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(54) **CONTRACTION JOINT FOR FIBER OPTICS INTELLIGENT COMPLETION**

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(Continued)

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CPC ***E21B 17/07*** (2013.01); ***E21B 17/023*** (2013.01); ***E21B 17/043*** (2013.01); ***E21B 23/00*** (2013.01); *E21B 17/04* (2013.01)

(58) **Field of Classification Search**
CPC E21B 17/07; E21B 17/023; E21B 17/043; E21B 17/04; E21B 23/00
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

1,844,257 A 2/1932 Lincoln
2,886,289 A 5/1959 Le Bus, Sr.
(Continued)

FOREIGN PATENT DOCUMENTS

AU 2014413985 B2 6/2016
WO 2009042310 A1 4/2009
(Continued)

OTHER PUBLICATIONS

International Search Report and Written Opinion issued in the PCT Application PCT/US2022/022999 (IS21.3061-WO-PCT), dated Jul. 14, 2022 (9 pages).
(Continued)

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(57) **ABSTRACT**

A contraction joint includes an upper tubular member, an upper mandrel, a lower mandrel, a nipple housing connected to the upper tubular member, a support sleeve disposed around the upper mandrel, an activation dog disposed within the support sleeve, a lock housing disposed in an annular space between the nipple housing and the mandrel, the lock housing connecting the upper mandrel to the lower mandrel, and a stroke locking mechanism disposed within the lock housing. In the locked position, the lock housing is affixed to the support sleeve with a shear mechanism, the stroke locking mechanism is supported by the support sleeve, and
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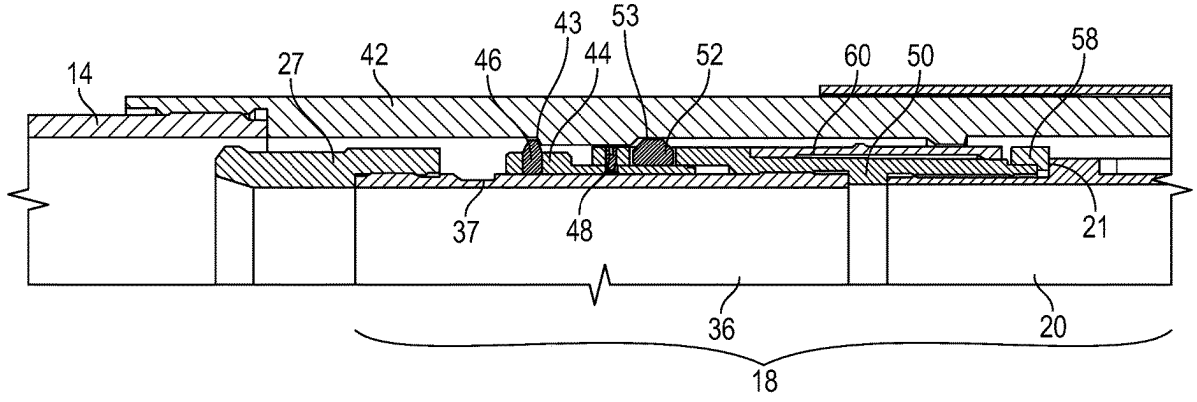

a stroke locking mechanism profile and an activation profile of the activation dog prevent the nipple housing from moving.

20 Claims, 3 Drawing Sheets

(51) **Int. Cl.**

E21B 17/043	(2006.01)
E21B 23/00	(2006.01)
E21B 17/04	(2006.01)

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,356,145	A	12/1967	Fredd	
5,103,902	A	4/1992	Ross	
5,538,082	A *	7/1996	Zwart	E21B 23/02 166/123
6,367,552	B1	4/2002	Scott	
6,540,025	B2	4/2003	Scott	
7,216,713	B2 *	5/2007	Read, Jr.	E21B 23/006 166/321
7,503,395	B2	3/2009	Meijer et al.	
7,806,190	B2	10/2010	Du	
8,061,430	B2	11/2011	Du	
9,371,703	B2	6/2016	Roane	
10,301,888	B2	5/2019	Richards	
10,422,191	B2	9/2019	Richards	
2010/0224360	A1	9/2010	MacDougall	
2010/0224375	A1	9/2010	Du	
2013/0199799	A1	8/2013	Phan	
2016/0069145	A1	3/2016	McGuire	
2016/0153248	A1 *	6/2016	Richards	E21B 17/06 166/335
2016/0290062	A1	10/2016	Richards	
2017/0183918	A1	6/2017	Grattan	
2017/0183919	A1 *	6/2017	Cochran	E21B 17/07
2024/0183229	A1 *	6/2024	Lai	E21B 17/07

FOREIGN PATENT DOCUMENTS

WO	2010078111	A2	7/2010
WO	2019067307	A1	4/2019
WO	2022212810	A1	10/2022

OTHER PUBLICATIONS

International Search Report and Written Opinion issued in the PCT Application PCT/US2022/033005 (IS21.3548-WO-PCT), dated Sep. 22, 2022 (9 pages).

* cited by examiner

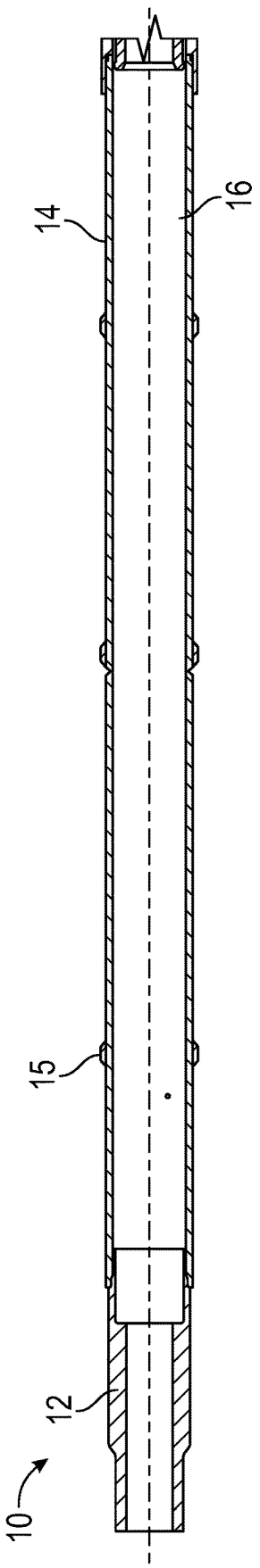

FIG. 1

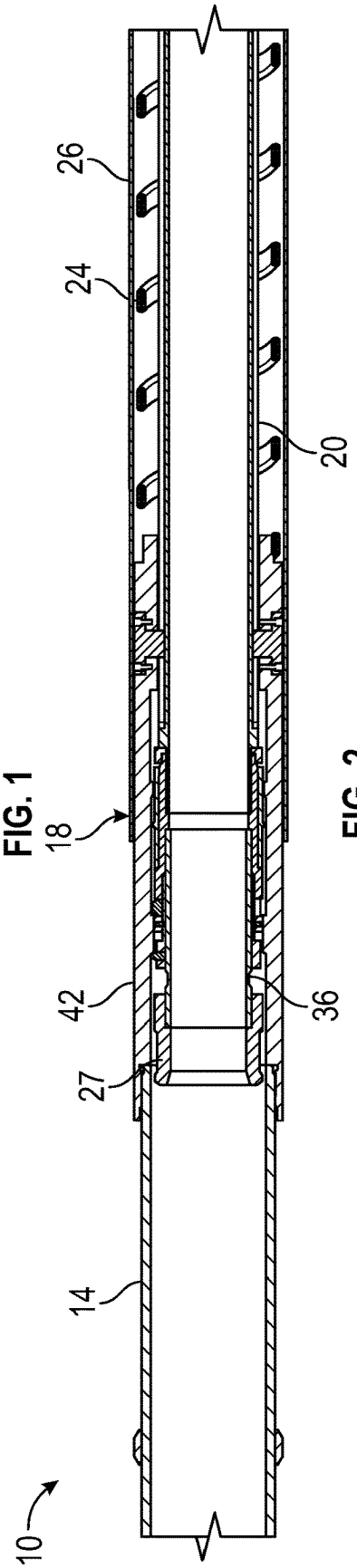

FIG. 2

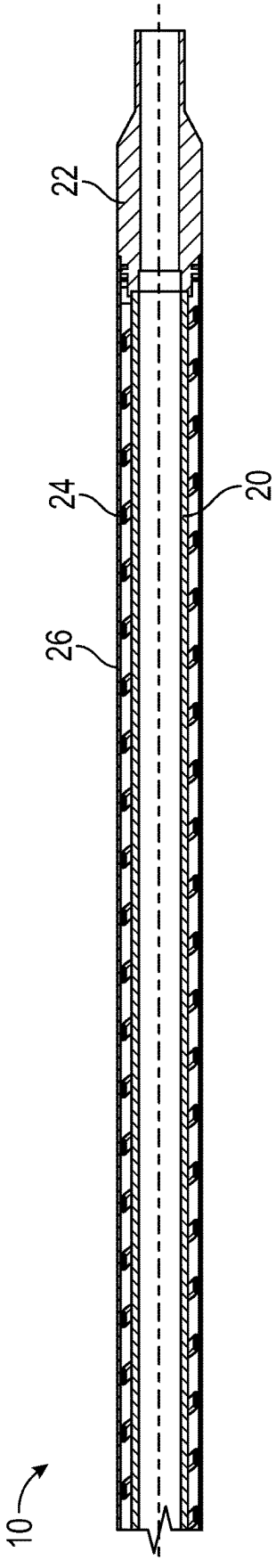

FIG. 3

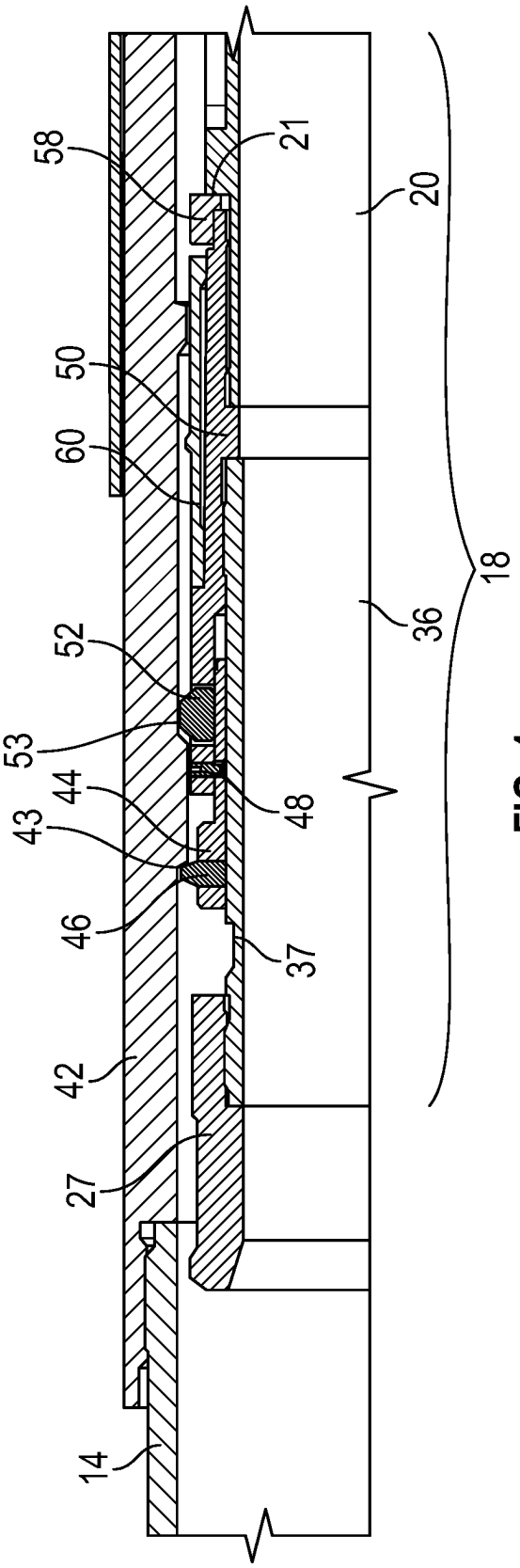
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FIG. 4

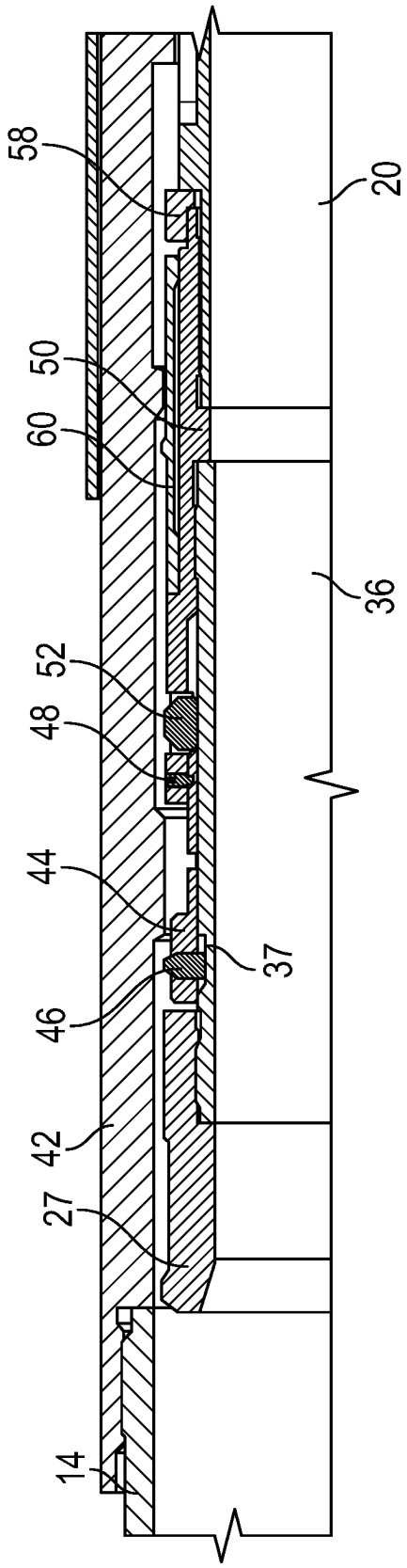
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FIG. 5

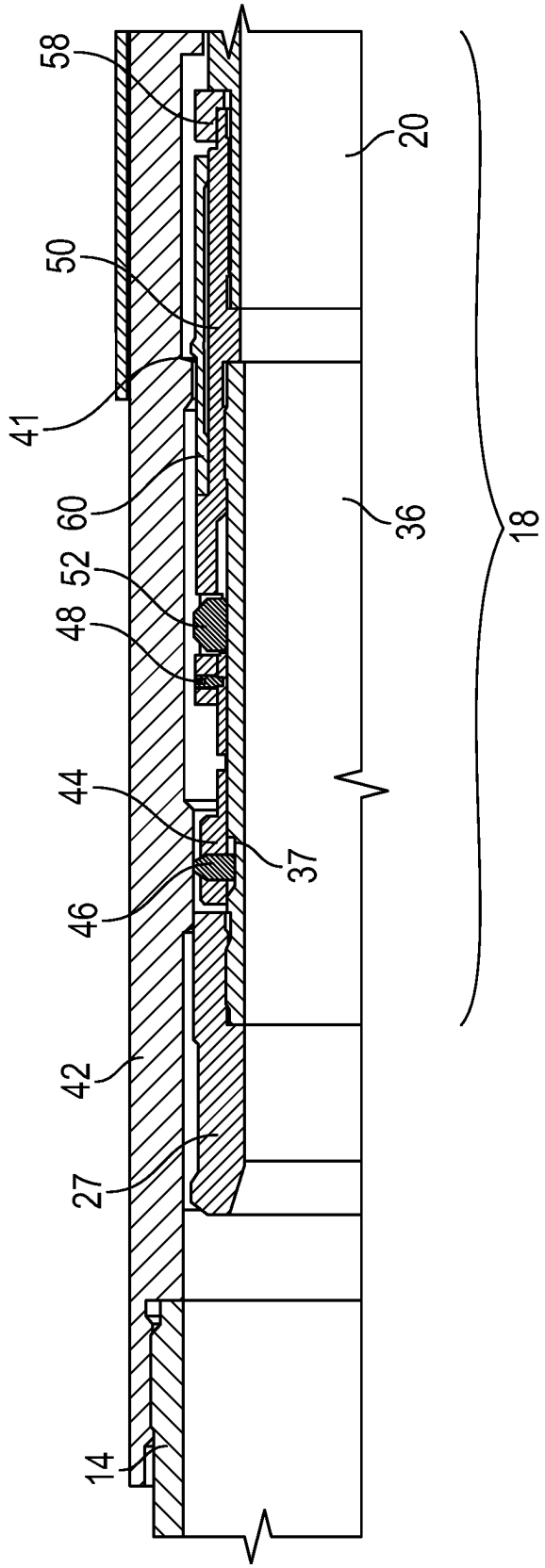

FIG. 6

CONTRACTION JOINT FOR FIBER OPTICS INTELLIGENT COMPLETION

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a National Stage Entry of International Application No. PCT/US2022/033005, filed Jun. 10, 2022, which claims the benefit of U.S. Provisional Application No. 63/213,675, entitled "Contraction Joint for Fiber Optics Intelligent Completion," filed Jun. 22, 2021, the disclosure of which is incorporated herein by reference in its entirety.

BACKGROUND

In many well related operations, contraction joints are used with well completions, such as between two or more completion assemblies, to compensate for contraction and expansion of the completion string. Wellbore completions typically utilize one or more control lines to carry signals between components within the wellbore and/or the surface. It can be difficult to control or maintain the integrity of those control lines at a contraction joint because axial movement of the contraction joint can cause the lines to knot or tangle as the contraction joint expands or contracts. Moreover, it may be difficult to control the functionality of the contraction joint until the contraction joint reaches a desired depth downhole and to accommodate production operations at depth through the contraction joint. There is a need, therefore, for a contraction joint that can accommodate control lines, and that remains locked until a desired depth downhole is reached to facilitate production operations.

SUMMARY

According to one or more embodiments of the present disclosure, a contraction joint includes an upper tubular member; a mandrel including an upper mandrel including a recess; and a lower mandrel, wherein the upper tubular member is capable of moving uphole and downhole to change a length of the contraction joint, a nipple housing connected to the upper tubular member, a support sleeve disposed around the upper mandrel, an activation dog disposed within the support sleeve, the activation dog including an activation profile; a lock housing disposed in an annular space between the nipple housing and the mandrel, the lock housing connecting the upper mandrel to the lower mandrel; and a stroke locking mechanism disposed within the lock housing, the stroke locking mechanism including a profile that engages the nipple housing, wherein in a locked position, the lock housing is affixed to the support sleeve with a shear mechanism, the storke locking mechanism is supported by the support sleeve, and the stroke locking mechanism profile and the activation profile prevent the nipple housing from moving.

However, many modifications are possible without materially departing from the teachings of this disclosure. Accordingly, such modifications are intended to be included within the scope of this disclosure as defined in the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

Certain embodiments of the disclosure will hereafter be described with reference to the accompanying drawings, wherein like reference numerals denote like elements. It should be understood, however, that the accompanying figures illustrate the various implementations described herein and are not meant to limit the scope of various technologies described herein, and:

FIG. **1** shows a top section of a contraction joint according to one or more embodiments of the present disclosure;

FIG. **2** shows a middle section of a contraction joint according to one or more embodiments of the present disclosure;

FIG. **3** shows a bottom section of a contraction joint according to one or more embodiments of the present disclosure;

FIG. **4** shows a detailed cross-sectional view of a portion of the middle section of the contraction joint with a stroke locking mechanism in a locked position and before activation, according to one or more embodiments of the present disclosure;

FIG. **5** shows a detailed cross-sectional view of a portion of the middle section of the contraction joint with the stroke locking mechanism in an unlocked position after activation, according to one or more embodiments of the present disclosure; and

FIG. **6** shows a detailed cross-sectional view of a portion of the middle section of the contraction joint in a resettable locked position, according to one or more embodiments of the present disclosure.

DETAILED DESCRIPTION

In the following description, numerous details are set forth to provide an understanding of some embodiments of the present disclosure. However, it will be understood by those of ordinary skill in the art that the system and/or methodology may be practiced without these details and that numerous variations or modifications from the described embodiments may be possible.

In the specification and appended claims, the terms "connect," "connection," "connected," "in connection with," and "connecting," are used to mean "in direct connection with," in connection with via one or more elements." The terms "couple," "coupled," "coupled with," "coupled together," and "coupling" are used to mean "directly coupled together," or "coupled together via one or more elements." The term "set" is used to mean setting "one element" or "more than one element." As used herein, the terms "up" and "down," "upper" and "lower," "upwardly" and "downwardly," "upstream" and "downstream," "uphole" and "downhole," "above" and "below," "top" and "bottom," and other like terms indicating relative positions above or below a given point or element are used in this description to more clearly describe some embodiments of the disclosure. Commonly, these terms relate to a reference point at the surface from which drilling operations are initiated as being the top point and the total depth being the lowest point, wherein the well (e.g., wellbore, borehole) is vertical, horizontal, or slanted relative to the surface.

The present disclosure generally relates to a system and methodology that facilitates the use of a contraction joint in a well completion application. Specifically, the present disclosure relates to a contraction joint that includes a stroke locking mechanism that allows the contraction joint to remain locked when running in hole, and allows the contraction joint to achieve contraction functionality at depth downhole. Advantageously, the contraction joint according to one or more embodiments of the present disclosure accommodates one or more control lines and facilitates production operations at depth when in the unlocked position. Moreover, the contraction joint according to one or more embodiments of the present disclosure eliminates the

possibility of being inadvertently activated via compression. That is, the contraction joint according to one or more embodiments of the present disclosure can only be activated via tension. The contraction joint according to one or more embodiments of the present disclosure is related to the contraction joint described in U.S. Provisional Patent Application No. 63/170,090 filed on Apr. 2, 2021, which is incorporated herein by reference in its entirety.

Referring now to FIGS. **1-3**, a contraction joint **10** according to one or more embodiments of the present disclosure is shown. Specifically, FIG. **1** shows a top section of the contraction joint **10**, FIG. **2** shows a middle section of the contraction joint **10**, and FIG. **3** shows a bottom section of the contraction joint **10**. In one or more embodiments of the present disclosure, the contraction joint **10** may be a component of a well completion system having an upper completion and a lower completion (not shown), for example. As shown in FIG. **1**, the top section of the contraction joint **10** may include a top sub **12** connected to an upper tubular member **14**, according to one or more embodiments of the present disclosure. As also shown in FIG. **1**, the upper tubular member **14** has a bore **16** therethrough, according to one or more embodiments of the present disclosure. The upper tubular member **14** is capable of moving uphole and downhole to change a length of the contraction joint **10** according to one or more embodiments of the present disclosure.

As shown in FIG. **2**, the middle section of the contraction joint **10** may include a mandrel **18** including an upper mandrel **36** and a lower mandrel **20**. As more clearly shown in FIG. **4**, for example, the upper mandrel **36** of the mandrel **18** may include a recess **37**. Moreover, the contraction joint **10** may include an anti-rotation mechanism **34**, as shown in FIG. **2**, for example, to prevent rotation of the upper tubular member **14** and the mandrel **18** relative to one another, while allowing telescoping movement of the upper tubular member **14** and the mandrel **18** relative to one another. As further shown in FIG. **2**, the contraction joint **10** may include an end cap **27** disposed at an upper end of the upper mandrel **36**, according to one or more embodiments of the present disclosure. FIG. **2** also shows that the contraction joint **10** may include a nipple housing **42** connected to the upper tubular member **14** according to one or more embodiments of the present disclosure. In one or more embodiments of the present disclosure, the anti-rotation mechanism **34** may be disposed within the nipple housing **42** and affixed to the lower mandrel **20**, as shown in FIG. **2**, for example. As further shown in FIG. **2**, the contraction joint **10** according to one or more embodiments of the present disclosure may also include at least one cable **24** coiled around at least a portion of the lower mandrel **20**. In one or more embodiments of the present disclosure, the contraction joint **10** may also include a cable shroud **26** disposed around the lower mandrel **20** to protect the at least one cable **24**.

As shown in FIG. **3**, the bottom section of the contraction joint **10** may include a bottom sub **22** connected to the lower mandrel **20**. According to one or more embodiments of the present disclosure, the upper completion of the well completion system may be connected to the contraction joint **10** via the top sub **12**, and the lower completion of the well completion system may be connected to the contraction joint **10** via the bottom sub **22**.

In view of FIGS. **2** and **3**, the contraction joint **10** according to one or more embodiments of the present disclosure may accommodate at least one cable **24** coiled around at least a portion of the lower mandrel **20**. According to one or more embodiments of the present disclosure, the at least one cable **24** may be a control line, such as an optical, electrical, and/or hydraulic control line to carry signals between components within the wellbore and/or the surface. According to one or more embodiments of the present disclosure, the top section of the contraction joint **10**, as shown in FIG. **1**, may include a plurality of bypass rings **15** to facilitate intelligent completion cable bypass, for example. Referring back to FIGS. **2** and **3**, the contraction joint **10** according to one or more embodiments of the present disclosure may include a cable shroud **26** disposed around the lower mandrel **20** to protect the at least one cable **24**. The contraction joint **10** according to one or more embodiments of the present disclosure may also include at least one transition component (not shown) affixed to the lower mandrel **20**. According to one or more embodiments of the present disclosure, the transition component is configured to allow the at least one cable **24** to transition from a coiled configuration to a straight configuration for running uphole.

Referring now to FIG. **4**, a detailed cross-sectional view of a portion of the middle section of the contraction joint **10** is shown before activation of the contraction joint **10**. Specifically, FIG. **4** provides a more detailed view of the components that make up the middle section of the contraction joint **10**, as shown in FIG. **2**, for example. According to one or more embodiments of the present disclosure, the contraction joint **10** includes a nipple housing **42** connected to the upper tubular member **14**. According to one or more embodiments of the present disclosure, the contraction joint **10** also includes a support sleeve **44** disposed around the upper mandrel **36**, and an activation dog **46** disposed within the support sleeve **44**. According to one or more embodiments of the present disclosure, the activation dog **46** includes an activation profile **43** that is configured to engage with the nipple housing **42** before activation of the contraction joint **10**.

Still referring to FIG. **4**, the contraction joint **10** according to one or more embodiments of the present disclosure may also include a lock housing (or dog housing) **50** disposed in an annular space between the nipple housing **42** and the mandrel **18**. In one or more embodiments of the present disclosure, the lock housing **50** connects the upper mandrel **36** to the lower mandrel **20**, for example. The contraction joint **10** according to one or more embodiments of the present disclosure also includes a tension shoulder **58** disposed between an end of the lock housing **50** and a stop **21** of the lower mandrel **20**. According to one or more embodiments of the present disclosure, the contraction joint **10** also includes a collet **60** disposed in the annular space between the nipple housing **42** and the lock housing **50**. The contraction joint **10** also includes a stroke locking mechanism (or compression dog) **52** disposed within the lock housing **50**, according to one or more embodiments of the present disclosure. The stroke locking mechanism **52** includes a profile **53** that engages the nipple housing **42** in one or more embodiments of the present disclosure. FIG. **4** shows the stroke locking mechanism **52** in the locked position, which is the position that the stroke locking mechanism **52** assumes when the contraction joint **10** is run-in-hole, for example. Specifically, FIG. **4** shows that the stroke locking mechanism **52** is supported by the support sleeve **44**, and the stroke locking mechanism profile **53** and the activation profile **43** prevent the nipple housing **42** from moving. According to one or more embodiments of the present disclosure, before activation, the contraction joint **10** is in a locked position, and the lock housing **50** is affixed to the support sleeve **44** with a shear mechanism **48**. According to one or more

embodiments of the present disclosure, the shear mechanism **48** may be a shear pin or a shear screw, for example. When the contraction joint **10** is in the locked position, when tension is applied through the upper tubular member **14**, the tension transfers to the nipple housing **42**, to the activation dog **46**, to the support sleeve **44**, to the shear mechanism **48**, to the lock housing **50**, to the tension shoulder, to the lower mandrel **20**, and to the lower completion, according to one or more embodiments of the present disclosure. The source of this tension may be from one or more components of the lower completion downhole of the contraction joint **10**, for example. Moreover, when the contraction joint **10** is in the locked position, when compression is applied through the upper tubular member **14**, the compression transfers to the nipple housing **42**, to the stroke locking mechanism **52**, to the lock housing **50**, to the tension shoulder, to the lower mandrel **20**, and to the lower completion, according to one or more embodiments of the present disclosure. The source of this compression may be from one or more components of the lower completion downhole of the contraction joint **10**, for example.

Referring now to FIG. **5**, the stroke locking mechanism **52** of the contraction joint **10** unlocked or activated at depth, according to one or more embodiments of the present disclosure. In operation, when sufficient tension is applied through the upper tubular member **14**, the tension shears the shear mechanism **48** and shifts the support sleeve **44** and the activation dog **46** uphole, causing the activation dog **46** to drop into the recess **37** of the upper mandrel **36**, and the stroke locking mechanism **52** to drop from the support sleeve **44** into an unlocked position and break the compression load path. Thereafter, application of a compression force to the upper tubular member **14** pushes the upper tubular member **14** and the nipple housing **42** downhole to achieve contraction functionality of the contraction joint **10**, according to one or more embodiments of the present disclosure.

In operation, a well completion including the contraction joint **10** according to one or more embodiments of the present disclosure may be run-in-hole to a downhole location while the stroke locking mechanism **52** of the contraction joint **10** is in the locked position. As previously described, tension may be applied through the upper tubular member **14** until the shear mechanism **48** shears, allowing the support sleeve **44** and the activation dog **46** to shift uphole, causing the activation dog to drop into the recess of the upper mandrel **36**, and the stroke locking mechanism **52** to drop from the support sleeve **44** into an unlocked position. Thereafter, a compression force may be applied to the upper tubular member **14** to push the upper tubular member **14** and the nipple housing **42** downhole to achieve contraction functionality of the contraction joint **10**. In one or more embodiments of the present disclosure, a production operation may be initiated after the upper tubular member **14** and the nipple housing **42** of the contraction joint **10** are pushed downhole. According to one or more embodiments of the present disclosure, during the production operation, production fluid flows uphole through the mandrel **18** and into the bore **16** of the upper tubular member **14** to a surface location. According to one or more embodiments of the present disclosure, during the production operation, the contraction joint **10** is non-sealing.

Referring now to FIG. **6**, a resettable locked position of the contraction joint **10** according to one or more embodiments of the present disclosure is shown. That is, in a method according to one or more embodiments of the present disclosure, the contraction joint **10** may be repeatedly reset to the locked position after being previously unlocked. For example, to reset the contraction joint **10** and axially lock the movement again, tension may be applied through the upper tubular member **14** and nipple housing **42** to a locked position through collet **60**. To space out again to land the tubing hanger, compression may be applied to the upper tubular member **14** to move the nipple housing **42** profile **41** to the lower side of the collet **60** to initiate the stroking motion. According to one or more embodiments of the present disclosure, the reset of the contraction joint **10** may be repeated multiple times.

Although a few embodiments of the disclosure have been described in detail above, those of ordinary skill in the art will readily appreciate that many modifications are possible without materially departing from the teachings of this disclosure. Accordingly, such modifications are intended to be included within the scope of this disclosure as defined in the claims.

What is claimed is:

1. A contraction joint, comprising:

an upper tubular member;

a mandrel comprising: an upper mandrel comprising a recess; and a lower mandrel,

wherein the upper tubular member is capable of moving uphole and downhole to change a length of the contraction joint;

a nipple housing connected to the upper tubular member;

a support sleeve disposed around the upper mandrel;

an activation dog disposed within the support sleeve, the activation dog comprising an activation profile;

a lock housing disposed in an annular space between the nipple housing and the mandrel, the lock housing connecting the upper mandrel to the lower mandrel; and

a stroke locking mechanism disposed within the lock housing, the stroke locking mechanism comprising a stroke locking mechanism profile that engages the nipple housing,

wherein, in a locked position, the lock housing is affixed to the support sleeve with a shear mechanism, the stroke locking mechanism is supported by the support sleeve, and the stroke locking mechanism profile and the activation profile prevent the nipple housing from moving.

2. The contraction joint of claim **1**,

wherein application of tension through the upper tubular member shears the shear mechanism and shifts the support sleeve and the activation dog uphole, causing the activation dog to drop into the recess of the upper mandrel, and the stroke locking mechanism to drop from the support sleeve into an unlocked position,

wherein application of a compression force to the upper tubular member pushes the upper tubular member and the nipple housing downhole to achieve contraction functionality of the contraction joint.

3. The contraction joint of claim **1**, further comprising an anti-rotation mechanism disposed in the nipple housing and affixed to the lower mandrel.

4. The contraction joint of claim **1**, further comprising at least one cable coiled around at least a portion of the lower mandrel.

5. The contraction joint of claim **4**, further comprising a cable shroud disposed around the lower mandrel to protect the at least one cable.

6. The contraction joint of claim **1**, further comprising an end cap disposed at an upper end of the upper mandrel.

7. The contraction joint of claim 1, further comprising a tension shoulder disposed between an end of the lock housing and a stop of the lower mandrel.

8. The contraction joint of claim 1, further comprising a collet disposed in the annular space between the nipple housing and the lock housing.

9. A system, comprising:

an upper completion;

a lower completion; and

the contraction joint of claim 1, wherein the contraction joint further comprises: a top sub connected to the upper tubular member; and a bottom sub connected to the lower mandrel,

wherein the upper completion is connected to the top sub, and

wherein the lower completion is connected to the bottom sub.

10. A method, comprising:

running a well completion comprising the contraction joint of claim 1 to a downhole location,

wherein the stroke locking mechanism of the contraction joint is in the locked position during the running step;

applying tension through the upper tubular member,

shearing the shear mechanism;

shifting the support sleeve and the activation dog uphole, causing the activation dog to drop into the recess of the upper mandrel, and the stroke locking mechanism to drop from the support sleeve into an unlocked position,

applying a compression force to the upper tubular member to push the upper tubular member and the nipple housing downhole to achieve contraction functionality of the contraction joint.

11. The method of claim 10, further comprising:

initiating a production operation after the applying the compression force step,

wherein, during the production operation, production fluid flows uphole through the mandrel and into a bore of the upper tubular member to a surface location.

12. The method of claim 10, the contraction joint further comprising an anti-rotation mechanism.

13. The method of claim 10, the contraction joint further comprising at least one cable coiled around at least a portion of the lower mandrel.

14. The method of claim 13, the contraction joint further comprising a cable shroud disposed around the lower mandrel to protect the at least one cable.

15. The method of claim 10, the contraction joint further comprising an end cap disposed at an upper end of the upper mandrel.

16. The method of claim 10, the contraction joint further comprising a tension shoulder disposed between an end of the lock housing and a stop of the lower mandrel.

17. The method of claim 10, the contraction joint further comprising a collet disposed in the annular space between the nipple housing and the lock housing.

18. The method of claim 17, further comprising:

resetting the contraction joint by:

applying tension through the upper tubular member and the nipple housing to achieve a locked position through the collet; and

applying compression to the upper tubular member to move a profile of the nipple housing to a lower side of the collet to initiate a stroking motion.

19. The method of claim 18, further comprising repeating the resetting step.

20. The method of claim 10,

wherein the well completion further comprises: an upper completion; and a lower completion,

wherein the contraction joint further comprises: a top sub connected to the upper tubular member; and a bottom sub connected to the lower mandrel,

wherein the upper completion is connected to the top sub, and

wherein the lower completion is connected to the bottom sub.

* * * * *