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(54) **RISER JOINT SYSTEM, WELL DRILLING SYSTEM AND METHOD FOR WELL DRILLING SYSTEM**

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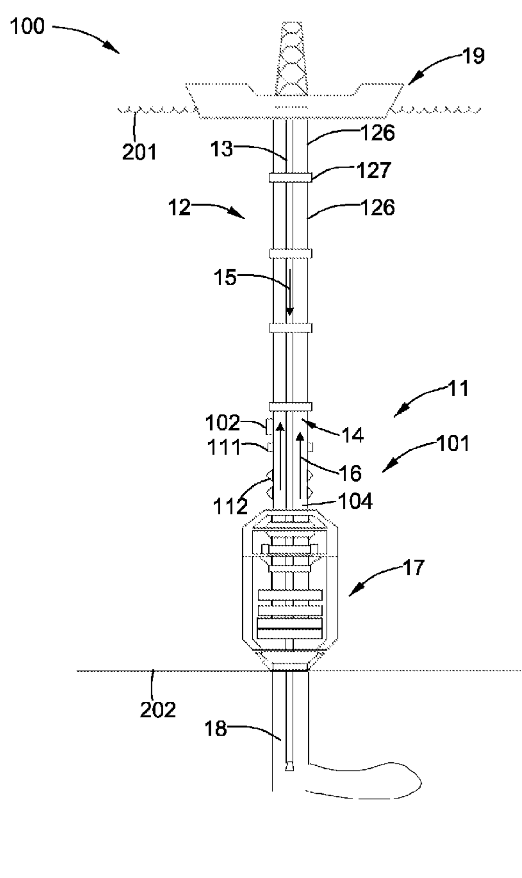
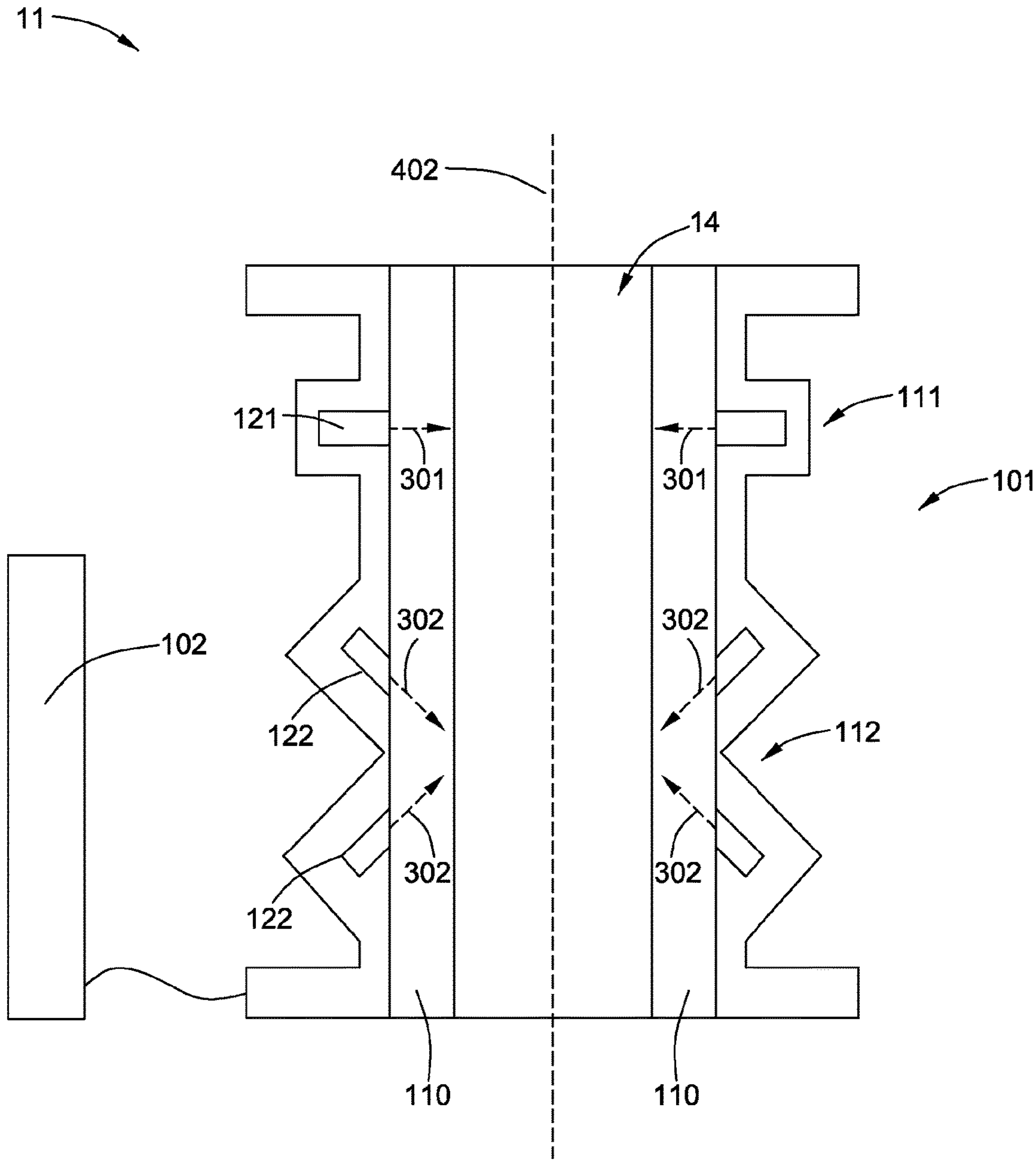
(57) **ABSTRACT**

A riser joint system, comprising: a riser joint assembly defining a channel and comprising a first ultrasound module for transmitting a first ultrasound signal to obtain first ultrasound data and a second ultrasound module for transmitting a second ultrasound signal to obtain second ultrasound data, wherein a beam direction of the first ultrasound signal is perpendicular to an axial line of the channel and a beam direction of the second ultrasound signal is oblique to the axial line of the channel; and a processing module for receiving the first ultrasound data and the second ultrasound data and obtaining first information and second information. A well drilling system and a method for the well drilling system are also described.




11
402
14
121
111
301
301
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102
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112
122
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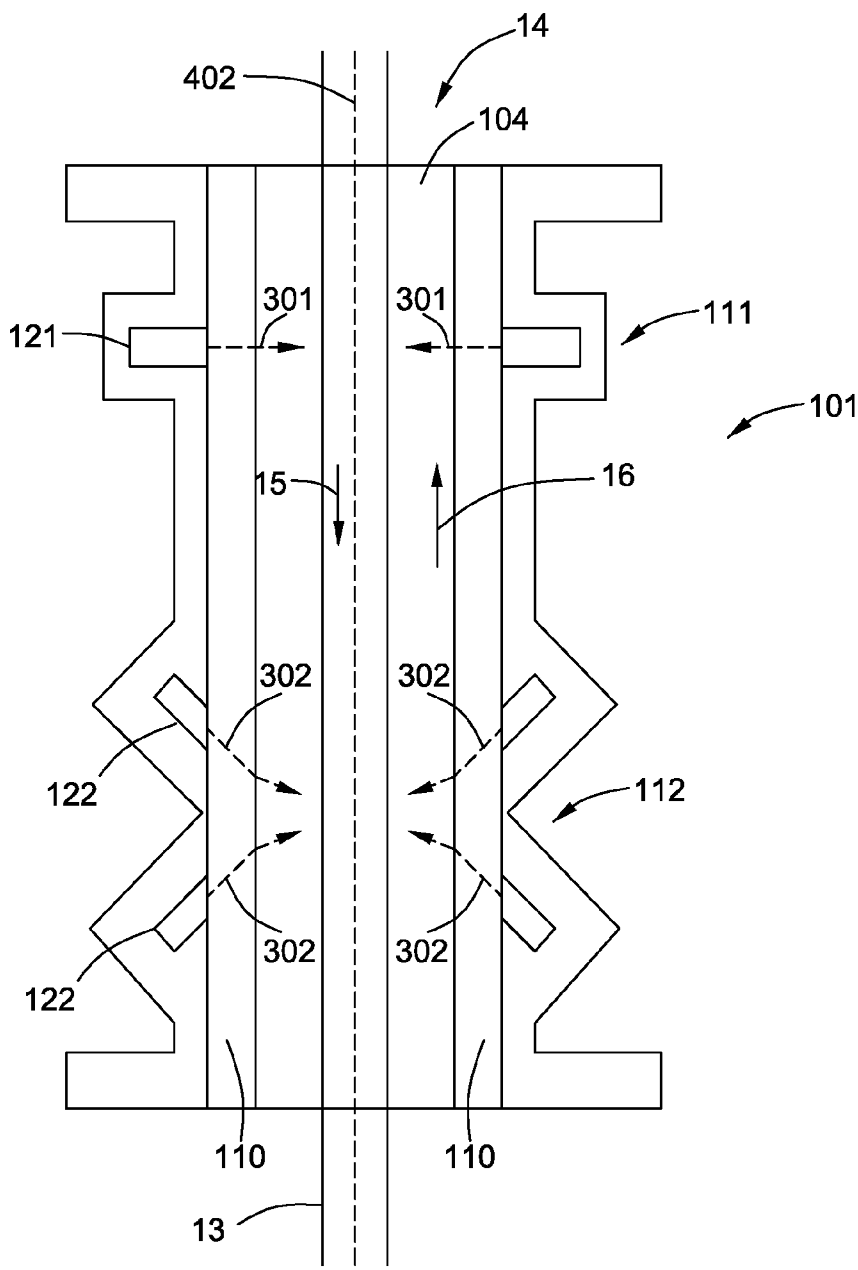
110
110

FIG. 1


14
402
104
301
301
121
111
101
15
16
302
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122
112
302
302
122
110
110
13

FIG. 2

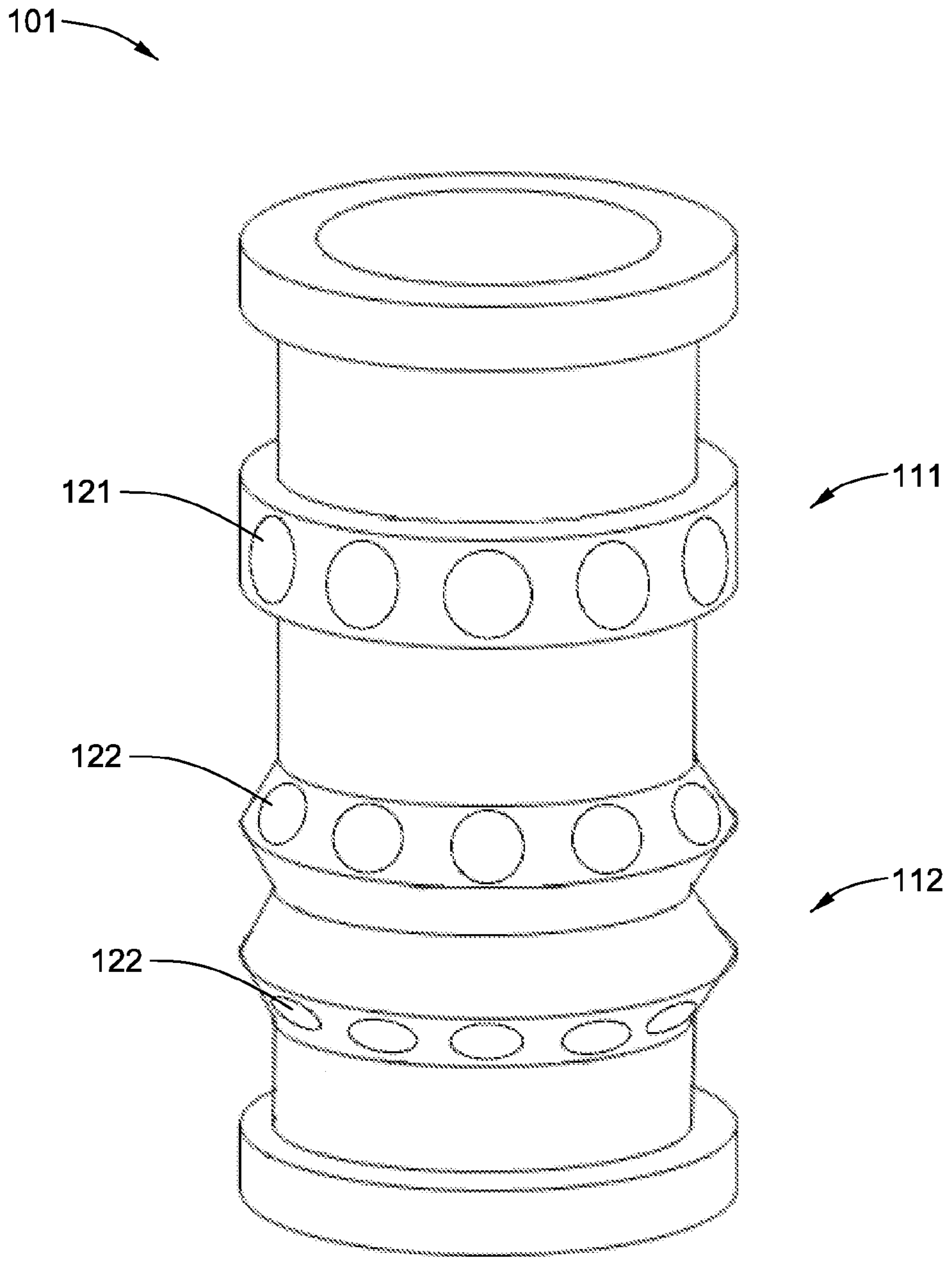

FIG. 3

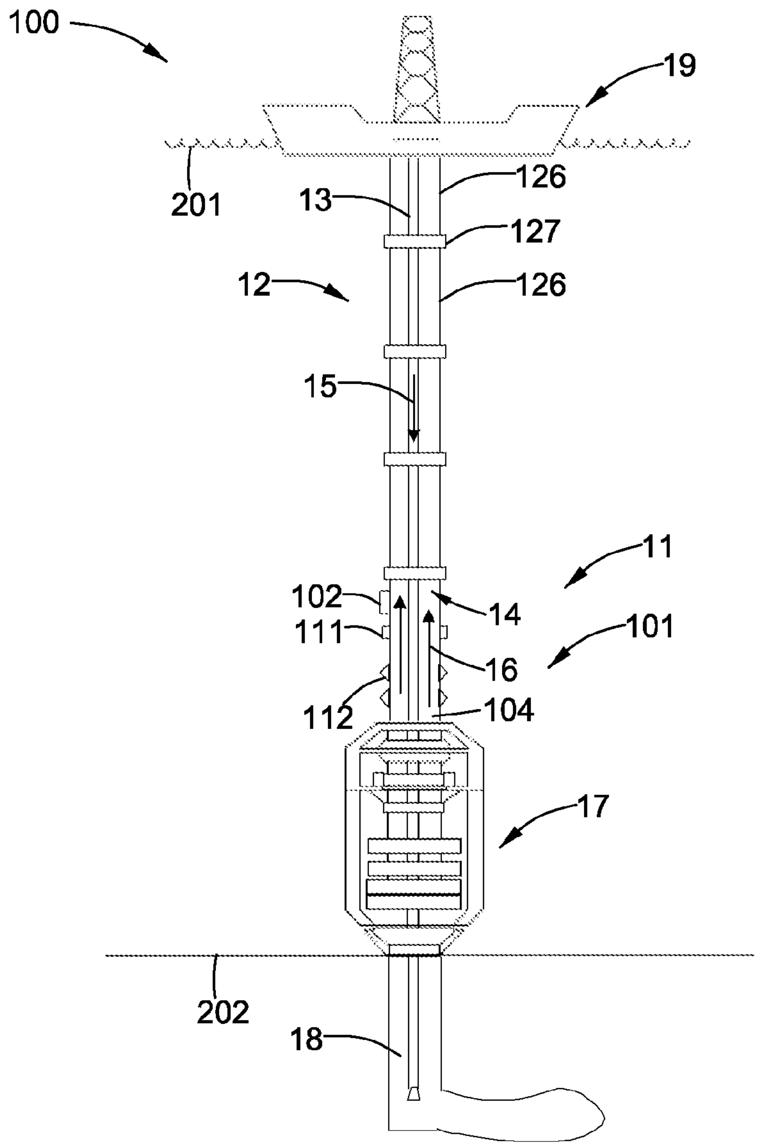
100
19
201
126
13
127
12
126
15
11
102
14
111
101
16
112
104
17
202
18

FIG. 4

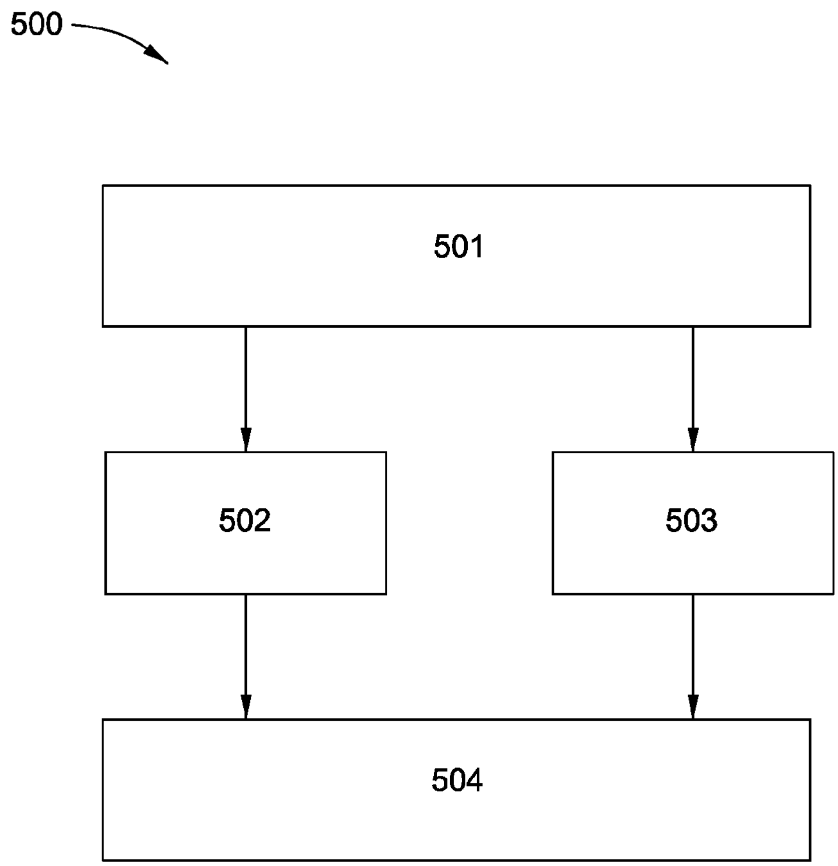

FIG. 5

RISER JOINT SYSTEM, WELL DRILLING SYSTEM AND METHOD FOR WELL DRILLING SYSTEM

BACKGROUND

[0001] This invention relates generally to a riser joint system, a well drilling system and a method for the well drilling system.

[0002] The exploration and production of hydrocarbons from subsurface formations have been done for decades. Due to the limited productivity of aging land-based production wells, there is a growing interest in the hydrocarbon recovery from subsea wells. Generally, for drilling an offshore well, a rotatable drill bit attached to a drill pipe is used to create the well below the seabed. The drill pipe allows control of the drill bit from a surface location, typically from an offshore platform or a drill ship. A riser is also deployed to connect the platform at the surface to the wellhead on the seabed. The drill pipe passes through the riser so as to guide the drill bit to the well.

[0003] During well drilling, the drill bit is rotated while the drill pipe conveys the necessary power from the surface platform. Meanwhile, a drilling fluid is circulated from the surface platform through the drill pipe to the drill bit, and is returned to the surface platform through a space between the drill pipe and a casing or a riser. The drilling fluid maintains a hydrostatic pressure to counter-balance the pressure of fluids coming from the well and cools the drill bit during operation. In addition, the drilling fluid mixes with materials excavated during the creation of the well bore and carries the materials to the surface for disposal.

[0004] Under certain circumstances, the pressure of fluids entering the well from the formation may be higher than the pressure of the drilling fluid. This may lead to an unwanted influx of fluid into the well, known in the industry as a “kick”. Under some circumstances, the occurrence of a kick brings potential for catastrophic equipment failures and the attendant potential harm to well operators and the environment.

[0005] Well operators are keenly aware of the destructive potential of such unwanted influxes and continuously monitor inflows and outflows of the drilling fluid at the sea surface in order to detect kick. However, it is difficult to employ a traditional device for monitoring the drilling fluid in the surface platform due to the volume and complexity of the traditional device. Moreover, there is a relative long time (e.g., tens of minutes) between a moment when a disturbance of the fluid occurs at the well and when the disturbance is detected at the sea surface, i.e., when a kick warning is obtained by the operators at the sea surface, the kick may have already happened. Thus, early detection of kicks have been a desired goal for decades. Besides, a blow out preventer (hereinafter referred to as “BOP”) may be utilized to shear the drill pipe if a risk of kick is detected. However, some portions of the drill pipe may be difficult to be sheared, thus cause that the BOP fails to prevent the kick.

[0006] Therefore, it would be desirable to provide a new and improved system and method for monitoring both the fluid returning from the well and location of the drill pipe.

BRIEF DESCRIPTION

[0007] In one aspect, the present disclosure relates to a riser joint system, comprising: a riser joint assembly defining a channel and comprising a first ultrasound module for transmitting a first ultrasound signal to obtain first ultrasound data and a second ultrasound module for transmitting a second ultrasound signal to obtain second ultrasound data, wherein a beam direction of the first ultrasound signal is perpendicular to an axial line of the channel and a beam direction of the second ultrasound signal is oblique to the axial line of the channel; and a processing module for receiving the first ultrasound data and the second ultrasound data and obtaining first information and second information.

[0008] In another aspect, the present disclosure relates to a well drilling system, comprising: a riser; a drill pipe for guiding a drilling fluid to a well; a riser joint assembly connected to the riser , the riser joint assembly and the riser defining a channel for accommodating the drill pipe and passing a fluid returning from the well through an annular space formed by the riser joint assembly and the drill pipe, the riser joint assembly comprising a first ultrasound module for transmitting a first ultrasound signal to obtain first ultrasound data and a second ultrasound module for transmitting a second ultrasound signal to obtain second ultrasound data, wherein a beam direction of the first ultrasound signal is perpendicular to an axial line of the channel and a beam direction of the second ultrasound signal is oblique to the axial line of the channel; and an processing module for receiving the first ultrasound data and the second ultrasound data and obtaining first information relating to the drill pipe and second information relating to the fluid returning from the well.

[0009] In yet another aspect, the present disclosure relates to a method for a well drilling system, comprising: passing a fluid through an annular space formed by a drill pipe and a riser joint assembly of the well drilling system; transmitting a first ultrasound signal to obtain first ultrasound data; transmitting a second ultrasound signal to obtain second ultrasound data, wherein a beam direction of the first ultrasound signal is perpendicular to an axial line of the riser joint assembly and a beam direction of the second ultrasound signal is oblique to the axial line of the riser joint assembly; and obtaining first information relating to the drill pipe and second information relating to the fluid based on the first ultrasound data and the second ultrasound data.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] The above and other aspects, features, and advantages of the present disclosure will become more apparent in light of the following detailed description when taken in conjunction with the accompanying drawings in which:

[0011] FIG. **1** is a schematic view of a riser joint system in accordance with an embodiment of the present invention;

[0012] FIG. **2** is a schematic view of a riser joint system with a drill pipe passing through a channel of the riser joint system in accordance with an embodiment of the present invention;

[0013] FIG. **3** is a schematic view of multiple sets of transducers circled around the riser joint assembly in accordance with an embodiment of the present invention;

[0014] FIG. **4** is a schematic view of a well drilling system in accordance with an embodiment of the present invention; and

[0015] FIG. **5** is a flow diagram of a method for a well drilling system in accordance with an embodiment of the present invention.

DETAILED DESCRIPTION

[0016] In an effort to provide a concise description of these embodiments, not all features of an actual implementation are described in one or more specific embodiments. It should be appreciated that in the development of any such actual implementation, as in any engineering or design project, numerous implementation-specific decisions must be made to achieve the developers' specific goals, such as compliance with system-related and business-related constraints, which may vary from one implementation to another. Moreover, it should be appreciated that such a development effort might be complex and time consuming, but would nevertheless be a routine undertaking of design, fabrication, and manufacture for those of ordinary skill having the benefit of the present disclosure.

[0017] Unless defined otherwise, technical and scientific terms used herein have the same meaning as is commonly understood by one of ordinary skill in the art to which the present disclosure belongs. The terms "first," "second," and the like, as used herein do not denote any order, quantity, or importance, but rather are used to distinguish one element from another. Also, the terms "a" and "an" do not denote a limitation of quantity, but rather denote the presence of at least one of the referenced items. The term "or" is meant to be inclusive and mean either any, several, or all of the listed items. The use of "including", or "comprising" and variations thereof herein are meant to encompass the items listed thereafter and equivalents thereof as well as additional items.

[0018] FIG. **1** is a schematic view of a riser joint system **11** in accordance with an embodiment of the present invention. The riser joint system **11** comprises a riser joint assembly **101** and a processing module **102**.

[0019] The riser joint assembly **101** defines a channel **14** and comprises a first ultrasound module **111** and a second ultrasound module **112**. The first ultrasound module **111** transmits a first ultrasound signal toward the channel **14** and obtains first ultrasound data. The second ultrasound module **112** transmits a second ultrasound signal toward the channel **14** and obtains second ultrasound data. A beam direction **301** of the first ultrasound signal is perpendicular to an axial line **402** of the channel **14** and a beam direction **302** of the second ultrasound signal is oblique to the axial line **402** of the channel **14**. Herein, the "perpendicular" comprises "exactly perpendicular" and "almost perpendicular", e.g., an angle formed by the beam direction **301** and the axial line **402** may range from 70° to 110°. In some embodiments, an angle formed by the beam direction **301** and a radial line (not shown) of the axial line **402** is less than 20°. In some embodiments, an angle formed by the beam direction **302** and the axial line **402** may range from 25° to 65°.

[0020] A beam direction of an ultrasound signal may change when the ultrasound signal passes through an interface of two mediums. The beam direction **301** of the first ultrasound signal according to the present embodiment is defined as the beam direction of the first ultrasound signal directly from the first ultrasound module **111** and almost without a reflection and refraction, e.g., the beam direction of the first ultrasound signal without passing through the interface of two mediums. In some embodiments, the first ultrasound signal is transmitted by a transducer of the first ultrasound module **111** and the beam direction **301** may be the direction of the transducer, e.g., the direction of an axle line of the transducer. In some embodiments, the beam direction of the first ultrasound signal in the wall **110** is almost the same as the beam direction **301**. Similarly, the beam direction **302** of the second ultrasound signal according to the present embodiment is defined as the beam direction of the second ultrasound signal directly from the second ultrasound module **112** and almost without a reflection and refraction. In some embodiments, the beam direction of the second ultrasound signal in the wall **110** is almost the same as the beam direction **302**.

[0021] The riser joint assembly **101** may comprise a single riser joint or a plurality of riser joints, e.g., comprise two riser joints connected with each other through an adaptor, or comprise three riser joints and the neighbouring riser joints are connected with each other. In some embodiments, the first ultrasound module **111** and the second ultrasound module **112** are located on the same riser joint. In some embodiments, the first ultrasound module **111** is located on one riser joint and the second ultrasound module **112** is located on another one, i.e., the first ultrasound module **111** and the second ultrasound module **112** are respectively located on two riser joints connected with each other. In some embodiments, the first ultrasound module **111** is located on one riser joint, the second ultrasound module **112** is located on a plurality of riser joints, e.g., the second ultrasound module **112** comprises multiple sets of transducers respectively located on a plurality of riser joints.

[0022] Please refer to FIG. **2**, during a well drilling operation, a drill pipe **13** passes through the channel **14** and guides a drilling fluid **15** to a well (not shown in FIG. **2**), and a fluid **16** from the well passes through an annular space **104** formed by the drill pipe **13** and the riser joint assembly **101**. Although the drill pipe **13** shown in FIG. **2** is located in the middle of the channel **14**, during the well drilling operation, the drill pipe **13** may be located in any area of the channel **14**.

[0023] As the beam direction **301** of the first ultrasound signal transmitted by the transducer **122** is perpendicular to the axial line **402** of the channel **14**, i.e., the beam direction **301** is very likely to be perpendicular to the drill pipe **13** during the well drilling operation, a portion of the first ultrasound signal reflected by the drill pipe **13** is received by the first ultrasound module **111**, so the first ultrasound data obtained by the first ultrasound module **111** comprises information relating to the drill pipe **13**.

[0024] During a well drilling operation, the fluid **16** returning from the well usually comprise particles (not shown) as the fluid **16** comprises a mixture of the drilling fluid **15** and materials, such as cuttings including crushed or cut rock, excavated during drilling the well. A portion of the second ultrasound signal reflected by these particles is received by the second ultrasound module **112**, so the second ultrasound data obtained by the second ultrasound module **112** comprises information relating to the fluid **16**. And, the beam direction **302** oblique to the axial line **402** is helpful for obtaining better information relating to the fluid **16**.

[0025] Please refer to FIG. **3**, in some embodiments, the first ultrasound module **111** comprises a plurality of transducers **121** circled around the riser joint assembly **101**, and the second ultrasound module **112** comprises multiple sets of transducers **122**, for example, two sets of transducers **122**, and each set of transducers circled around the riser joint assembly **101**. For the sake of brevity, only one of the plurality of transducers of the first ultrasound module **111** is illustrated with the reference numeral **121**, and only one of each set of transducers of the second ultrasound module **112** is illustrated with the reference numeral **122**.

[0026] In some embodiments, each of the transducers **121** transmits a first ultrasound signal with a beam direction **301** perpendicular to the axial line **402**, and each of the multiple sets of transducers **122** transmits a second ultrasound signal with beam direction **302** oblique to the axial line **402**.

[0027] Please refer back to FIG. **1&2**, the processing module **102** receives the first ultrasound data and the second ultrasound data, and obtains first information and second information. In some embodiments, the processing module **102** is integrated with the riser joint assembly **11**. In some embodiments, the processing module **102** is packaged in an electrical cabinet (E-POD). In some embodiments, the E-POD comprises other electronic modules such as a transceiver for receiving and transmitting information with the first ultrasound module **111**, the second ultrasound module **112**, the processing module **102**, etc. In some embodiments, the processing module **102** may be powered by batteries, an undersea power device or a nearbouring or relating device, e.g., the BOP.

[0028] In some embodiments, the first information relates to the drill pipe **13**. In some embodiments, the first information comprises but is not limited to a location, diameter of the drill pipe **13**, etc. In some embodiments, the processing module **102** generates a warning for an unshearable portion of the drill pipe **13** based on the first information, e.g., when the unshearable portion is detected in real time based on the first information, the processing module **102** generates the warning. The unshearable portion is a portion of the drill pipe **13** that is not easy to be sheared by a BOP. In some embodiments, the unshearable portion may comprise but is not limited to a joint of the drill pipe **13**, and in some embodiments, the processing module **102** detects the unshearable portion based on the diameter of the drill pipe **13**.

[0029] In some embodiments, the second information relates to the fluid **16** passing through the annular space **104**. In some embodiments, the second information comprises but is not limited to a flow rate, velocity profile, property of the fluid **16**, etc.

[0030] In some embodiments, the processing module **102** obtains the first information based on the first ultrasound data and obtains the second information based on the second ultrasound data. As discussed above, during a well drilling operation, the first ultrasound data obtained by the first ultrasound module **111** may comprise information relating to the drill pipe **13** and the second ultrasound data obtained by the second ultrasound module **112** may comprise information relating to the fluid **16**, then the processing module **102** processes the first ultrasound data to obtain the first information and processes the second ultrasound data to obtain the second information. In some embodiments, the processing module **102** obtains the first information by processing the first ultrasound data with a first algorithm and obtains the second information by processing the second ultrasound data with a second algorithm. Please be noted that, the first ultrasound data may also comprise information relating to the fluid **16** and the second ultrasound data may also comprise information relating to the drill pipe **13**, however, a better information relating to the drill pipe **13** may be obtained usually based on the first ultrasound data and a better information relating to the fluid **16** may be obtained usually based on the second ultrasound data.

[0031] In some embodiments, the processing module **102** obtains the first information based on the first ultrasound data and the second ultrasound data. In some embodiments, the processing module **102** obtains the second information by processing the second ultrasound data with, for example, the second algorithm, and obtains the first information by processing the second information and the first ultrasound data with, for example, the first algorithm. That is to say, the second information obtained based on the second algorithm is fed to the first algorithm for obtaining the first information.

[0032] In some embodiments, the processing module **102** obtains the second information based on the first ultrasound data and the second ultrasound data. In some embodiments, the processing module **102** obtains the first information by processing the first ultrasound data with, for example, the first algorithm, and obtains the second information by processing the first information and the second ultrasound data with, for example, the second algorithm. That is to say, the first information obtained based on the first algorithm is fed to the second algorithm for obtaining the second information.

[0033] The drill pipe **13** and the fluid **16** interact each other in the channel **14**. Therefore, it is helpful to obtain the first information based on both the first ultrasound data and the second ultrasound data, and to obtain the second information based on both the first ultrasound data and the second ultrasound data. For example, the second information comprising a velocity profile may somehow indicate a location and/or diameter of the drill pipe **13**, and continuously knowing the location of the drill pipe **13** may be helpful to obtain more accurate second information, e.g., to establish a dynamics model of the fluid **16** inside the annular space **104**.

[0034] In some embodiments, the processing module **102** is integrated with the riser joint assembly **101**. In some embodiments, the processing module **102** is packaged in the E-POD together with other electronic modules, and the E-POD is integrated with the riser joint assembly **101**. In some embodiments, the riser joint assembly **101** and the processing module **102** are configured to be located below a sea surface. Integrating the riser joint assembly **101** and the processing module **102** together decreases the cost and increases the reliability in a subsea environment.

[0035] The riser joint system **11** according to the embodiments is capable of monitoring both the fluid **16** returning from the well and the location of the drill pipe **13**, and a subsea monitoring is also realized if the riser joint system **11** is located subsea. Moreover, if the riser joint system **11** is located on or close to a seabed, a kick may be detected earlier and a higher stability may be achieved as there is less shake near the seabed.

[0036] FIG. **4** illustrates a schematic view of a well drilling system **100** in accordance with an embodiment of the present invention. The well drilling system **100** comprises a riser **12**, a drill pipe **13**, a riser joint assembly **101** connected to the riser **12** and a processing module **102**.

[0037] The riser **12** comprises a plurality of riser joints **126** and two neighbouring riser joints **126** are connected with each other through a connector **127**. For the sake of brevity, only two neighbouring riser joints are illustrated with the reference numeral **126** and only one connector is illustrated with the reference numeral **127**.

[0038] The riser **12** and the riser joint assembly **101** defines the chnnel **14** for accommodating the drill pipe **13**.

The drill pipe **13** is assembled to an offshore device **19**, such as an offshore platform or a drill ship. During a well drilling operation, a drilling fluid **15** is guided to the well **18**, a drilling bit (not shown) on the top of the drill pipe **13** rotates to perform the drilling below the seabed **202**, and a fluid **16** returning from the well **18** passes through an annular space **104** formed by the riser joint assembly **101**, the riser **12** and the drill pipe **13**.

[0039] The riser joint assembly **101** comprises the first ultrasound module **111** for transmitting the first ultrasound signal to obtain first ultrasound data and the second ultrasound module **112** for transmitting the second ultrasound signal to obtain second ultrasound data, wherein the beam direction of the first ultrasound signal is perpendicular to an axial line of the channel **14** and the beam direction of the second ultrasound signal is oblique to the axial line of the channel **14**. The processing module **102** receives the first ultrasound data and the second ultrasound data and obtaining first information relating to the drill pipe **13** and second information relating to the fluid **16** returning from the well **18**. The riser joint assembly **101** and the processing module **102** are described in the embodiments according to FIG. **1-3** and are not detailed introduced in the present embodiment.

[0040] In some embodiments, the well drilling system **100** comprises a BOP **17**. The BOP **17** is used during the drilling and completion of wells to protect drilling and operational personnel, as well as the well site and its equipment, from the effects of a kick. Generally, the BOP **17** comprises a remotely controlled valve or set of valves that can close off the well **18** in the event of an unanticipated increase in well pressure. In some embodiments, BOP **17** is connected with the riser joint assembly **101**. In some embodiments, BOP **17** is close to the riser joint assembly **101**, e.g., there is one or several riser joints **126** located between the BOP **17** and the riser joint assembly **101**.

[0041] In some embodiments, a displaying module (not shown) is located above the sea surface **201** for displaying first information and/or second information obtained by the processing module **102**. In some embodiments, the displaying module is located on the offshore device **19**. In some embodiments, the displaying module comprises but is not limited to a surface computer.

[0042] Please refer to FIGS. **1**, **4** and **5**. FIG. **5** is a flow diagram of a detection method **500** for a well drilling system **100** in accordance with an embodiment of the present invention. The method **500** comprises a step **501**, a step **502**, a step **503** and a step **504**.

[0043] In the step **501**, a fluid **16** passes through an annular space **104** formed by a drill pipe **13** and a riser joint assembly **101** of the well drilling system **100**.

[0044] In the step **502**, a first ultrasound signal is transmitted by a first ultrasound module **111** to obtain first ultrasound data.

[0045] In the step **503**, a second ultrasound signal is transmitted by a second ultrasound module **112** to obtain second ultrasound data, wherein a beam direction **301** of the first ultrasound signal is perpendicular to an axial line **402** of the riser joint assembly **111** and a beam direction **302** of the second ultrasound signal is oblique to the axial line **402** of the riser joint assembly **111**. Please be noted that, usually, there is no specific order of the step **501**, the step **502** and the step **503**.

[0046] In the step **504**, first information relating to the drill pipe **13** and second information relating to the fluid **16** is obtained by the processing module **102** based on the first ultrasound data and the second ultrasound data. In some embodiments, the first information and the second information are displayed above the sea surface **201** through a displaying module.

[0047] In some embodiments, the first information is obtained based on the first ultrasound data and the second ultrasound data. In some embodiments, the second information is obtained based on the second ultrasound data, and the first information is obtained based on the second information and the first ultrasound data.

[0048] In some embodiments, the second information is obtained based on the first ultrasound data and the second ultrasound data. In some embodiments, the first information is obtained based on the first ultrasound data, and the second information is obtained based on the first information and the second ultrasound data.

[0049] In some embodiments, a warning for an unshearable portion of the drill pipe **13** is generated based on the first information.

[0050] While the disclosure has been illustrated and described in typical embodiments, it is not intended to be limited to the details shown, since various modifications and substitutions can be made without departing in any way from the spirit of the present disclosure. As such, further modifications and equivalents of the disclosure herein disclosed may occur to persons skilled in the art using no more than routine experimentation, and all such modifications and equivalents are believed to be within the spirit and scope of the disclosure as defined by the following claims.

What is claimed is:

1. A riser joint system, comprising:

a riser joint assembly defining a channel and comprising a first ultrasound module for transmitting a first ultrasound signal to obtain first ultrasound data and a second ultrasound module for transmitting a second ultrasound signal to obtain second ultrasound data, wherein a beam direction of the first ultrasound signal is perpendicular to an axial line of the channel and a beam direction of the second ultrasound signal is oblique to the axial line of the channel; and

a processing module for receiving the first ultrasound data and the second ultrasound data and obtaining first information and second information.

2. The riser joint system of claim **1**, wherein the first information relates to a drill pipe passing through the channel

3. The riser joint system of claim **2**, wherein the processing module generates a warning for an unshearable portion of the drill pipe based on the first information.

4. The riser joint system of claim **1**, wherein the second information relates to a fluid passing through an annular space formed by the riser joint assembly and a drill pipe passing through the channel

5. The riser joint system of claim **1**, wherein the first ultrasound module comprises a plurality of transducers circled around the riser joint assembly, and the second ultrasound module comprises multiple sets of transducers, each set of transducers circled around the riser joint assembly.

6. The riser joint system of claim **1**, wherein the processing module obtains the second information based on the first ultrasound data and the second ultrasound data.

7. The riser joint system of claim 6, wherein the processing module obtains the first information based on the first ultrasound data, and obtains the second information based on the second ultrasound data and the first information.

8. The riser joint system of claim 1, wherein the processing module obtains the first information based on the first ultrasound data and the second ultrasound data.

9. The riser joint system of claim 8, wherein the processing module obtains the second information based on the second ultrasound data, and obtains the first information based on the first ultrasound data and the second information.

10. The riser joint system of claim 1, wherein the riser joint assembly and the processing module are configured to be located below a sea surface.

11. The riser joint system of claim 1, wherein the processing module is integrated with the riser joint assembly.

12. A well drilling system, comprising:

a riser;

a drill pipe for guiding a drilling fluid to a well;

a riser joint assembly connected to the riser , the riser joint assembly and the riser defining a channel for accommodating the drill pipe and passing a fluid returning from the well through an annular space formed by the riser joint assembly and the drill pipe, the riser joint assembly comprising a first ultrasound module for transmitting a first ultrasound signal to obtain first ultrasound data and a second ultrasound module for transmitting a second ultrasound signal to obtain second ultrasound data, wherein a beam direction of the first ultrasound signal is perpendicular to an axial line of the channel and a beam direction of the second ultrasound signal is oblique to the axial line of the channel; and

an processing module for receiving the first ultrasound data and the second ultrasound data and obtaining first information relating to the drill pipe and second information relating to the fluid returning from the well.

13. The system of claim 12, wherein the well drilling system comprises a blow out preventer, and the riser joint assembly is connected with the blow out preventer, or is located close to the blow out preventer.

14. The system of claim 12, further comprising a displaying module located above the sea surface for displaying the first information and the second information.

15. A method for a well drilling system, comprising:

passing a fluid through an annular space formed by a drill pipe and a riser joint assembly of the well drilling system;

transmitting a first ultrasound signal to obtain first ultrasound data;

transmitting a second ultrasound signal to obtain second ultrasound data, wherein a beam direction of the first ultrasound signal is perpendicular to an axial line of the riser joint assembly and a beam direction of the second ultrasound signal is oblique to the axial line of the riser joint assembly; and

obtaining first information relating to the drill pipe and second information relating to the fluid based on the first ultrasound data and the second ultrasound data.

* * * * *