US 20250262733A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2025/0262733 A1**

Brodhead (43) **Pub. Date: Aug. 21, 2025**

(54) **FASTENER TOOLS AND METHODS**

(71) Applicant: **The Boeing Company**, Arlington, VA (US)

(72) Inventor: **James E. Brodhead**, Everett, WA (US)

(73) Assignee: **The Boeing Company**, Arlington, VA (US)

(21) Appl. No.: **18/443,599**

(22) Filed: **Feb. 16, 2024**

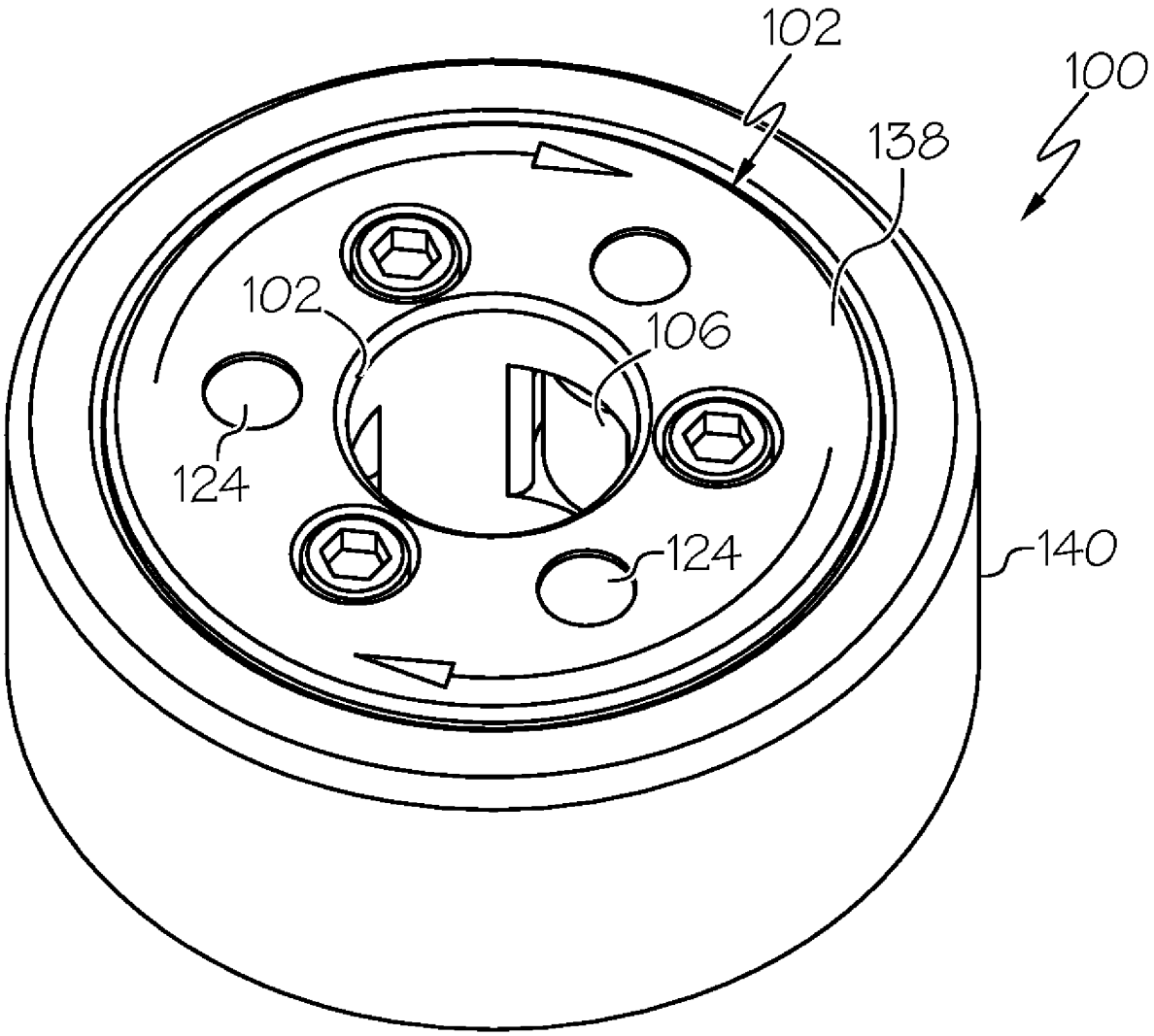
Publication Classification

(51) **Int. Cl.**
B25B 31/00 (2006.01)

(52) **U.S. Cl.**
CPC ***B25B 31/005*** (2013.01)

(57) **ABSTRACT**

A tool for installing and/or removing a fastener includes a body having an opening having a center axis. The tool includes a plurality of grips coupled to the body and angularly spaced apart from each other around the opening. At least one of the grips is radially movable relative to the opening. The tool includes a plurality of lugs coupled to the body. The lugs limit radially inward movement of the at least one of the grips. The tool includes a cam coupled to the body. Rotation of the cam about the central axis in a first rotational direction relative to the body moves the at least one of the grips radially inward. Pins and lugs serve to prevent escapement of the grips, which constitute a foreign object debris that may cause mechanical or electrical damage.



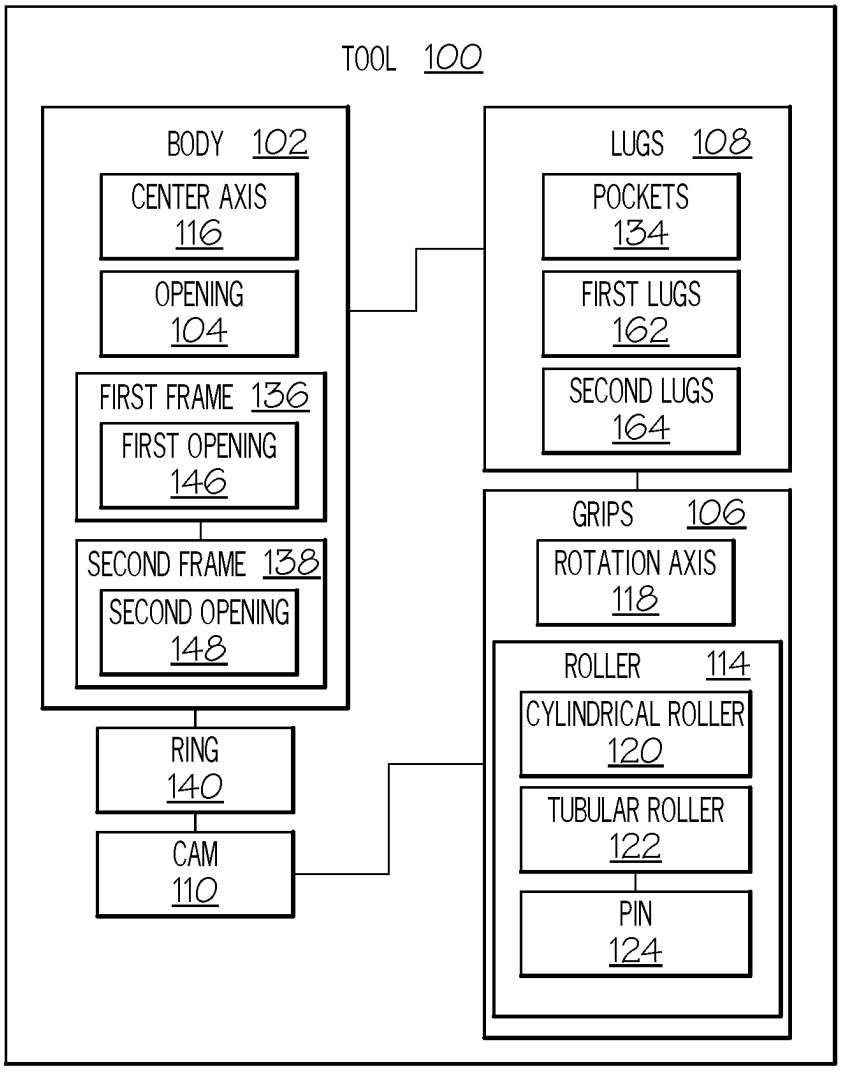

TOOL 100
BODY 102
CENTER AXIS 116
OPENING 104
FIRST FRAME 136
FIRST OPENING 146
SECOND FRAME 138
SECOND OPENING 148
RING 140
CAM 110
LUGS 108
POCKETS 134
FIRST LUGS 162
SECOND LUGS 164
GRIPS 106
ROTATION AXIS 118
ROLLER 114
CYLINDRICAL ROLLER 120
TUBULAR ROLLER 122
PIN 124

FIG. 1

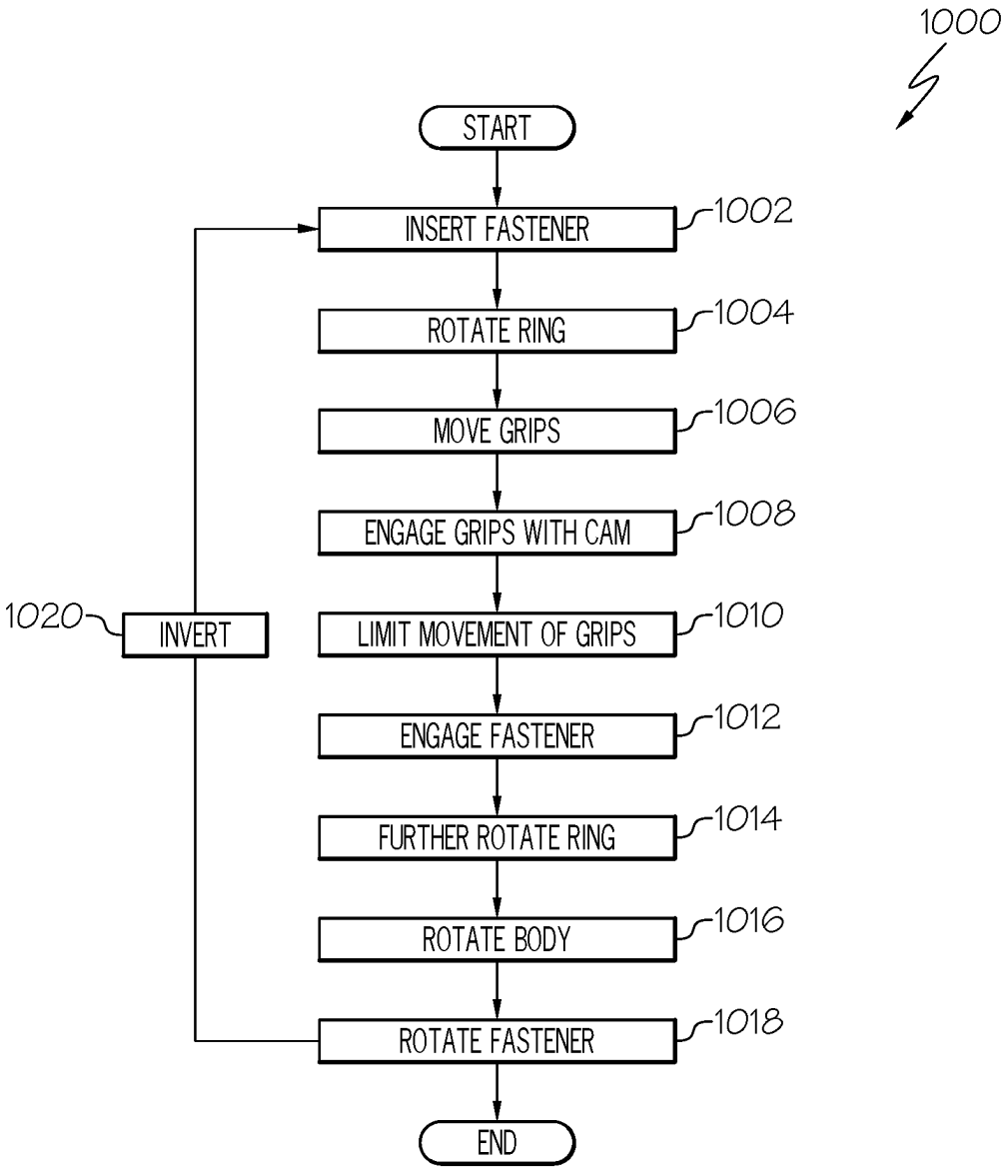

1000
START
INSERT FASTENER
1002
ROTATE RING
1004
MOVE GRIPS
1006
ENGAGE GRIPS WITH CAM
1008
1020
INVERT
LIMIT MOVEMENT OF GRIPS
1010
ENGAGE FASTENER
1012
FURTHER ROTATE RING
1014
ROTATE BODY
1016
ROTATE FASTENER
1018
END

FIG. 2

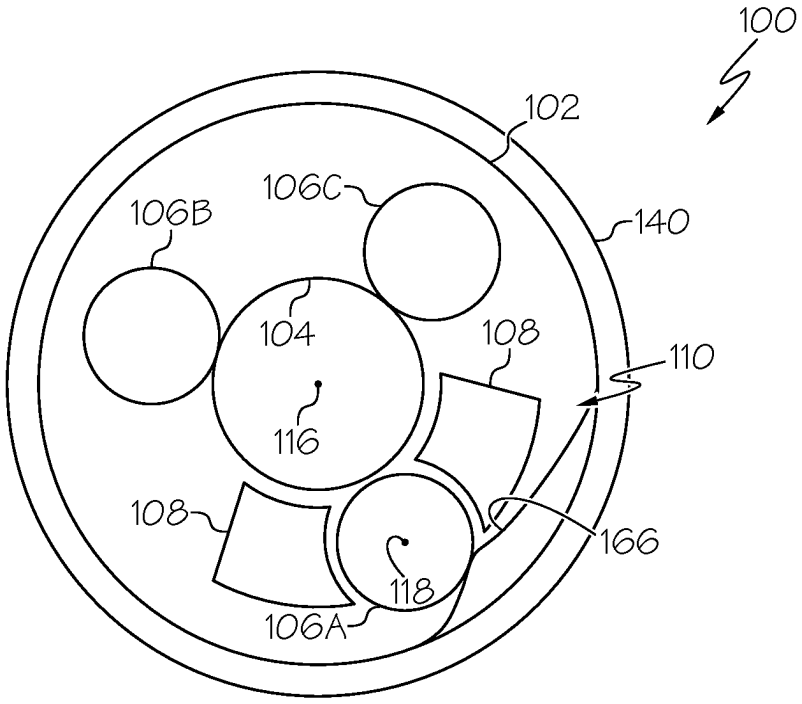

100
102
106C
106B
140
104
108
110
116
108
166
118
106A

FIG. 3

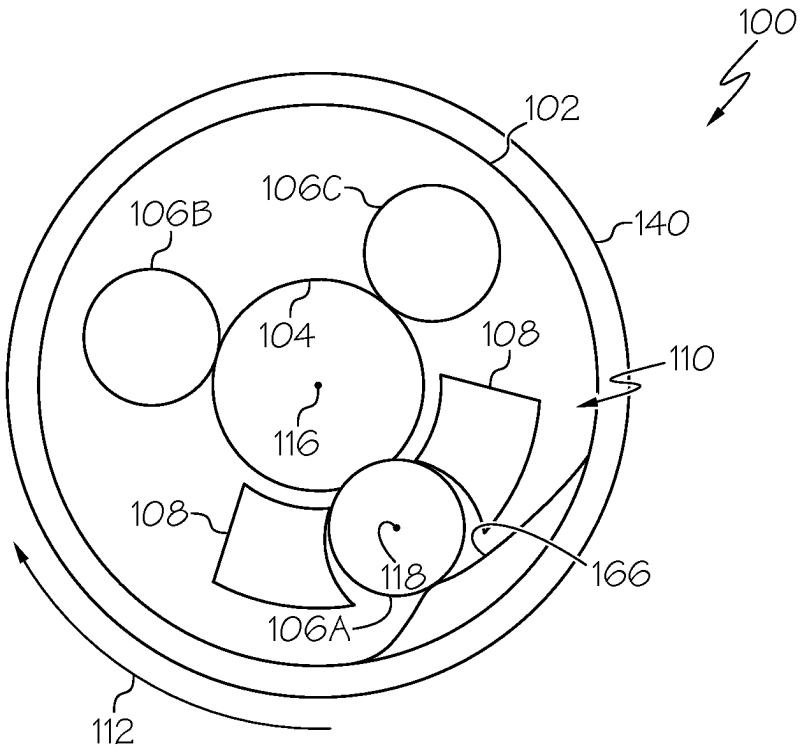

100
102
106C
106B
140
104
108
110
116
108
166
118
106A
112

FIG. 4

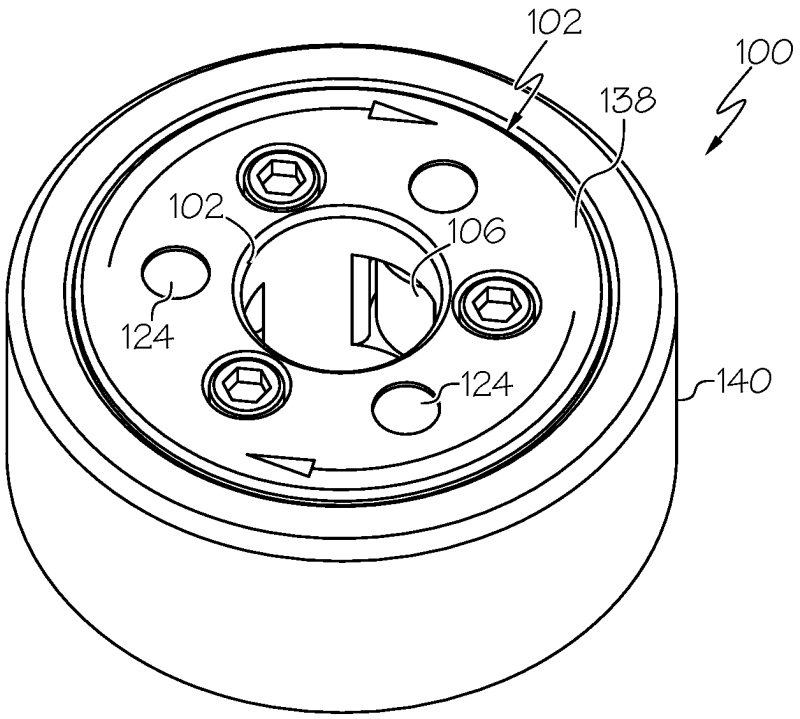

102
100
138
102
106
124
124
140

FIG. 5

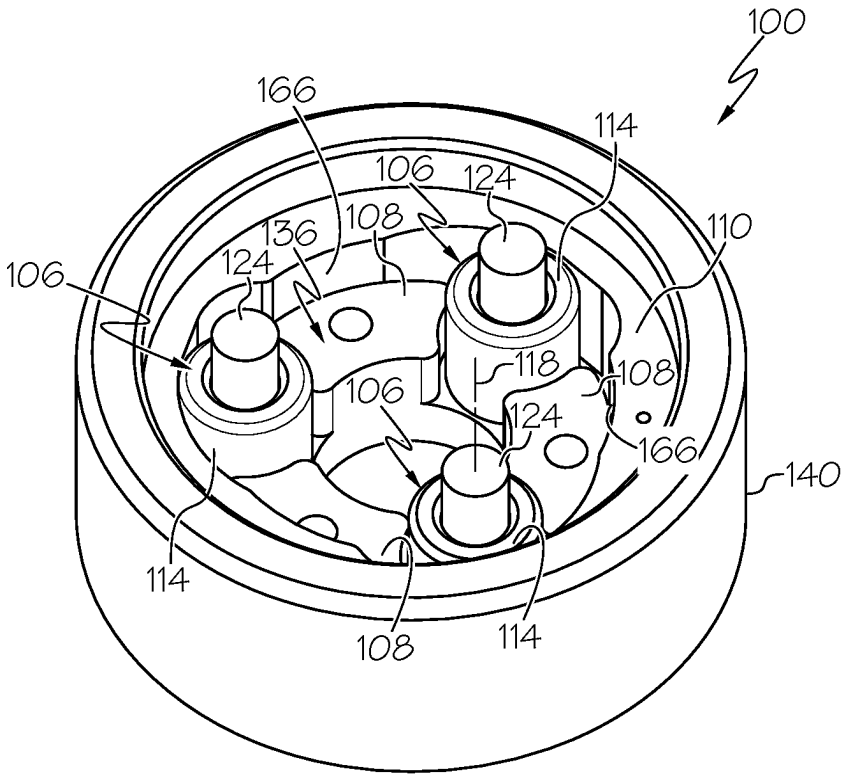

100
166
114
106
124
108
136
110
124
106
118
108
106
124
166
140
114
108
114

FIG. 6

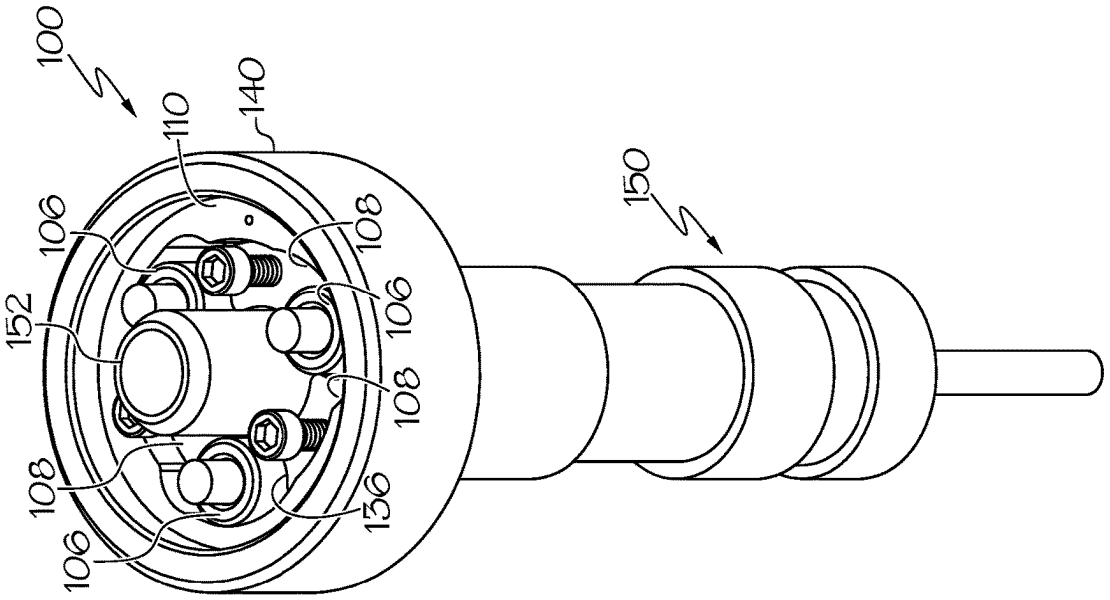

100
110
140
150
106
108
152
106
108
108
106
136

FIG. 8

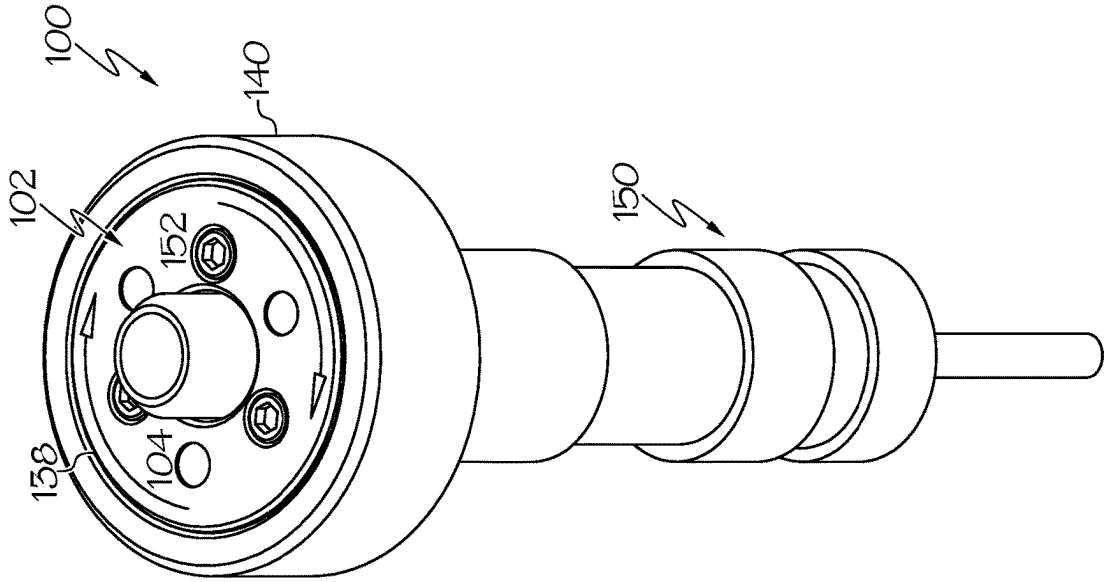

100
140
150
102
152
104
138

FIG. 7

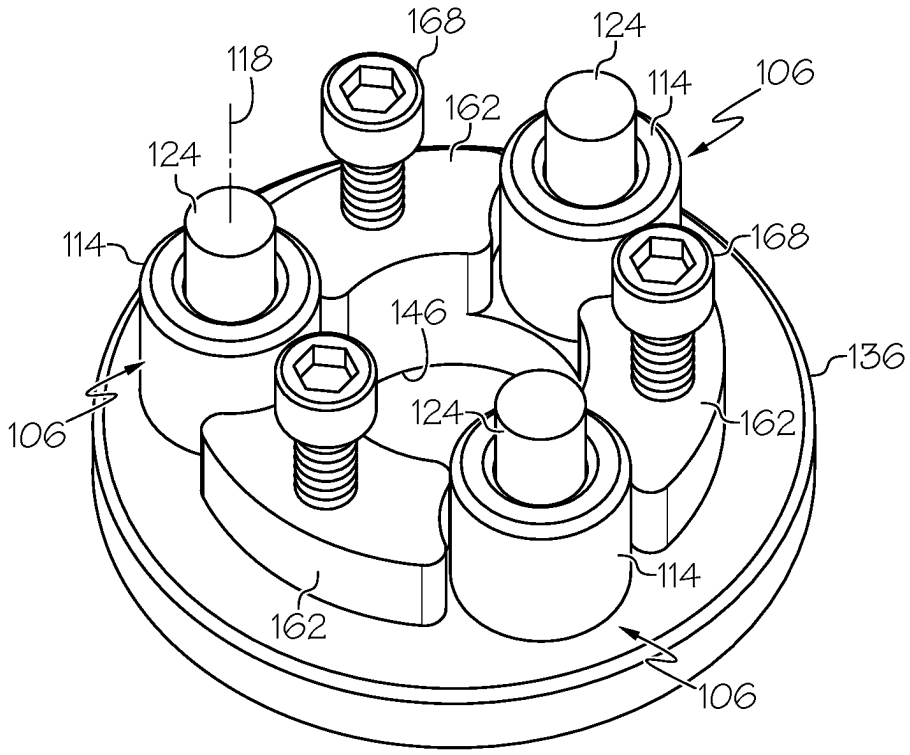

168
124
118
114
106
162
124
114
168
146
136
106
124
162
114
162
106

FIG. 9

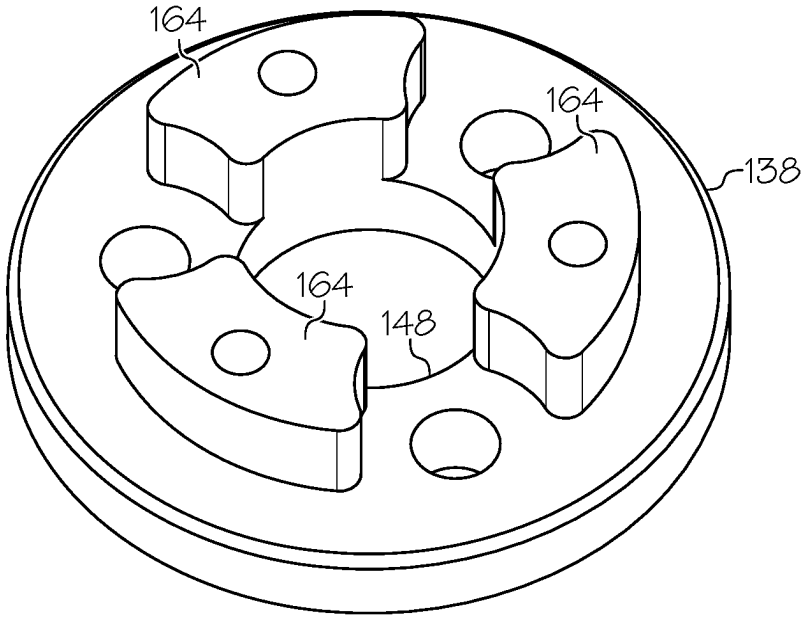

164
164
138
164
148

FIG. 10

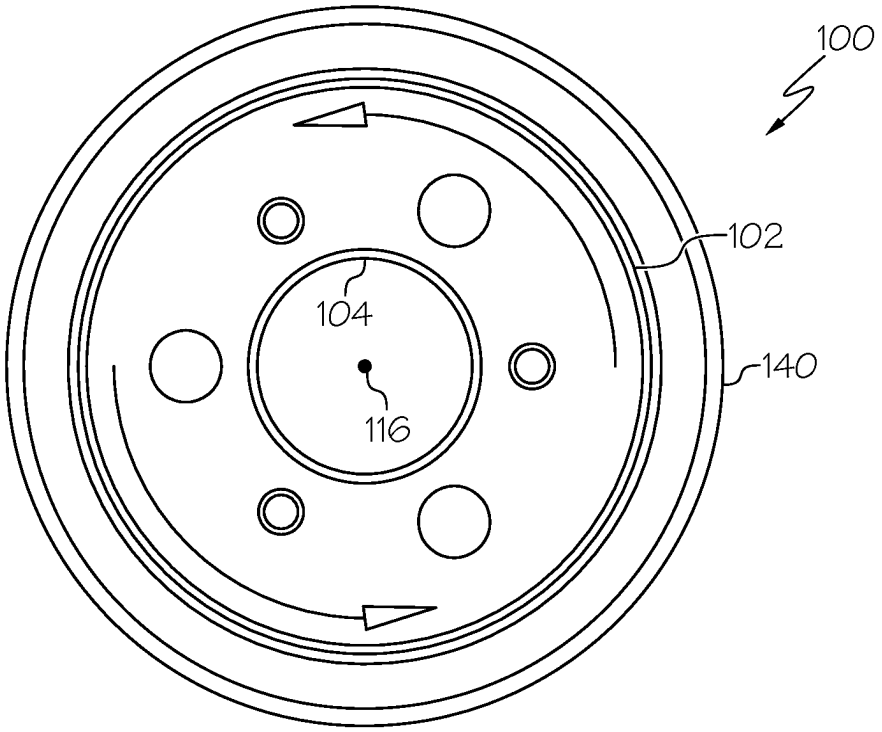


FIG. 11

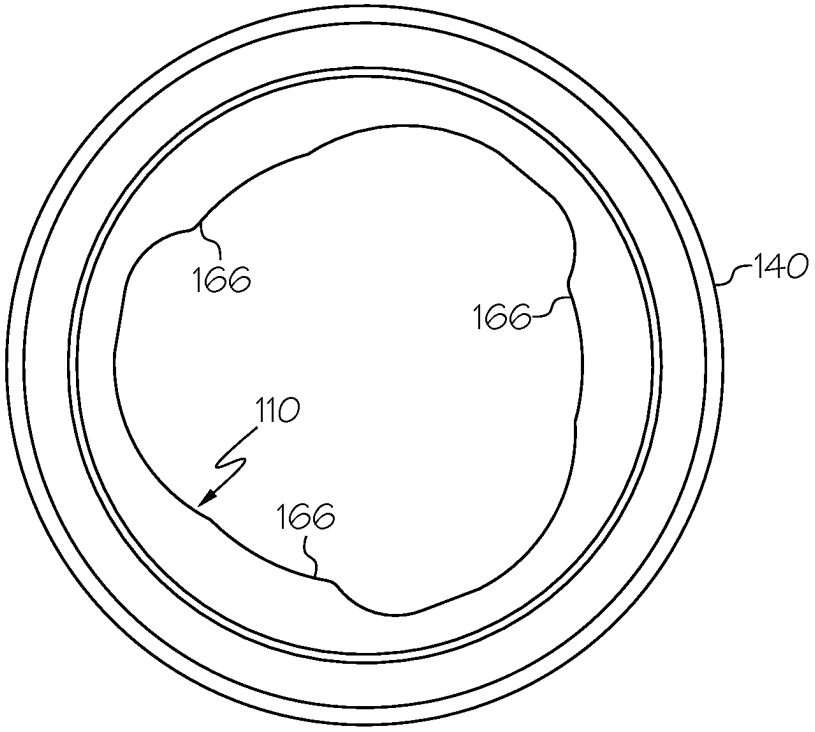


FIG. 12

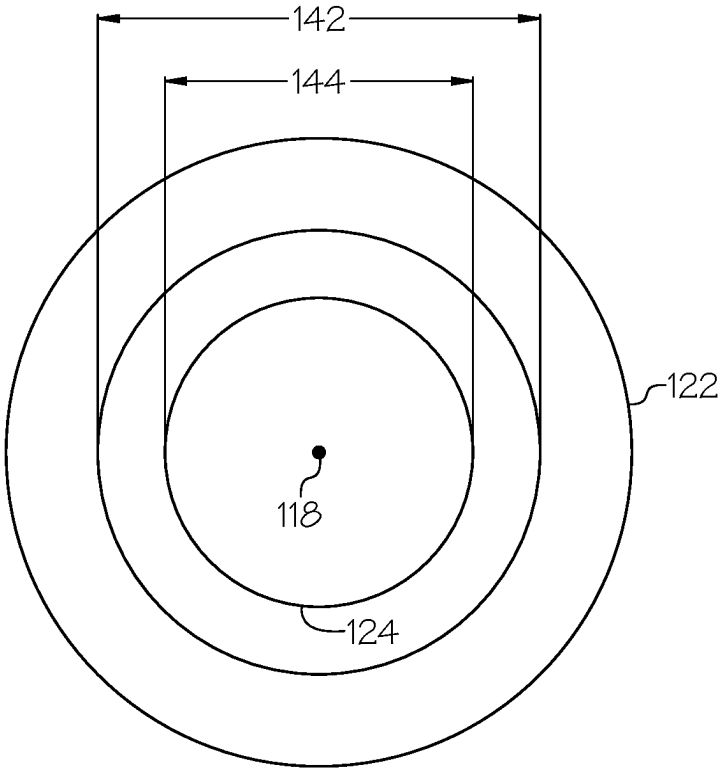


FIG. 13

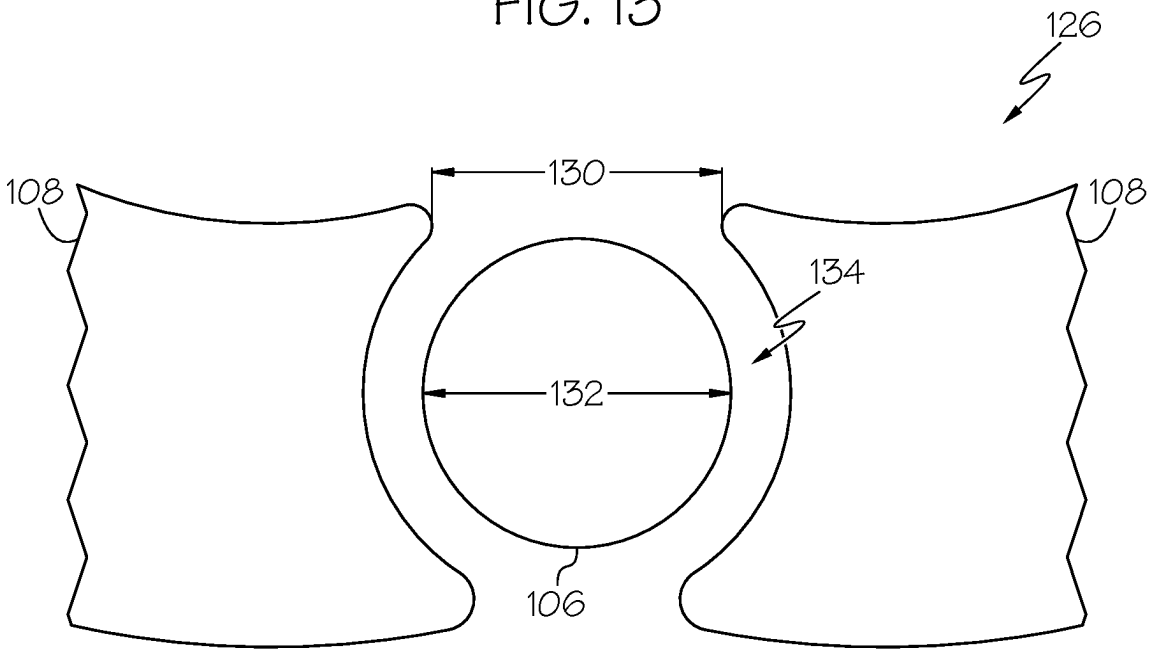


FIG. 14

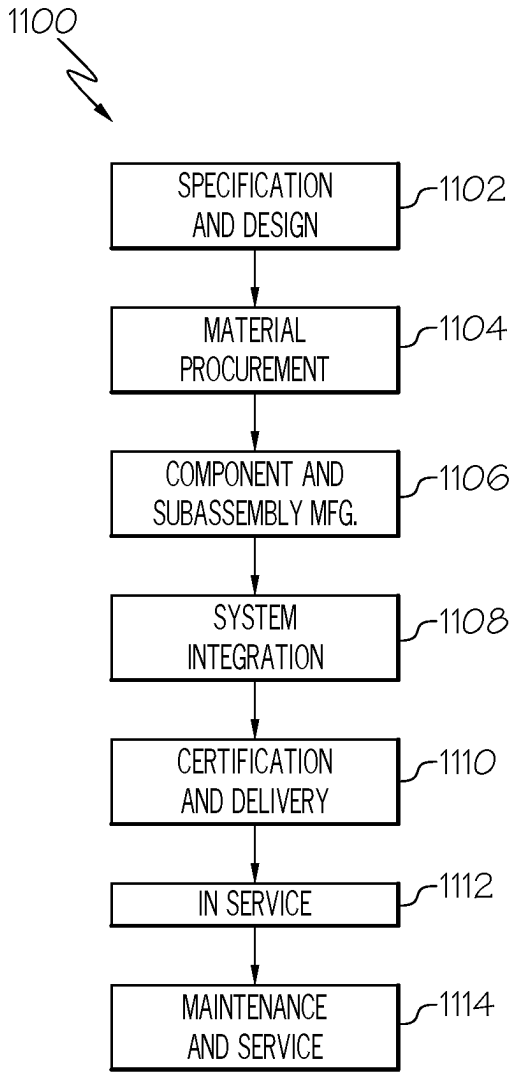

1100
SPECIFICATION AND DESIGN
1102
MATERIAL PROCUREMENT
1104
COMPONENT AND SUBASSEMBLY MFG.
1106
SYSTEM INTEGRATION
1108
CERTIFICATION AND DELIVERY
1110
IN SERVICE
1112
MAINTENANCE AND SERVICE
1114

FIG. 15

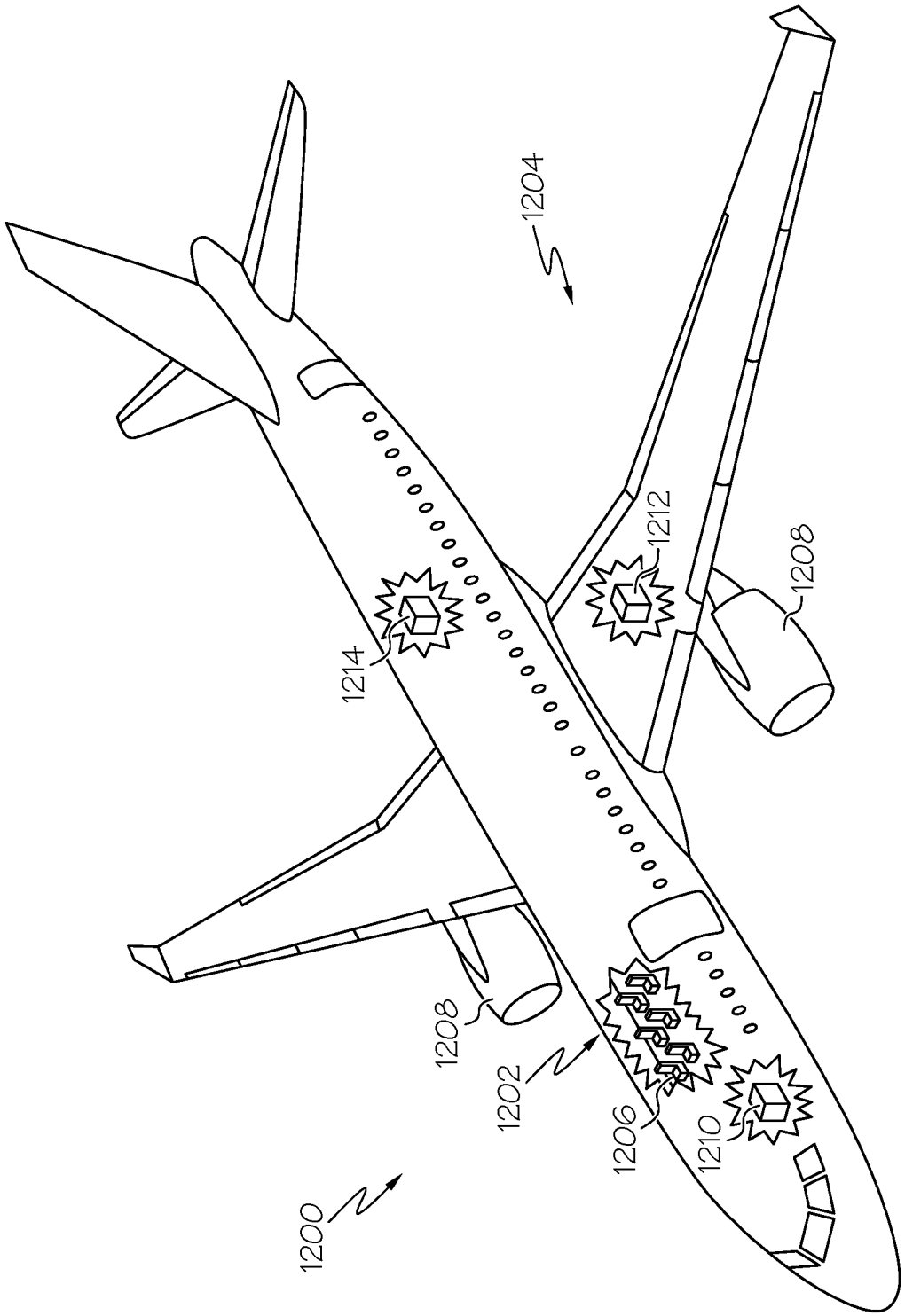


FIG. 16

FASTENER TOOLS AND METHODS

FIELD

[0001] The present disclosure relates generally to fastener installation and removal and, more particularly, to devices and methods for installing and removing fasteners, such as temporary fasteners.

BACKGROUND

[0002] Various industries, such as aerospace, utilize specialized fasteners to temporarily, or permanently, retain certain components. For example, it is frequently necessary for parts to be temporarily joined together during manufacture or assembly using special fasteners that are removable and reusable. In the aerospace industry, such temporary fasteners are widely used in the manufacture and repair of aircraft, for example, to temporarily fasten sheets of material together or to align and hold parts, such as stiffeners, frames, etc., together before they are permanently joined. One example of such a temporary fastener is commonly referred to as a "Cleco" fastener. These Cleco fasteners generally include a cylindrical body, a plunger at one end, and expandable prongs or jaws at the opposing end, which are typically activated by an internal spring or threaded shaft. The prongs or jaws expand on the far side of the workpieces and then draw and clamp them together while maintaining a desired alignment and preventing distortion of the workpieces.

[0003] The spring-type fasteners are typically installed and removed using special hand-operated pliers or pneumatic power tools. However, the threaded-type fasteners are typically installed and removed by hand or using a hand-operated ratchet tool, such as a roller clutch. However, these hand tools have operational limitations, require lubrication, and are not designed for repeated removal and reinstallation. Further, installation and removal of the threaded-type fasteners can put a user's hand, wrist, and arm at awkward angles. Additionally, it can be increasingly difficult to install and remove the fasteners when the fasteners are used in tight or inaccessible areas. Thus, there exists a need for improved tools for rotating fasteners and for improved methods for installing and removing fasteners. Accordingly, those skilled in the art continue with research and development efforts in fastener utilization.

SUMMARY

[0004] Disclosed are examples of a tool and a method for installing and removing a fastener. The following is a non-exhaustive list of examples, which may or may not be claimed, of the subject matter according to the present disclosure.

[0005] In an example, the disclosed tool includes a body having an opening and a center axis. The tool includes a plurality of grips that are coupled to the body and angularly spaced apart from each other around the opening. At least one of the grips is radially movable relative to the opening. The tool includes a plurality of lugs that are coupled to the body. The lugs limit radially inward movement of the at least one of the grips. The tool includes a cam that is coupled to the body. Rotation of the cam about the central axis in a first rotational direction relative to the body moves the at least one of the grips radially inward.

[0006] In another example, the disclosed tool includes a body having a center axis. The body includes a first frame. The first frame includes a first opening that is concentric with the center axis. The body includes a second frame that is coupled to the first frame. The second frame includes a second opening that is concentric with the center axis. The tool includes a plurality of grips that are disposed between the first frame and the second frame and angularly spaced apart from each other around the center axis. The tool includes a plurality of lugs that extend between the first frame and the second frame. The tool includes a ring that is coupled to the body and concentric with the center axis. The tool includes a cam that is coupled to the ring and extends radially inward. The grips are radially movable relative to the center axis. The lugs limit radially inward movement of the grips. The ring is rotatable about the center axis relative to the body. Rotation of the ring about the central axis in a first rotational direction relative to the body engages the cam with the grips to move the grips radially inward.

[0007] In an example, the disclosed method includes steps of: (1) inserting a portion of a fastener in an opening of a body of a tool; (2) rotating a ring relative to the body in a first rotational direction about a center axis of the tool, wherein the ring is coupled to and concentric with the body; (3) moving a plurality of grips radially inward in response to rotating the ring, wherein the grips are coupled to the body and angularly spaced apart from each other around the opening; (4) engaging the portion of the fastener with the grips in response to moving the grips; (5) with the grips engaged with the portion of the fastener, further rotating the ring in the first rotational direction about the center axis; (6) rotating the body in the first rotational direction about the center axis in response to further rotating the ring; and (7) rotating the fastener in response to rotating the body.

[0008] Other examples of the tool and method will become apparent from the following detailed description, the accompanying drawings, and the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] FIG. **1** is a schematic block diagram of an example of a tool for installing and removing fasteners;

[0010] FIG. **2** is a flow diagram of an example of a method for installing and removing fasteners;

[0011] FIG. **3** is a schematic illustration of an example of the tool;

[0012] FIG. **4** is a schematic illustration of an example of the tool;

[0013] FIG. **5** is a schematic, perspective view of an example of the tool;

[0014] FIG. **6** is a schematic, perspective view of an example of a portion of the tool;

[0015] FIG. **7** is a schematic, perspective view of an example of the tool and a fastener;

[0016] FIG. **8** is a schematic, perspective view of an example of a portion of the tool and the fastener;

[0017] FIG. **9** is a schematic, perspective view of an example of a portion of a body of the tool;

[0018] FIG. **10** is a schematic, perspective view of an example of a portion of the body of the tool;

[0019] FIG. **11** is a schematic, orthogonal view of an example of the tool;

[0020] FIG. **12** is a schematic, orthogonal view of an example of a ring and cam of the tool;

[0021] FIG. **13** is a schematic illustration of an example of a grip;

[0022] FIG. **14** is a schematic illustration of an example of a grip and lugs;

[0023] FIG. **15** is a flow diagram of an example of an aircraft manufacturing and service method; and

[0024] FIG. **16** is a schematic illustration of an example of an aircraft.

DETAILED DESCRIPTION

[0025] Referring generally to FIGS. **1-13**, by way of examples, the present disclosure is directed to a tool **100** and a method **1000** for installing and removing fasteners (e.g., fastener **150** in FIGS. **1**, **7** and **8**). The fastener **150** includes any type of fastener that is rotated to install and remove from one or more workpieces.

[0026] Examples of the fastener **150** include temporary fasteners used to temporarily align and hold components together, for example, during assembly, drilling of holes, installation of permanent fasteners, and the like. A particular example of this type of temporary, reusable fastener is commonly referred to as a Cleco fastener or skin pin. Generally, these Cleco-type temporary fasteners come in two variations, namely the spring-type in which prongs or jaws of the fastener are activated by an internal spring and the threaded-type in which the prongs or jaws of the fasteners are activated by rotation of an internal threaded shaft. Other examples of the fastener **150** include permanent fasteners (e.g., threaded fasteners) used to permanently couple or join components of an assembly together.

[0027] Examples of the tool **100** and method **1000** disclosed herein are primarily intended for use with these threaded-type temporary ("Cleco") fasteners, which include a threaded mechanism (rather than a spring) to extend and retract a spreader bar between the prongs or jaws of the fastener. Rotation of the threaded mechanism in a first direction (e.g., clockwise) retracts the spreader bar into the prongs or jaws, which separates step-cut locks of the prongs or jaws. Further rotation of the threaded mechanism in the first direction squeezes the workpieces in between the step-cut lock area and the cylindrical body of the fastener. Rotation of the threaded mechanism in an opposing second direction (e.g., counterclockwise) extends the spreader bar out from between the prongs or jaws, which allows the step-cut locks of the prongs or jaws to come together. Fasteners of this type can pull parts together more tightly than the spring-type of the first variation.

[0028] Referring generally to FIG. **1**, in one or more examples, the tool **100** includes a number of components, including one or more of a body **102** having an opening **104**, a plurality of grips **106**, a plurality of lugs **108**, a cam **110**, and a ring **140**.

[0029] To install the fastener **150**, a portion of the fastener **150**, such as a head or stem **152** (FIGS. **7** and **8**) of an internal threaded shaft, is received in the opening **104** of the tool **100**. With the fastener **150** in the opening **104**, the stem **152** is positioned between the grips **106**, which are arranged around the opening **104**. At least one of the grips **106** is radially movable relative to the opening **104**. The one or more of the grips **106** that is radially movable may also be referred to as a movable grip or as a radially movable one of the grips **106**. The one or more of the grips **106** that is not radially movable may also be referred to as a fixed grip or as a fixed one of the grips **106**.

[0030] Rotation of the ring **140** in a first rotational direction **112** (e.g., clockwise) relative to the body **102** causes the cam **110** to engage the radially movable one of the grips **106**. Further rotation of the ring **140** relative to the body **102** moves the cam **110** relative to the radially movable one of the grips **106**, which, in turn, moves (e.g., drives or pushes) the radially movable one of the grips **106** in a radially inward direction toward the opening **104** and, thus, the stem **152** of the fastener **150** to lock or clamp down on the stem **152** of the fastener **150** between the grips **106**. With the grips **106** clamped down around the stem **152** of the fastener **150**, still further rotation of the ring **140** rotates the body **102**, which, in turn, rotates the internal threaded shaft of the fastener **150** to spread the prongs or jaws of the fastener **150** and to squeeze a workpiece in between step-cut locks of the prongs or jaws and the cylindrical body of the fastener **150**.

[0031] To remove the tool **100** from the fastener **150** after installation of the fastener **150**, the ring **140** is rotated in a second rotational direction, opposite the first rotational direction **112**, (e.g., counterclockwise). Rotation of the ring **140** relative to the body **102** in the second rotational direction moves the cam **110** relative to the radially movable one of the grips **106** and disengages the cam **110** from the radially movable one of the grips **106**, which, in turn, unlocks or unclamps the fastener **150** from between the grips **106** and permits body **102** to rotate freely relative to the fastener **150**. The tool **100** can then be removed from the fastener **150**.

[0032] To remove the fastener **150**, the tool **100** is inverted or flipped over and a portion of the fastener **150**, such as the head or stem **152** (FIGS. **7** and **8**) of the internal threaded shaft, is received in the opening **104** of the tool **100**. With the fastener **150** in the opening **104**, the stem **152** is positioned between the grips **106**, which are arranged around the opening **104**. Rotation of the ring **140** in the second rotational direction (e.g., counterclockwise) relative to the body **102** causes the cam **110** to engage the radially movable one of the grips **106**. Further rotation of the ring **140** relative to the body **102** moves the cam **110** relative to the radially movable one of the grips **106**, which, in turn, moves (e.g., drives or pushes) the radially movable one of the grips **106** in a radially inward direction toward the opening **104** and, thus, the stem **152** of the fastener **150** to lock or clamp down on the stem **152** of the fastener **150** between the grips **106**. With the grips **106** clamped down around the stem **152** of the fastener **150**, still further rotation of the ring **140** rotates the body **102**, which, in turn, rotates the internal threaded shaft of the fastener **150** to release the workpiece from in between step-cut locks of the prongs or jaws and the cylindrical body of the fastener **150** and to close the prongs or jaws of the fastener **150**.

[0033] Referring to FIGS. **1** and **3-13**, the following are examples of the tool **100**, according to the present disclosure. In various illustrative examples, the tool **100** includes a number of elements, features, and components. Not all of the elements, features, and/or components described or illustrated in one example are required in that example. Some or all of the elements, features, and/or components described or illustrated in one example can be combined with other examples in various ways without the need to include other elements, features, and/or components described in those other examples, even though such combination or combinations are not explicitly described or illustrated by example herein.

[0034] Referring to FIGS. **1** and **3-13**, in one or more examples, the tool **100** includes the body **102**, the grips **106**, the lugs **108**, and the cam **110**. The body **102** includes the opening **104** having a center axis **116**. The grips **106** are coupled to the body **102**. The grips **106** are angularly spaced apart from each other around the opening **104**. At least one of the grips **106** is radially movable relative to the opening **104**. The lugs **108** are coupled to the body **102**. The lugs **108** limit radially inward movement of the at least one of the grips **106**. The cam **110** is coupled to the body **102**. Rotation of the cam **110** about the center axis **116** in the first rotational direction **112** relative to the body **102** moves the at least one of the grips **106** radially inward.

[0035] As illustrated in FIGS. **3** and **4**, at least one of the grips **106** (e.g., a movable grip **106**A) is movable relative to the body **102** and the opening **104** in a radially inward direction (e.g., toward the center of the opening **104**) and in a radially outward direction (e.g., away from the center of the opening **104**). In the example illustrated in FIGS. **3** and **4**, two of the grips **106** (e.g., fixed grips **106**B and **106**C) are fixed relative to the body **102** and the opening **104** and do not move in the radial directions. In one or more examples, each radially movable one of the grips **106** is inwardly movable until at least a portion of the radially movable one of the grips **106** enters the opening **104** (e.g., at least a portion of the radially movable grip **106**A overlaps the opening **104** when viewed along the center axis **116** as shown in FIG. **4**).

[0036] FIGS. **7** and **8** schematically illustrate examples of the tool **100** applied to an example of the fastener **150**. In FIG. **8**, a portion of the body **102** (e.g., a second frame **138**) is removed for clarity. In one or more examples, the dimension (e.g., diameter) of the opening **104** is slightly larger than the cross-sectional dimension (e.g., diameter) of the portion of the threaded mechanism (e.g., the stem **152**) of the fastener **150** to be received in the opening **104**. For example, the opening **104** is sized to permit a clearance fit or fixed fit with the fastener **150**. In examples where at least one of the grips **106** is fixed relative to the body **102** and the opening **104** (i.e., fixed grips **106**B and/or **106**C are not radially movable), a portion of the surface of the fixed one of the grips **106** is directly adjacent to or intersects a perimeter of the opening **104**, as illustrated in FIGS. **3** and **4**.

[0037] As illustrated in FIGS. **3**, **4**, **8**, **9** and **14**, in one or more examples, the lugs **108** form a physical barrier or stop, which limits the radially inward movement of an associated movable one of the grips **106**. As such, the lugs **108** retain the movable one of the grips **106** within the body **102** and prevent the movable one of the grips **106** from escaping (e.g., falling out) of the tool **100** and becoming foreign object debris.

[0038] As illustrated in FIGS. **3**, **4**, and **12**, in one or more examples, the cam **110** includes a cam surface **166** that engages or disengages each movable one of the grips **106** (e.g., movable grip **106**A in FIGS. **3** and **4**) in response to rotation of the ring **140** about the center axis **116** relative to the body **102**. In examples in which more than one of the grips **106** is radially movable relative to the opening **104** (e.g., as illustrated in FIG. **9**), a portion of the cam surface **166** is associated with or corresponds to each of the movable ones of the grips **106** (e.g., as illustrated in FIG. **12**). Generally, the cam surface **166** includes a ramped section that is positioned closer to the opening **104** of the body **102**, which is configured to push the movable one of the grips **106** radially inward, and a dipped section the is positioned farther from the opening **104**, which is configured to permit the movable one of the grips **106** to freely move radially outward.

[0039] Referring to FIGS. **1** and **5-12**, in one or more examples of the tool **100**, at least two of the grips **106** are radially movable relative to the opening **104**. The lugs **108** limit radially inward movement of the at least two of the grips **106**. Rotation of the cam **110** in the first rotational direction **112** relative to the body **102** moves the at least two of the grips **106** radially inward.

[0040] Referring to FIGS. **1** and **5-12**, in one or more examples of the tool **100**, an entirety of the grips **106** is radially movable relative to the opening **104**. The lugs **108** limit radially inward movement of the entirety (i.e., all) of the grips **106**. Rotation of the cam **110** in the first rotational direction **112** relative to the body **102** moves the entirety of the grips **106** radially inward.

[0041] In the illustrated examples, the tool **100** includes three of the grips **106**. However, in other examples, the tool **100** can include only two of the grips **106** or can include four or more of the grips **106**. In the examples illustrated in FIGS. **3** and **4**, one of the grips **106** is radially movable (e.g., movable grip **106**A) and two of the grips **106** are fixed (e.g., fixed grips **106**B and **106**C). In the examples illustrated in FIGS. **6**, **8** and **9**, all three of the grips **106** are radially movable.

[0042] Referring to FIGS. **1**, **3-9** and **13**, in one or more examples of the tool **100**, at least one of or each one of the grips **106** is rotatable about the rotation axis **118** (FIGS. **4**, **6**, **9** and **13**). The rotation axis **118** is at least approximately parallel to the center axis **116**. Generally, the grips **106** that are rotatable about the rotation axis **118** are the radially movable ones of the grips **106** (e.g., the rotatable ones of the grips **106** are also radially movable relative to the opening **104**). However, in other examples, the grips **106** that are rotatable about the rotation axis **118** are the fixed ones of the grips **106** (e.g., the rotatable ones of the grips **106** are fixed relative to the opening **104**). In still other examples, both the fixed ones of the grips **106** and the radially movable ones of the grips **106** are rotatable about the rotation axis **118**.

[0043] Referring to FIGS. **1** and **3-14**, in one or more examples of the tool **100**, at least one of or each one of the grips **106** (e.g., the radially movable ones and/or the fixed ones) includes or takes the form of a roller **114**. In these examples, the roller **114** rotates about the rotation axis **118**. In one or more examples, the radially movable ones of the grips **106** and/or the fixed ones of the grips **106** include the roller **114**.

[0044] Referring to FIGS. **1** and **3-14**, in one or more examples of the tool **100**, the roller **114** is a cylindrical roller **120**. In these examples, the rotation axis **118** extends though the length of the cylindrical roller **120** and the cylindrical roller **120** rotates about the rotation axis **118**. In other examples, the radially movable ones of the grips **106** and/or the fixed ones of the grips **106** can include or take the form of other roller structures, such as spherical rollers and the like.

[0045] Referring to FIGS. **1** and **3-14**, in one or more examples of the tool **100**, the roller **114** is a tubular roller **122**. In these examples, the rotation axis **118** extends though the length of the tubular roller **122** and the tubular roller **122** rotates about the rotation axis **118**.

[0046] Referring to FIGS. **1** and **3-14**, in one or more examples of the tool **100**, at least one of or each one of the

grips **106** also includes a pin **124** that is coupled to the body **102**. In these examples, the tubular roller **122** is rotatable about the pin **124**. The pin **124** extends along or is centered on the rotation axis **118**. In one or more examples, the tubular roller **122** is linearly moveable relative to the pin **124**. As example, the tubular roller **122** is linearly movable relative to the pin **124** in a radial direction relative to the center axis **116** (e.g., in the radially inward and radially outward directions relative to the opening **104**). As another example, the tubular roller **122** is linearly movable relative to the pin **124** along the rotation axis **118**.

[0047] Referring generally to FIGS. **1** and **3-12** and particularly to FIG. **13**, which illustrates an example of one of the grips **106**, which includes the tubular roller **122** and the pin **124**. In one or more examples of the tool **100**, the tubular roller **122** has an inner diameter **142**. The pin **124** has a diameter **144**. As illustrated in FIG. **13**, the diameter **144** of the pin **124** is less than the inner diameter **142** of the tubular roller **122**. The difference between the diameter **144** of the pin **124** and the inner diameter **142** of the tubular roller **122** enables the tubular roller **122** to move radially inward and radially outward relative to the pin **124** in response to engagement of the cam **110** and movement of the cam **110** relative to the tubular roller **122**.

[0048] Referring generally to FIGS. **1** and **3-13** and particularly to FIG. **14**, which illustrates an example of one of the grips **106** with an associated pair of the lugs **108**. In one or more examples of the tool **100**, the plurality of lugs **108** includes at least one lug pair **126** that is associated with at least one of the grips **106**. At least one of the grips **106** is located between the lug pair **126**. A dimension **130** between the lug pair **126** is less than a cross-sectional dimension **132** of the at least one of the grips **106**.

[0049] As illustrated in FIG. **14**, the dimension **130** between the lugs **108** of the lug pair **126** generally refers to the smallest dimension between the lugs **108** of the lug pair **126**, which is closest to the opening **104**. Each of the movable ones of the grips **106** has a corresponding lug pair **126**. The dimension **130** between the lug pair **126** (e.g., the directly adjacent pair of the lugs **108**) being less than the cross-sectional dimension **132** of the movable one of the grips **106** associated with and retained by the lug pair **126** prevents the movable one of the grips **106** from escaping the body **102** during use of the tool **100**.

[0050] Referring to FIGS. **1** and **3-14**, in one or more examples of the tool **100**, each one of the grips **106** is equally angularly spaced apart from a directly adjacent one of the grips **106** around the opening **104**. In one or more examples, each pair of the lugs **108** (e.g., each lug pair **126**) is equally angularly spaced apart from a directly adjacent pair of the lugs **108** (e.g., directly adjacent lug pair **126**).

[0051] Referring to FIGS. **1** and **3-14**, in one or more examples of the tool **100**, the body **102** includes a first frame **136** and the second frame **138**. The second frame **138** is coupled to the first frame **136**. The grips **106** and the lugs **108** are disposed between the first frame **136** and the second frame **138**.

[0052] Referring to FIG. **9**, which illustrates an example of the first frame **136**, and FIG. **10**, which illustrates an example of the second frame **138**. In one or more examples, each one of the grips **106** extends between and/or is coupled to the first frame **136** and the second frame **138**. In one or more examples of the grips **106** (e.g., the movable ones and/or the fixed ones), the roller **114**, such as the cylindrical roller **120**, extend between the first frame **136** and the second frame **138**. In one or more examples of the grips **106** (e.g., the movable ones), the roller **114**, such as the cylindrical roller **120**, is rotatable about the rotation axis **118** relative to the first frame **136** and the second frame **138**. For example, the first frame **136** and the second frame **138** include recesses that receive and retain opposing ends of the roller **114**. In one or more examples of the grips **106** (e.g., the movable ones and/or the fixed ones), the pin **124** extends between and/or is coupled to the first frame **136** and the second frame **138**. For example, the first frame **136** and the second frame **138** include recesses that receive and retain opposing ends of the pin **124**. The tubular roller **122** is situated on the pin **124** between the first frame **136** and the second frame **138**. In these examples, the pin **124** serves as a primary retention feature for the roller **114** and the grips **106** of the lug pair **126** serve as a secondary retention feature in cases where the pin **124** may fail.

[0053] As illustrated in FIGS. **9** and **10**, in one or more examples, each one of the lugs **108** extends between and/or is coupled to the first frame **136** and the second frame **138**. In one or more examples, at least one of the lugs **108** is continuous or is formed by a unitary body. In other examples, such as illustrated in FIGS. **9** and **10**, at least one of the lugs **108** is discontinuous or is formed by multiple segments.

[0054] As illustrated in FIGS. **9** and **10**, in one or more examples of the tool **100**, the first frame **136** and the second frame **138** are coupled or otherwise joined together using a plurality of fasteners **168**.

[0055] Referring to FIGS. **1** and **3-14**, in one or more examples, the tool **100** includes the ring **140**. The ring **140** is coupled to the body **102**. The ring **140** is concentric with the body **102**. The ring **140** is rotatable about the center axis **116** relative to the body **102**. Rotation of the ring **140** about the center axis **116** in turn moves the cam **110** relative to the movable ones of the grips **106**. In one or more examples, the cam **110** is coupled to the ring **140**. In these examples, Rotation of the ring **140** about the center axis **116** in turn rotates the cam **110** about the center axis **116**. At least a portion of the cam surface **166** of the cam **110** extends or projects radially inward from the ring **140** toward the opening **104** of the body **102**. As such, rotation of the ring **140** moves the radially inward section of the cam surface **166** of the cam **110** into engagement with the movable one of the grips **106**, which, in turn, pushes the movable one of the grips **106** in the radially inward direction to engage the fastener **150**. In the example illustrated in FIG. **12**, the cam **110** includes three sections of the cam surface **166**, which are associated with the three movable ones of the grips **106** (e.g., as illustrated in FIG. **9**).

[0056] In various examples, the ring **140** can have any outer shape (e.g., two-dimensional shape viewed along the center axis **116**. The outer shape of the ring **140** can be selected or configured to enable use of a secondary tool (e.g., wrench or pliers) or the hand of an operator. In one or more examples, the ring **140** has a circular shape (e.g., as illustrated). In one or more examples, the ring **140** has a polygonal shape, such as a hexagonal shape. In one or more examples, the ring **140** has an ovular or elliptical shape. Other shapes for the ring **140** are also contemplated.

[0057] Referring to FIGS. **1** and **3-14**, in one or more examples, the tool **100** includes the body **102**. The body **102** includes the center axis **116**, the first frame **136**, and the

second frame **138**. The first frame **136** includes a first opening **146**. The first opening **146** is concentric with the center axis **116**. The second frame **138** is coupled to the first frame **136**. The second frame **138** includes a second opening **148**. The second opening **148** is concentric with the center axis **116**. In other words, the first opening **146** and the second opening **148** are axially aligned along the center axis **116** and, in combination, form the opening **104** of the body **102**. The tool **100** includes the plurality of grips **106**. The grips **106** are disposed between the first frame **136** and the second frame **138**. The grips **106** are angularly spaced apart from each other around the center axis **116**. The tool **100** includes the plurality of lugs **108**. The lugs **108** extend between the first frame **136** and the second frame **138**. The tool **100** includes the ring **140**. The ring **140** is coupled to the body **102**. The ring **140** is concentric with the center axis **116**. The tool **100** includes the cam **110**. The cam **110** is coupled to the ring **140**. The cam **110** extends radially inward. The grips **106** are radially movable relative to the center axis **116**. The lugs **108** limit radially inward movement of the grips **106**. The ring **140** is rotatable about the center axis **116** relative to the body **102**. Rotation of the ring **140** about the center axis **116** in the first rotational direction **112** relative to the body **102** engages the cam **110** with the grips **106** to moves the grips **106** radially inward.

[0058] Referring to FIGS. **1** and **3-14**, in one or more examples of the tool **100**, the lugs **108** includes a plurality of first lugs **162**. The first lugs **162** are coupled to the first frame **136**. The first lugs **162** are angularly spaced apart from each other around the first opening **146**. The lugs **108** also includes a plurality of second lugs **164**. The second lugs **164** are coupled to the second frame **138**. The second lugs **164** are angularly spaced apart from each other around the second opening **148**. In these examples, one of the first lugs **162** and one of the second lugs **164**, in combination, form one of the lugs **108** when the first frame **136** and the second frame **138** are coupled together.

[0059] Referring to FIGS. **1** and **3-14**, in one or more examples of the tool **100**, at least one or each one of the grips **106** (e.g., radially movable ones) is disposed between a directly adjacent pair of the lugs **108** (e.g., the lug pair **126**).

[0060] Referring to FIGS. **1** and **3-14**, in one or more examples of the tool **100**, a directly adjacent pair of the lugs **108** (e.g., the lug pair **126**) forms a pocket **134**. The pocket **134** is configured (e.g., shaped, sized, etc.) to contain an associated one of the grips **106** (e.g., a movable one).

[0061] Referring to FIG. **2**, the following are examples of the method **1000** for installing and removing the fastener **150**, according to the present disclosure. In one or more examples, the method **1000** is implemented using the tool **100** (FIG. **1**). The method **1000** includes a number of elements, steps, operations, or processes. Not all of the elements, steps, operations, or processes described or illustrated in one example are required in that example. Some or all of the elements, steps, operations, or processes described or illustrated in one example can be combined with other examples in various ways without the need to include other elements, steps, operations, or processes described in those other examples, even though such combination or combinations are not explicitly described or illustrated by example herein.

[0062] Generally, the examples of the tool **100** and the method **1000** disclosed herein are designed to allow more installation compliance onto a shaft (e.g., stem **152** or head) of the fastener **150** and removal from the shaft without stripping the roller element (e.g., rotatable ones of the grips **106**, such as the roller **114**) from tool **100**, which may become foreign object debris (FOD). The design is configured to retain the grips **106** and prevent accidental escapement the grips **106** and/or the pin **124** (e.g., FOD prevention is a primary advantage of the tool **110**). Also, examples of the tool **100** and the method **1000** disclosed herein are designed such that the tool **100** does not require lubrication, which may collect debris. In various examples, the tool **100** can be cleaned by ultrasonic cleaning or other means. In one or more examples, the tool **100** and the method **1000** can be used to lock or power other shaft type mechanical components. In various examples, the design of the tool **100** can be scaled and/or sized according to use requirements.

[0063] Referring generally to FIGS. **1** and **3-14** and particularly to FIG. **2**, in one or more examples, the method **1000** includes a step of inserting **1002** a portion of the fastener **150** in the opening **104** of the body **102** of the tool **100**. The method **1000** includes a step of rotating **1004** the ring **140** relative to the body **102** in the first rotational direction **112** about the center axis **116** of the tool **100**. The ring **140** is coupled to and is concentric with the body **102**. The method **1000** includes a step of moving **1006** the plurality of grips **106** radially inward in response to rotating **1004** the ring **140**. The grips **106** are coupled to the body **102** and are angularly spaced apart from each other around the opening **104**. The method **1000** includes a step of engaging **1012** the portion of the fastener **150** (e.g., received by the opening **104**) with the grips **106** in response to moving **1006** the grips **106**. With the grips **106** engaged with the portion of the fastener **150**, the method **1000** includes a step of further rotating **1014** the ring **140** in the first rotational direction **112** about the center axis **116**. The method **1000** includes a step of rotating **1016** the body **102** in the first rotational direction **112** about the center axis **116** in response to further rotating **1014** the ring **140**. The method **1000** includes a step of rotating **1018** the fastener **150** in response to rotating **1016** the body **102**.

[0064] Referring generally to FIGS. **1** and **3-14** and particularly to FIG. **2**, in one or more examples, the method **1000** includes a step of limiting **1010** radially inward movement of the grips **106** using the plurality of lugs **108**. The lugs **108** are coupled to the body **102** and are angularly spaced apart from each other around the opening **104**. Each one of the grips **106** is disposed between a directly adjacent pair of the lugs **108**.

[0065] Referring generally to FIGS. **1** and **3-14** and particularly to FIG. **2**, in one or more examples, according to the method **1000**, moving **1006** the grips **106** radially inward in response to rotating **1004** the ring **140** includes a step of engaging **1008** the grips **106** with the cam **110**. The cam **110** extends radially inward from the ring **140**.

[0066] In one or more examples, the tool **100** is flipped or inverted and the method **1000** is repeated with rotation in the second rotational direction to remove the fastener **150**. As an example, the method **1000** includes a step of inverting **1020** the tool **100** and the method **1000** returns to installing the tool **100** on the fastener **150** (e.g., the step of inserting **1002**). The operational steps of the method **1000** are repeated with the steps of rotating **1004**, **1014**, **1016**, and **1018** being in the second rotational direction.

[0067] Referring now to FIGS. **15** and **16**, examples of the tool **100** and the method **1000** described herein, may be

related to, or used in the context of, the aerospace manufacturing and service method **1100**, as shown in the flow diagram of FIG. **15** and an aircraft **1200**, as schematically illustrated in FIG. **16**. As an example, the aircraft **1200** and/or the manufacturing and service method **1100** may include or utilize fasteners (e.g., fastener **150**) that are installed and/or removed using the tool **100** and/or according to the method **1000**.

[0068] Referring to FIG. **16**, which illustrates an example of the aircraft **1200**. The aircraft **1200** can be any aerospace vehicle or platform. In one or more examples, the aircraft **1200** includes the airframe **1202** having the interior **1206**. The aircraft **1200** includes a plurality of onboard systems **1204** (e.g., high-level systems). Examples of the onboard systems **1204** of the aircraft **1200** include propulsion systems **1208**, hydraulic systems **1212**, electrical systems **1210**, and environmental systems **1214**. In other examples, the onboard systems **1204** also includes one or more control systems coupled to the airframe **1202** of the aircraft **1200**. In yet other examples, the onboard systems **1204** also include one or more other systems **1216**, such as, but not limited to, communications systems, avionics systems, software distribution systems, network communications systems, passenger information/entertainment systems, guidance systems, radar systems, weapons systems, and the like.

[0069] Referring to FIG. **15**, during pre-production of the aircraft **1200**, the manufacturing and service method **1100** includes specification and design (**1102**) of the aircraft **1200** and material procurement (**1104**). During production of the aircraft **1200**, component and subassembly manufacturing (**1106**) and system integration (**1108**) of the aircraft **1200** take place. Thereafter, the aircraft **1200** goes through certification and delivery (**1110**) to be placed in service (**1112**). Routine maintenance and service (**1114**) includes modification, reconfiguration, refurbishment, etc. of one or more systems of the aircraft **1200**.

[0070] Each of the processes of the manufacturing and service method **1100** illustrated in FIG. **15** may be performed or carried out by a system integrator, a third party, and/or an operator (e.g., a customer). For the purposes of this description, a system integrator may include, without limitation, any number of aircraft manufacturers and major-system subcontractors; a third party may include, without limitation, any number of vendors, subcontractors, and suppliers; and an operator may be an airline, leasing company, military entity, service organization, and so on.

[0071] Examples of the tool **100** and the method **1000**, shown and described herein, may be employed during any one or more of the stages of the manufacturing and service method **1100** shown in the flow diagram illustrated by FIG. **15**. In an example, components of the aircraft **1200** can be coupled or otherwise joined together (temporarily or permanently) using fasteners that are installed and/or removed using the tool **100** and/or according to the method **1000** during a portion of component and subassembly manufacturing (**1106**) and/or system integration (**1108**). Further, components of the aircraft **1200** can be coupled or otherwise joined together (temporarily or permanently) using fasteners that are installed and/or removed using the tool **100** and/or according to the method **1000** while the aircraft **1200** is in service (**1112**). Also, components of the aircraft **1200** can be coupled or otherwise joined together (temporarily or permanently) using fasteners that are installed and/or removed using the tool **100** and/or according to the method **1000** during system integration (**1108**) and certification and delivery (**1110**). Similarly, components of the aircraft **1200** can be coupled or otherwise joined together (temporarily or permanently) using fasteners that are installed and/or removed using the tool **100** and/or according to the method **1000** while the aircraft **1200** is in service (**1112**) and during maintenance and service (**1114**).

[0072] The preceding detailed description refers to the accompanying drawings, which illustrate specific examples described by the present disclosure. Other examples having different structures and operations do not depart from the scope of the present disclosure. Like reference numerals may refer to the same feature, element, or component in the different drawings. Throughout the present disclosure, any one of a plurality of items may be referred to individually as the item and a plurality of items may be referred to collectively as the items and may be referred to with like reference numerals. Moreover, as used herein, a feature, element, component, or step preceded with the word "a" or "an" should be understood as not excluding a plurality of features, elements, components, or steps, unless such exclusion is explicitly recited.

[0073] Illustrative, non-exhaustive examples, which may be, but are not necessarily, claimed, of the subject matter according to the present disclosure are provided above. Reference herein to "example" means that one or more feature, structure, element, component, characteristic, and/or operational step described in connection with the example is included in at least one aspect, embodiment, and/or implementation of the subject matter according to the present disclosure. Thus, the phrases "an example," "another example," "one or more examples," and similar language throughout the present disclosure may, but do not necessarily, refer to the same example. Further, the subject matter characterizing any one example may, but does not necessarily, include the subject matter characterizing any other example. Moreover, the subject matter characterizing any one example may be, but is not necessarily, combined with the subject matter characterizing any other example.

[0074] As used herein, a system, apparatus, device, structure, article, element, component, or hardware "configured to" perform a specified function is indeed capable of performing the specified function without any alteration, rather than merely having potential to perform the specified function after further modification. In other words, the system, apparatus, device, structure, article, element, component, or hardware "configured to" perform a specified function is specifically selected, created, implemented, utilized, programmed, and/or designed for the purpose of performing the specified function. As used herein, "configured to" denotes existing characteristics of a system, apparatus, structure, article, element, component, or hardware that enable the system, apparatus, structure, article, element, component, or hardware to perform the specified function without further modification. For purposes of this disclosure, a system, apparatus, device, structure, article, element, component, or hardware described as being "configured to" perform a particular function may additionally or alternatively be described as being "adapted to" and/or as being "operative to" perform that function.

[0075] Unless otherwise indicated, the terms "first," "second," "third," etc. are used herein merely as labels, and are not intended to impose ordinal, positional, or hierarchical requirements on the items to which these terms refer. More-

over, reference to, e.g., a "second" item does not require or preclude the existence of, e.g., a "first" or lower-numbered item, and/or, e.g., a "third" or higher-numbered item.

[0076] As used herein, the phrase "at least one of," when used with a list of items, means different combinations of one or more of the listed items may be used and only one of each item in the list may be needed. For example, "at least one of item A, item B, and item C" may include, without limitation, item A or item A and item B. This example also may include item A, item B, and item C, or item B and item C. In other examples, "at least one of" may be, for example, without limitation, two of item A, one of item B, and ten of item C; four of item B and seven of item C; and other suitable combinations. As used herein, the term "and/or" and the "/" symbol includes any and all combinations of one or more of the associated listed items.

[0077] For the purpose of this disclosure, the terms "coupled," "coupling," and similar terms refer to two or more elements that are joined, linked, fastened, attached, connected, put in communication, or otherwise associated (e.g., mechanically, electrically, fluidly, optically, electromagnetically) with one another. In various examples, the elements may be associated directly or indirectly. As an example, element A may be directly associated with element B. As another example, element A may be indirectly associated with element B, for example, via another element C. It will be understood that not all associations among the various disclosed elements are necessarily represented. Accordingly, couplings other than those depicted in the figures may also exist.

[0078] As used herein, the term "approximately" refers to or represents a condition that is close to, but not exactly, the stated condition that still performs the desired function or achieves the desired result. As an example, the term "approximately" refers to a condition that is within an acceptable predetermined tolerance or accuracy, such as to a condition that is within 10% of the stated condition. However, the term "approximately" does not exclude a condition that is exactly the stated condition. As used herein, the term "substantially" refers to a condition that is essentially the stated condition that performs the desired function or achieves the desired result.

[0079] FIGS. **1**, **3-14** and **16**, referred to above, may represent functional elements, features, or components thereof and do not necessarily imply any particular structure. Accordingly, modifications, additions and/or omissions may be made to the illustrated structure. Additionally, those skilled in the art will appreciate that not all elements, features, and/or components described and illustrated in FIGS. **1**, **3-14** and **16**, referred to above, need be included in every example and not all elements, features, and/or components described herein are necessarily depicted in each illustrative example. Accordingly, some of the elements, features, and/or components described and illustrated in FIGS. **1**, **3-14** and **16** may be combined in various ways without the need to include other features described and illustrated in FIGS. **1**, **3-14** and **16**, other drawing figures, and/or the accompanying disclosure, even though such combination or combinations are not explicitly illustrated herein. Similarly, additional features not limited to the examples presented, may be combined with some or all of the features shown and described herein. Unless otherwise explicitly stated, the schematic illustrations of the examples depicted in FIGS. **1**, **3-14** and **16**, referred to above, are not meant to imply structural limitations with respect to the illustrative example. Rather, although one illustrative structure is indicated, it is to be understood that the structure may be modified when appropriate. Accordingly, modifications, additions and/or omissions may be made to the illustrated structure. Furthermore, elements, features, and/or components that serve a similar, or at least substantially similar, purpose are labeled with like numbers in each of FIGS. **1**, **3-14** and **16**, and such elements, features, and/or components may not be discussed in detail herein with reference to each of FIGS. **1**, **3-14** and **16**. Similarly, all elements, features, and/or components may not be labeled in each of FIGS. **1**, **3-14** and **16**, but reference numerals associated therewith may be utilized herein for consistency.

[0080] In FIGS. **2** and **15**, referred to above, the blocks may represent operations, steps, and/or portions thereof and lines connecting the various blocks do not imply any particular order or dependency of the operations or portions thereof. It will be understood that not all dependencies among the various disclosed operations are necessarily represented. FIGS. **2** and **15** and the accompanying disclosure describing the operations of the disclosed methods set forth herein should not be interpreted as necessarily determining a sequence in which the operations are to be performed. Rather, although one illustrative order is indicated, it is to be understood that the sequence of the operations may be modified when appropriate. Accordingly, modifications, additions and/or omissions may be made to the operations illustrated and certain operations may be performed in a different order or simultaneously. Additionally, those skilled in the art will appreciate that not all operations described need be performed.

[0081] Further, references throughout the present specification to features, advantages, or similar language used herein do not imply that all of the features and advantages that may be realized with the examples disclosed herein should be, or are in, any single example. Rather, language referring to the features and advantages is understood to mean that a specific feature, advantage, or characteristic described in connection with an example is included in at least one example. Thus, discussion of features, advantages, and similar language used throughout the present disclosure may, but does not necessarily, refer to the same example.

[0082] The described features, advantages, and characteristics of one example may be combined in any suitable manner in one or more other examples. One skilled in the relevant art will recognize that the examples described herein may be practiced without one or more of the specific features or advantages of a particular example. In other instances, additional features and advantages may be recognized in certain examples that may not be present in all examples. Furthermore, although various examples of the tool **100** and the method **1000** have been shown and described, modifications may occur to those skilled in the art upon reading the specification. The present application includes such modifications and is limited only by the scope of the claims.

1. A tool comprising:

a body comprising an opening having a center axis;

a plurality of grips coupled to the body and angularly spaced apart from each other around the opening, wherein at least one of the grips is radially movable relative to the opening;

a plurality of lugs coupled to the body, wherein the lugs limit radially inward movement of the at least one of the grips; and

a cam coupled to the body, wherein rotation of the cam about the center axis in a first rotational direction relative to the body moves the at least one of the grips radially inward.

2. The tool of claim **1**, wherein:

at least two of the grips are radially movable relative to the opening;

the plurality of lugs limits radially inward movement of the at least two of the grips; and

rotation of the cam in the first rotational direction relative to the body moves the at least two of the grips radially inward.

3. The tool of claim **1**, wherein:

an entirety of the grips is radially movable relative to the opening;

the plurality of lugs limits radially inward movement of the entirety of the grips; and

rotation of the cam in the first rotational direction relative to the body moves the entirety of the grips radially inward.

4. The tool of claim **1**, wherein the at least one of the grips is rotatable about a rotation axis that is parallel to the center axis.

5. The tool of claim **1**, wherein the at least one of the grips comprises a roller.

6. The tool of claim **5**, wherein the roller is a cylindrical roller.

7. The tool of claim **5**, wherein the roller is a tubular roller.

8. The tool of claim **7**, wherein:

the at least one of the grips further comprises a pin that is coupled to the body; and

the tubular roller is rotatable about the pin and is linearly moveable relative to the pin.

9. The tool of claim **8**, wherein:

the tubular roller has an inner diameter;

the pin has a diameter; and

the diameter of the pin is less than the inner diameter of the tubular roller.

10. The tool of claim **1**, wherein:

the plurality of lugs comprises at least one lug pair associated with the at least one of the grips;

the at least one of the grips is located between the lug pair; and

a dimension between the lug pair is less than a cross-sectional dimension of the at least one of the grips.

11. The tool of claim **1**, wherein each one of the grips is equally angularly spaced apart from a directly adjacent one of the grips around the opening.

12. The tool of claim **1**, wherein:

the body comprises:

a first frame; and

a second frame coupled to the first frame; and

the grips and the lugs are disposed between the first frame and the second frame.

13. The tool of claim **1**, further comprising a ring that is coupled to and concentric with the body,

wherein:

the ring is rotatable about the center axis relative to the body; and

the cam is coupled to the ring.

14. A tool comprising:

a body comprising:

a center axis;

a first frame comprising a first opening that is concentric with the center axis;

a second frame coupled to the first frame and comprising a second opening that is concentric with the center axis;

a plurality of grips disposed between the first frame and the second frame and angularly spaced apart from each other around the center axis;

a plurality of lugs extending between the first frame and the second frame;

a ring coupled to the body and concentric with the center axis; and

a cam coupled to the ring and extending radially inward, wherein:

the grips are radially movable relative to the center axis;

the lugs limit radially inward movement of the grips;

the ring is rotatable about the center axis relative to the body; and

rotation of the ring about the center axis in a first rotational direction relative to the body engages the cam with the grips to move the grips radially inward.

15. (canceled)

16. The tool of claim **14**, wherein each one of the grips is rotatable about a rotation axis that is parallel to the center axis.

17. The tool of claim **14**, wherein each one of the grips comprises a roller.

18-24. (canceled)

25. The tool of claim **14**, wherein each one of the grips is disposed between a directly adjacent pair of the lugs.

26-29. (canceled)

30. A method for installing a fastener using a tool, the method comprising:

inserting a portion of the fastener in an opening of a body of the tool;

rotating a ring relative to the body in a first rotational direction about a center axis of the tool, wherein the ring is coupled to and concentric with the body;

moving a plurality of grips radially inward in response to rotating the ring, wherein the grips are coupled to the body and angularly spaced apart from each other around the opening;

engaging the portion of the fastener with the grips in response to moving the grips;

with the grips engaged with the portion of the fastener, further rotating the ring in the first rotational direction about the center axis;

rotating the body in the first rotational direction about the center axis in response to further rotating the ring; and

rotating the fastener in response to rotating the body.

31. The method of claim **30**, further comprising limiting radially inward movement of the grips using a plurality of lugs, wherein:

the lugs are coupled to the body and angularly spaced apart from each other around the opening; and

each one of the grips is disposed between a directly adjacent pair of the lugs.

32. The method of claim **30**, wherein:
moving the grips radially inward in response to rotating the ring comprises engaging the grips with a cam; and
the cam extends radially inward from the ring.

* * * * *