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### Method and apparatus for securing threaded connections against unwanted rotation

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#### Abstract

A lock ring to secure threaded components from inadvertent unscrewing, loosening or disassembling from each other. The lock ring can be constructed of relatively thin and pliable material. The lock ring has a central bore or hole and defines inner and outer ring surfaces. A plurality of locking tabs (including at least one bendable tab) extends outwardly from the outer ring surface, while at least one stand-off or spacer tab extends inwardly from the inner ring surface. Certain locking tabs can be bent or otherwise repositioned so that they are received in aligned recesses in the threaded components. The lock ring can be installed between threaded components (such as, for example, wireline or electric line tools) and thereby prevents adjacent threaded components from unwanted or inadvertent rotation relative to each other.

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## Background/Summary

### BACKGROUND OF THE INVENTION

#### 1. Field of the Invention

(1) The present invention pertains to a method and apparatus for securing a plurality of members joined by threaded connection(s) from inadvertently unscrewing, decoupling, loosening and/or disconnecting from each other. More particularly, the present invention pertains to a method and apparatus for securing components together without requiring use of set screws or other means that can severely damage said components or require substantial alterations to at least one of said components.

## 2. Description of Related Art

(2) Many different devices used in many different applications comprise separate components that are joined together using threaded connections. Said threaded connections typically comprise a first connection member having “male” external threads, and a second “female” connection having internal threads. Application of torque force to one or both threaded connection members cause said male and female threads to be joined together in mating relationship.

(3) By way of illustration, but not limitation, downhole electric line tools generally comprise multiple substantially cylindrical members that are commonly joined together in end-to-end relationship using threaded connections. Such tools can include, without limitation, casing collar locators and logging tools that are well known in the art. Typically, such tools are joined together using said threaded connections at a shop or other facility before being transported to a well site or other location where they can be conveyed within a subterranean wellbore. It is to be understood that such downhole electric line tools are just one illustrative example of devices or tools comprising multiple components joined together using mating male/female threaded connections.

(4) In the case of such downhole electric line tools, it is critically important that the threaded connection between said members must not inadvertently loosen. Further, said components of said tools must not inadvertently unscrew or come apart from each other, particularly while being conveyed or operated within a wellbore. In many cases, such tools are exposed to contact or jarring with other objects that can apply torque or other forces to the components of said tools, thereby causing said components to inadvertently unscrew or detach from each other. Even if said components do not fully detach or separate from each other, partial unscrewing of said components can cause tool malfunctions, poor performance and/or other unwanted problems.

(5) In order to prevent against such inadvertent loosening or unscrewing, set screws are frequently used to secure said components against unwanted rotation relative to each other. Generally, a set screw is screwed in a transverse threaded bore drilled in a first component to be secured, and partially received within an aligned detent or hole formed in the second (mating) component to ensure that the set screw cannot slide relative to the second component. Said set screw secures said components, by pressure and/or friction, against rotation relative to each other.

(6) However, set screws and other conventional means of preventing such unwanted relative rotation of threaded components have significant drawbacks. Importantly, use of said set screws generally requires detailed machining of bores into, or other alteration of, said threaded components in order to accommodate said set screws, which can significantly increase the cost and complexity of the threaded components. Further, the set screws themselves can also inadvertently unscrew within a wellbore; when this occurs, the set screw can fall out of a threaded bore, and the loose set screw can create a “fish” downhole within a well that negatively impacts future operations in said well.

(7) Thus, there is a need for an efficient and cost-effective means for securing threaded components against inadvertent loosening/unscrewing without drawbacks or limitations of conventional set screws or other existing solutions.

## SUMMARY OF THE INVENTION

(8) The present invention generally comprises a method and apparatus for locking a pair of members that are joined together in opposing end-to-end relationship using threaded connection(s); said locking system prevents said members from inadvertently unscrewing, decoupling, loosening and/or unintentionally disconnecting from each other. The locking system of the present invention

can secure components together without requiring use of set screws or other conventional means that can severely damage said components or require substantial alterations to at least one of said components.

(9) A lock ring can be selectively installed between first and second tool members that are joined together in opposing end-to-end relationship using threaded connection members. In a preferred embodiment, said lock ring comprises a substantially circular central ring member that is substantially planar or flat and defines a center hole. At least one spacer stand-off member is oriented radially inward from said central ring member and is disposed in said hole area. Said at least one spacer stand-off member ensures that said central ring member is positioned a desired distance away from the threads of one or both of said joined tool members.

(10) A plurality of locking tabs extend radially outward from said central ring member; said locking tabs are generally disposed around the circumference of said central ring member in spaced relationship. In a preferred embodiment, said locking tabs are attached to central ring member in a substantially co-planar orientation, but can be selectively bent or intentionally deformed so that said locking tabs are oriented out of planar alignment with said central ring member. Put another way, said locking tabs can be selectively bent so that said locking tabs are disposed at an acute angle relative to central ring member.

(11) At least one of said locking tabs of said lock ring can be selectively bent or otherwise displaced into at least one aligned notch of a first tool member and at least one aligned notch of a second tool member. In this manner, said lock ring effectively acts as a connector that structurally links said first and second tool members and prevents relative rotation of said first and second tool members around their central longitudinal axes. Said first tool member and said second tool member are prevented from rotating relative to each other by said lock ring and, as a result, from inadvertently unscrewing, decoupling, loosening and/or unintentionally disconnecting from each other.

(12) The locking system of the present invention is relatively inexpensive and efficient to manufacture and use. It can be incorporated into new threaded components or tool members, or it can be used with existing equipment. The locking system can be utilized without specialized tools virtually anywhere including, without limitation, in a shop, staging area, load-out facility, job location or well site.

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## Description

### BRIEF DESCRIPTION OF DRAWINGS/FIGURES

(1) The foregoing summary, as well as any detailed description of the preferred embodiments, is better understood when read in conjunction with the drawings and figures contained herein. For the purpose of illustrating the invention, the drawings and figures show certain preferred embodiments. It is understood, however, that the invention is not limited to the specific methods and devices disclosed in such drawings or figures.

(2) Further, the drawings constitute a part of this specification and include exemplary embodiments of the technology. It is to be understood that in some instances, various aspects of the invention may be shown exaggerated or enlarged to facilitate an understanding of the invention. Therefore, the drawings may not be to scale.

(3) FIG. 1 depicts a front view of a lock ring of the present invention.

(4) FIG. 2 depicts a side view of a lock ring of the present invention.

(5) FIG. 3 depicts a side perspective view of a lock ring of the present invention.

(6) FIG. 4 depicts an overhead perspective and partially exploded view of a locking system of the present invention.

(7) FIG. 5 depicts a bottom perspective and partially exploded view of a locking system of the

present invention.

(8) FIG. 6 depicts a detailed overhead perspective view of a locking system of the present invention.

(9) FIG. 7 depicts a detailed bottom perspective view of a locking system of the present invention.

(10) FIG. 8 depicts a perspective view of an assembled locking system of the present invention.

(11) FIG. 9 depicts a detailed perspective view of the assembled locking system depicted in FIG. 8.

#### DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT OF THE INVENTION

(12) The present invention generally comprises a method and apparatus for locking a pair of opposing components that are joined together in end-to-end configuration using threaded connection(s); said locking system of the present invention prevents said members from inadvertently unscrewing, decoupling, loosening, disconnecting and/or unintentionally detaching from each other.

(13) By way of illustration, but not limitation, downhole electric line tools generally comprise a plurality of substantially cylindrical members that are commonly joined together in end-to-end relationship using threaded connections. Although the present invention is described herein as being employed in connection with downhole electric line tools used in subterranean oil and gas wells, it is to be understood that such downhole electric line tools are just one illustrative example of devices or tools that can beneficially employ the locking system of the present invention. As such, although described herein in connection with said downhole electric line tools, it is to be observed that the locking system of the present invention can also be beneficially used in connection with other applications.

(14) FIG. 1 depicts a front view of a lock ring **10** of the present invention. In a preferred embodiment, said lock ring **10** comprises a substantially circular central ring body member **11** forming a “doughnut” configuration and defining a center hole **12**. At least one spacer stand-off member **13** is disposed within said central hole **12** and is oriented radially inward from the inner surface **11a** of said central ring body member **11**. In the embodiment depicted in FIG. 1, three (3) stand-off members **13** are disposed equidistantly around the circumference of said inner surface **11a** at approximately 120-degrees separation between each of said stand-off members **13**; however, it is to be observed that the number and spacing of said stand-off members **13** depicted in FIG. 1 are illustrative only, and said stand-off members **13** can number more or less than 3, and can be positioned relative to ring body member **11** differently than the depiction shown in FIG. 1. Said at least one spacer stand-off member **13** ensures that said central ring body member **11** is beneficially positioned at a desired distance relative to one or both of said joined tool members as more fully described herein.

(15) Still referring to FIG. 1, a plurality of external locking tabs **14** extend radially outward from said central ring body member **11**. Said plurality of external locking tabs **14** are generally disposed around the outer circumference of said central ring member in spaced relationship along outer surface **11b** of said ring body member **11**. The number and spacing of said external locking tabs **14** depicted in FIG. 1 are also illustrative only, and the actual number and spacing of said locking tabs **14** can be altered without departing from the scope of the present invention.

(16) FIG. 2 depicts a side view of a lock ring **10** of the present invention. In a preferred embodiment, said lock ring **10** comprises central ring body member **11** having a substantially planar or flat shape when viewed from the side. As depicted in FIG. 2, a plurality of locking tabs **14** have been selectively bent or intentionally deformed so that said locking tabs **14a** are at least partially oriented out of planar alignment with said central ring body member **11**. Put another way, said locking tabs **14** can be selectively bent so that at least one of said locking tabs **14** can be re-positioned out of planar alignment with central ring body member **11**. In the embodiment depicted in FIG. 2, said locking tabs **14a** are intentionally bent to until they are oriented in approximately a 90-degree angle relative planar central body member **11**.

(17) FIG. 3 depicts a side perspective view of a lock ring **10** of the present invention. In a preferred

embodiment, said lock ring **10** comprises central ring body member **11** having a substantially planar or flat shape, as well as a center hole **12** defining inner surface **11a**. As depicted in FIG. 3, a plurality of spacer stand-off members **13** is disposed within said central hole **12** in spaced relationship around said inner surface **11a**; said spacer stand-off members **13** are oriented radially inward from inner surface **11a** of said central ring body member **11**.

(18) A plurality of external locking tabs **14** extend radially outward in spaced relationship from outer surface **11b** of said central ring body member **11**. Referring to FIGS. 2 and 3, it is to be understood that said external locking tabs **14** can be selectively bent or intentionally deformed so that they are, at least partially, out of planar alignment with said central ring body member **11**. In a preferred embodiment, at least one of said locking tabs **14a** can be repositioned at a right angle, or an acute angle, relative to central ring body member **11**. Nonetheless, in the configuration depicted in FIGS. 2 and 3, the particular locking tabs **14a** that are bent/deformed are illustrative only and are not in any particular pattern. Said locking tabs can be bent or deformed as desired by hand, or using common or readily available tools (such as pliers), but without requiring specialized tools.

(19) FIG. 4 depicts an overhead perspective and partially exploded view of a locking system of the present invention, while FIG. 5 depicts a bottom perspective and partially exploded view of said locking system. Substantially cylindrical first member **100** and substantially cylindrical second member **200** are disposed in end-to-end relationship, while lock ring **10** is positioned between said first member **100** and second member **200**. For illustration purposes, said members **100** and **200** can represent components of a downhole electric line tool; however, it is to be understood that the present invention is not limited solely to use with electric line tools or similar applications.

(20) First member **100** generally comprises body member **110** and male or “pin” threaded connection member **120** having external threads and defining shoulder surface **140** (best viewed in FIG. 5). Second member **200** generally comprises body member **210** defining shoulder surface **240**, and female or “box” connection member **220** having internal threads. Referring to FIG. 4, a plurality of notches **230** are disposed in spaced relationship around said shoulder surface **240** of second member **200**. Referring to FIG. 5, a plurality of notches **130** are disposed in spaced relationship around shoulder surface **140** of first member **100**. The number and spacing of notches **230** and **130** depicted in the figures are illustrative only; the actual number and spacing of said notches **230** and **130** can be varied.

(21) When joined, threaded connection member **120** of first member **100** is received within female threaded connection member **220** of second member **200**. Application of torque forces causes external threads of threaded connection member **120** to engage with (that is, “screw into”) internal threads of threaded connection member **220**. In this configuration, lock ring **10** is disposed between said first member **100** and second member **200**.

(22) Still referring to FIGS. 4 and 5, lock ring **10** comprises central ring body member **11** having a substantially planar or flat shape, and defining a center hole **12**. At least one spacer stand-off member **13** is disposed within said central hole **12** and is oriented radially inward from the inner surface **11a** of said central ring body member **11**. It is to be observed that threaded connection member **120** of first member **100** can be received within said central hole **12** of lock ring **10**. Said at least one spacer stand-off member **13** disposed around inner surface **11b** of said lock ring **10** ensures that said central ring body member **11** remains positioned a desired radial distance away from threaded connection member **120** of first member **100**. A plurality of external locking tabs **14** extend radially outward from said central ring body member **11** of lock ring **10** and can be selectively bent or deformed so that at least one of said locking tabs **14a** are at least partially disposed at an acute or right angle relative to central ring body member **11**.

(23) FIG. 6 depicts a detailed overhead perspective view of a locking system of the present invention, while FIG. 7 depicts a detailed bottom perspective view of said locking system. First member **100** generally comprises body member **110** and male or “pin” threaded connection member **120** having external threads. Second member **200** generally comprises body member **210**

and female or “box” connection member **220** having internal threads. In the configurations depicted in FIGS. **6** and **7**, it is to be observed that male or “pin” external threads **120** of first member **100** are being inserted through hole **12** of lock ring **10** and into female or “box” connection member **220** of second member **200** having internal threads.

(24) Referring to FIG. **6**, body member **210** of second member **200** defines shoulder surface **240**. A plurality of notches **230** are disposed in spaced relationship around said shoulder surface **240**.

Referring to FIG. **7**, body member **110** of first member **100** defines shoulder surface **140**. A plurality of notches **130** are disposed in spaced relationship around said shoulder surface **140**. Said first member **100** and second member **200** can be joined and connected to each other in end-to-end relationship so that shoulder surfaces **140** and **240** oppose each other, and are in close proximity to each other.

(25) Still referring to FIGS. **6** and **7**, lock ring **10** is disposed between said first member **100** and second member **200**. At least one spacer stand-off member **13** is disposed radially inward from said central ring member **11**. Said at least one spacer stand-off member **13** ensures that said central ring member **11** is positioned a desired radial distance away from external threads **120** of first member **100** when said threads **120** are received within hole **12** of locking ring **10**.

(26) A plurality of locking tabs **14** extend radially outward from said central ring member **11**; said locking tabs **14** are disposed around the circumference of said central ring member **11** in spaced relationship. In a preferred embodiment, said locking tabs **14** are attached to central ring member **11** in a substantially co-planar orientation, but can be selectively bent so that at least a portion of said locking tabs **14a** are oriented out of planar alignment with said central ring member **11**. Put another way, said locking tabs **14a** can be selectively bent or partially repositioned, and can be bent or repositioned by hand and/or without the use of specialized tools.

(27) FIG. **8** depicts an overhead perspective view of an assembled locking system of the present invention, while FIG. **9** depicts a detailed perspective view of the assembled locking system depicted in FIG. **8**. Referring to FIG. **8**, body section **110** of first member **100**, and body section **210** of second member **200**, are joined to each other in end-to-end relationship so that shoulder surfaces **140** and **240** oppose each other. Lock ring **10** is disposed or “sandwiched” between said shoulder surface **140** of first member **100** and shoulder surface **240** of second member **200**.

(28) Referring to FIG. **9**, a portion of at least one locking tab **14a** of lock ring **10** can be selectively bent or otherwise displaced into at least one notch **230** of second member **200**. In this configuration, said at least one locking tab **14a** is received between side walls **231** formed by notch **230**; said locking tab **14a** cooperates with said side walls **231** to prevent side-to-side movement and rotation of lock ring **10** relative to shoulder **240** and second member **200** (such as around the longitudinal axis of said second member **200**). Similarly, a portion of at least one locking tab **14a** of lock ring **10** can be selectively bent or otherwise displaced into at least one notch **130** of first member **100**. In this configuration, said at least one locking tab **14a** is received between side walls **131** formed by notch **130**; said locking tab **14a** cooperates with said side walls **131** to prevent side-to-side movement and rotation of lock ring **10** relative to shoulder **140** and first member **100** (such as around the longitudinal axis of said first member **100**).

(29) In this configuration, lock ring **10** will not rotate relative to body section **110** of first member **100**. Similarly, lock ring **10** will not rotate relative to body section **210** of second member **200**. In this manner, lock ring **10** effectively acts as an intermediate linkage member disposed between first member **100** and second member **200** that interlocks said components and effectively prevents unwanted rotation of said first member **100** relative to said second member **200**, and vice versa. As such, the lock ring of the present invention interlocks and prevents relative rotation between said first and second members.

(30) It is to be observed that first member **100** and second member **200** can have the same number of notches (**130** and **230**, respectively). However, under this scenario, it is possible that notches **130** and **230** may become aligned with each other when first member **100** and second member **200** are

threadedly connected. When this occurs, it can negatively affect connection of said first member **100** to said second member **200**, and use of lock ring **10**, particularly when said connection occurs at a wellsite or other remote location. Therefore, in a preferred embodiment, said first member **100** has a different number of notches **130** than the number of notches **230** in second member **200**. When configured in this manner, at least one of said notches is effectively ensured to be out of direct alignment with an opposing notch.

(31) Additionally, it is possible to “pre-bend” at least one locking tab **14a** of lock ring **10** to fit into notches in one of said members (such as, for example, notches **130** of first member **100**). By way of illustration, but not limitation, lock ring **10** can be installed on said first member **100** and said pre-bent locking tab(s) **14a** can be received within notch(es) **130** of said first member **100**; said pre-bent locking tab(s) **14a** cooperate with notch(es) **130** to prevent rotation or spinning of lock ring **10** when second member **200** is threadedly connected to said first member **100**. Thereafter, following threaded connection of first member **100** to second member **200**, additional locking tab(s) **14a** can be bent or deformed to be received within notch(es) **230** of second member **200**. It is to be understood that locking tab(s) **14a** can be bent or deformed into the desired configuration without the use of specialized tools; said tabs can be bent and/or deformed (including on a well site or other remote location) by hand or by using conventional pliers or other commonly available tools.

(32) In the case of downhole electric line tools, said tools can be exposed to contact or jarring with the surrounding wellbore, casing, tubing and/or other objects, particularly while said tools are being conveyed in and/or out of the wellbore. Such contact can frequently result in the application of torque or other forces to the components of said tools, thereby causing said components to inadvertently unscrew, decouple, loosen and/or otherwise disconnect from each other. The locking system of the present invention can secure said components together without requiring use of set screws or other conventional locking means that can significantly damage said components and/or require substantial alterations to at least one of said components. Further, the locking system of the present invention is inexpensive and efficient to manufacture and deploy.

(33) The above-described invention has a number of particular features that should preferably be employed in combination, although each is useful separately without departure from the scope of the invention. While the preferred embodiment of the present invention is shown and described herein, it will be understood that the invention may be embodied otherwise than herein specifically illustrated or described, and that certain changes in form and arrangement of parts and the specific manner of practicing the invention may be made within the underlying idea or principles of the invention.

## Claims

1. A lock ring configured to prevent relative rotation of first and second threaded cylindrical downhole wireline tools comprising: a) a ring member defining a central hole, said ring member received between a first threaded cylindrical downhole wireline tool and a second threaded cylindrical downhole wireline tools, wherein said first threaded cylindrical downhole wireline tool and said second threaded cylindrical downhole wireline tool are joined together in end-to-end relationship, and wherein said ring member further comprises an inner surface and an outer surface; and b) a plurality of locking tabs disposed along said outer surface, wherein at least one of said locking tabs is configured to be at least partially received within an aligned notch on said first threaded cylindrical downhole wireline tool, and at least one of said locking tabs is configured to be at least partially received within an aligned notch on said second threaded downhole wireline tool.
2. The lock ring of claim 1, wherein at least one of said plurality of locking tabs is configured to be selectively repositioned out of planar alignment with said ring member and received within an aligned notch.



3. The lock ring of claim 2, wherein said at least one of said plurality of locking tabs is configured to be selectively repositioned without the use of specialized tools.

4. A method for preventing relative rotation of threaded downhole wireline tools comprising: a) installing a lock ring between a first threaded cylindrical downhole wireline tool and a second threaded cylindrical downhole wireline tool, wherein said lock ring comprises: i) a ring member defining a central hole, wherein said ring member further comprises an inner surface and an outer surface; ii) a plurality of locking tabs disposed along said outer surface; and b) threadedly connecting said first threaded cylindrical downhole wireline tool to said second threaded cylindrical downhole wireline tool in end-to-end relationship, wherein at least one of said locking tabs is received within an aligned notch on said first threaded cylindrical downhole wireline tool, and at least one of said locking tabs is received within an aligned notch on said second threaded cylindrical downhole wireline tool, and wherein said lock ring prevents relative rotation between said first threaded cylindrical downhole wireline tool and said second threaded cylindrical downhole wireline tools.

5. The method of claim 4, wherein at least one of said plurality of locking tabs is configured to be selectively repositioned out of planar alignment with said ring member.

6. The method of claim 5, wherein said at least one of said locking tabs is configured to be selectively repositioned without the use of specialized tools.

7. A method for preventing relative rotation of threaded downhole wireline tools comprising: a) providing a lock ring, wherein said lock ring comprises: i) a ring member defining a central hole, and wherein said ring member further comprises an inner surface and an outer surface; ii) a plurality of locking tabs disposed along said outer surface; b) installing said lock ring on a first threaded cylindrical downhole wireline tool having male threads, wherein said male threads are received in said central hole of said ring member; c) threadedly connecting said first threaded cylindrical downhole wireline tool to a second threaded cylindrical downhole wireline tool having female threads in end-to-end relationship; d) selectively positioning at least one of said locking tabs at least partially within an aligned notch on said first threaded cylindrical downhole wireline tool; and e) selectively positioning at least one of said locking tabs at least partially within an aligned notch on said second threaded cylindrical downhole wireline tool, wherein said lock ring prevents relative rotation between said first threaded cylindrical downhole wireline tool and second threaded cylindrical downhole wireline tools.

8. The method of claim 7, wherein at least one of said plurality of locking tabs is configured to be selectively repositioned out of planar alignment with said ring member.

9. The method of claim 8, wherein said at least one of said locking tabs is configured to be selectively repositioned without the use of specialized tools.

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