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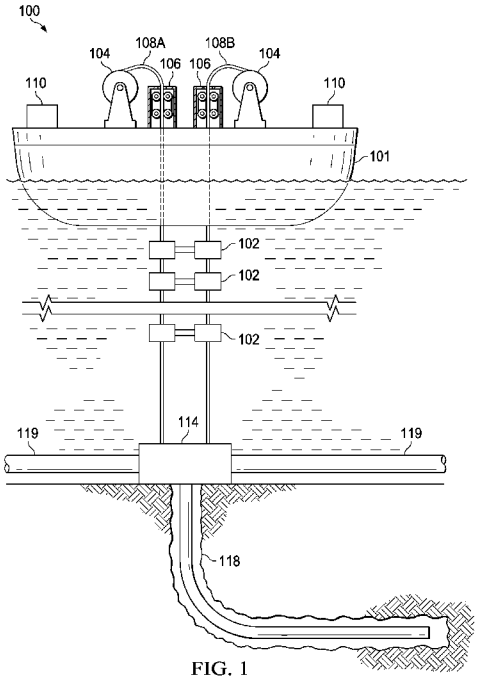


FIG. 1

(57) Abstract: The disclosed embodiments include a tubing deployment system. In one embodiment, the tubing deployment system includes a first tubing string having a first weightable collar. The tubing deployment system also includes a second tubing string having a second weightable collar. The first weightable collar and the second weightable collar each includes an interlocking locking member and a plurality of receivers spaced radially about an external surface of the respective weightable collar, where each of the plurality of receivers is configured to receive a weight.

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METHOD AND SYSTEM FOR DEPLOYMENT OF TUBING STRINGS FOR RISER-LESS APPLICATIONS

BACKGROUND

[0001] The present disclosure relates generally to continuous tubing deployment systems and methods to deploy multiple continuous tubing strings.

[0002] Riser pipes are often used in subsea drilling and intervention operations to connect subsea wells or pipelines to vessels or mobile offshore platforms or vessels (collectively referred to as platforms). More particularly, sections of riser pipes are connected together to form a conduit between a subsea well structures and the platforms. The conduit provides a flow path for fluids and particulates to travel from the platforms down to the subsea well, and provides a return flow path for hydrocarbon resources to travel from the subsea well to the platforms, where the hydrocarbon resources are extracted.

[0003] As hydrocarbon resources are discovered at greater sea depth, additional sections of riser pipes are used to connect the subsea wells to platforms, thereby greatly increasing material costs of the riser pipes and prolonging the installation and uninstallation processes. Further, once deployed, the riser pipes form a semi-permanent fixture, and may not be quickly or easily disconnected from the platforms. However, ocean weather conditions are often unpredictable and severe, in certain adverse weather conditions, such as, but not limited to hurricanes, tsunamis, and maelstroms, it may be desirable for platforms to quickly disengage from the riser pipes. In response to the foregoing shortcomings of riser pipes, tubing strings, such as coiled tubing, have been used as an alternative for riser pipes in subsea pipeline and intervention operations. Deployment and recovery of tubing strings is faster than the installation process of riser pipes. Further, the material cost of tubing strings is also less than riser pipes.

Brief Description of the Drawings

[0004] Illustrative embodiments of the present disclosure are described in detail below with reference to the attached drawing figures, which are incorporated by reference herein, and wherein:

[0005] FIG. 1 is a schematic, side view of a riser-less offshore intervention environment with multiple tubing strings deployed to connect a platform to a subsea structure such as a wellhead of a subsea well; or a pipeline manifold.

[0006] FIG. 2 is a schematic, side view of an example of a tubing deployment system deployed to secure the tubing strings of FIG. 1;

[0007] FIG. 3A is a schematic, side view of an example of weightable collar as used with a tubing deployment system of FIG. 2 that includes several radial receivers for receiving weights;

[0008] FIG. 3B is a schematic, top view of another example of weightable collar as used with a tubing deployment system of FIG. 2 that includes several radial receivers for receiving weights;

[0009] FIG. 4A is a schematic top view of an example clamp assembly of the tubing deployment system of FIG. 2, deployed to secure the tubing strings of FIG. 2; and

[0010] FIG. 4B is a schematic side view of an example of an articulated chain of the clamp assembly of FIG. 4A.

[0011] The illustrated figures are only exemplary and are not intended to assert or imply any limitation with regard to the environment, architecture, design, or process in which different embodiments may be implemented.

Detailed Description

[0012] The present disclosure relates to a tubing deployment system, a method to secure multiple tubing strings, and a weightable collar. More particularly, this disclosure relates to a tubing deployment system having a first tubing string having a first weightable collar and a second tubing string having a second weightable collar. The system facilitates the deployment of two or more strings of coiled tubing in, for example, pipeline intervention applications, and enhances the ability to prevent twisting or binding, and to extract tubing strings from a subsea environment. As such, each of the first weightable collar and the second weightable collar includes an interlocking mechanism and a plurality of receivers spaced radially about an external surface of the collar. The interlocking mechanism of each collar engages a complementary interlocking mechanism on an adjacent collar, thereby orienting the collars and their associating tubing strings with respect to each other. Each of the plurality of receivers is configured to receive a weight to facilitate deployment of the tubing string to which it is coupled.

[0013] Referring generally to the operation of subsea pipelines or wells, a platform or support structure may include a vessel or a floating rig (platform). The platform is often deployed offshore to excavate hydrocarbon resources trapped in underwater formations. Multiple tubing strings may be deployed from the platform at sea level to connect to a tie-in point such as a subsea well. Fluids and particulates may flow from the platform, through the tubing strings, into a subsea manifold, and hydrocarbon resources may flow from the subsea manifold, through the tubing strings, to the platform, where the hydrocarbon resources are collected. Different tubing strings may be deployed to form conduits and return conduits for wellbore fluids including hydrocarbon resources, as well as other types of fluids and/or particulates that may be pumped through the tubing strings. The tubing strings may be rapidly deployed, thereby reducing setup time. The tubing strings may also be rapidly retracted once well operations are complete or in presence of adverse weather conditions.

[0014] In an illustrative embodiment, a tubing deployment system facilitates deployment of multiple tubing strings. More particularly, the tubing deployment system prevents different tubing strings from becoming entangled. The tubing deployment system also inhibits undesirable motion caused by underwater environmental conditions, such as buoyancy, underwater currents, and other types of environmental conditions that the tubing strings may experience during deployment. The tubing deployment system includes at least one clamp

assembly to clamp multiple tubing strings together. The tubing deployment system also includes at least one weightable collar with receiving slots (receivers). In some embodiments, receivers are spaced radially about the weightable collar to receive weights such as clump weights. The weights may be selected to have different weights based on the material strength of the tubing string and the amount of downward force desired in consideration of the subsea environment. In some embodiments, the weightable collar includes an interlocking mechanism to secure the weightable collar to another weightable collar of a nearby tubing string. Securing a weightable collar to an adjacent weightable collar effectively couples the tubing strings to which the collars are attached, thereby restricting relative motion between the tubing strings. In some embodiments, multiple weightable collars, each containing weights, are deployed at different depths to secure the tubing strings at intervals along the tubing strings.

[0015] Turning now to the figures, FIG. 1 is a schematic, side view of a riser-less offshore intervention environment 100 with multiple tubing strings 108A and 108B deployed to connect a platform 101 to a manifold 114 attached to a wellhead of a subsea well 118 and connected to subsea pipelines 119. The pipelines 119 may connect other manifolds (not shown), subsea trees (not shown), or wells (not shown) to the manifold 114. While the system is shown as an intervention system, the disclosure is equally applicable to production and preparation environments. As illustrated in FIG. 1, the platform 101 is deployed above the manifold 114. The platform 101 includes tubing string spools 104 carrying first tubing string 108A and second tubing string 108B, and tubing string injectors 106. The first and second tubing strings (e.g., coiled tubing) 108A and 108B are fed into tubing string injectors 106. One or more controllers 110 are communicatively connected to the tubing string injectors 106 and are operable to control the tubing string injectors 106 to deploy or to recover the first and second tubing strings 108A and 108B.

[0016] The first and second tubing strings 108A and 108B form conduits connecting the platform 101 to the manifold 114 to provide a return flow path for hydrocarbon resources. Weightable collars 102, which may include clump weight housings, are deployed at different depths to inhibit undesired motion due to underwater environmental conditions, as previously discussed. The weightable collars 102 are coupled to the first and second tubing strings 108A and 108B and interlocked to stabilize the first and second tubing strings 108A and 108B individually and relative to each other.

[0017] In some embodiments, additional tubing strings (not shown) may be deployed from the platform 101 or from a nearby vessel (not shown). In such embodiments, the additional tubing strings may also connect to the manifold 114 to provide flow paths for pumped fluids or to provide return flow paths for hydrocarbon resources. The additional tubing strings may be secured by additional weightable collars that are interlocked to the weightable collars 102 illustrated in FIG. 1 or one or both of the tubing strings 108A and 108B. Further, although FIG. 1 illustrates three pairs of weightable collars, any number of weightable collars may be deployed at different depths to secure the tubing strings 108A and 108B based on the material properties of the tubing strings, and the surrounding environmental conditions.

[0018] FIG. 2 is a schematic, side view of an example of a tubing deployment system 200 deployed to secure the tubing strings 108A and 108B of FIG. 1. In the embodiment illustrated in FIG. 2, the first and second tubing strings 108A and 108B are coupled to a first weightable collar 202A and a second weightable collar 202B, respectively. The first and second weightable collars 202A and 202B each includes at least one receiver configured to receive and secure additional weights to the first and second tubing strings 108A and 108B. The first and second weightable collars 202A and 202B and the weights inserted into the at least one receiver together counteract buoyancy and other environmental conditions (forces) that may cause the first or the second tubing string 108A or 108B to drift or to become entangled. The first weightable collar 202A and the second weightable collar 202B include interlocking members 206 that may be engaged to lock together to further secure the first and second tubing strings 108A and 108B and to counteract adverse environmental conditions.

[0019] The tubing deployment system 200 also includes a first deflector 210A and a second deflector 210B overlying to the first and second weightable collars 202A and 202B. The first and second deflectors 210A and 210B are configured to help guide the tubing strings108A and 108B and to allow individual tubing strings to be separately manipulated. The deflectors 210A and 210B may also act as a shroud or shield to protect the adjacent weightable collars 202A and 202B from debris or impact from external objects.

[0020] In some embodiments, the first and second tubing strings 108A and 108B are coupled to a first clamp assembly 212 and a second clamp assembly 214. The first and second clamp assemblies 212 and 214 include extension portions such as extension rods, cords, articulated chains, or similar connecting members that extend from the first tubing string 108A to the second tubing string 108B, and clamps configured to secure the first and second tubing strings

108A and 108B to the first and second clamp assemblies 212 and 214. In some embodiments, each of the clamp assemblies 212 and 214 has a clamping member that forms a fixed interface with the first tubing 108A. In some embodiments, each of the clamp assemblies 212 and 214 also has a vertically compliant interface with the second tubing string 108B, which allows freedom of motion in a vertical or axial direction. In one of such embodiments, the vertically compliant interface is an articulated chain-type collar, where each link of the collar includes one or more ball bearings or rollers to provide the second tubing string 108B with freedom of motion in the vertical direction.

[0021] In some embodiments, the tubing deployment system 200 may include additional clamp assemblies, deflectors, and weightable collars to secure the first and second tubing strings 108A and 108B and to counteract adverse environmental conditions. Furthermore, the tubing deployment system 200 may also include additional clamp assemblies, deflectors, and weightable collars to secure additional tubing strings (not shown) that are deployed by the platform 101 or by a nearby vessel. Additional details of the weightable collars 202A and 202B and the clamp assemblies 212 and 214 are described in the following paragraphs and are illustrated in at least FIGs. 3A, 3B, 4A, and 4B.

[0022] FIG. 3A is a schematic, side view of an example of the weightable collars 202A and 202B of the tubing deployment system 200 of FIG. 2 that includes several radial receivers for receiving weights. In the embodiment illustrated in FIG. 3A, the first weightable collars 202A includes a hollow passage that allows the first tubing string 108A to pass through. The first weightable collar 202A may include a clamp or a mechanism to fixedly secure the first weightable collar 202A to the first tubing string 108A.

[0023] In the embodiment illustrated in FIG. 3A, the first weightable collar includes multiple weight receivers 204 radially spaced across a side surface of the first weightable collar. Each of the weight receivers 204 may receive a weight. The number of weight receivers 204 occupied by weights 220 and the weight of each weight 220 are dependent on a number of factors including, but not limited to the material strength of the first tubing string 108A, the depth of the weightable collar 202A, the number of other weightable collars attached to the tubing string 108A or interlocked to the first weightable collar 202A, and environmental factors discussed in the previous paragraphs. In some embodiments, each receiver 204 includes a securing mechanism such as an interlock or latch (not shown), configured to secure the weight 220 once the weight 220 is inserted into the receiver 204 to prevent the weight 220 from falling out of the

first weightable collar 202A. In such embodiments, the interlock is further configured to disengage the weight 220 when the weight 220 is removed from the first weightable collar 202A. The first weightable collar 202A also includes a first interlocking member 206A, which is configured to engage the first weightable collar 202A with another weightable collar, such as the second weightable collar 202B.

[0024] The second weightable collar 202B, similar to the first weightable collar 202A, also includes a hollow interior, a mechanism to secure the second tubing string 108B, receivers 204 for receiving the weights 220, and a second interlocking member 206B. The first and second interlocking members 206A and 206B may be coupled to each other to join the first and second weightable collars 202A and 202B. Once coupled, the first and second interlocking members 206A and 206B may also be released to disengage the first and second weightable collars 202A and 202B from each other. In the embodiment illustrated in FIG. 3A, a pinned coupling 207 is installed around the first and second interlocking members 206A and 206B and a shear pin 208 is inserted into the pinned coupling 207 to secure the first interlocking member 206A with the second interlocking member 206B. The tensile strength of the shear pin may be based on a variety of factors, such as, the material strength of the first and second tubing strings 108A and 108B, the number of other weightable collars engaged to the tubing strings 108A and 108B, environmental factors discussed in the previous paragraphs, and a desired yield strength.

[0025] In an exemplary embodiment, the shear pin 208 is selected to have a predetermined yield strength that results in failure in response to the failure of one of the tubing strings 108A or 108B. For example, if one of the tubing strings 108A or 108B fails when both the first and second interlocking members 206A and 206B are engaged, the weight of the failed tubing string 108A or 108B together with the combined weight of the weightable collars 202A and 202B may cause the other tubing string 108A or 108B to eventually fail. In such an embodiment, the shear pin 208 is manufactured to have a yield strength that is less than the force that would be exerted on to the shear pin 208 due to failure of one of the first or second tubing strings 108A or 108B. In such an example, the shear pin 208 would fail as a result of the force generated by the failed tubing string (108A or 108B) force, thereby allowing the first and second interlocking members 206A and 206B to disengage from each other, and mitigating the risk that failure of (for example) the first tubing string 108A will result in failure of the second tubing string 108B. Additional embodiments of the first and second weightable collars 202A and 202B are described in the following paragraphs and are illustrated in at least FIG. 3B.

[0026] FIG. 3B is a schematic, top view of another embodiment of a weightable collar assembly of the tubing deployment system of FIG. 2 that includes several radial receivers 304 for receiving weights 320. In the embodiment illustrated in FIG. 3B, the receivers 304 are radially spaced and extend from the top of the first and second weightable collars 302A and 302B. Weights 320 may be inserted radially from a side or downwardly from above into the receivers 304. In most respects, the embodiment of FIG. 3B functions similarly to that of FIG. 3A.

[0027] The first and second weightable collars 302A and 302B also include the first and second interlocking members 306A and 306B. The first and second interlocking members 306A and 306B include hollow passages that may be aligned when the first and second weightable collars 302A and 302B are engaged along an engagement surface 309 to allow a shear pin 308 to slide into both hollow passages to couple the first and second interlocking members 306A and 306B. In some embodiments, the hollow passage of the first and second interlocking members 306A and 306B contain internal threads. In such embodiments, the shear pin 308 includes external threads and is rotatable about an axis that is approximately perpendicular to the longitudinal axes of the first and second tubing strings 108A and 108B to engage the internal threads of the hollow passages to engage the first and second interlocking members 306A and 306B. The shear pin 308 can be removed from the hollow passages of the first and second interlocking members 306A and 306B to disengage the first and second weightable collars 302A and 302B.

[0028] In some embodiments, each of the weightable collars 302A and 302B includes additional interlocks that are configured to engage the interlocks of additional weightable collars. Although each of the weightable collars 302A and 302B illustrated in FIGs. 3A and 3B includes 8 receivers, the of the weightable collars 302A and 302B may include a different number of receivers spaced across the external surfaces of the weightable collars 302A and 302B. Further, the weightable collars 302A and 302B may have dimensions different from the shapes illustrated in FIGs. 3A and 3B.

[0029] FIG. 4A is a schematic top view of an example clamp assembly 212 or 214 of the tubing deployment system 200 of FIG. 2, deployed to secure the tubing strings 108A and 108B of FIG. 1. As illustrated in FIG. 4A, the clamp assembly 400 includes an internally threaded rod 402 having externally threaded extendable members 403A and 403B. The internally threaded rod 402 and externally threaded extendable members 403A and 403B are rotatable about an axis that is approximately perpendicular to the longitudinal axes of the first and second tubing strings 108A and 108B to extend from the first tubing string 108A to the second tubing string

108B. The first extendable member 403A is coupled to first clamp 406, which is operable to engage the first tubing string 108A. When the first clamp 406 engages the first tubing string 108A, the first clamp 406 firmly grips the first tubing string 108A and the clamp assembly 400 is fixedly secured to the first tubing string 108A. The clamp assembly 400 remains fixedly secured to the first tubing string 108A until the first clamp 406 disengages from the first tubing string 108A.

[0030] The second extendable member 403B is connected to a second clamp 408 that is operable to engage the second tubing string 108B. When both the first and second tubing strings 108A and 108B are engaged, and one of the first or second tubing string 108A or 108B fails, the weight of the failed tubing string 108A or 108B may cause the other tubing string to also fail. To prevent such sequential failure, the second clamp 408 may be fitted with ball bearings 410. When the second clamp 408 is in the engage position, the second clamp 408 wraps around the second tubing string 108B, thereby inhibiting horizontal motion of the second tubing string 108B. However, the ball bearings 410 provide the second tubing string 108B with freedom of motion in the vertical direction. As such, if the second tubing string 108B fails, the second tubing string 108B would slide through the second clamp 408 without overloading and inducing failure of the first tubing string 108A.

[0031] In some embodiments, the second clamp is fitted with rollers. The rollers, similar to the ball bearings 410, also provide the second tubing string 108B with freedom of motion in the vertical direction. In some embodiments, the clamp assembly 400 includes additional sections with additional clamps (not shown) that are operable to engage additional tubing strings. In some embodiments, both the first and the second clamps 406 and 408 include ball bearings or rollers to allow vertical motion of the first and second tubing strings 108A and 108B. In further embodiments, both the first and the second clamps 406 and 408 are operable to tightly grip the first and second tubing strings 108A and 108B, respectively, to fixedly secure the clamp assembly 400 to the first and second tubing strings 108A and 108B. In some embodiments, multiple clamp assemblies are deployed at different depths to engage both the first and second tubing strings 108A and 108B. The number of clamp assemblies deployed as well as the locations of deployment may be based on the depth of the manifold 114, the number of tubing strings deployed, and environmental conditions proximate to the deployed tubing strings 108A and 108B.

[0032] FIG. 4B is a schematic side view of an example of an articulated chain 404 of the clamp assembly 400 of FIG. 4A. In some embodiments, the clamp assembly 400 of FIG. 4A includes an articulated chain 404 that extends from the first tubing string 108A to the second tubing string 108B. In some embodiments, the articulated chain 404 is connected to the first clamp 406 at one end and includes multiple links, where each link includes a clamp 412 and ball bearings 410. In other embodiments, each link includes a clamp 412 and rollers. In some embodiments, the first clamp 406 engages the first tubing string 108A to fixedly secure the articulated chain to the first tubing string 108A and one of the clamps 412 wraps around the second tubing string 108B. In another one of such embodiments, different clamps 412 of the articulated chain engage both the first and the second tubing strings 108A and 108B.

[0033] The above-disclosed embodiments have been presented for purposes of illustration and to enable one of ordinary skill in the art to practice the disclosure, but the disclosure is not intended to be exhaustive or limited to the forms disclosed. Many insubstantial modifications and variations will be apparent to those of ordinary skill in the art without departing from the scope and spirit of the disclosure. For instance, although the flowcharts depict a serial process, some of the steps/processes may be performed in parallel or out of sequence, or combined into a single step/process. The scope of the claims is intended to broadly cover the disclosed embodiments and any such modification. Further, the following clauses represent additional embodiments of the disclosure and should be considered within the scope of the disclosure:

[0034] Clause 1: a tubing deployment system comprising a first tubing string having a first weightable collar; and a second tubing string having a second weightable collar, wherein each of the first weightable collar and second weightable collar comprises an interlocking member and a plurality of receivers spaced radially about an external surface of the weightable collar, each of the plurality of receivers being configured to receive a weight.

[0035] Clause 2: the system of clause 1, further comprising a clamping member having a fixed interface with the first tubing string, the fixed interface comprising a clamp.

[0036] Clause 3: the system of any combination of clauses 1 and 2, comprising a clamping member having a vertically compliant interface with the second tubing string.

[0037] Clause 4: the system of any combination of clauses 1-3, wherein the vertically compliant interface comprises an articulated chain.

[0038] Clause 5: the system of any combination of clauses 1-4, wherein each link of the articulated chain comprises one or more ball bearings.

[0039] Clause 6: the system of any combination of clauses 1-5, wherein each link of the articulated chain comprises one or more rollers.

[0040] Clause 7: the system of any combination of clauses 1-6, further comprising a first deflector overlying to the plurality of receivers of the first weightable collar and coupled to the first tubing string, and a second deflector overlying to the plurality of receivers of the second weightable collar and coupled to the second tubing string.

[0041] Clause 8: the system of any combination of clauses 1-7, wherein the interlocking member of the first weightable collar and the interlocking member of the second weightable collar are engagable along an engagement surface to secure the interlocking member of the first weightable collar to the interlocking member of the second weightable collar.

[0042] Clause 9: the system of any combination of clauses 1-8, further comprising a pinned coupling, wherein the first interlocking member is secured to the second interlocking member by a shear pin.

[0043] Clause 10: the system of any combination of clauses 1-9, further comprising: a first clamping member having a fixed interface with the first tubing string, the fixed interface comprising a clamp; a second clamping member having a vertically compliant interface with the second tubing string; a first deflector overlying to the plurality of receivers of the first weightable collar and coupled to the first tubing string; and a second deflector overlying to the plurality of receivers of the second weightable collar and coupled to the second tubing string, wherein the first interlocking member of the first weightable collar extends from the first weightable collar and the interlocking member of the second weightable collar extends from the second weightable collar.

[0044] Clause 11: the system of any combination of clauses 1-10, further comprising a releasable coupling between the interlocking members of the first and the second weightable collars.

[0045] Clause 12: a weightable collar, the weightable collar comprising: a hollow interior for receiving a tubing string; an interlocking mechanism; and a plurality of receivers spaced radially about an external surface of the weightable collar, each receiver of the plurality of receivers being configured to receive a weight.

[0046] Clause 13: the weightable collar of clause 12, wherein the weight is radially and inwardly inserted within a receiver of the plurality of receivers.

[0047] Clause 14: the weightable collar of any combination of the clauses 12 and 13, wherein the receiver comprises a securing mechanism configured to engage the inserted weight.

[0048] Clause 15: the weightable collar of any combination of the clauses 12 and 14, wherein the weight is radially and downwardly inserted into one or more receivers of the plurality of receivers.

[0049] Clause 16: the weightable collar of any combination of the clauses 12-15, wherein the interlocking mechanism is configured to engage an adjacent interlocking mechanism of an adjacent weightable collar.

[0050] Clause 17: the weightable collar of any combination of the clauses 12-16, wherein the interlocking mechanism comprises a shear pin to engage the adjacent interlocking mechanism.

[0051] Clause 18: a method of securing at least two tubing strings, the method comprising: attaching the first tubing string to a first weightable collar, the first weightable collar comprising an interlocking member and a plurality of receivers spaced radially about an external surface of the first weightable collar, each of the plurality of receivers being configured to receive a weight; attaching a second tubing string to a second weightable collar, the second weightable collar comprising an interlocking member and a plurality of receivers spaced radially about an external surface of the second weightable collar, each of the plurality of receivers being configured to receive a weight; inserting at least one weight into one or more of the plurality of receivers of the first weightable collar and the second weightable collar; and engaging the first interlocking member with the second interlocking member.

[0052] Clause 19: the method of clause 18, further comprising: engaging a first deflector to the first tubing string, the first deflector overlying to the plurality of receivers of the first weightable collar and coupled to the first tubing string; and engaging a second deflector to the second tubing string, the second deflector overlying to the plurality of receivers of the second weightable collar and coupled to the second tubing string.

[0053] Clause 20: the method of any combination of clauses 18 and 19, wherein each of the first and second interlocking members comprises a hollow passage, and wherein engaging the first interlocking member with the second interlocking member further comprises: engaging the first and second interlocking members along an engagement surface to align the hollow passages of

the first and second interlocking members; and inserting a shear pin through the hollow passages of the first and second interlocking members.

[0054] As used herein, a "platform" is defined to include oil rigs, vessels, and any other support structure operable to deploy tubing strings in a subsea environment.

[0055] As used herein, the singular forms "a", "an" and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms "comprise" and/or "comprising," when used in this specification and/or the claims, specify the presence of stated features, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, steps, operations, elements, components, and/or groups thereof. In addition, the steps and components described in the above embodiments and figures are merely illustrative and do not imply that any particular step or component is a requirement of a claimed embodiment.

[0056] It should be apparent from the foregoing that embodiments of an invention having significant advantages have been provided. While the embodiments are shown in only a few forms, the embodiments are not limited but are susceptible to various changes and modifications without departing from the spirit thereof.

[0057] What is claimed is:

Claims

1. A tubing deployment system comprising:
   a first tubing string having a first weightable collar; and
   a second tubing string having a second weightable collar,
   wherein each of the first weightable collar and second weightable collar comprises:
      an interlocking member and
      a plurality of receivers spaced radially about an external surface of the weightable collar, each of the plurality of receivers being configured to receive a weight.

2. The system of claim 1, further comprising a clamping member having a fixed interface with the first tubing string, the fixed interface comprising a clamp.

3. The system of claim 1, further comprising a clamping member having a vertically compliant interface with the second tubing string.

4. The system of claim 3, wherein the vertically compliant interface comprises an articulated chain.

5. The system of claim 4, wherein each link of the articulated chain comprises one or more ball bearings.

6. The system of claim 4, wherein each link of the articulated chain comprises one or more rollers.

7. The system of claim 1, further comprising a first deflector overlying to the plurality of receivers of the first weightable collar and coupled to the first tubing string, and a second deflector overlying to the plurality of receivers of the second weightable collar and coupled to the second tubing string.

8. The system of claim 1, wherein the interlocking member of the first weightable collar and the interlocking member of the second weightable collar are engagable along an

engagement surface to secure the interlocking member of the first weightable collar to the interlocking member of the second weightable collar.

9. The system of claim 8, further comprising a pinned coupling, wherein the first interlocking member is secured to the second interlocking member by a shear pin.

10. The system of claim 1, further comprising:

a first clamping member having a fixed interface with the first tubing string, the fixed interface comprising a clamp;

a second clamping member having a vertically compliant interface with the second tubing string;

a first deflector overlying to the plurality of receivers of the first weightable collar and coupled to the first tubing string; and

a second deflector overlying to the plurality of receivers of the second weightable collar and coupled to the second tubing string,

wherein the first interlocking member of the first weightable collar extends from the first weightable collar and the interlocking member of the second weightable collar extends from the second weightable collar.

11. The system of claim 10, further comprising a releasable coupling between the interlocking members of the first and the second weightable collars.

12. A weightable collar, the weightable collar comprising:

a hollow interior for receiving a tubing string;

an interlocking mechanism; and

a plurality of receivers spaced radially about an external surface of the weightable collar, each receiver of the plurality of receivers being configured to receive a weight.

13. The weightable collar of claim 12, wherein the weight is radially and inwardly inserted within a receiver of the plurality of receivers.

14. The weightable collar of claim 13, wherein the receiver comprises a securing mechanism configured to engage the inserted weight.

15. The weightable collar of claim 12, wherein the weight is radially and downwardly inserted into one or more receivers of the plurality of receivers.

16. The weightable collar of claim 12, wherein the interlocking mechanism is configured to engage an adjacent interlocking mechanism of an adjacent weightable collar.

17. The weightable collar of claim 16, wherein the interlocking mechanism comprises a shear pin to engage the adjacent interlocking mechanism.

18. A method of securing at least two tubing strings, the method comprising:

attaching the first tubing string to a first weightable collar, the first weightable collar comprising an interlocking member and a plurality of receivers spaced radially about an external surface of the first weightable collar, each of the plurality of receivers being configured to receive a weight;

attaching a second tubing string to a second weightable collar, the second weightable collar comprising an interlocking member and a plurality of receivers spaced radially about an external surface of the second weightable collar, each of the plurality of receivers being configured to receive a weight;

inserting at least one weight into one or more of the plurality of receivers of the first weightable collar and the second weightable collar; and

engaging the first interlocking member with the second interlocking member.

19. The method of claim 18, further comprising:

engaging a first deflector to the first tubing string, the first deflector overlying to the plurality of receivers of the first weightable collar and coupled to the first tubing string; and

engaging a second deflector to the second tubing string, the second deflector overlying to the plurality of receivers of the second weightable collar and coupled to the second tubing string.

20. The method of claim 18, wherein each of the first and second interlocking members comprises a hollow passage, and wherein engaging the first interlocking member with the second interlocking member further comprises:

engaging the first and second interlocking members along an engagement surface to align the hollow passages of the first and second interlocking members; and

inserting a shear pin through the hollow passages of the first and second interlocking members.

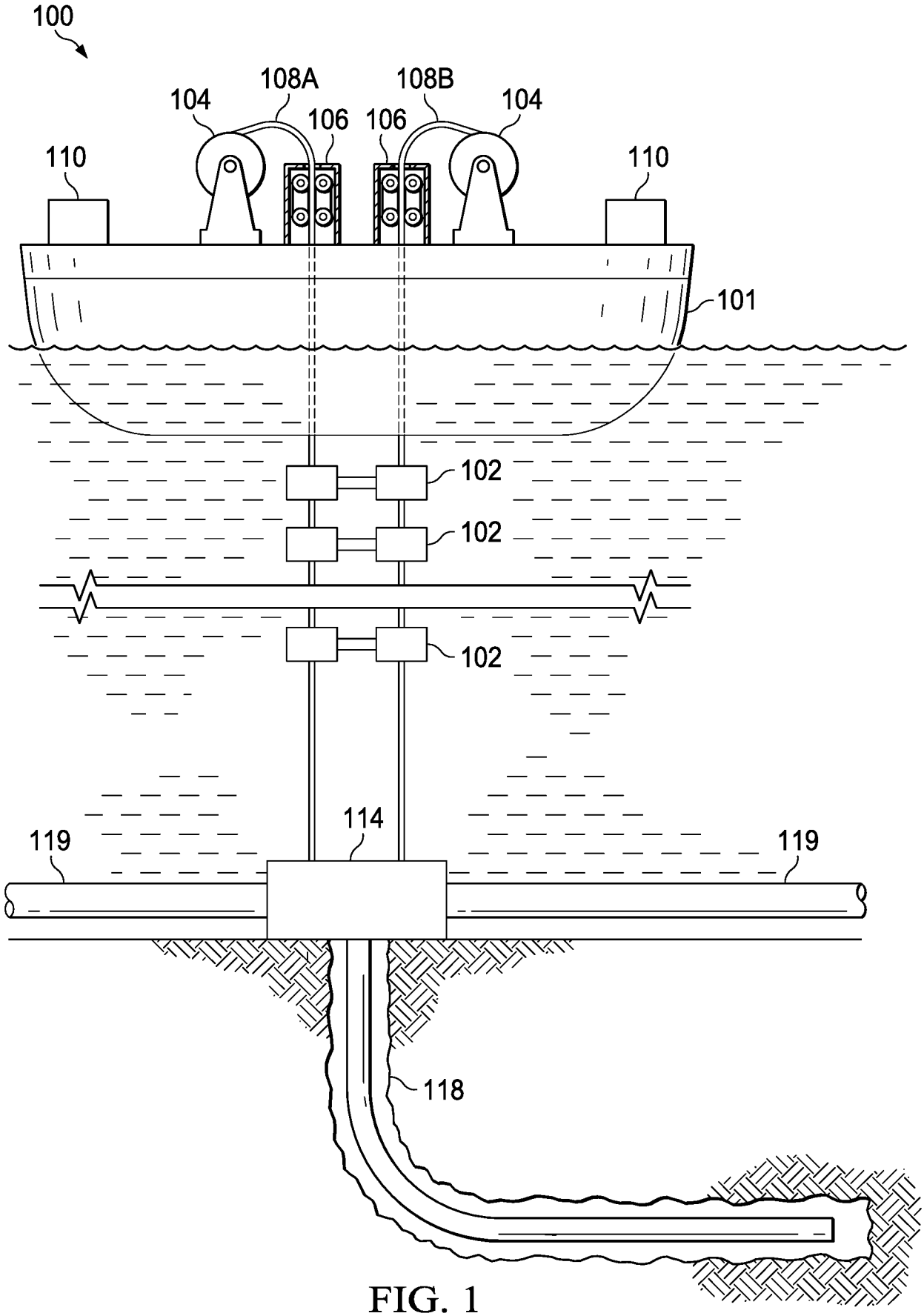

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FIG. 1

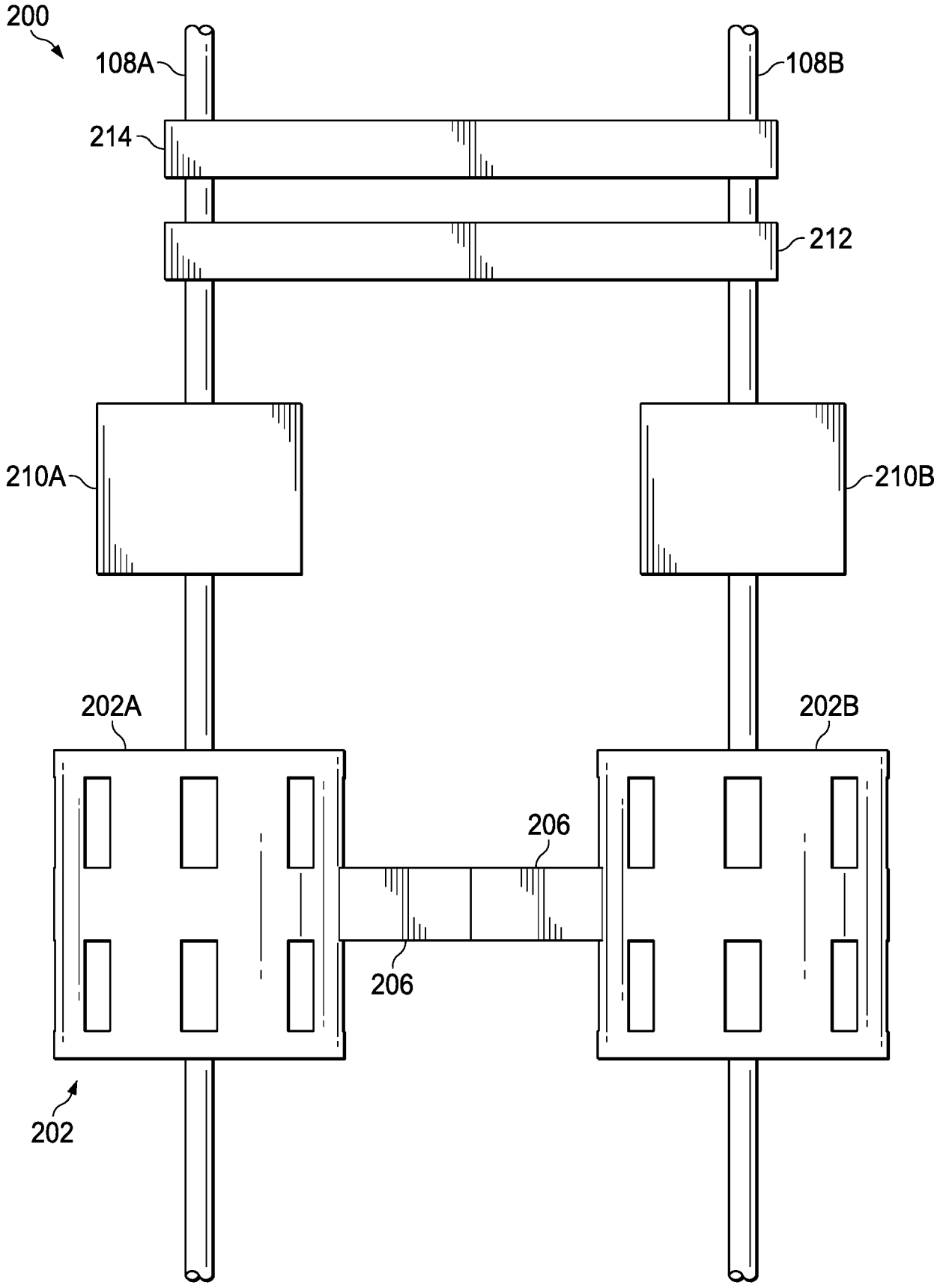


FIG. 2

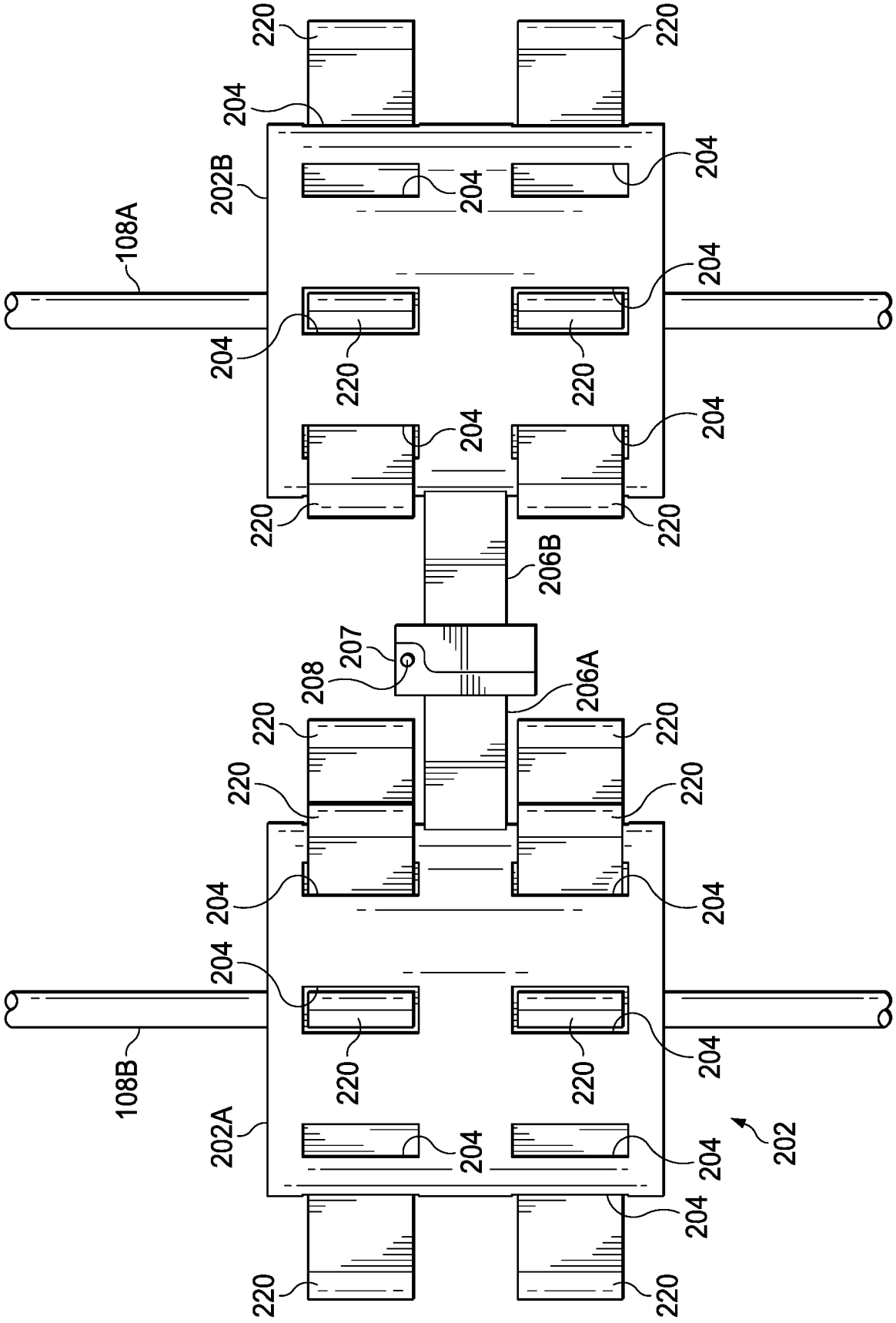


FIG. 3A

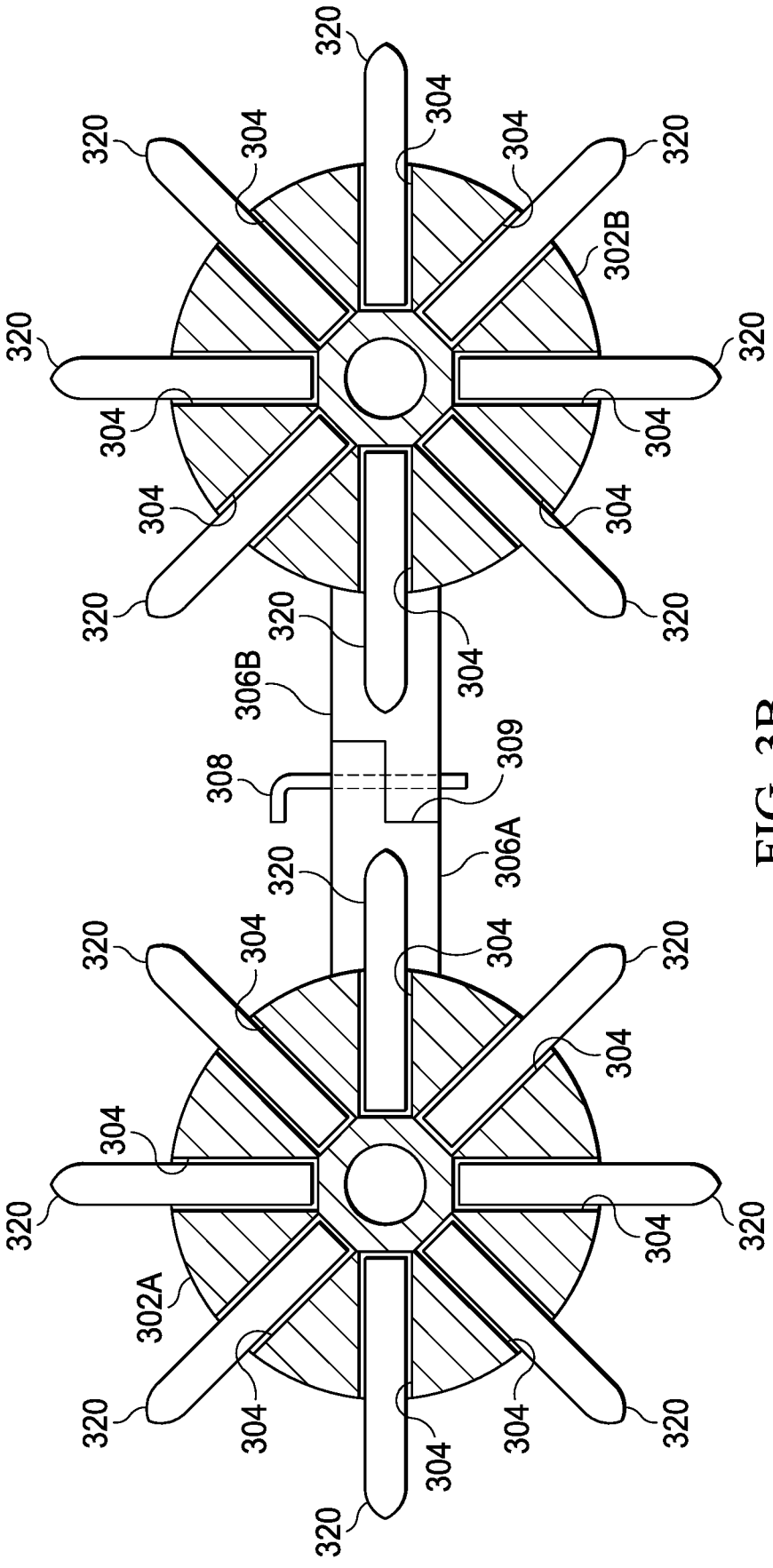


FIG. 3B

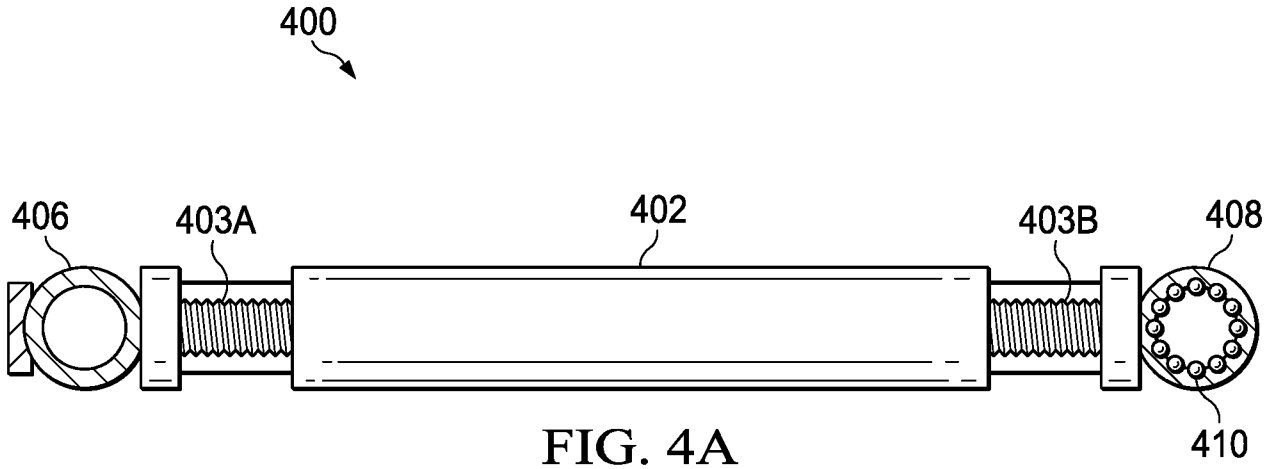

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FIG. 4A

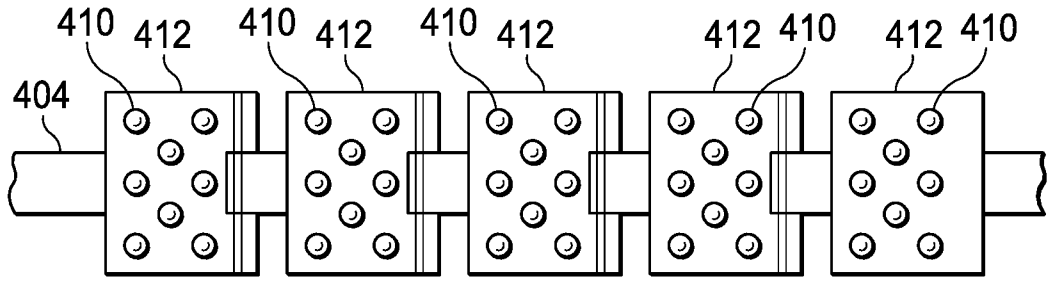

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FIG. 4B

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2015/067066

A. CLASSIFICATION OF SUBJECT MATTER

B63B 35/03(2006.01)i, F16L 1/15(2006.01)i, E21B 17/00(2006.01)i, E21B 17/10(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)
B63B 35/03; E21B 41/04; F16L 1/16; E21B 43/013; E21B 17/01; B63B 35/44; F16L 1/15; E21B 17/00; E21B 17/10

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: riser, string, weight, collar, interlocking member, receiver, securing, and clamping

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2010-0243262 A1 (GUO et al.) 30 September 2010 See paragraphs [0017], [0020] and figure 2.	1-20
Y	US 2008-0044233 A1 (O`SULLIVAN, JAMES) 21 February 2008 See paragraphs [0024]-[0025] and figure 4.	1-20
Y	US 2014-0041878 A1 (MAGMA GLOBAL LIMITED) 13 February 2014 See paragraph [0101] and figures 2-3.	2-6,10-11
Y	US 3983706 A (KALINOWSKI, DAVID W.) 05 October 1976 See column 4, lines 58-64 and figures 3-4.	8-11,16-17,20
A	US 2012-0103620 A1 (AYKENS, JOHN DAVID CHRISTOPHER) 03 May 2012 See paragraphs [0014]-[0015], [0025]-[0027] and figures 1, 3A-3C.	1-20

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:
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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
24 August 2016 (24.08.2016)	**24 August 2016 (24.08.2016)**

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/US2015/067066

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