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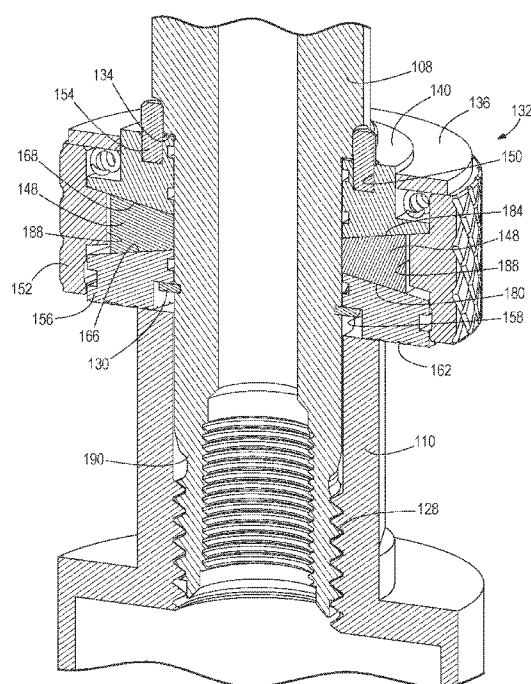


FIG. 10

(57) Abstract: A bit-removal assembly includes a first ring coupled to an output shaft for co-rotation therewith, a second ring supported on the lower retaining ring of the output shaft, a frusto-conical surface on at least one of the first or second rings, and a wedge positioned between the first and second rings and engaging with the frusto-conical surface. A collar defines a cam surface located radially outward of the wedge. The collar is movable between a locked position, in which the cam surface is engaged with the wedge to displace the wedge radially inward on the frusto-conical surface to separate the second ring from the first ring, and a released position, in which the cam surface is misaligned with the wedge to permit the wedge to move radially outward on the frusto-conical surface. A biasing member urges the collar towards the locked position.

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CORE DRILL

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to co-pending U.S. Provisional Patent Application No. 63/170,084 filed on April 2, 2021, the entire content of which is incorporated herein by reference.

FIELD OF THE INVENTION

[0002] The present invention relates a large drill, and more particularly to a core drill.

BACKGROUND OF THE INVENTION

[0003] Large drills, such as core drills, typically provide a large amount of torque during operation to rotate a core bit. With the reaction torque on the core bit being equally as large, a core bit may become seized on the chuck of the core drill, which makes removal difficult for the user.

SUMMARY OF THE INVENTION

[0004] In one aspect, the invention provides a core drill assembly including a housing, a drive mechanism supported within the housing, an output shaft configured to rotate about a rotational axis in response to torque received from the drive mechanism, the output shaft having a threaded connection to which a core bit is threaded, a lower retaining ring, and an upper retaining shoulder. The core drill assembly also includes a bit-removal assembly coupled to the output shaft between the lower retaining ring and the upper retaining shoulder. The bit-removal assembly includes a first ring coupled to the output shaft for co-rotation therewith, a second ring supported on the lower retaining ring of the output shaft, a frusto-conical surface on at least one of the first or second rings, a wedge positioned between the first and second rings, the wedge being engaged with the frusto-conical surface, and a collar defining a cam surface located radially outward of the wedge. The collar is movable between a locked position, in which the cam surface is engaged with the wedge to displace the wedge radially inward on the frusto-conical surface to separate the second ring from the first ring, and a released position, in which the cam surface is misaligned with the wedge to permit the wedge to move radially outward on the frusto-conical surface. A biasing member is configured to urge the collar towards the locked position.

[0005] In another aspect, the invention provides a bit removal assembly configured to be coupled to an output shaft of a power tool. The bit-removal assembly includes a first ring configured to be coupled to the output shaft for co-rotation therewith, a second ring supported on a retaining ring on the output shaft, a frusto-conical surface on at least one of the first or second rings, a wedge positioned between the first and second rings, the wedge being engaged with the frusto-conical surface, and a collar defining a cam surface located radially outward of the wedge. The collar is movable between a locked position, in which the cam surface is engaged with the wedge to displace the wedge radially inward on the frusto-conical surface to separate the second ring from the first ring, and a released position, in which the cam surface is misaligned with the wedge to permit the wedge to move radially outward on the frusto-conical surface. A biasing member is configured to urge the collar towards the locked position.

[0006] In yet another aspect, the invention provides a core drill assembly including a housing, a drive mechanism supported within the housing, an output shaft configured to rotate about a rotational axis in response to torque received from the drive mechanism, the output shaft having a threaded connection to which a core bit is threaded, and a bit-removal assembly removably coupled to the output shaft between a lower retaining ring and an upper retaining shoulder. The bit-removal assembly includes a first ring removably coupled to the output shaft for co-rotation therewith, a second ring selectively supported on the lower retaining ring, a frusto-conical surface on at least one of the first or second rings, a wedge positioned between the first and second rings, the wedge being engaged with the frusto-conical surface, and a collar disposed around the wedge. The collar is movable between a locked position, in which the wedge is displaced radially inward on the frusto-conical surface to separate the second ring from the first ring, and a released position, in which the wedge is permitted to move radially outward on the frusto-conical surface. A washer is disposed within the collar and coupled to the collar for co-rotation therewith and a biasing member is positioned between the washer and the first ring. The biasing member is configured to urge the collar towards the locked position.

BRIEF DESCRIPTION OF THE DRAWINGS

- [0007] FIG. 1 is a perspective view of a core drill assembly in accordance with an embodiment of the invention, including a core drill and a stand.
- [0008] FIG. 2 is another perspective view of the core drill assembly of FIG. 1.
- [0009] FIG. 3 is a rear view of the core drill assembly of FIG. 1.
- [0010] FIG. 4 is a front view of the core drill assembly of FIG. 1.
- [0011] FIG. 5 is a perspective view of a modular bit-removal assembly for use with the core drill assembly of FIG. 1.
- [0012] FIG. 6 is a perspective, cross-sectional view of the modular bit-removal assembly of FIG. 5.
- [0013] FIG. 7 is an exploded view of the modular bit-removal assembly of FIG. 5.
- [0014] FIG. 8 is a cross-sectional view of the modular bit-removal assembly of FIG. 5 through section line 8-8 in FIG. 6, illustrating a collar of the bit-removal assembly in a locked position.
- [0015] FIG. 9 is a top, partial cutaway view of the modular bit-removal assembly of FIG. 5, illustrating a biasing member that urges the collar towards the locked position.
- [0016] FIG. 10 is a perspective, cross-sectional view of a portion of the core drill of FIG. 1, illustrating the modular bit-removal assembly of FIG. 5 coupled to an output shaft of the core drill and the collar in the locked position.
- [0017] FIG. 11 is a side, cross-sectional view of a portion of the core drill of FIG. 1, illustrating the modular bit-removal assembly of FIG. 5 coupled to an output shaft of the core drill and the collar in a released position.
- [0018] FIG. 12 a perspective, cross-sectional view of a portion of the core drill of FIG. 1, illustrating a core bit being removed from the output shaft of the core drill.

[0019] Before any embodiments of the invention are explained in detail, it is to be understood that the invention is not limited in its application to the details of construction and the arrangement of components set forth in the following description or illustrated in the following drawings. The invention is capable of other embodiments and of being practiced or of being carried out in various ways. Also, it is to be understood that the phraseology and terminology used herein is for the purpose of description and should not be regarded as limiting.

DETAILED DESCRIPTION

[0020] FIGS. 1-4 illustrate a core drill assembly 10 including a stand 12 having a base 14 for mounting on a mounting surface 16 that can be vertical (e.g., a wall) or horizontal (e.g., the ground, as shown in FIG. 1). The stand 12 includes a mast 18, a carriage 22 that is movable along the length of the mast 18, and a support bracket 26 moveably coupled to the mast 18 and the base 14. The mast 18 defines a longitudinal axis 30 and is pivotably coupled to the base 14 to pivot about a pivot joint 34. The core drill assembly 10 also includes a core drill 36 mounted to the carriage 22.

[0021] The support bracket 26 is moveably coupled to the mast 18 via a tool-free clamping mechanism 38 that selectively locks the support bracket 26 to the mast 18. As shown in FIG. 3, the clamping mechanism 38 includes a pair of clamping arms 42 positioned on respective rails 46 on the mast 18. The rails 46 are parallel with the longitudinal axis 30 of the mast 18. A handle 50 can be rotated to tighten the clamping arms 42 to the rails 46. Specifically, a bolt 51 (FIG. 1) is coupled for rotation with the handle 50. The bolt 51 extends through and is rotatable relative to the clamping arms 42 to selectively lock or unlock the support bracket 26 with respect to the mast 18 so the support bracket 26 is movable between an operational position (FIG. 1-4) and a stowed position (not shown). When the support bracket 26 is locked with respect to the mast 18, an operator may grasp the support bracket 26 to carry the drill assembly 10.

[0022] As shown in FIGS 1-4, the drill stand 12 includes a battery mount 28 that selectively receives a battery pack. The battery mount 28 is attached to the mast 18 within a space bounded by the mast 18, the support bracket 26, and the base 14. In the illustrated embodiment, the core drill 36 includes a battery pack 104, and the battery mount 28 may be used to store a spare (charged) battery pack ready for the core drill 36 in case the battery pack

104 on the core drill 36 requires recharging. In other embodiments, the battery mount 28 may receive a battery pack that can power the core drill 36. In other embodiments (not shown), the battery mount 28 may be arranged on the support bracket 26 but within the same space bounded by the mast 18, the support bracket 26, and the base 14 to provide protection for the battery pack.

[0023] With continued reference to FIGS. 1-4, the stand 12 further includes a handle 54 coupled to a top portion of the mast 18. In the illustrated embodiment, the handle 54 is a D-shaped handle. In some embodiments, the handle 54 may be rotatable about the longitudinal axis 30. The base 14 further includes a pair of wheels 58 coupled to a rear portion of the base 14 to aid with the movement of the drill assembly 10 on the mounting surface 16. The wheels 58 may engage the mounting surface 16 when the base 14 is pivoted relative to the mounting surface 16. For example, the operator may grasp the handle 54 to pivot the base 14 relative to the mounting surface 16 and roll the drill assembly 10 to a desired location on the mounting surface 16 using the wheels 58.

[0024] As shown in FIGS. 1-4, the base 14 includes a wear plate 60 having an elongated slot 62 through which a mounting bolt 64 may be inserted to secure the base 14 to the mounting surface 16 by, for example, setting the mounting bolt through the wear plate 60 and into a bore created in the mounting surface 16. The base 14 also includes a plurality of adjusters 66 positioned at each corner of the base 14. The adjusters 66 may be threadably adjusted with respect to the base 14 in order to vertically adjust respective feet 70 attached to the screws 66 with respect to the base 14. In the illustrated embodiment, there are four screws 66, one in each corner of the base 14, but in other embodiments there may be more or fewer screws 66, and the screws may be in different locations on the base 14. The operator may adjust the height and orientation of the base 14 with respect to the mounting surface 16 by adjusting one or more of the screws 66 with respect to the base 14.

[0025] As shown in FIGS. 1-3, the carriage 22 includes a spindle assembly 74 for moveably adjusting the carriage 22 along the mast 18, a handle assembly 78 for rotating the spindle assembly 74, and a lock assembly 82 that is operable to secure the carriage 22 in a selected position on the mast 18. The handle assembly 78 can be interchangeably coupled to the spindle assembly 74 on either side of the carriage 22 and is configured to translate the core drill 36 relative to the mast 18. In some embodiments, the spindle assembly 74 may include a brake mechanism that prevents the handle assembly 78 from rotating when the

operator is not holding the handle assembly 78. The lock assembly 82 includes a first adjustment dial 86 positioned on a first side 88 (FIG. 1) of the carriage 22 and a second adjustment dial 90 positioned on a second side 92 (FIG. 2) of the carriage 22.

[0026] Now with reference to FIG. 1, the core drill 36 includes a main body housing 96, a drive mechanism housing 100 enclosing a drive mechanism 102 (schematically shown in FIG. 1), a battery receptacle formed in the housing 96 that receives the battery pack 104, and an output shaft 108 coupled to the drive mechanism. The output shaft 108 is operable to rotate about a rotational axis in response to torque received from the drive mechanism. The core drill 36 includes a water jacket 112 surrounding the output shaft 108 to supply water to the interior of the output shaft 108 and to a connected core bit 110 (FIGS. 8-10) to abate dust formation during a coring operation. The water jacket 112 includes an inlet 116 that can be operably coupled to a water source (e.g., a hose) for supplying water to the output shaft 108. In the illustrated embodiment, the core drill assembly 10 includes an auxiliary hose 120 having a first end connected to the inlet 116 and an opposite, second end connected to a valve 124, which has a fitting that is connectable to another hose for supplying water to the water jacket 112.

[0027] Now with reference to FIGS. 10-12, the output shaft 108 of the core drill 36 includes a threaded connection 128 to which the core bit 110 is threaded. A bit-removal assembly 132 is coupled to the output shaft 108 above the threaded connection 128. In the illustrated embodiment, the bit-removal assembly 132 is supported on the output shaft 108 between a lower retaining ring 130 and an upper retaining shoulder 134 of the output shaft 108. The bit-removal assembly 132 restricts the core bit 110 from threading beyond a desired height (FIG. 10) to prevent the core bit 110 from seizing on the threaded connection 128 of the output shaft 108 during a high-torque event. In the illustrated embodiment, the bit-removal assembly 132 is modular and may be removed from the output shaft 108, if necessary, for repair or replacement. In other words, the bit-removal assembly 132 is not integrally formed on the output shaft 108 of the core drill 36.

[0028] Now with reference to FIGS. 5-9, the bit-removal assembly 132 includes an upper washer 136, an upper (first) ring 140 positioned within the upper washer 136, a biasing member 144 positioned between the upper washer 136 and the upper ring 140, a collar 152 coupled for co-rotation with the upper washer 136, a lower ring 156, and a plurality of wedges 148 positioned between the upper and lower rings 140, 156. The upper ring 140 is

coupled to the output shaft 108 of the core drill 36 for co-rotation with the output shaft 108 during operation of the core drill 36. In the illustrated embodiment, the upper ring 140 includes a pair of recesses 150 (FIG. 5) that are sized to receive respective pins 154 (FIG. 10), which rotationally affix the upper ring 140 to the output shaft 108. And, the top surface of the upper ring 140 (in which the recesses 150 are formed) is abutted with the upper retaining shoulder 134. The lower ring 156 includes a ledge 158 that engages the lower retaining ring 130 (FIG. 10) of the output shaft 108. As such, the bit-removal assembly 132 is axially captured between the shoulder 134 and the retaining ring 130. The lower ring 156 further includes an engagement surface 162 that engages the core bit 110 to restrict threading of the core bit 110 beyond a desired height on the output shaft 108. In the illustrated embodiment, the engagement surface 162 has a knurled surface that enhances friction between the core bit 110 and the bit-removal assembly 132.

[0029] As illustrated in FIGS. 7 and 9, the upper washer 136 includes a pair of protrusions 160 that move relative to a second pair of protrusions 164 formed on the upper ring 140. In the illustrated embodiment, the upper ring 140 is fixed to the output shaft 108 of the core drill 36 and the upper washer 136 is coupled for co-rotation with the collar 152. The biasing member 144 extends between the protrusions 160 formed on the upper ring 140 and the protrusions 164 formed on the upper washer 136 to urge the collar 152 of the bit-removal assembly 132 towards a locked position, which is further described below (FIGS. 6 and 10). In the illustrated embodiment, the biasing member 144 includes two coil springs that together urge the collar 152 towards the locked position. In other embodiments, the upper washer 136 and the upper ring 140 may be formed as a single structure that is coupled for co-rotation with the output shaft 108 of the core drill 36. In such embodiments, the biasing member 144 may be positioned between the collar 152 and the upper ring 140 to urge the collar 152 towards the locked position.

[0030] With continued reference to FIGS. 6-8, the lower ring 156 defines a frusto-conical support surface 166 (FIG. 6) formed on a top portion of the lower ring 156 opposite the engagement surface 162. The upper ring 140 includes an opposing frusto-conical support surface 168 formed on a bottom-facing portion of the upper ring 140 and a second plurality of protrusions 172 (FIG. 7) that extend downward from the support surface 168. The second plurality of protrusions 172 are radially spaced on the support surface 168 to define receiving channels 176 (FIG. 7), which are respectively sized to receive one of the wedges 148. In the

illustrated embodiment, the upper ring 140 includes four receiving channels 176, which are each sized to receive one of the wedges 148 (for a total of four wedges). In other embodiments, the bit-removal assembly 132 may include more (e.g., five, six, etc.) or less (e.g., three, two, or one) receiving channels and wedges.

[0031] In the illustrated embodiment, the frusto-conical support surface 166 of the lower ring 156 is tapered in a radially outward direction (i.e., the thickness of the lower ring 156 decreases in a radially outward direction) and supports a lower angled surface 180 of the wedge 148. The opposing frusto-conical support surface 168 of the upper ring 140 is also tapered in a radially outward direction (i.e., the thickness of the upper ring 140 decreases in a radially outward direction) and engages a top angled surface 184 of the wedge 148 to locate the wedge 148 within the channel 176. In the illustrated embodiment, the wedges 148 and the receiving channels 176 each have a trapezoidal geometry.

[0032] Now with reference to FIG. 8, the collar 152 includes a cam surface 188 that engages the wedges 148 to adjust the radial position of the wedges 148 on the support surface 166 of the lower ring 156. In the illustrated embodiment, the cam surface 188 extends radially inward from an inner surface of the collar 152 in a gradually increasing manner. Rotation of the collar 152 in a first (clockwise) direction 192 causes each wedge 148 to move radially inward (e.g., towards the output shaft 108) on the support surface 166 and towards a locked position (FIGS. 8 and 10). In the illustrated embodiment, the biasing member 144 urges the upper washer 136 and the collar 152 in the first direction 192 and towards the locked position. In the locked position, the cam surface 188 engages with the wedges 148 to displace the wedges 148 radially inward on the frusto-conical support surface 166, which pushes the lower ring 156 away from the upper ring 140. Accordingly, the wedges 148 separate the upper and lower rings 140, 156 such that the bit-removal assembly 132 forms a rigid body. In the locked position of the collar 152, the lower ring 156 may receive a clamping force from the core bit 110 in response to a reaction torque applied to the core bit 110 during a drilling operation, causing the core bit 110 to further tighten on the threaded connection 128 and frictionally engage the engagement surface 162 of the lower ring 156.

[0033] Rotation of the collar 152 in a second (counter-clockwise) direction 196 permits each wedge 148 to move radially outward (e.g., away from the output shaft 108) on the support surface 166 and towards a released position (FIG. 11). In the illustrated embodiment, the co-rotation of the collar 152 and the upper washer 136 in the second direction 196 causes

the protrusion 160 of the upper washer 136 to move towards the opposing protrusion 164 of the upper ring 140, which compresses the biasing member 144. As the biasing member 144 compresses, the cam surfaces 188 on the collar 152 become rotationally misaligned with the wedges 148, permitting them to move radially outward along the support surface 166 of the lower ring 156. In the released position, the cam surface 188 is misaligned with the wedge 148 to permit the wedge 148 to move radially outward on the frusto-conical support surface 166, which releases the clamping force against the lower ring 156 from the core bit 110 to permit unthreading of the core bit 110 from the output shaft 108. After the collar 152 is released by the user, the biasing member 144 urges the collar 152 back towards the locked position (FIGS. 8 and 10).

[0034] Now with reference to FIG. 10-12, when the core bit 110 is threaded to the threaded connection 128, the top surface of the core bit 110 contacts the engagement surface 162 of the lower ring 156 (FIG. 10) prior to an uppermost thread 190 on the core bit 110 reaching the end of the threaded connection 128. In the locked position, the wedges 148 restrict upward movement of the lower ring 156 on the output shaft 108. This also prevents the uppermost thread on the core bit 110 from reaching the end of the threaded connection 128 that might otherwise cause the core bit 110 to seize on the output shaft 108 after being subject to a large reaction torque during a coring operation.

[0035] To remove the core bit 110 after a coring operation, the collar 152 is rotated in the second direction 196 (FIG. 8), which rotationally misaligns the cam surfaces 188 with the respective wedges 148 and compresses the biasing member 144. With the cam surfaces 188 being rotationally misaligned with the wedges 148, the wedges 148 may be displaced radially outward (FIG. 11) along the support surface 166 and towards the released position. With the wedges 148 in their radially outward position of FIG. 11, the clamping force formerly applied to the lower ring 156 and the core bit 110 by the wedges 148 is also released, permitting the lower ring 156 and the core bit 110 to be rotated relative to the output shaft 108, which allows the core bit 110 to begin to unthread from the output shaft 108. After a gap is created between the core bit 110 and the lower ring 156 (FIG. 11), the core bit 110 may be easily removed from the output shaft 108 (FIG. 12) without any frictional resistance being applied. Therefore, the core bit 110 can be removed from the output shaft 108, even after a high-torque event, by hand without the use of tools.

[0036] Various features of the invention are set forth in the following claims.

CLAIMS

What is claimed is:

1. A core drill comprising:
 - a housing;
 - a drive mechanism supported within the housing;
 - an output shaft configured to rotate about a rotational axis in response to torque received from the drive mechanism, the output shaft having a threaded connection to which a core bit is threaded, a lower retaining ring, and an upper retaining shoulder; and
 - a bit-removal assembly coupled to the output shaft between the lower retaining ring and the upper retaining shoulder, the bit-removal assembly including
 - a first ring coupled to the output shaft for co-rotation therewith,
 - a second ring supported on the lower retaining ring of the output shaft,
 - a frusto-conical surface on at least one of the first or second rings,
 - a wedge positioned between the first and second rings, the wedge being engaged with the frusto-conical surface,
 - a collar defining a cam surface located radially outward of the wedge, the collar being movable between a locked position, in which the cam surface is engaged with the wedge to displace the wedge radially inward on the frusto-conical surface to separate the second ring from the first ring, and a released position, in which the cam surface is misaligned with the wedge to permit the wedge to move radially outward on the frusto-conical surface, and
 - a biasing member configured to urge the collar towards the locked position.
2. The core drill of claim 1, wherein the second ring includes an engagement surface that engages the core bit to restrict threading of the core bit beyond a desired height of the output shaft when the collar is in the locked position.
3. The core drill of claim 2, wherein the engagement surface of the second ring has a knurled surface that enhances friction between the engagement surface and the core bit.
4. The core drill of claim 2, wherein
 - the frusto-conical surface is a first frusto-conical surface formed on a bottom-facing portion of the first ring, and

the second ring includes a second frusto-conical support surface formed on a top portion of the second ring opposite the engagement surface.

5. The core drill of claim 1, wherein the bit-removal assembly is modular and removable from the output shaft.

6. The core drill of claim 5, wherein the first ring includes a pair of recesses that are sized to receive pins that couple the first ring to the output shaft.

7. The core drill of claim 1, wherein
a washer is coupled to the collar for co-rotation therewith,
the biasing member extends between a first protrusion formed on the first ring and a second protrusion formed on the washer, and
moving the collar toward the released position moves the first protrusion toward the second protrusion to compress the biasing member.

8. A bit-removal assembly configured to be coupled to an output shaft of a power tool, the bit-removal assembly comprising:

a first ring configured to be coupled to the output shaft for co-rotation therewith;

a second ring supported on a retaining ring on the output shaft;

a frusto-conical surface on at least one of the first or second rings;

a wedge positioned between the first and second rings, the wedge being engaged with the frusto-conical surface;

a collar defining a cam surface located radially outward of the wedge, the collar being movable between a locked position, in which the cam surface is engaged with the wedge to displace the wedge radially inward on the frusto-conical surface to separate the second ring from the first ring, and a released position, in which the cam surface is misaligned with the wedge to permit the wedge to move radially outward on the frusto-conical surface; and

a biasing member configured to urge the collar towards the locked position.

9. The bit-removal assembly of claim 8, wherein

the frusto-conical surface is a first frusto-conical surface formed on a bottom-facing portion of the first ring, and

the second ring includes a second frusto-conical support surface formed on a top portion of the second ring.

10. The bit-removal assembly of claim 8, wherein the first ring further includes a plurality of protrusions spaced radially apart from one another to define a channel, and wherein the channel is configured to receive the wedge.

11. The bit-removal assembly of claim 10, wherein both the channel and the wedge have a trapezoidal geometry.

12. The bit-removal assembly of claim 8, wherein
a washer is coupled to the collar for co-rotation therewith,
the biasing member extends between a first protrusion formed on the first ring and a
second protrusion formed on the washer, and
moving the collar toward the released position moves the first protrusion toward the
second protrusion to compress the biasing member.
13. The bit-removal assembly of claim 8, wherein the frusto-conical surface tapers
outwardly in a radially outward direction.

14. A core drill comprising:
a housing;
a drive mechanism supported within the housing;
an output shaft configured to rotate about a rotational axis in response to torque received from the drive mechanism, the output shaft having a threaded connection to which a core bit is threaded; and

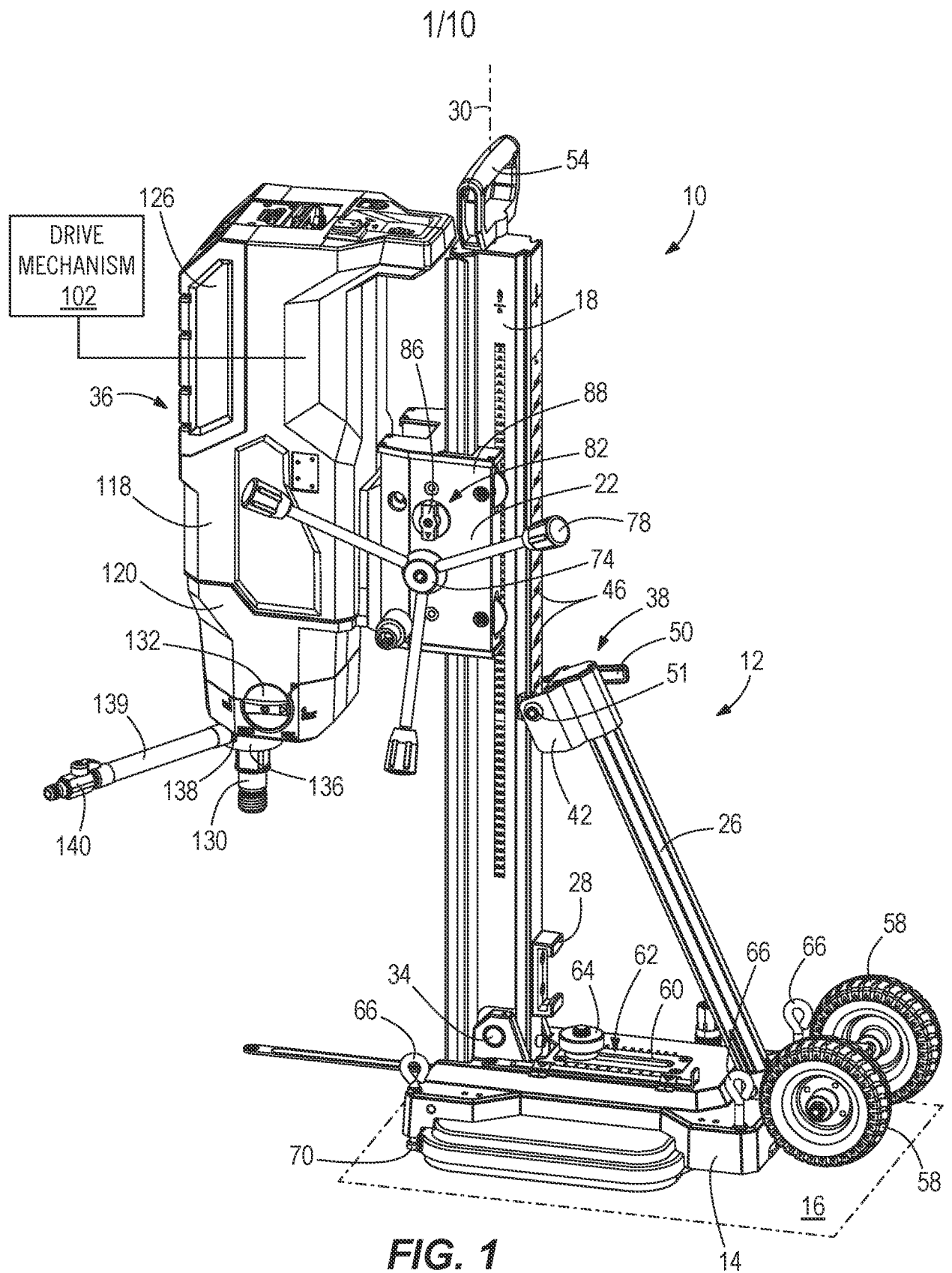
a bit-removal assembly removably coupled to the output shaft between a lower retaining ring and an upper retaining shoulder, the bit-removal assembly including
a first ring removably coupled to the output shaft for co-rotation therewith,
a second ring selectively supported on the lower retaining ring,
a frusto-conical surface on at least one of the first or second rings,
a wedge positioned between the first and second rings, the wedge being engaged with the frusto-conical surface,
a collar disposed around the wedge, the collar being movable between a locked position, in which the wedge is displaced radially inward on the frusto-conical surface to separate the second ring from the first ring, and a released position, in which the wedge is permitted to move radially outward on the frusto-conical surface,
a washer disposed within the collar and coupled to the collar for co-rotation therewith, and
a biasing member positioned between the washer and the first ring, the biasing member configured to urge the collar towards the locked position.

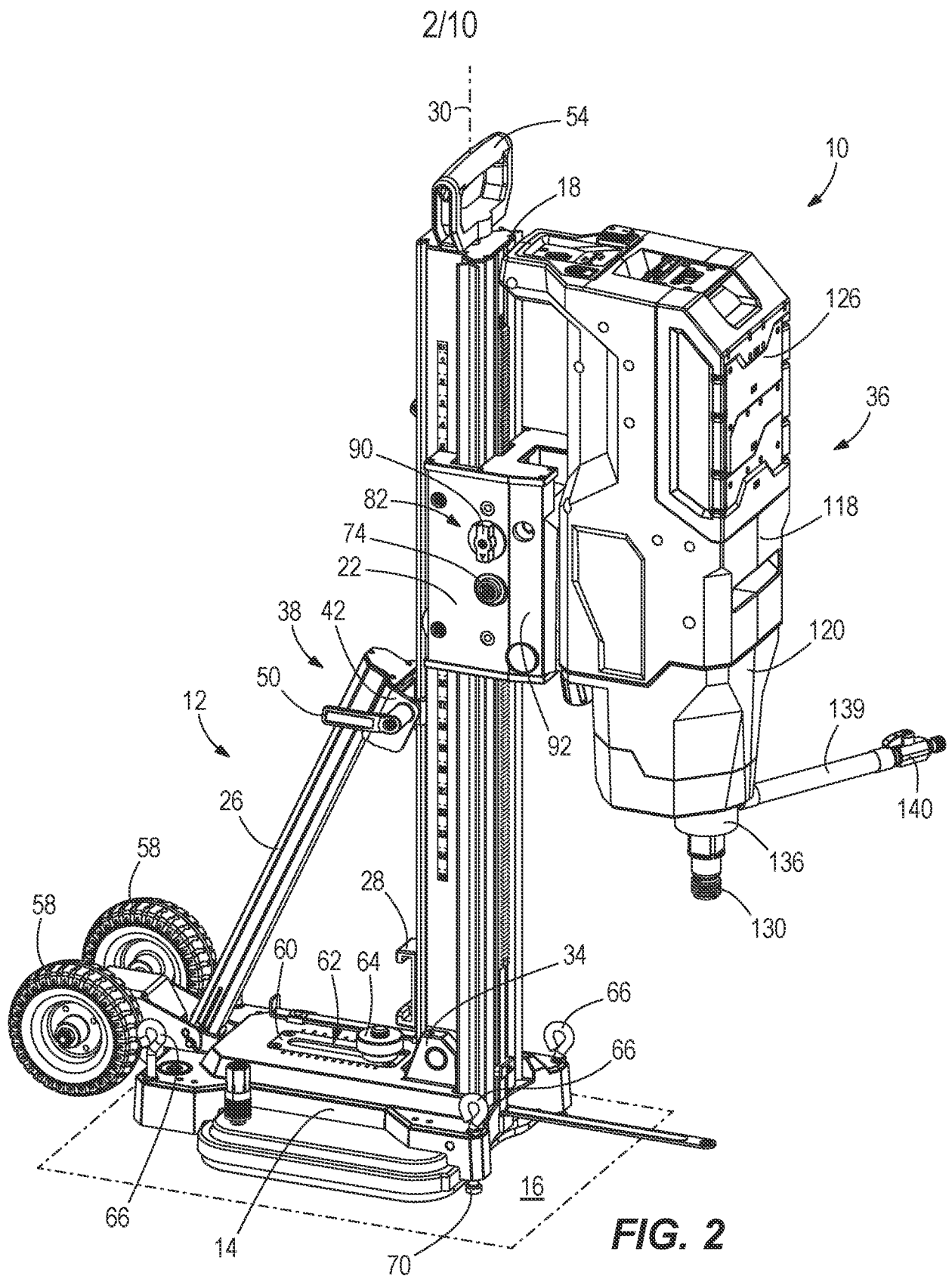
15. The core drill of claim 14, wherein the second ring of the bit-removal assembly includes a ledge that engages the lower retaining ring when the bit-removal assembly is coupled to the output shaft.

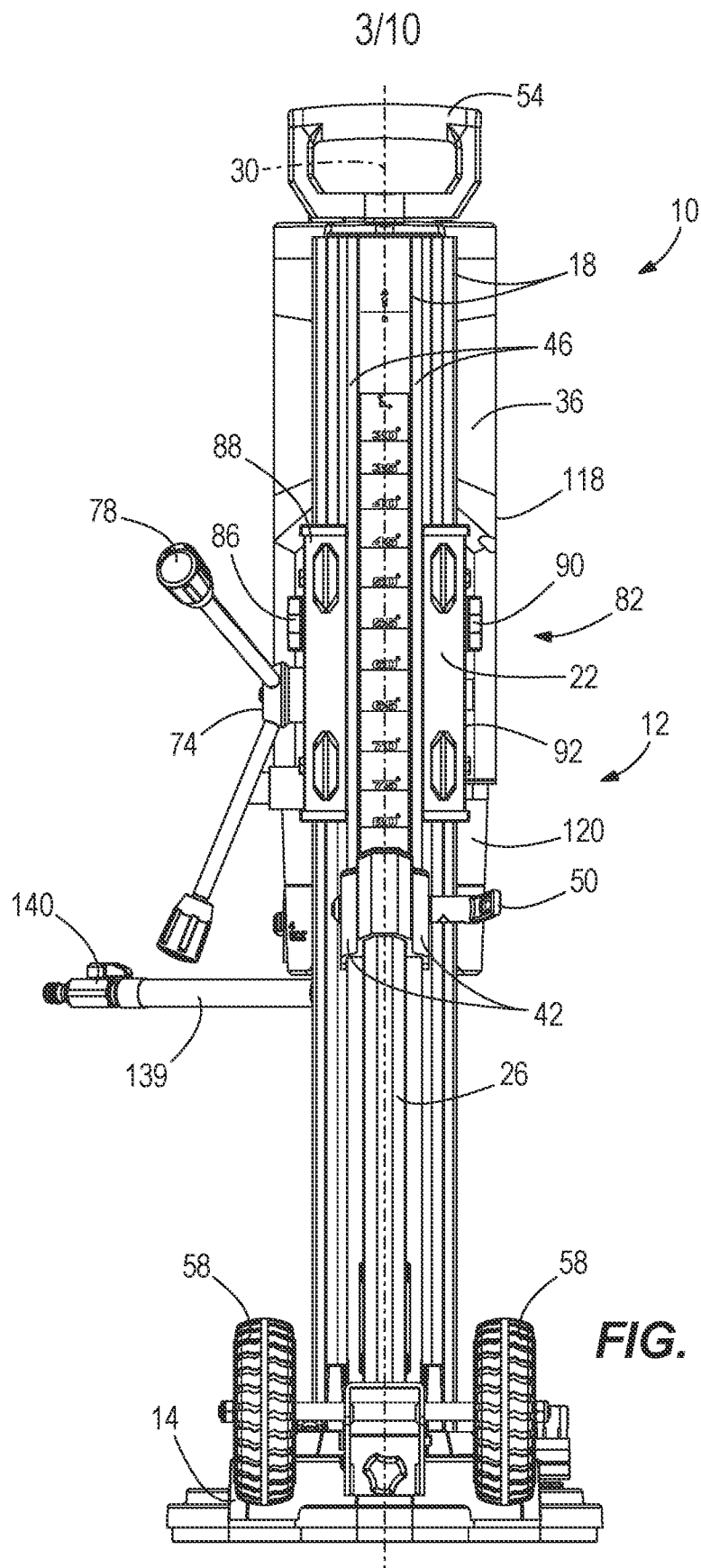
16. The core drill of claim 14, wherein the first ring abuts the upper retaining shoulder when the bit-removal assembly is coupled to the output shaft.

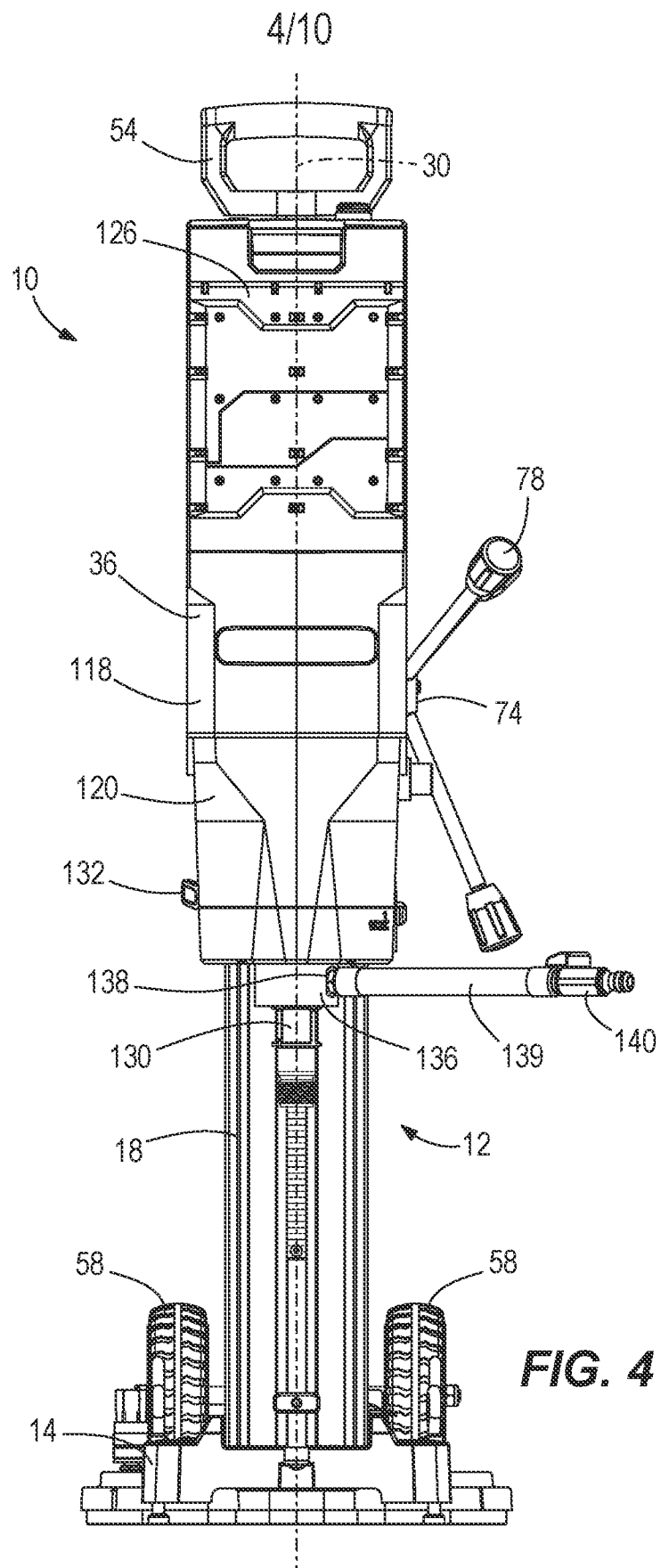
17. The core drill of claim 14, wherein the second ring includes an engagement surface that engages the core bit to restrict threading of the core bit beyond a desired height of the output shaft when the collar is in the locked position.

18. The core drill of claim 17, wherein the engagement surface of the second ring has a knurled surface that enhances friction between the engagement surface and the core bit.
19. The core drill of claim 17, wherein
the frusto-conical surface is a first frusto-conical surface formed on a top portion of the second ring opposite the engagement surface, and
the first ring includes a second frusto-conical support surface formed on a bottom-facing portion.
20. The core drill of claim 14, wherein
the biasing member extends between a first protrusion formed on the first ring and a second protrusion formed on the washer, and
moving the collar toward the released position moves the first protrusion toward the second protrusion to compress the biasing member.









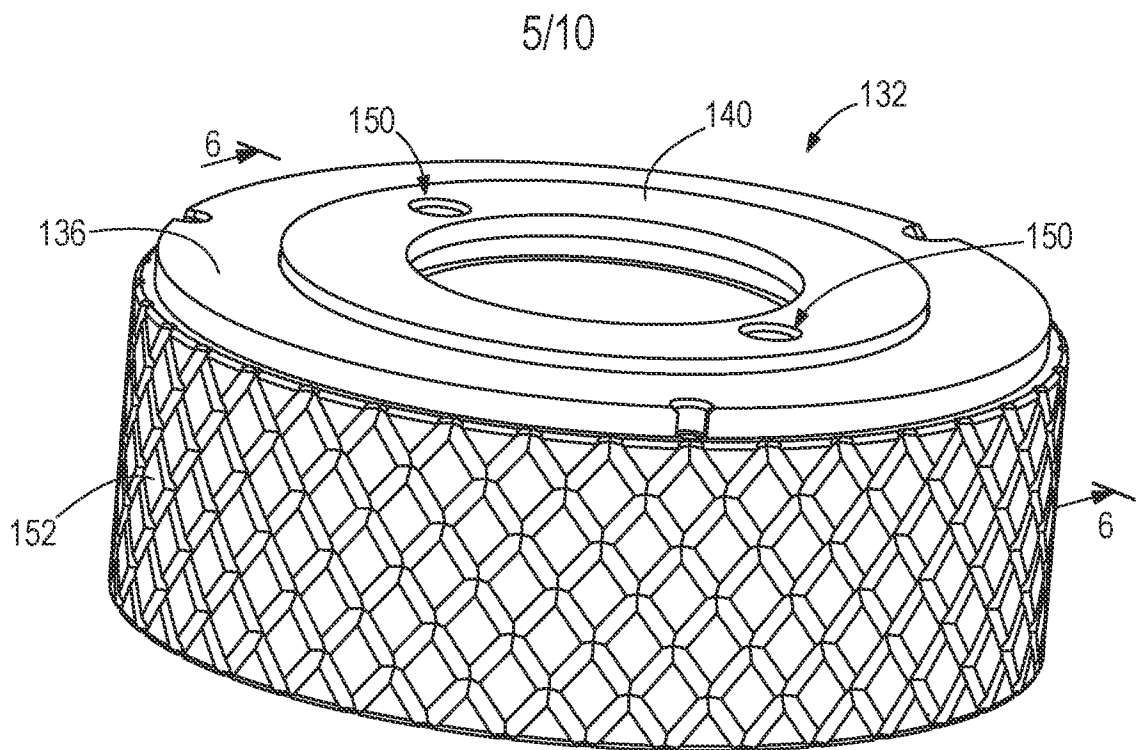


FIG. 5

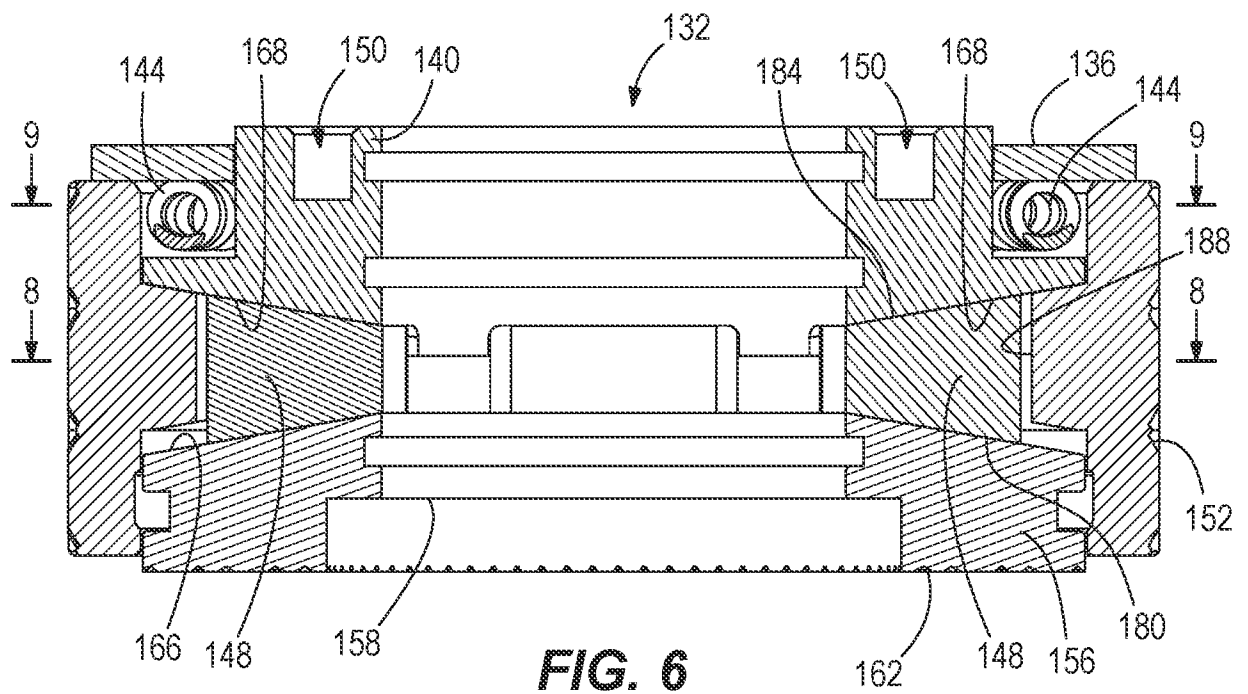


FIG. 6

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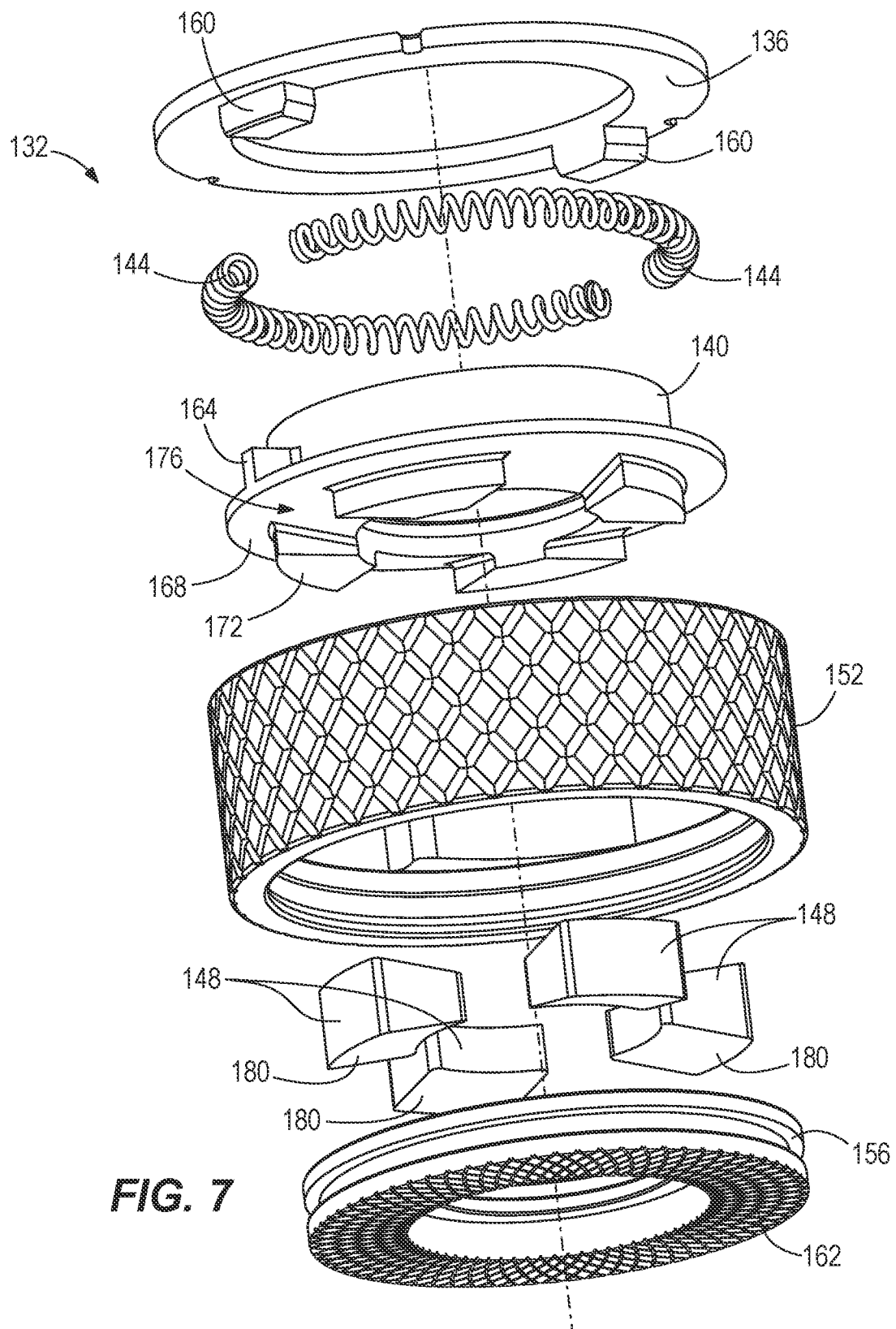
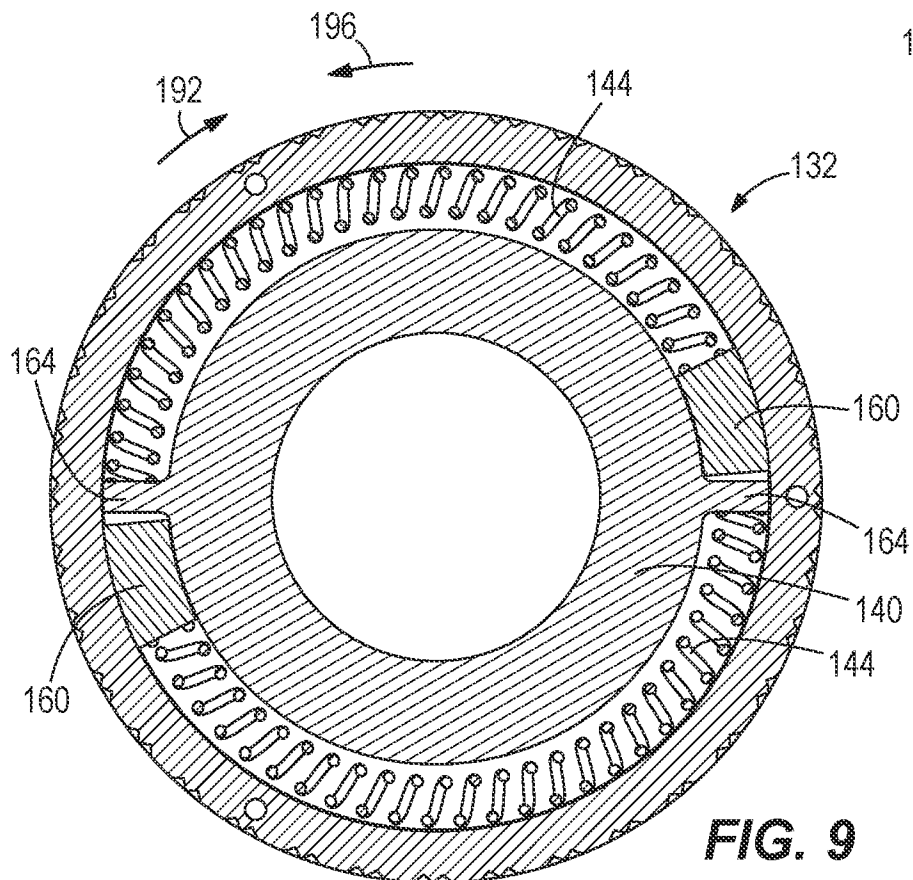
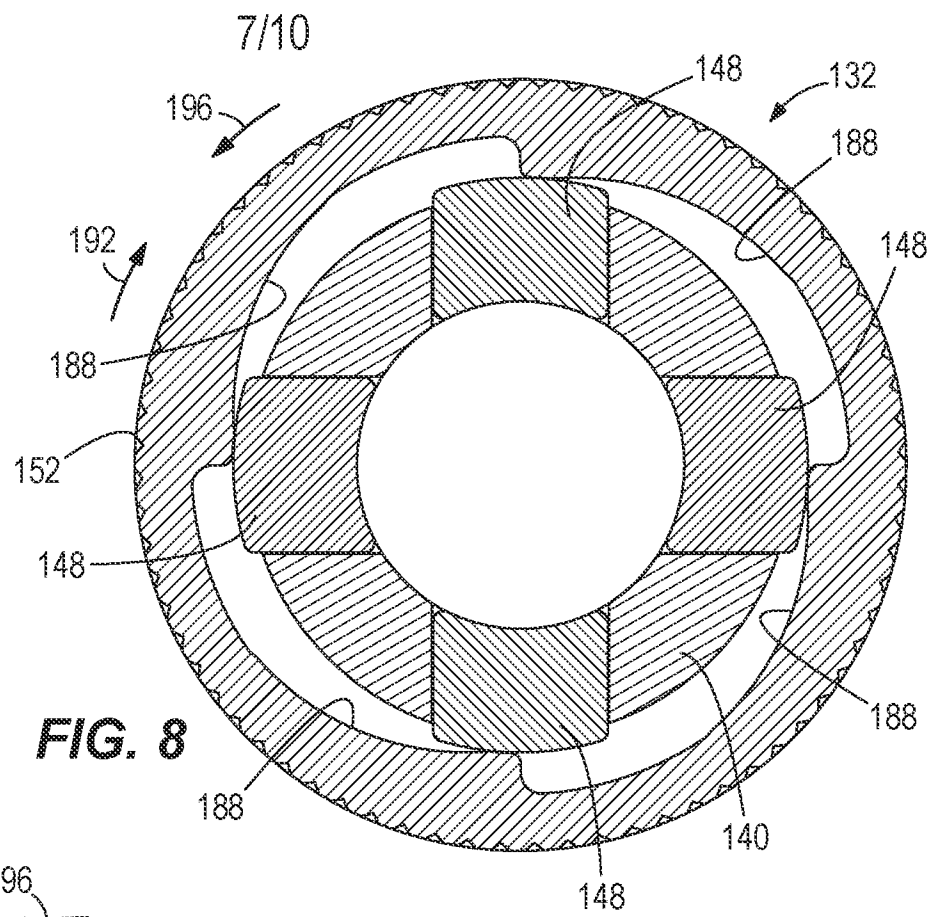
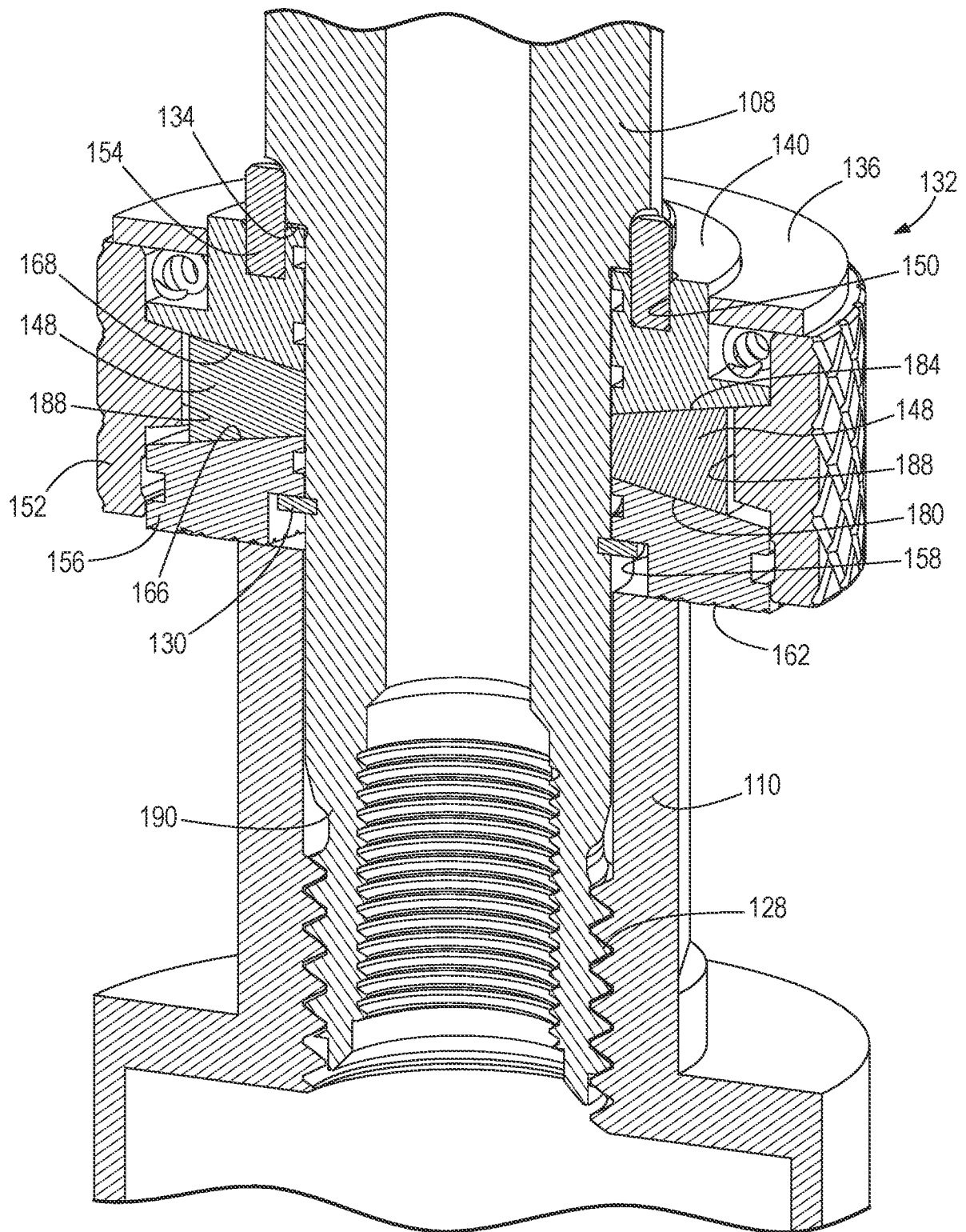


FIG. 7



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**FIG. 10**

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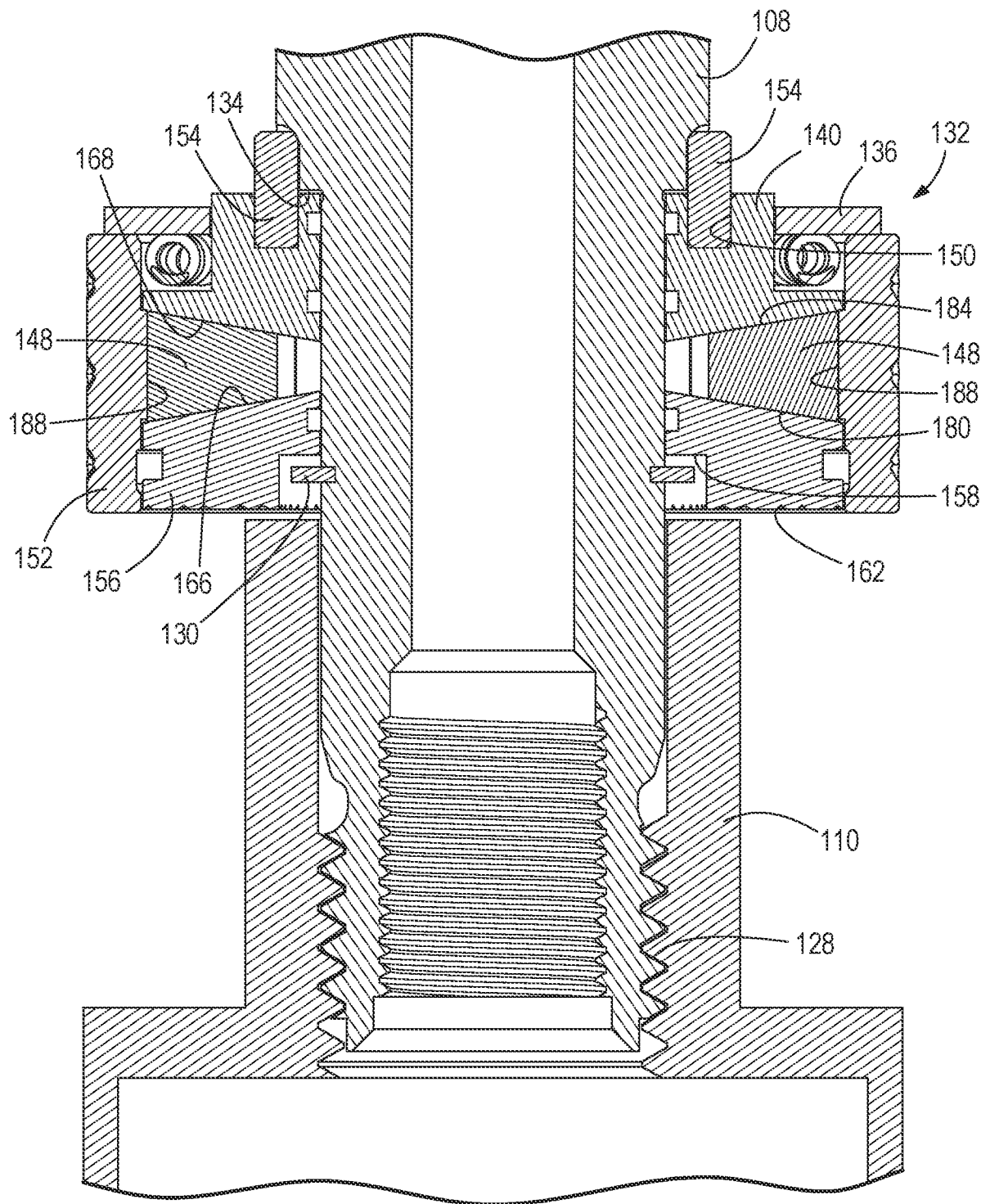
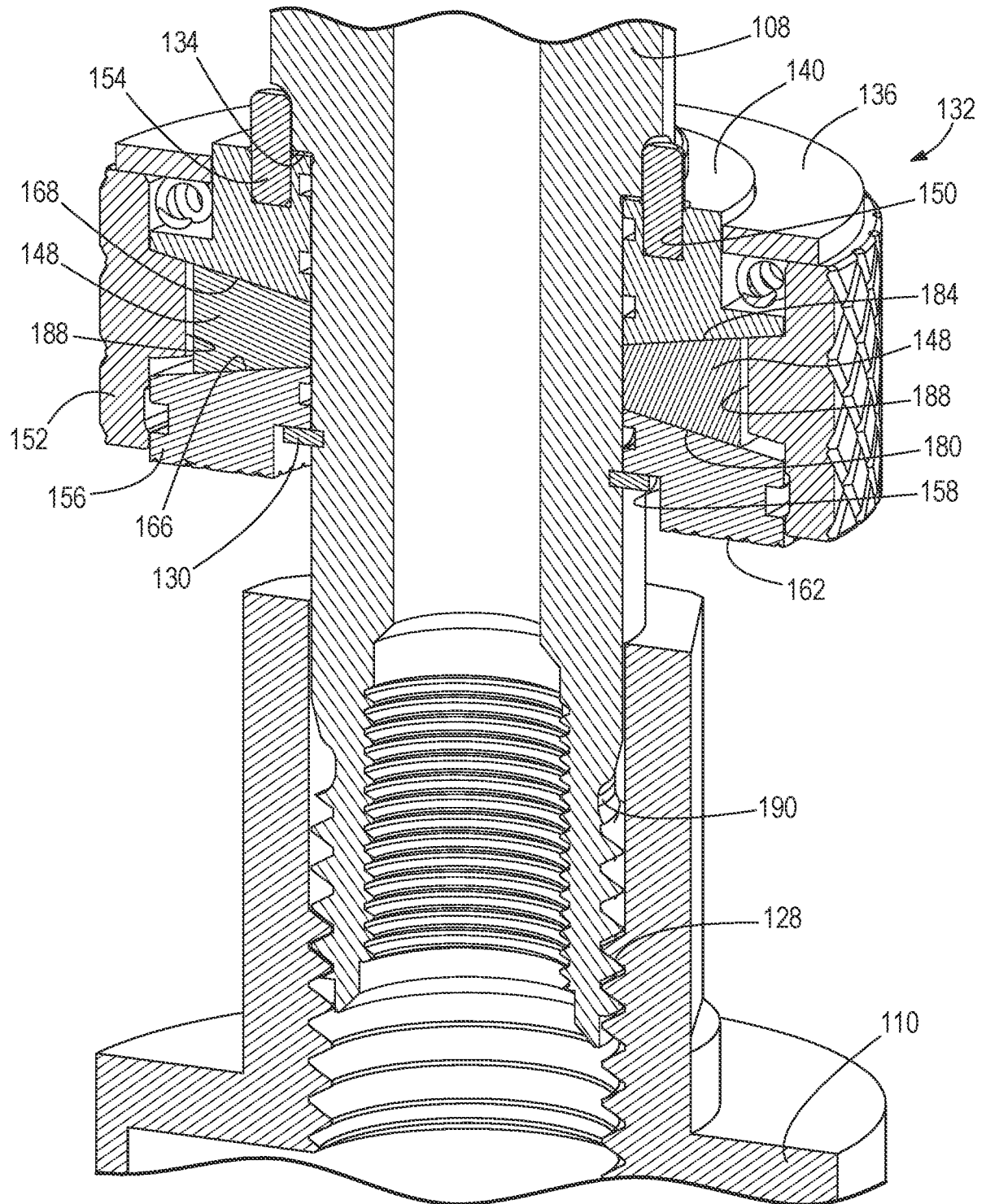


FIG. 11

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**FIG. 12**

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2022/023082

A. CLASSIFICATION OF SUBJECT MATTER**B23B 45/02(2006.01)i; B23B 45/00(2006.01)i; B23B 47/26(2006.01)i**

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B23B 45/02(2006.01); B23B 31/06(2006.01); B23B 51/00(2006.01); B23B 51/04(2006.01); B24B 23/02(2006.01);
B24B 45/00(2006.01); F16B 37/08(2006.01)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) & Keywords: core drill, bit-removal assembly, first ring, second ring, wedge, collar, biasing, cam surface, frusto-conical surface, washer

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2004-0018063 A1 (OSTERMEIER, PETER) 29 January 2004 (2004-01-29) paragraphs [0011], [0024]-[0025], claim 1, and figures 1-2	1-20
Y	US 2009-0136310 A1 (NAUGHTON et al.) 28 May 2009 (2009-05-28) paragraphs [0027], [0046] and figures 1-2, 6	1-20
Y	EP 1923161 B1 (BLACK & DECKER, INC.) 07 August 2013 (2013-08-07) paragraphs [0015]-[0017] and figure 4	7,12,14-20
A	US 6149364 A (MAEDA, YUTAKA) 21 November 2000 (2000-11-21) column 3, line 62 - column 6, line 50 and figures 1A-1B	1-20
A	JP 2005-313275 A (MAKITA CORPORATION) 10 November 2005 (2005-11-10) paragraphs [0008]-[0011] and figure 2	1-20



Further documents are listed in the continuation of Box C.



See patent family annex.

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“O” document referring to an oral disclosure, use, exhibition or other means

“P” document published prior to the international filing date but later than the priority date claimed

“T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

“X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

“Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

“&” document member of the same patent family

Date of the actual completion of the international search

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Date of mailing of the international search report

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/US2022/023082

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