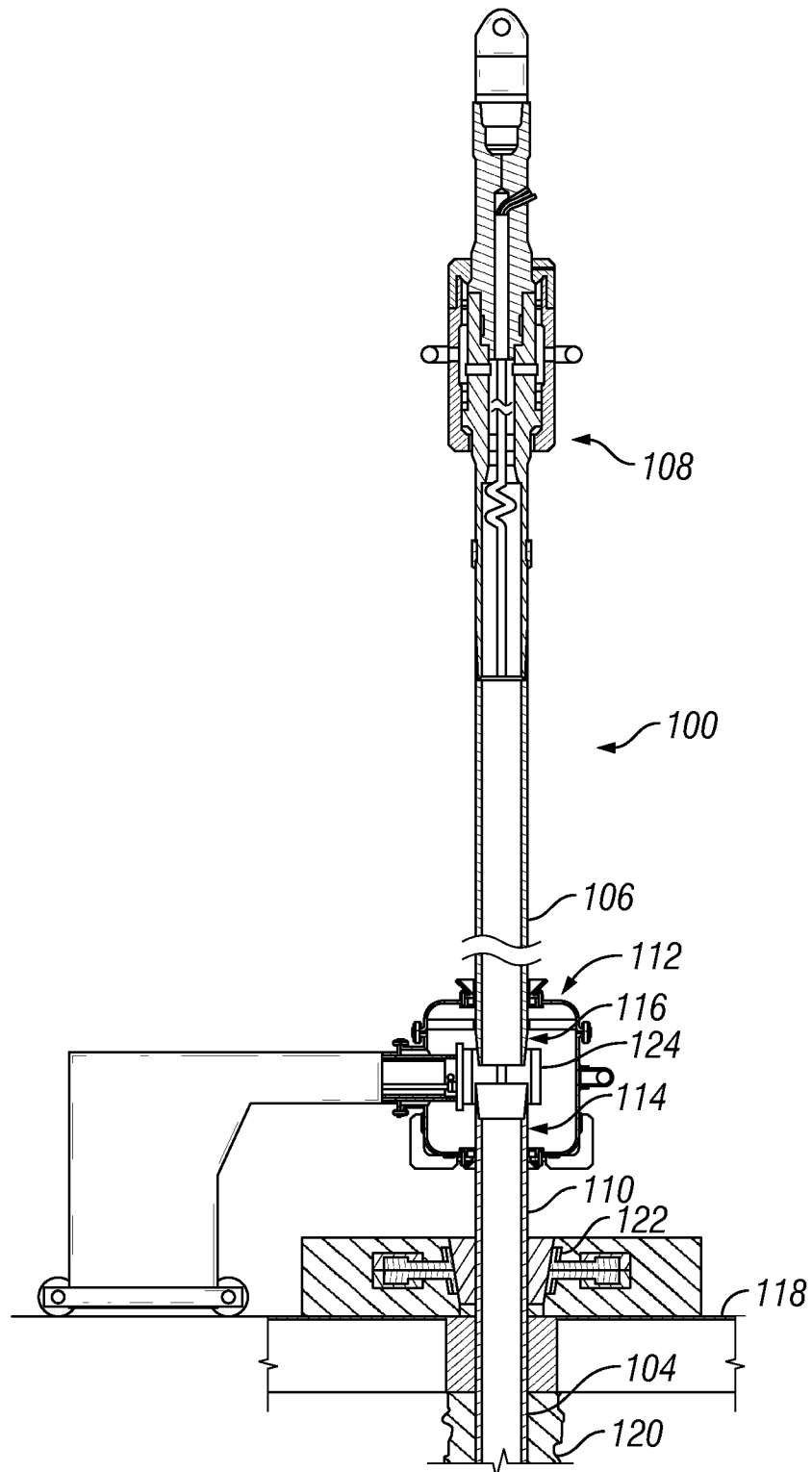


FIG. 1

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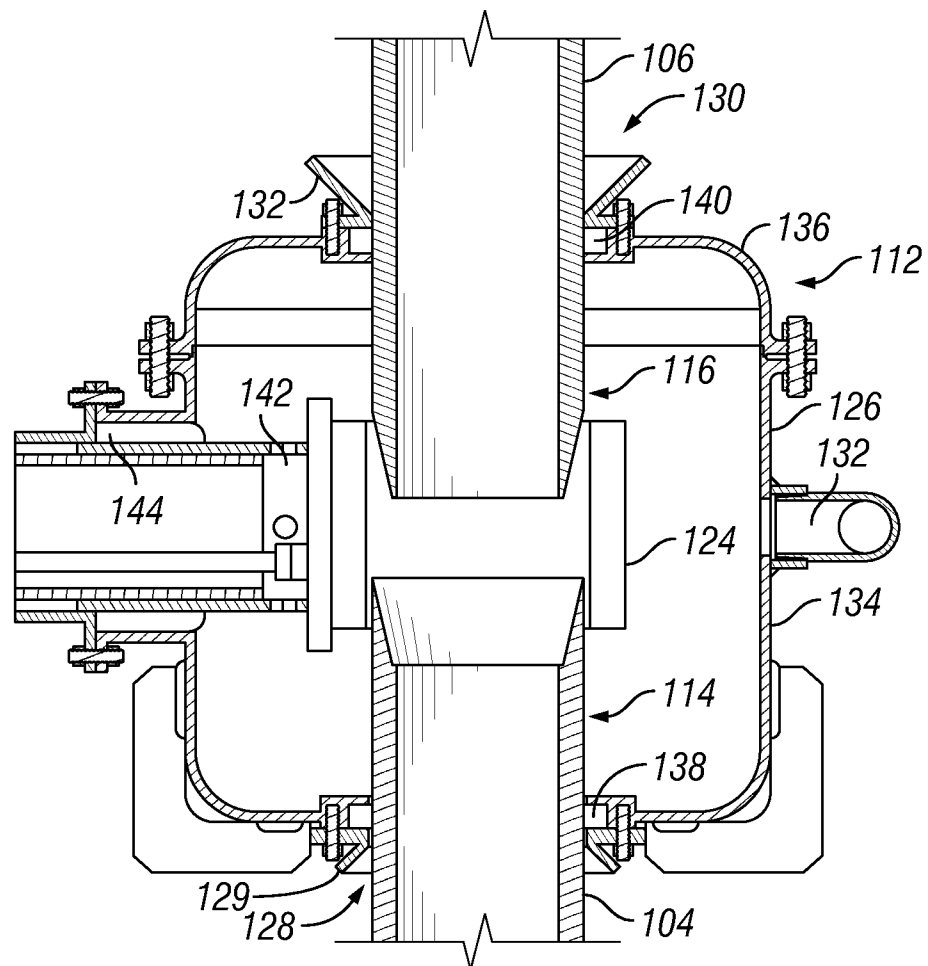
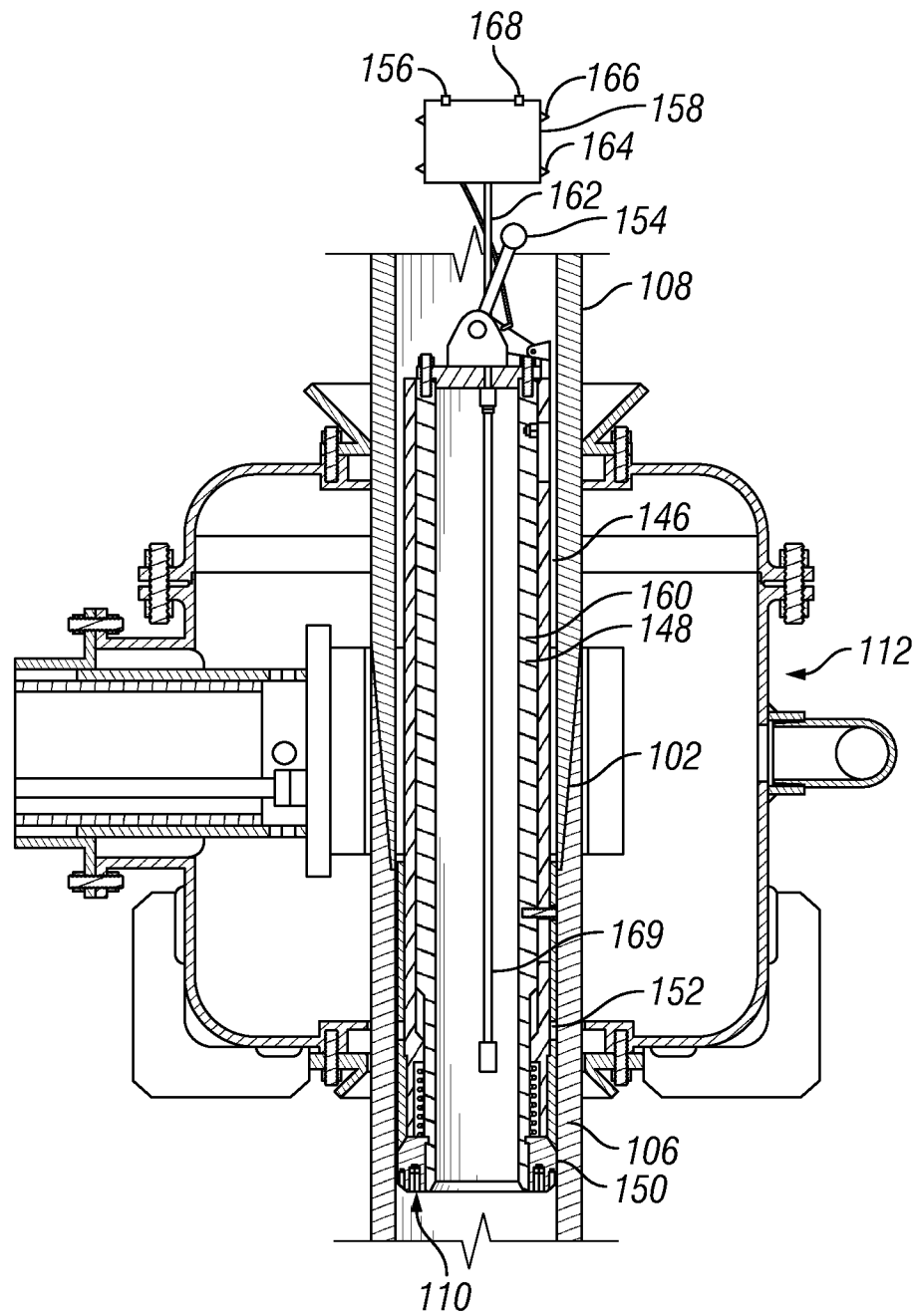


FIG. 2

3/4**FIG. 3**

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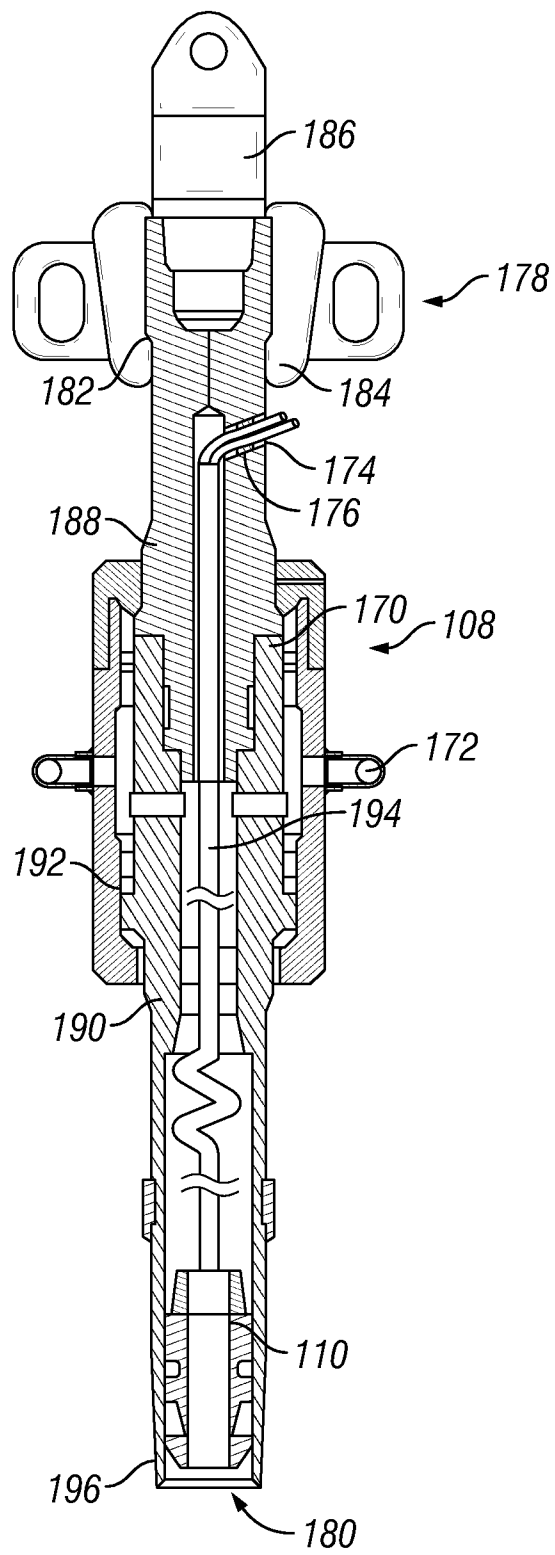


FIG. 4

A. CLASSIFICATION OF SUBJECT MATTER**E21B 19/18(2006.01)i, E21B 33/03(2006.01)i, B23K 1/00(2006.01)i**

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

E21B 19/18; B23K 13/01; E21B 33/126; B25B 13/50; E21B 19/00; E21B 33/129; E21B 33/03; B23K 1/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) & Keywords: plug, slip, packing element, actuator, purge opening, string, tubular, gas

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 6288373 B1 (JAHN et al.) 11 September 2001 See column 3, line 15 - column 5, line 15 and figures 1-2.	1-2, 5-11, 14-15
A		3-4, 12-13
Y	US 5014782 A (DASPIT, RONALD A.) 14 May 1991 See column 3, line 14 - column 4, line 17 and figures 1-2.	1-2, 5-11, 14-15
A	US 7100697 B2 (HAUGEN et al.) 05 September 2006 See column 3, line 59 - column 4, line 26 and figure 1.	1-15
A	US 6184493 B1 (TSUCHIYA, MASAKI) 06 February 2001 See column 5, line 26 - column 6, line 39 and figure 1.	1-15
A	US 7028586 B2 (ROBICHAUX, DICKY) 18 April 2006 See column 15, lines 37-47 and figure 24.	1-15

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

* Special categories of cited documents:

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22 March 2016 (22.03.2016)

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