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TRAVERSING A TRAVEL JOINT WITH A FLUID LINE**TECHNICAL FIELD**

10 This disclosure relates generally to equipment utilized and operations performed in conjunction with a subterranean well and, in an example described below, more particularly provides for traversing a travel joint with a fluid line.

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BACKGROUND

It is known to use a travel joint in a production tubing string to allow for dimensional variations between a wellhead and a packer or other tool engaged by the tubing string. Travel joints can be released for telescoping or
20 otherwise longitudinally extending or compressing by means of various devices, such as shear pins, J-slots, metered hydraulic time releases, etc.

However, travel joints do not usually provide for extending fluid lines across the travel joints. It would be
25 particularly difficult to traverse a travel joint with a chemical injection line, due in large part to relatively large diameters of typical chemical injection lines.

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It will be appreciated that improvements are continually needed in the arts of constructing and operating travel joints.

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SUMMARY

In the disclosure below, a travel joint system and associated methods are provided which bring improvements to the art. One example is described below in which a fluid line traverses a travel joint. Another example is described
10 below in which sections of the fluid line are connected to each other in response to pressure being applied to the fluid line.

In one aspect of the disclosure below, a method of traversing a travel joint with a line is provided to the
15 art. The method can include activating a connector which provides sealed fluid communication between sections of the line on respective opposite sides of the travel joint, after the travel joint has been installed in a well.

In another aspect of the disclosure, a travel joint
20 system for use with a subterranean well is provided to the art. The system can include a travel joint comprising a releasing device that permits relative displacement between sections of the travel joint, and a connector that provides fluid communication between sections of a line.

25 These and other features, advantages and benefits will become apparent to one of ordinary skill in the art upon careful consideration of the detailed description of representative examples below and the accompanying drawings, in which similar elements are indicated in the various
30 figures using the same reference numbers.

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BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a representative partially cross-sectional view of a well system and associated method that can embody principles of this disclosure.

5 FIGS. 2A & B are representative cross-sectional views of a travel joint system that can embody principles of this disclosure.

10 FIG. 3 is a representative enlarged scale cross-sectional view of a portion of a travel joint that can embody principles of this disclosure.

FIG. 4 is a representative cross-sectional view of another configuration of the travel joint.

15 FIG. 5 is a representative enlarged scale cross-sectional view of a portion of the FIG. 4 travel joint configuration.

DETAILED DESCRIPTION

Representatively illustrated in FIG. 1 is a well system 10 and associated method that can embody principles of this disclosure. In the system 10, a tubular string 12 extends downwardly from a floating rig 14 (such as a drill ship, floating platform, etc.). The tubular string 12 may be in a riser (not shown) between the rig 14 and a wellhead 16, or a riser may not be used.

25 The tubular string 12 is stabbed into a completion assembly 18 previously installed in a wellbore 20. In the example depicted in FIG. 1, the tubular string 12 is sealingly received in a packer 22 at an upper end of the completion assembly 18.

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In other examples, the tubular string 12 could have a seal stack thereon which seals within a sealed bore receptacle, e.g., above a liner hanger, etc. Any manner of connecting the tubular string 12 with the completion assembly 18 may be used in keeping with the scope of this disclosure.

The completion assembly 18 is preferably used to complete a portion of the well, that is, to prepare the well for production or injection operations. The completion assembly 18 could include elements which facilitate such production or injection (such as, packers, well screens, perforated liner or casing, production or injection valves, chokes, etc.).

A travel joint system 23 is used to provide for dimensional variations between the completion assembly 18 and the wellhead 16. After the tubular string 12 has been connected to the completion assembly 18, a travel joint 24 in the tubular string is released to allow the tubular string to be landed in the wellhead 16. In the example of FIG. 1, a hanger 26 is landed on a wear bushing 28, but other manners of securing a tubular string in a wellhead may be used in keeping with the scope of this disclosure.

The travel joint 24 permits some variation in the length of the tubular string 12 between the hanger 26 and the completion assembly 18. More specifically, the travel joint 24 preferably allows the length of the tubular string 12 to shorten after the completion assembly 18 has been sealingly engaged, so that the hanger 26 can be appropriately landed in the wellhead 16.

A suitable travel joint that has been used in the past for this purpose is described in U.S. Patent No. 6540025, the entire disclosure of which is incorporated herein by

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this reference. The travel joint described in that patent includes a hydraulic release device which releases the travel joint in response to a predetermined compressive force being applied to the travel joint for a predetermined amount of time. The described travel joint also includes a
5 resetting feature whereby the travel joint can be again locked in its extended configuration, after having been compressed.

However, other types of travel joints may be used for
10 the travel joint 24 in the system 10, if desired. For example, travel joints which release in response to shearing one or more shear pins/screws, and travel joints which release by means of a J-slot or ratchet are available and are known to those skilled in the art.

15 One unique feature of the travel joint 24 in the system 10 is that the travel joint provides for fluid communication between sections 30a,b of a fluid line 30 on opposite sides of the travel joint. The line 30 may be used for any purpose (e.g., supplying pressure, supplying flow, telemetry,
20 chemical injection, etc.) in keeping with the scope of this disclosure.

In the event that the line 30 is of a relatively large size (such as, the type used for chemical injection, etc.), it can be impractical to merely coil the line within the
25 travel joint 24, so that the coil elongates or compresses along with the travel joint. Space limitations in the wellbore 20, for example, can prevent using such coiled large size lines in the travel joint 24.

Instead, the travel joint 24 includes provisions for
30 establishing sealed fluid communication between the sections 30a,b of the line 30 after the travel joint has been released. Preferably, sealed fluid communication between the

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sections 30a,b is established after the tubular string 12 has connected with the completion assembly 18 and the tubular string has been landed in the wellhead 16, although other sequences of steps may be used in keeping with the scope of this disclosure.

At this point it should be noted that the system 10 and method are described herein as merely one example of how the principles of this disclosure may be used to advantage in a real world situation. However, it should be clearly understood that the principles of this disclosure are not limited in any manner to the details of the system 10, the method or the travel joint 24 examples described herein or depicted in the drawings.

Referring additionally now to FIGS. 2A & B, representative cross-sectional views of the travel joint 24 are representatively illustrated, apart from the remainder of the system 10. The travel joint 24 can be used with the system 10, or it may be used with other well systems, in keeping with the scope of this disclosure.

In FIG. 2A, the travel joint 24 is shown in a locked configuration, in which sections 24a,b of the travel joint are prevented from displacing relative to each other. In FIG. 2B, the sections 24a,b of the travel joint 24 are released for displacement relative to each other.

In this example, the travel joint section 24a comprises an outer housing of the travel joint, and the travel joint section 24b comprises an inner tubular mandrel of the travel joint. The mandrel is sealingly received in the outer housing.

The travel joint section 24a includes a releasing device 32 which initially prevents relative displacement between the travel joint sections 24a,b, but which, when

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activated, permits relative displacement between the travel joint sections. The releasing device 32 is preferably similar to, or the same as, the hydraulic releasing device described in U.S. Patent No. 6540025, but other types of releasing devices (such as, shear pins/screws, J-slots, ratchets, latches, etc.) may be used, if desired.

In the example of FIGS. 2A & B, the releasing device 32 includes dogs, lugs, collets or other latching members 34 which releasably engage a profile 36 formed on the mandrel section 24b. When the members 34 are disengaged from the profile 36, relative displacement is permitted between the travel joint sections 24a,b as depicted in FIG. 2B.

If the releasing device 32 is similar to that described in U.S. Patent No. 6540025, the members 34 disengage from the profile 36 in response to a predetermined compressive force being applied to the travel joint 24 (e.g., by setting down weight of the tubular string 12 on the travel joint) for a predetermined period of time.

The travel joint 24 further includes a connector 38 which provides sealed fluid communication between the sections 30a,b of the line 30. As depicted in FIG. 2B, the connector 38 preferably provides such sealed fluid communication after the releasing device 32 is activated to permit relative displacement between the travel joint sections 24a,b, but in other examples the connector could provide such fluid communication prior to activating the releasing device.

Referring additionally now to FIG. 3, a more detailed enlarged scale cross-sectional view of a portion of the travel joint 24 is representatively illustrated. In this configuration, the connector 38 includes a piston 40 which displaces downward (as viewed in FIG. 3) in response to

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elevated pressure being applied to a chamber 42 via the line section 30a.

A shear pin/screw (not shown) or other means may be used to prevent displacement of the piston 40 until a
5 predetermined pressure differential is applied across the piston. The connector 38 is shown in FIG. 3 after the piston 40 has displaced downward.

When the piston 40 displaces downward, a ratchet-type latch 44 engages, preventing upward displacement of the
10 piston. In this manner, the piston 40 is secured to the travel joint section 24b, and sealed fluid communication is provided through a passage 46 in the piston between the sections 30a,b of the line 30. Seals 48 isolate the passage 46 and sections 30a,b from communication with an internal
15 flow passage 50, so that the line 30 traverses the travel joint 24.

After the piston 40 has displaced downward and is secured to the travel joint section 24b, pressure in the line section 30a is further increased to rupture a rupture
20 disc 52, thereby permitting flow through the passage 46. Fluid pressure and flow can then be transmitted between the line sections 30a,b via the passage 46.

Referring additionally now to FIG. 4, another configuration of the travel joint 24 is representatively
25 illustrated. In this configuration, the travel joint 24 includes a pressure equalizing port 54 which allows pressure to equalize between an internal volume 56 of the travel joint and an exterior of the travel joint (such as, an annulus 58 formed radially between the tubular string 12 and
30 the wellbore 20, see FIG. 1).

The volume 56 varies as the sections 24a,b of the travel joint 24 displace relative to each other. The

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equalizing port 54 permits fluid to flow between the volume 56 and the exterior of the travel joint 24.

In one unique feature of this configuration of the travel joint 24, the connector 38 closes off the equalizing
5 port 54 and places the line sections 30a,b in sealed fluid communication with each other via the volume 56. An enlarged scale and more detailed cross-sectional view of the connector 38 is representatively illustrated in FIG. 5.

In this view, it may be seen that the connector 38
10 includes the piston 40 which displaces downward in response to increased pressure being applied to the line section 30a. In addition, the connector 38 includes a valve 60 in the form of a sleeve which is displaced downward by the piston 40. The valve 60 prevents flow through the port 54 when the
15 increased pressure is applied to the line section 30a.

After the piston 40 has been displaced downward, thereby closing the valve 60, pressure in the line section 30a is further increased to rupture the rupture disc 52. Note that, in this configuration, the rupture disc 52 when
20 ruptured provides fluid communication between the line section 30a and the volume 56.

The line section 30b is already in fluid communication with the volume 56. Thus, when the rupture disc 52 is ruptured, sealed fluid communication is provided between the
25 line sections 30a,b via the volume 56.

It may now be fully appreciated that the disclosure above provides significant advancements to the art. The line 30 can effectively and conveniently traverse the travel joint 24. Sealed fluid communication between the sections
30 30a,b of the line 30 can be readily achieved by manipulating pressure in the line.

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The above disclosure provides to the art a method of traversing a travel joint 24 with a line 30. The method can include, after the travel joint 24 has been installed in a well, activating a connector 38 which provides sealed fluid communication between sections 30a,b of the line 30 on
5 respective opposite sides of the travel joint 24.

The sealed fluid communication may not be provided by the connector 38 prior to activating the connector 38.

The method can include releasing sections 24a,b of the travel joint 24 for displacement of the travel joint
10 sections 24a,b relative to each other, prior to activating the connector 38.

Activating the connector 38 may include manipulating pressure in the line 30.

15 Activating the connector 38 may be performed after a tubular string 12 is connected with a completion assembly 18, with the travel joint 24 being interconnected in the tubular string 12.

20 Activating the connector 38 may be performed after a tubular string 12 is landed in a wellhead 16, with the travel joint 24 being interconnected in the tubular string 12.

25 Activating the connector 38 can include increasing pressure in the line 30 to a predetermined level, displacing a piston 40 and/or rupturing a rupture disc 52.

30 Activating the connector 38 may include preventing fluid communication with an internal volume 56 of the travel joint 24, the internal volume 56 varying in response to relative displacement between sections 24a,b of the travel joint 24.

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Also described above is a travel joint system 23 for use with a subterranean well. The system 23 can include sections 30a,b of a line 30, and a travel joint 24 including a releasing device 32 which permits relative displacement
5 between sections 24a,b of the travel joint 24, and a connector 38 which provides fluid communication between the sections 30a,b of the line 30.

The connector 38 may include at least one piston 40 responsive to pressure manipulations in at least one of the
10 sections 30a,b of the line 30.

The connector 38 may comprise a device (such as the rupture disc 52) which opens in response to a predetermined pressure level in at least one of the sections 30a,b of the line 30.

15 The connector 38 may provide fluid communication between the sections 30a,b of the line 30 while relative displacement is permitted between the sections 24a,b of the travel joint 24.

The connector 38 may include a valve 60 which closes
20 off a pressure equalizing port 54. The valve 60 may prevent fluid communication with an internal volume 56 of the travel joint 24, which volume 56 varies in response to relative displacement between the travel joint sections 24a,b, and/or which volume 56 is placed in fluid communication with the
25 sections 30a,b of the line 30 by the connector 38.

The travel joint 24 may be interconnected in a tubular string 12 between a wellhead 16 and a completion assembly 18, whereby the line 30 traverses the travel joint 24 between the wellhead 16 and the completion assembly 18.

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The connector 38 may initiate fluid communication between the sections 30a,b of the line 30 while the travel joint 24 is positioned in the well.

Each of the sections 30a,b of the line 30 is preferably
5 attached to a respective one of the sections 24a,b of the travel joint 24.

It is to be understood that the various examples described above may be utilized in various orientations, such as inclined, inverted, horizontal, vertical, etc., and
10 in various configurations, without departing from the principles of this disclosure. The embodiments illustrated in the drawings are depicted and described merely as examples of useful applications of the principles of the disclosure, which are not limited to any specific details of
15 these embodiments.

In the above description of the representative examples, directional terms (such as "above," "below," "upper," "lower," "upward," "downward," etc.) are used for convenience in referring to the accompanying drawings.
20 However, it should be clearly understood that the scope of this disclosure is not limited to any particular directions described herein.

Of course, a person skilled in the art would, upon a careful consideration of the above description of
25 representative embodiments, readily appreciate that many modifications, additions, substitutions, deletions, and other changes may be made to these specific embodiments, and such changes are within the scope of the principles of this disclosure. Accordingly, the foregoing detailed description
30 is to be clearly understood as being given by way of illustration and example only, the spirit and scope of the

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invention being limited solely by the appended claims and their equivalents.

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WHAT IS CLAIMED IS:

1. A method of traversing a travel joint with a line, the method comprising:

5 after the travel joint has been installed in a well, activating a connector which provides sealed fluid communication between sections of the line on respective opposite sides of the travel joint.

10 2. The method of claim 1, wherein sealed fluid communication is not provided by the connector prior to activating the connector.

15 3. The method of claim 1, further comprising releasing sections of the travel joint for displacement of the travel joint sections relative to each other, prior to activating the connector.

20 4. The method of claim 1, wherein activating the connector further comprises manipulating pressure in the line.

25 5. The method of claim 1, wherein activating the connector is performed after a tubular string is connected with a completion assembly, the travel joint being interconnected in the tubular string.

6. The method of claim 1, wherein activating the connector is performed after a tubular string is landed in a

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wellhead, the travel joint being interconnected in the tubular string.

7. The method of claim 1, wherein activating the
5 connector further comprises increasing pressure in the line to a predetermined level.

8. The method of claim 1, wherein activating the connector further comprises displacing a piston.

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9. The method of claim 1, wherein activating the connector further comprises rupturing a rupture disc.

10. The method of claim 1, wherein activating the
15 connector further comprises preventing fluid communication with an internal volume of the travel joint, the internal volume varying in response to relative displacement between sections of the travel joint.

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11. A travel joint system for use with a subterranean well, the system comprising:

sections of a line; and

5 a travel joint including a releasing device which permits relative displacement between sections of the travel joint, and a connector which provides fluid communication between the sections of the line.

10 12. The system of claim 11, wherein the connector comprises at least one piston responsive to pressure manipulations in at least one of the sections of the line.

15 13. The system of claim 11, wherein the connector comprises a device which opens in response to a predetermined pressure level in at least one of the sections of the line.

20 14. The system of claim 11, wherein the connector provides fluid communication between the sections of the line while relative displacement is permitted between the sections of the travel joint.

25 15. The system of claim 11, wherein the connector includes a valve which closes off a pressure equalizing port.

16. The system of claim 15, wherein the valve prevents fluid communication with an internal volume of the travel

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joint, which volume varies in response to relative displacement between the travel joint sections.

17. The system of claim 15, wherein the valve prevents
5 fluid communication with an internal volume of the travel joint, which volume is placed in fluid communication with the sections of the line by the connector.

18. The system of claim 11, wherein the travel joint
10 is interconnected in a tubular string between a wellhead and a completion assembly, whereby the line traverses the travel joint between the wellhead and the completion assembly.

19. The system of claim 11, wherein the connector
15 initiates fluid communication between the sections of the line while the travel joint is positioned in the well.

20. The system of claim 11, wherein each of the
sections of the line is attached to a respective one of the
20 sections of the travel joint.