(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
26 November 2015 (26.11.2015)

WIPO | PCT

(10) International Publication Number
WO 2015/176121 A1

(51) International Patent Classification:
E21B 17/04 (2006.01) *E21B 12/00* (2006.01)
E21B 4/06 (2006.01)

(21) International Application Number:
PCT/AU2015/000309

(22) International Filing Date:
25 May 2015 (25.05.2015)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
2014901955 23 May 2014 (23.05.2014) AU

(71) Applicant: **IGNIS TECHNOLOGIES PTY LTD** [AU/AU]; 29A Clayton Street, Bellevue, Western Australia 6056 (AU).

(72) Inventor: **BOSWELL, Peter**; 29A Clayton Street, Bellevue, Western Australia 6056 (AU).

(74) Agent: **GRIFFITH HACK**; Level 19, 109 St George's Terrace, Perth, Western Australia 6000 (AU).

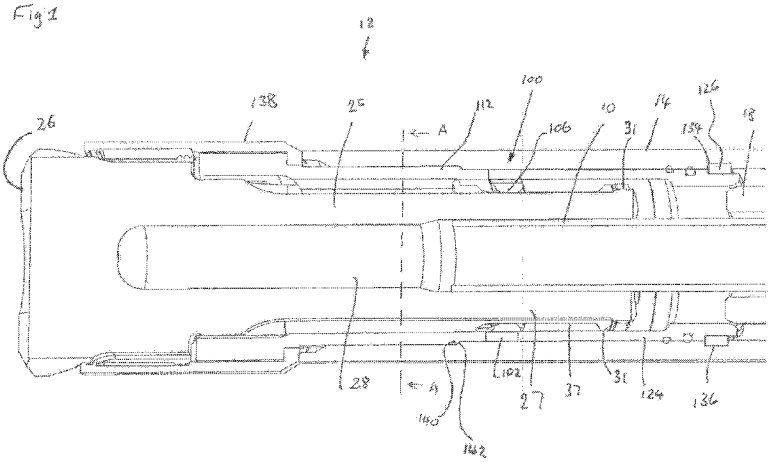
(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

(54) Title: BIT RETAINING SYSTEM



(57) Abstract: A retaining system (100) for a DTH hammer drill bit (25) having an outer surface with a plurality of stops (31) at an up-hole end (29) of the drill bit (25) the stops projecting radially outward from the outer surface and spaced by respective gaps (35). The retaining system has a ring (102) which is configured to pass over the stops (31) when in a first rotational position relative to the drill bit (25). However when the ring (102) is in a second rotational position relative to the drill bit (25) it prohibits passage of the stops (31) through the ring (102).

WO 2015/176121 A1

BIT RETAINING SYSTEM

Technical Field

A bit retaining system is disclosed for a down the hole (DTH) hammer drill bit.

Background Art

A down hole hammer comprises a drill bit having a shank provided with a plurality of axially extending and interleaved splines and grooves. These splines and grooves are located within complimentary splines and grooves formed on an inner circumferential surface of a drive sub. By this arrangement the drill bit is able to move in an axial direction in response to repetitive striking by a piston. In addition the arrangement of splines and grooves on the drill bit and drive sub enable torque from a rotation head to be transferred via an associate drill string and the drive sub to the drill bit.

The drill bit is retained from falling from an end of the drive sub by way of a split ring which engages a stop mechanism formed about an up hole end of the drill bit. The split ring comprises two semi-circular segments provided with one or more grooves on the outer circumferential surfaces, and an inner circumferential surface of constant radius. Rubber O-rings are located in the grooves to bias the segments together to form a ring. In order to retain the drill bit, semi-circular segments are spread apart against the bias of the O-rings and disposed over the stops on the drill bit. By virtue of the O-rings holding the segments together the stop mechanism is unable to pass axially through the inner diameter of the ring. The split ring is then held by various abutment surfaces or components within the drill string. In this way the drill bit is able to move in an axial direction but is prevented from falling from a drill. The stop mechanism can take various forms such as for example a continuous laterally projection lip or a plurality separate stops that project radially outward from the up-hole end of the bit.

The above described background art is not intended to limit the application of the retaining system as disclosed herein.

Summary of the Disclosure

In broad terms the specification discloses a retaining system for a drill bit. One component of the retaining system is a ring. In one embodiment the ring is continuous rather than being formed from a plurality of segments that are held together with O-rings. However in an alternate embodiment the ring may be formed of two or more segments (the "multi-segment embodiment"). In either embodiment the ring enables the drill bit to move in an axial direction relative to the ring but prevents the drill bit from falling through the ring. This is achieved by forming an inner circumferential surface of the ring with a profile configured such that the ring can pass over the stops formed on the drill bit when in a first rotational position relative to the drill bit, and prohibit passage of the stops through the ring when the ring is in a second rotational position relative to the drill bit. In both the single one piece embodiment and the multi-segment embodiment the ring has an inner circumferential surface of interleaved lugs and recesses.

In one aspect there is disclosed a bit retaining system for a DTH hammer drill bit having an outer surface with a plurality of interleaved stops and gaps at an up-hole end of the drill bit, the stops projecting radially outward from the outer surface, the retaining system comprising: a ring configured to pass over the stops in a first rotational position relative to the drill bit and prohibit passage of the stops through the ring when the ring is in a second rotational position relative to the drill bit.

In one embodiment the ring has an inner circumferential surface provided with a plurality of circumferentially spaced apart inwardly projection lugs.

In one embodiment the lugs are arranged so that when the ring is in the second position the lugs are in substantial axial alignment with the stops.

In one embodiment the lugs are arranged so that when the ring is in the first position the lugs are in substantial axial alignment with the gaps.

In one embodiment the ring has an inner circumferential surface provided with a plurality circumferentially spaced apart recesses that extend in an axial direction.

In one embodiment the recesses are arranged so that when the ring is in the second position the recesses are in substantial axial alignment with the gaps.

In one embodiment the recesses are arranged so that when the ring is in the first position the lugs are in substantial axial alignment with the stops whereby the ring is able to pass over the stops to surround a portion of the drill bit.

In one embodiment the ring has an inner circumferential surface provided with a plurality of circumferentially spaced apart inwardly projection lugs the lugs being spaced apart by respective axially extending recess, the lugs and recesses arranged so that when the ring is in the first position the recesses are in axial alignment with the stops to enable the ring to pass over the stops and surround a portion of the drill bit and when the ring is moved to the second position the lugs are in substantial axial alignment with the stops to prohibit the drill bit from axially passing out of the ring.

In one embodiment the retaining comprises a detent system capable of holding the ring in the second position.

In one embodiment the detent system comprises a sleeve locatable over a portion of the drill bit and wherein the sleeve and the ring are provided with complimentary parts capable of interlocking with each other.

In one embodiment the complementary parts comprise teeth or castellations formed on each of the ring and the sleeve.

In one embodiment the complementary parts comprise male parts formed on one of the ring and sleeve, and female parts formed on the other of the ring and sleeve.

In one embodiment the sleeve is provided with an inner circumferential surface which is provided to inhibit substantial relative rotation of the sleeve about the drill bit.

In one embodiment the circumferential surface of the sleeve is provided with a plurality of projections capable of residing in axially extending grooves formed on the drill bit wherein the projections are dimensioned to prevent passage in a rotational direction over axially extending splines formed on the drill bit which interleave with the grooves.

In a second aspect there is disclosed a bit retaining system for a DTH hammer drill bit having an outer surface with a stop mechanism at an up-hole end of the drill bit, the stop mechanism projecting radially outward from the outer surface, the retaining

system comprising: a ring having an inner circumferential surface provided with a plurality of lugs projecting in a radial inward direction the lugs being spaced apart by respective axially extending recess, the lugs arranged to project inwardly of the stop mechanism to prevent to stop from passing through the ring.

In one embodiment the ring is formed as single one piece continuous ring.

In an alternate embodiment the ring comprises two or more segments which when juxtaposed end to end form the ring. In this embodiment the retaining system comprises a bias mechanism operable to bias the segments toward a common center.

In one embodiment the bias mechanism comprises one or more: resilient O-rings; clips or spring clips.

In a third aspect there is disclosed a retaining system for a DTH hammer drill bit having an outer surface with a stop mechanism at an up-hole end of the drill bit the stop mechanism projecting radially outward from the outer surface, the retaining system comprising: a ring formed of two or more segments which when juxtaposed end to end form the ring; the ring having an inner circumferential surface provided with a plurality of circumferentially spaced apart inwardly projection lugs the lugs being spaced apart by respective axially extending recess, the lugs and recesses arranged so that the lugs project inwardly of the stop mechanism to prevent the stop mechanism from passing axially through the ring.

In one embodiment the recesses are arranged to form channels opposite the outer surface of the drill bit to enable fluid flow between the ring the and the bit.

In one embodiment the retaining system comprises a detent system capable of holding the ring in a fixed rotational position relative to the drill bit.

In one embodiment the detent system comprises a sleeve locatable over a portion of the drill bit and wherein the sleeve and the ring are provided with complementary parts arranged to interlock when in axial alignment.

In one embodiment the complementary parts comprise teeth or castellations formed on each of the ring and the sleeve.

In one embodiment when the drill bit is formed with plurality of axially extending and interleaved grooves and splines between the stop mechanism and a bit face of the drill bit, the detent system is arranged so that when ring in a fixed rotational position relative to the drill bit the recess on the ring are in radial alignment with the grooves on the drill bit.

Brief Description of the Drawings

Notwithstanding any other forms which may fall within the scope of the bit retaining system as set forth in the Summary, specific embodiments will now be described, by way of example only, with reference to the accompanying drawings in which:

Figure 1 is a longitudinal section view of an end portion of a DTH hammer depicting an embodiment of the disclosed bit retaining system;

Figure 2 is a view of section AA of the portion of the DTH hammer shown in Figure 1;

Figure 3 is an end view of a retaining ring incorporated in the bit retaining system;

Figure 4 is a perspective view of the bit retaining ring shown in Figure 3;

Figure 5 is a perspective view from the side of a DTH hammer bit and the retaining ring;

Figure 6a is a perspective view from the rear of the DTH hammer bit and retaining ring shown in Figure 5 in a first rotational juxtaposition enabling the retaining ring to fit over an up hole end of the drill bit;

Figure 6b is a perspective view from the rear of the DTH hammer bit and retaining ring shown in Figure 5 in a second rotational juxtaposition enabling the retaining ring to prevent removal of the drill bit;

Figure 7 is a side view of a sub and the retaining ring of the disclosed bit retaining system *in situ* on a DTH hammer bit;

Figure 8 is a longitudinal section view of the sub, retaining ring and bit shown in Figure 7;

Figure 9a is a perspective view of a spacer sleeve incorporated in the bit retaining system;

Figure 9b is a longitudinal section view of the spacer sleeve shown in Figure 9a;

Figure 10a is an end view of a retaining ring incorporated in a second embodiment the bit retaining system;

Figure 10b is a perspective view of the bit retaining ring shown in Figure 10a.

Detailed Description of Specific Embodiment

Figures 1 and 2 illustrate an embodiment of the disclosed bit retaining system 100 *in situ* at a down hole end of a DTH hammer 12. In this embodiment the DTH hammer 12 is a reverse circulation (RC) hammer. To provide some context to the description of the disclosed bit retaining system 100 a very brief description will be made of the illustrated portion of the DTH hammer 12.

The hammer 12 has an outer tube 14 which is coupled at an up-hole end to a drill string (not shown). The outer tube 14 houses an inner tube assembly 10 and a piston 18. A drill bit 25 is coupled to the down-hole end of the outer tube 14. Fluid such as air is delivered down the drill string and through a porting arrangement which has the effect of reciprocating the piston to cyclically strike the bit 25. The impact forces from the piston 18 are transferred via the drill bit 25 onto a toe of a hole being drilled. This fractures the toe of the hole.

Chips arising from this fracturing are transported up the inner tube assembly 10 via the fluid which is used to drive the piston 18. Torque is also delivered to the outer tube 14 from a rotation head (not shown) via the drill string. Thus the drill bit 25 also rotates about its longitudinal axis while cyclically impacting on the toe of the hole.

Figures 5 and 6 depict in more detail the configuration of the drill bit 25. The drill bit 25 is representative of the type of drill bits used in DTH hammers. However it is to be

understood that embodiments of the disclosed bit retaining system 100 are operable with other forms of DTH hammer bits.

The bit 25 comprises a bit face 26 which may be provided with tungsten carbide buttons. The bit 25 has a shank 27 formed with a central hole 28 which is in fluid communication with the inner tube 10. An up-hole end 29 of the drill bit 25 is provided with a stop mechanism in the form of a plurality of stops 31 that project radially outward from an outer surface 33 of the drill bit 25. The stops 31 are equally spaced circumferentially about the shank 27 by respective gaps 35. The gaps 35 lead into and are co-axial with axially extending grooves 37. The grooves 37 are interleaved with or spaced by axially extending splines 39.

In order for the hammer drill 12 to operate it is a requirement that the drill bit 25 can move in an axial direction. The disclosed bit retaining system 100 operates to prevent the drill bit 25 from falling out of the end of the outer tube 14 while allowing the required axial linear reciprocation and rotation.

The bit retaining system 100 comprises a ring 102. The ring 102 is configured to pass over the stops 31 when in a first rotational position relative to the drill bit 25 (shown in Figure 6a) and to prohibit passage of the stops 31 through the ring 102 when the ring 102 is in a second rotational position relative to the drill bit 25 (shown in Figure 6b). In this embodiment the ring 102 is a continuous one piece ring.

With particular reference to Figures 3 and 4 it will be seen that the retaining ring 102 has an inner circumferential surface 104 provided with a plurality of circumferentially spaced apart inwardly protecting lugs 106. The lugs 106 are spaced apart by respective recesses 108. The lugs 106 and recesses 108 extend axially of the ring 102.

As seen in Figure 6a when the ring 102 is in the first rotational position the recesses 108 are axially aligned with respective stops 31. In this way the ring 102 can be passed onto the drill bit 25 from the up-hole end 29. Once the ring 102 has been moved onto the shank 27 of the bit 25 passed the stops 31 the ring 102 and bit 25 can be rotated relative to each other to the second rotational position shown in Figure 6b. When in this position the lugs 106 are in substantial axial alignment with respective stops 31. It will also be noted that in this rotational position: the lugs 106 are in axial

alignment with the splines 39; and the recesses 108 are axially aligned with the grooves 37 and the gaps 35.

In this embodiment the ring 102 is provided with eight lugs 106 and eight recessed 108. The lugs and recesses extend for the same arc angle about the inner circumferential surface 104. Accordingly in this embodiment the lugs 106 and recesses 108 extend in a circumferential arc for approximately 22.5°. Thus the rotational movement between the first and second rotational positions is about 22.5°.

An end of the shank 27 nearest the face 26 flares outwardly so as to have a diameter greater than the inner diameter of the ring 102 formed by the surfaces of the lugs 106. In the absence of other components of the DTH hammer 12, this flaring prevents passage of the drill bit 25 in an up-hole direction through the ring 102.

In order for the ring 102 to retain the bit 25 within the hammer 12 the bit retaining system 100 incorporates a detent system 110 to hold the ring 102 in the second rotational position. The detent system 110 comprises a sleeve (also known as a sub) 112 that is locatable over a portion of the drill bit 25 including the shank 27. With particular reference to Figure 2, it can be seen that an inner circumferential surface 114 of the sleeve 112 is configured to inhibit substantial relative rotation of the sleeve 112 relative to the drill bit 25.

Specifically, the inner surface 114 is provided with a plurality of projections 116 that reside within the grooves 37 of the drill bit 25. In this embodiment the projections 116 are in the form of longitudinally extending splines. The sleeve 112 is also formed with a plurality of longitudinal grooves 118 between the projections/splines 116. The splines 39 of the drill bit 25 reside within the grooves 118. By virtue of this arrangement the drill bit 25 is able to move axially relative to the sleeve 112 but has limited rotational freedom. For example in one embodiment the bit 25 may be able to rotate by 8-12° relative to the sleeve 112. Although of no significance to the operation of the bit retaining system 100, the provision of the splines 116 and grooves 118 on the sleeve 112 enable torque to be transmitted through the drill string and outer tube 14 to the drill bit 25.

The detent system 110 also comprises complimentary parts 120a and 120b (hereinafter referred to in general as “complimentary parts 120”) on the ring 102 and the sleeve 112 respectively. The complimentary parts 120 are arranged to interlock in

an axial direction. In this specific embodiment the parts 120a and 120b comprise respective teeth which mesh with each other. Thus the teeth 120a on the ring 102 mesh with the teeth 120b on the sleeve 112. When the complimentary parts 120 are interlocked the ring 102 is limited in rotational motion relative to the drill bit 25 to the same extent as that of the sleeve 112. Accordingly the ring 102 cannot, when interlocked with the sleeve 112, rotate to the first position.

The sleeve 112 is provided with a screw thread (not shown) on its outer circumferential surface. This screw thread is arranged to threadingly engage with a complimentary thread formed on the inner circumferential surface of the outer tube 14 at its down-hole end.

The ring 102 is clamped in the second position and in engagement with the sleeve 112 by a spacer sleeve 124 (shown in Figs 1, 8, 9a and 9b) and a split landing ring 126 (Figs 1 and 8 only). The spacer sleeve 124 is in the form of a short tube having a down-hole end 128 that is arranged to abut with the up-hole axial end of the ring 102. An up-hole end 130 of the spacer sleeve 124 is provided with a reduced diameter portion 132 and corresponding shoulder 134.

The land ring 126 is a sprung ring having opposite ends 135 and 137 each provided with a hole 139. When in a relaxed state the ends 135 and 137 are spaced apart to provide the ring 126 with a relaxed outer diameter. The relaxed outer diameter is greater than the inner diameter of the outer tube 14. By engaging a tool (not shown) with the holes 139, the ends 135 and 137 can be brought closer together against the bias of the ring 126 to enable passage inside the outer tube 14.

The landing ring 126 is also configured to sit on the reduced diameter portion 132 adjacent the shoulder 134. However the landing ring 126 has a thickness greater than the depth of the shoulder 134. To accommodate the remaining thickness of the landing ring 126 and to lock the spacer sleeve 124 in position a circumferential landing groove 136 is formed on the inner diameter of the outer tube 14.

When the landing ring is seated in the landing groove 136 it is able to expand to some extent in outer diameter to or at least toward its relaxed diameter. Now a portion of the thickness of the landing ring protrudes inward of the inner circumference of the outer tube 14 creating a landing shoulder.

The seating of the landing ring 126 in the landing groove 136 and on the reduced diameter portion 132 locks the spacer sleeve 124 from axial motion in an up-hole direction.

With particular reference to Figure 1, a bit shroud 138 extends circumferentially over a lower end of the drill bit 25 and is locked between the down-hole end of the outer tube 14 and a shoulder formed circumferentially about the sleeve 112. The shroud 138 has no significance in relation to the bit retaining system 100. It is however shown for completeness.

During assembly of the DTH hammer 12, the sleeve 112 is first placed over the shank 27 in the orientation shown in Figure 2 where the splines 116 reside in the grooves 37, and the splines 39 reside in the grooves 118. Next the ring 102 is rotated to the first position shown in Figure 6a so that the recesses 108 are in axial alignment with the stops 31. The ring 102 can now be passed onto the drill bit 25. The ring 102 is subsequently rotated to the second position shown in Figure 6b so that the lugs 106 are in axial alignment with the stops 31. When in this orientation the parts 120a can interlock with the parts 120b on the sleeve 112 as shown in Figure 7. The landing ring 126 is passed up the inside of the outer tube 14 from the down-hole end so as to engage in the groove 126. Next the spacer sleeve 124 is located over the shank 27 in abutment with the ring 102. The shroud 138 is placed over the sleeve 112. The sleeve 112 can now be threadingly engaged with the lower end of the outer tube 14 until the shoulder 134 is adjacent the landing ring 126 and the shroud 138 is substantially clamped between the outer tube 14 and the sleeve 112. Consequently the ring 102 is held in the second position.

When the DTH hammer 12 is operated the bit 25 is able to reciprocate in an axial direction but is prevented from falling from the end of the outer tube 14 by the bit retaining system 100. In particular the drill bit 25 cannot move in an axial direction to a location where the stops 31 move axially past the ring 102/lugs 106.

It should also be understood that when the ring 102 is in the second position the recesses 108 are in axial alignment with the grooves 37 and gaps 35. This provides better fluid flow than the previously described prior art two piece ring as follows. The operational fluid (typically air) in a DTH hammer passes through the grooves 37 en-route to the outside of the bit face 26. By providing the recesses 108 in alignment with the grooves 37 the cross sectional area of these flow paths is significantly increased in

comparison to the prior art's two piece retaining ring. In effect, in the prior art the retaining ring has a substantially constant inner diameter which is equal to the inner diameter of the lugs 106. Clearly this will inhibit air flow through the grooves 37.

Figures 10a and 10b illustrate a multi-segment form of the ring 102a. The ring 102a differs from the one piece continuous ring 102 only by way of (a) being composes of two separate segments S1 and S2; and (b) having an associated bias mechanism 150 extending about the ring 102a. The multi-segment ring 102a can be considered to be a one piece ring but cut into two pieces each spanning 180°. Thus when the segments are juxtaposed end to end they form the complete ring 102a. The segments S1, S2 are biased together by the bias mechanism 150. The bias mechanism resiliently biases the segments S1, S2 toward a common center. The bias mechanism can take many forms including but not limited to one or more resilient O-rings, clips or spring clips. This enables the ring 102a to the opened or expanded in inner diameter. This feature is useful in the event that the stop mechanism on the drill bit is in the form of a continuous laterally projection lip.

The inner circumferential surface of the ring 102a is of identical configuration to the ring 102 having alternating lugs 106 and recesses 108. The lugs and recesses enable fitting of the multi-segment ring 102a in the same manner as the ring 102 when the stop mechanism is in the form of a plurality separate stops that project laterally outward from the up-hole end of the bit. The lugs and recesses on multi-segment ring 102a can also be positioned relative to the grooves 37 and splines 39 to assist in air flow. Also the ring 102a can be fixed in a particular rotational position relative the drill bit with an identical detent system. To this end the ring 102a has parts 120a which can engage with parts 120b on the sleeve 112.

While specific embodiments of the bit retaining system has been described, it should be appreciated that the bit retaining system may be embodied in many other forms.

For example the ring 102 and sleeve 112 are described and depicted as comprising four inter-engagable parts 120. Further these parts are depicted as substantially square-shaped teeth or castellations. However alternate arrangements and configurations are possible for interlocking the ring 102 with the sleeve 112. Further, it is possible to form the ring 102 and the spacer sleeve 124 together as a single component. The form of the component will in essence be the equivalent of the ring 102 and the sleeve 124 in axial alignment with each other and abutting end-to-end as a

one piece article. Further, while the embodiment of the bit retaining system 100 is described in relation to a RC DTH hammer the system may also be used with a conventional DTH hammer.

The claims defining the invention are as follows:

1. A retaining system for a DTH hammer drill bit having an outer surface with a plurality of stops at an up-hole end of the drill bit the stops projecting radially outward from the outer surface and spaced by respective gaps, the retaining system comprising: a ring configured to pass over the stops in a first rotational position relative to the drill bit and prohibit passage of the stops through the ring when the ring is in a second rotational position relative to the drill bit.

2. The retaining system according to claim 1 wherein the ring has an inner circumferential surface provided with a plurality of circumferentially spaced apart inwardly projection lugs.

3. The retaining system according to claim 2 wherein the lugs are arranged so that when the ring is in the second position the lugs are in substantial axial alignment with the stops.

4. The retaining system according to claim 2 or 3 wherein the lugs are arranged so that when the ring is in the first position the lugs are in substantial axial alignment with the gaps.

5. The retaining system according to claim 1 wherein the ring has an inner circumferential surface provided with a plurality circumferentially spaced apart recesses that extend in an axial direction.

6. The retaining system according to claim 5 wherein the recesses are arranged so that when the ring is in the second position the recesses are in substantial axial alignment with the gaps.

7. The retaining system according to claim 5 or 6 wherein the recesses are arranged so that when the ring is in the first position the lugs are in substantial axial alignment with the stops whereby the ring is able to pass over the stops to surround a portion of the drill bit.

8. The retaining system according to claim 1 wherein the ring has an inner circumferential surface provided with a plurality of circumferentially spaced apart inwardly projection lugs the lugs being spaced apart by respective axially extending

recess, the lugs and recesses arranged so that when the ring is in the first position the recesses are in axial alignment with the stops to enable the ring to pass over the stops and surround a portion of the drill bit and when the ring is moved to the second position the lugs are in substantial axial alignment with the stops to prohibit the drill bit from axially passing out of the ring.

9. The retaining system according to any one of claims 1 – 8 comprising a detent system capable of holding the ring in the second position.

10. The retaining system according to claim 9 wherein the detent system comprises a sleeve locatable over a portion of the drill bit and wherein the sleeve and the ring are provided with complimentary parts capable of interlocking with each other.

11. The retaining system according to claim 10 wherein the complementary parts comprise teeth or castellations formed on each of the ring and the sleeve.

12. The retaining system according to claim 10 wherein the complementary parts comprise male parts formed on one of the ring and sleeve, and female parts formed on the other of the ring and sleeve.

13. The retaining system according to any one of claims 10 – 12 wherein the sleeve is provided with an inner circumferential surface which is provided to inhibit substantial relative rotation of the sleeve about the drill bit.

14. The retaining system according to claim 13 wherein the circumferential surface of the sleeve is provided with a plurality of projections capable of residing in axially extending grooves formed on the drill bit wherein the projections are dimensioned to prevent passage in a rotational direction over axially extending splines formed on the drill bit which interleave with the grooves.

15. A bit retaining system for a DTH hammer drill bit having an outer surface with a stop mechanism at an up-hole end of the drill bit, the stop mechanism projecting radially outward from the outer surface, the retaining system comprising: a ring having an inner circumferential surface provided with a plurality of lugs projecting in a radial inward direction the lugs being spaced apart by respective axially extending recess, the lugs arranged to prevent to stop mechanism from passing through the ring.

16. The retaining system according to any one of claims 1 – 15 wherein the ring is formed as single one piece continuous ring.

17. The retaining system according to any one of claims 1 – 15 wherein the ring comprises two or more segments which when juxtaposed end to end form the ring.

18. The retaining system according to claim 17 comprising a bias mechanism operable to bias the segments toward a common center.

19. The retaining system according to claim 18 wherein the bias mechanism comprises one or more: resilient O-rings; clips or spring clips.

20. A retaining system for a DTH hammer drill bit having an outer surface with a stop mechanism at an up-hole end of the drill bit the stop mechanism projecting radially outward from the outer surface, the retaining system comprising: a ring formed of two or more segments; the ring having an inner circumferential surface provided with a plurality of circumferentially spaced apart inwardly projection lugs the lugs being spaced apart by respective axially extending recess, the lugs and recesses arranged so that the lugs project inwardly of the stop mechanism to prevent the stop mechanism from passing axially through the ring.

21. The retaining system according to claim 20 wherein the recesses are arranged to form channels opposite the outer surface of the drill bit to enable fluid flow between the ring the and the bit.

22. The retaining system according to claim 20 or 21 comprising a detent system capable of holding the ring in a fixed rotational position relative to the drill bit.

23. The retaining system according to claim 22 wherein the detent system comprises a sleeve locatable over a portion of the drill bit and wherein the sleeve and the ring are provided with complementary parts arranged to interlock when in axial alignment.

24. The retaining system according to claim 23 wherein the complementary parts comprise teeth or castellations formed on each of the ring and the sleeve.

25. The retaining system according to any one of claims 20 to 23 wherein when the

drill bit is formed with plurality of axially extending and interleaved grooves and splines between the stop mechanism and a bit face of the drill bit, the detent system is arranged so that when ring in a fixed rotational position relative to the drill bit the recess on the ring are in radial alignment with the grooves on the drill bit.

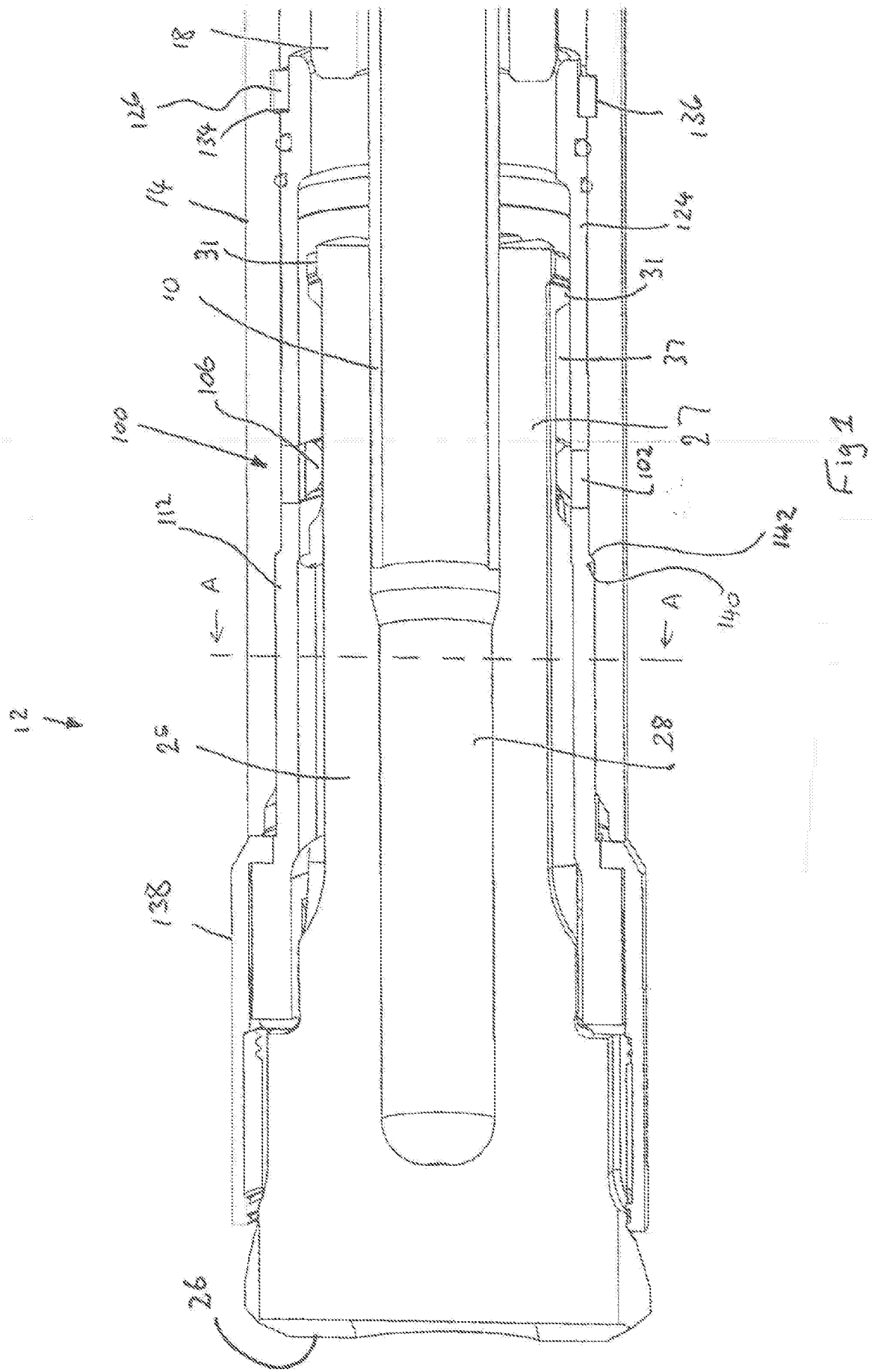

18
126
134
14
31
10
106
100
112
A
A
12
26
138
28
27
37
31
124
136
102
142
140

Fig 1

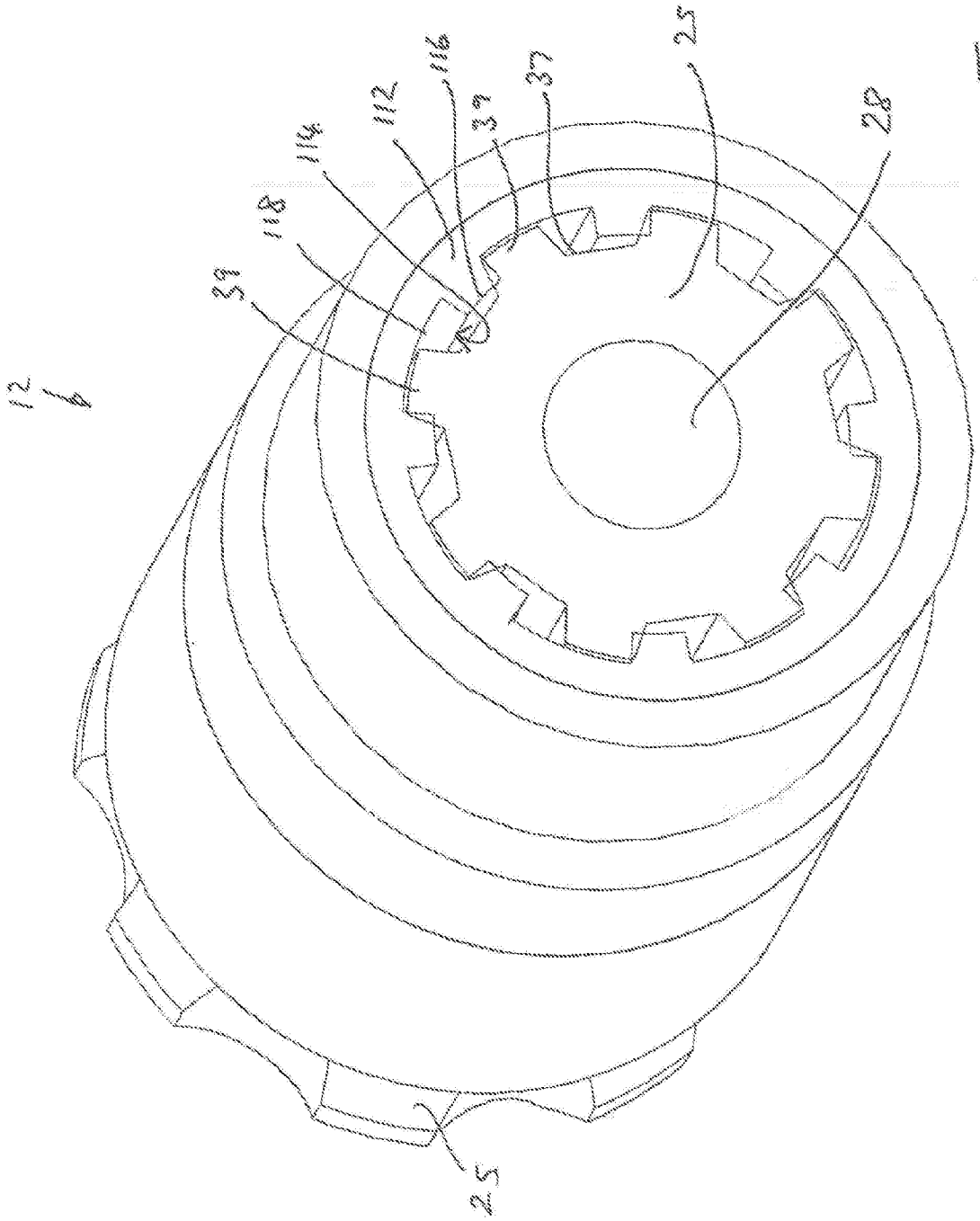


Fig 2

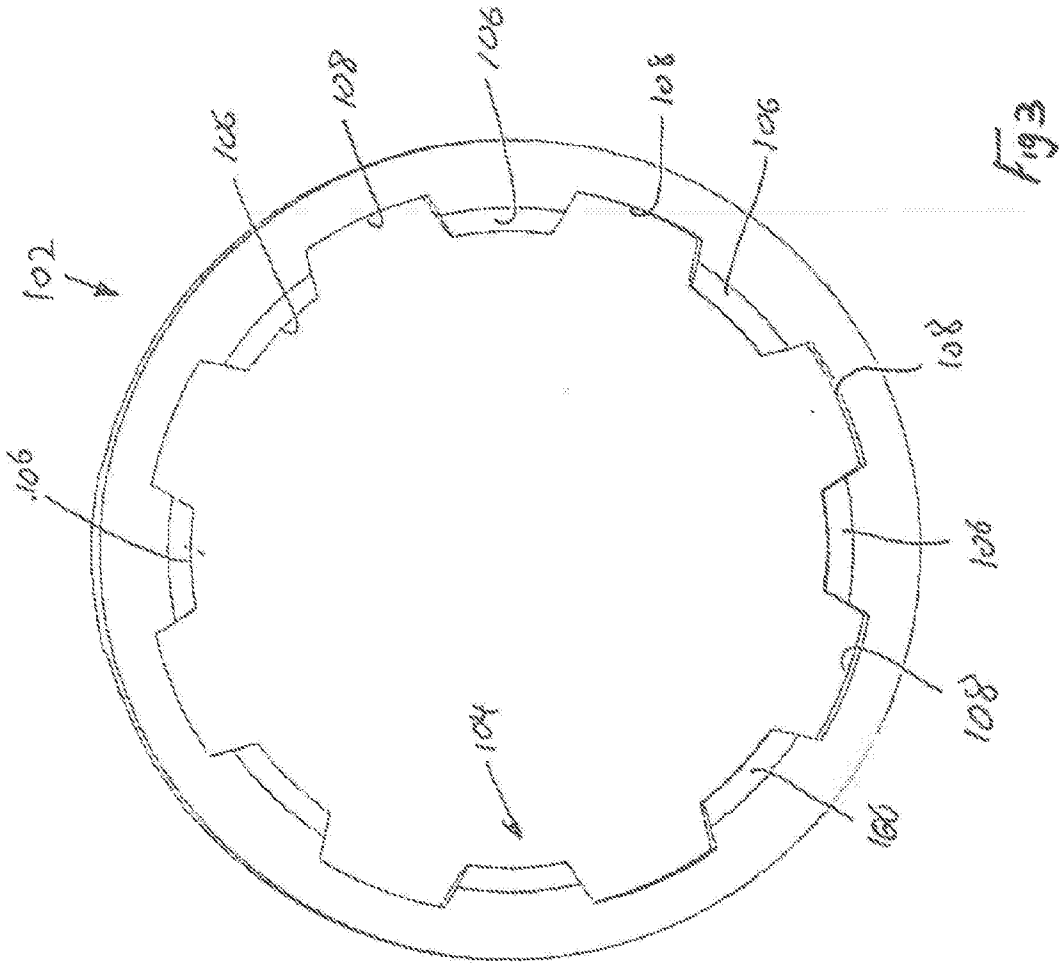


Fig 3

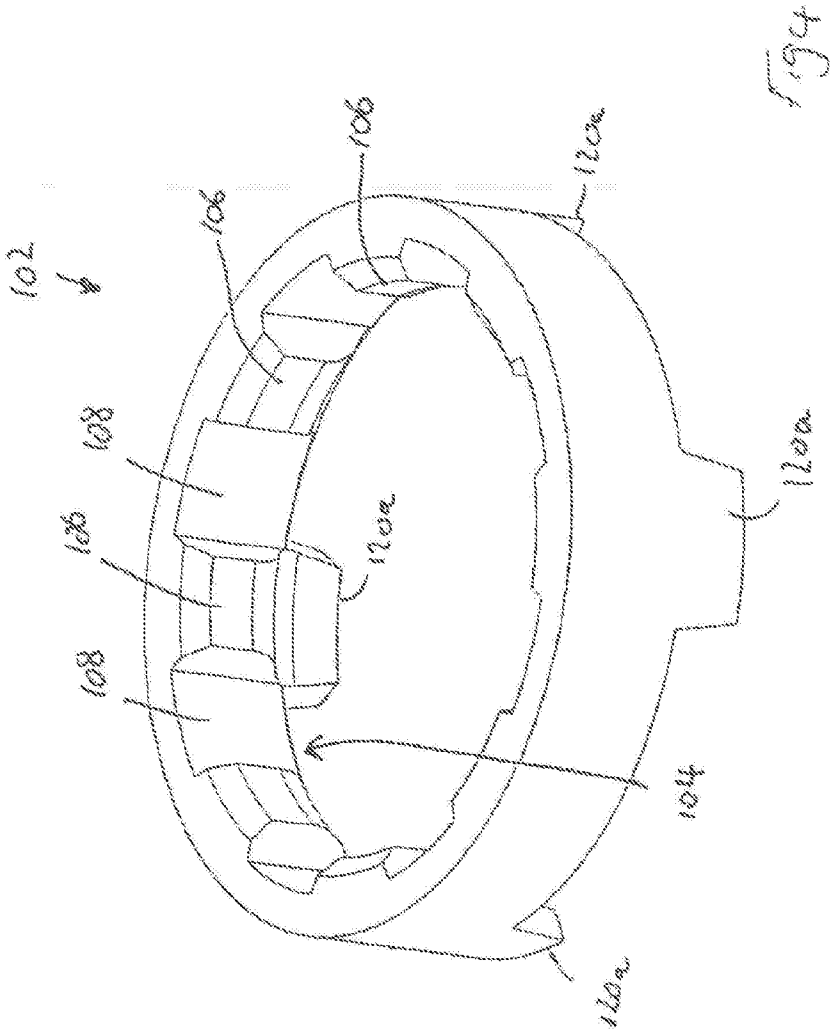


Fig 4

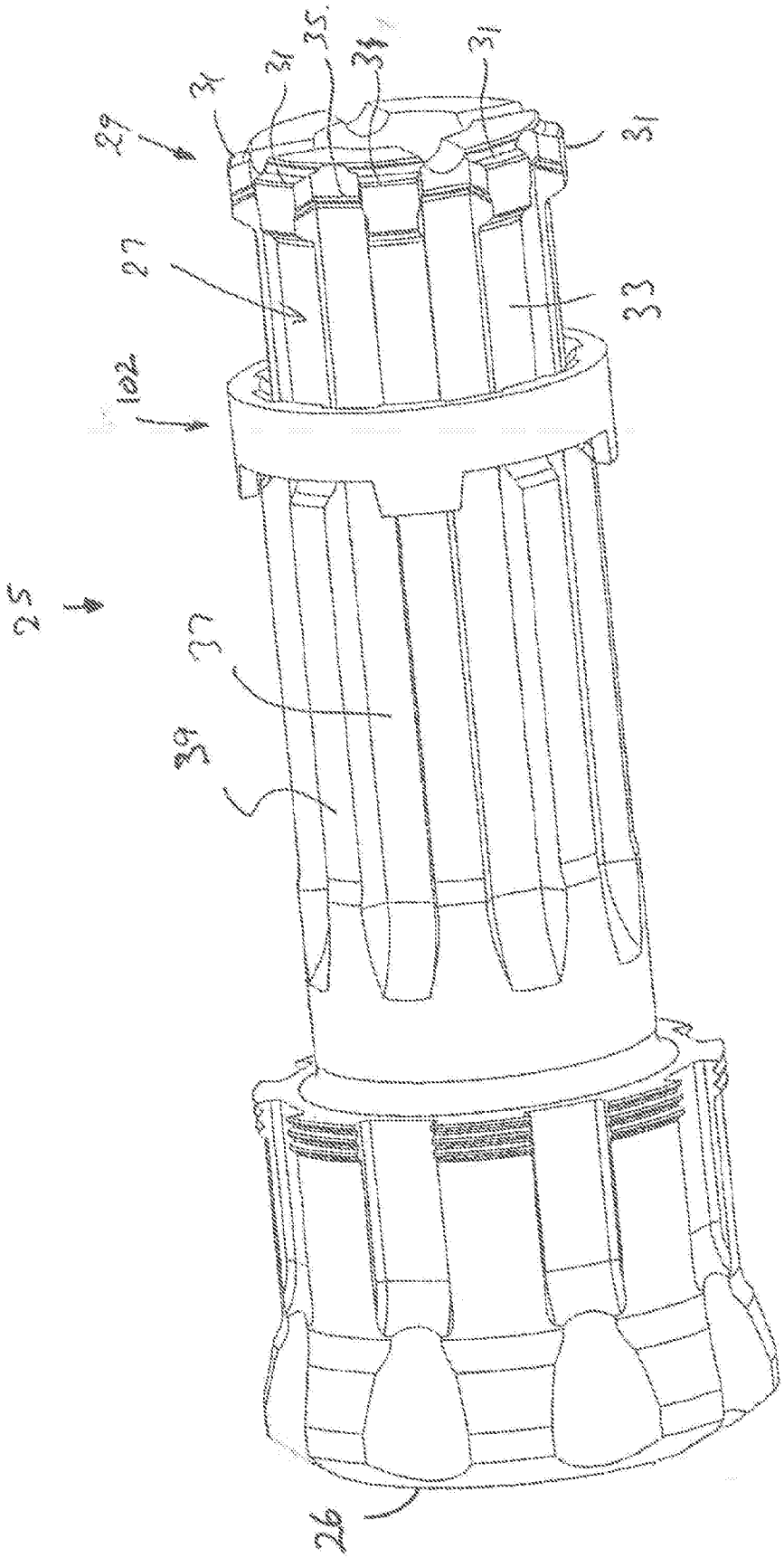


Fig 5

6/12

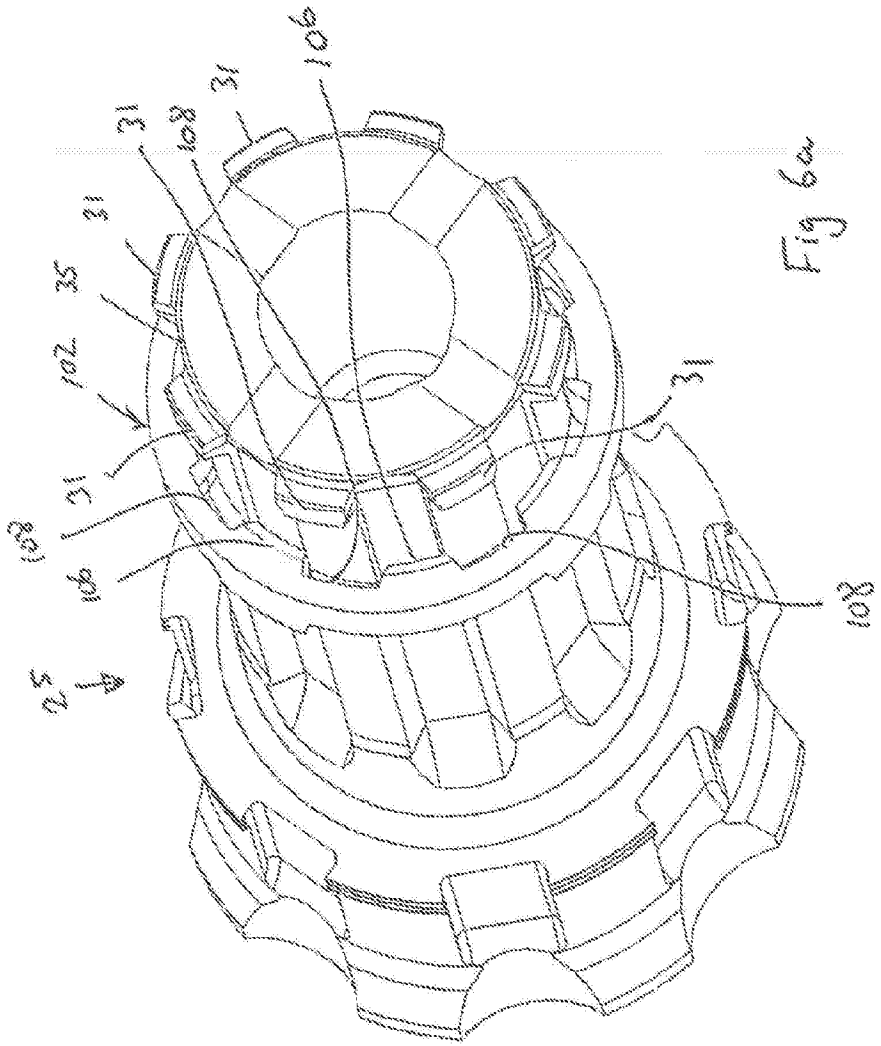


Fig 6a

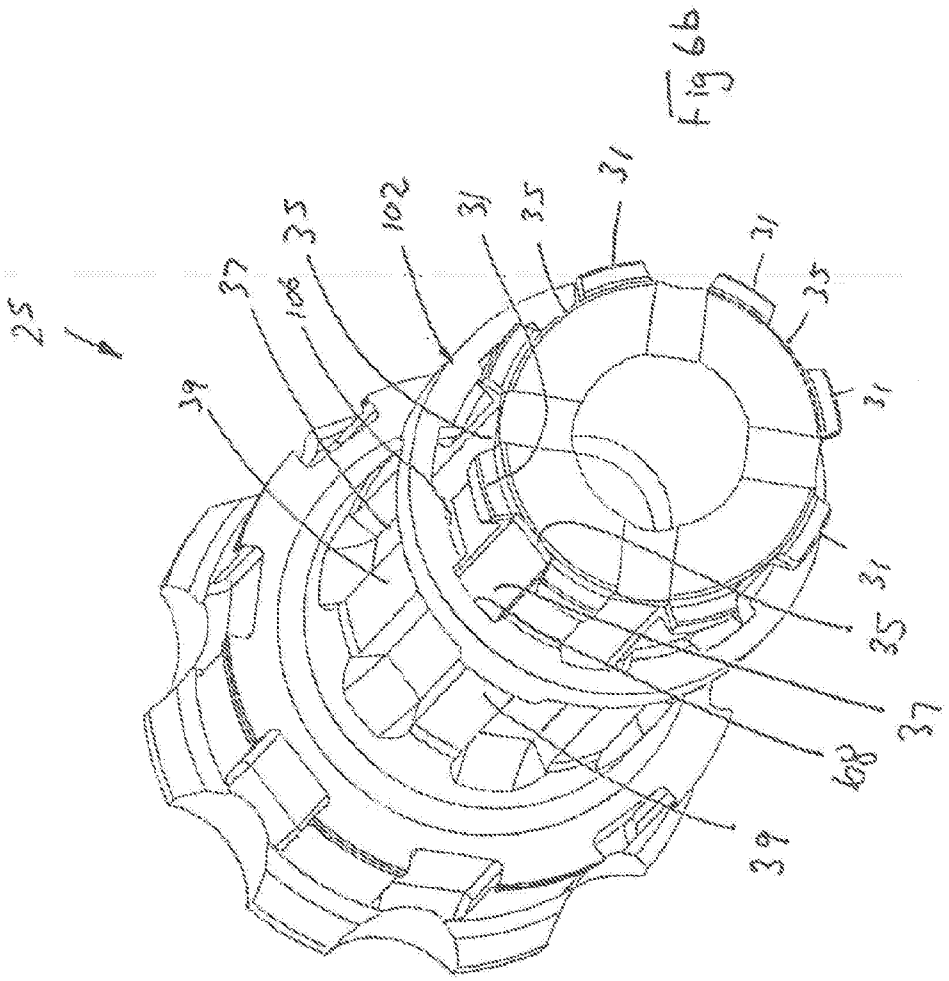


Fig 6b
25
1
39
37
106
35
102
33
35
31
31
33
31
31
35
37
68
39

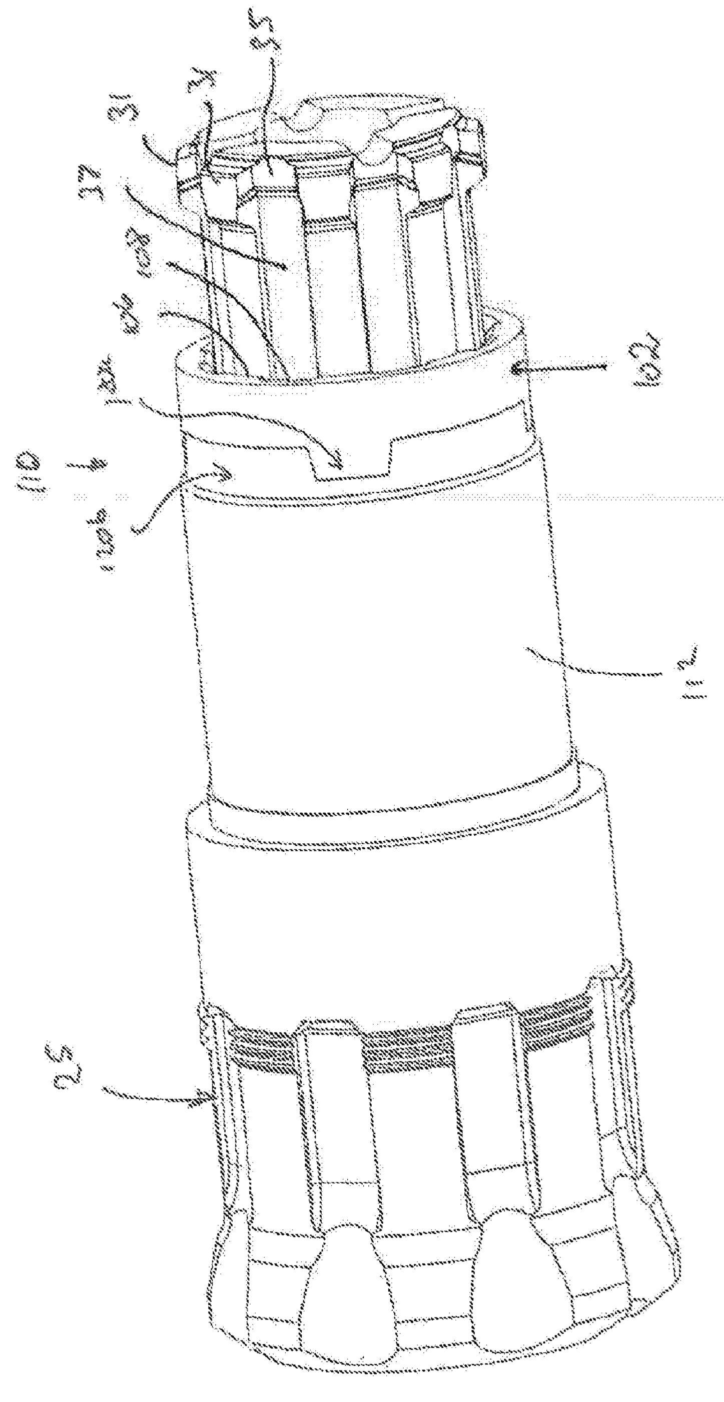


FIG 7

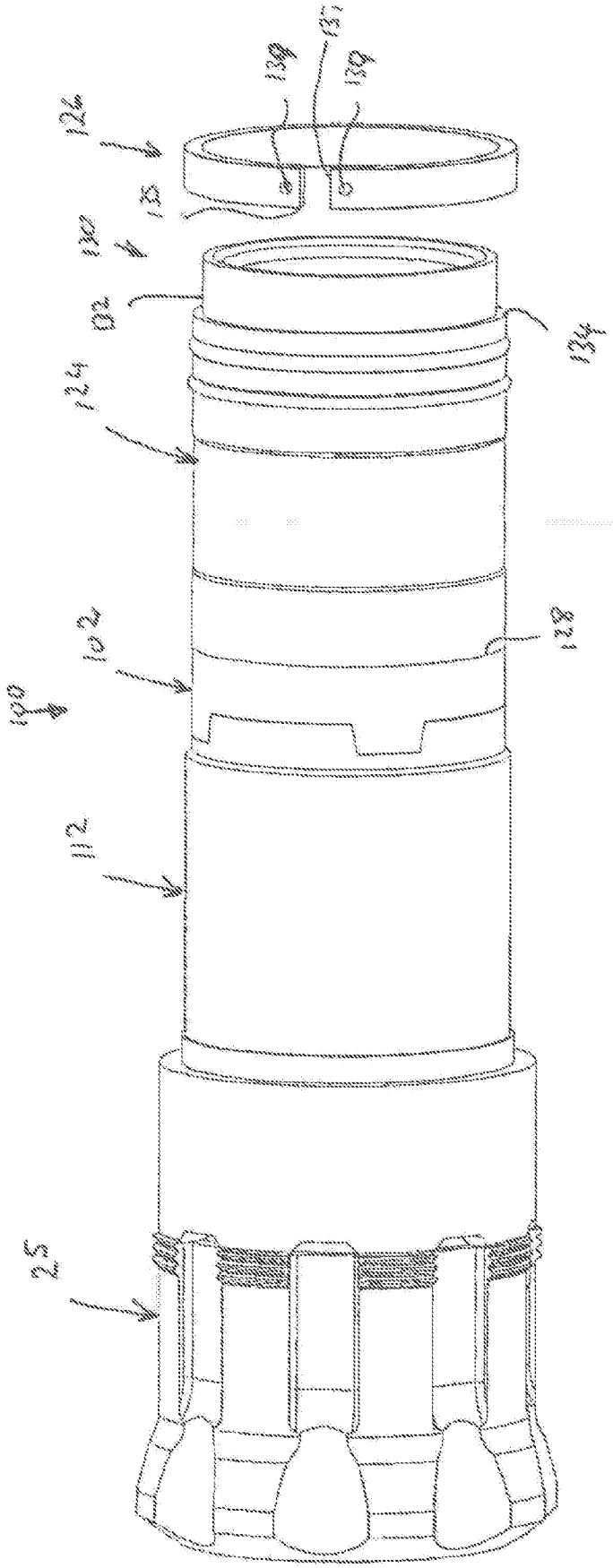


Fig 8

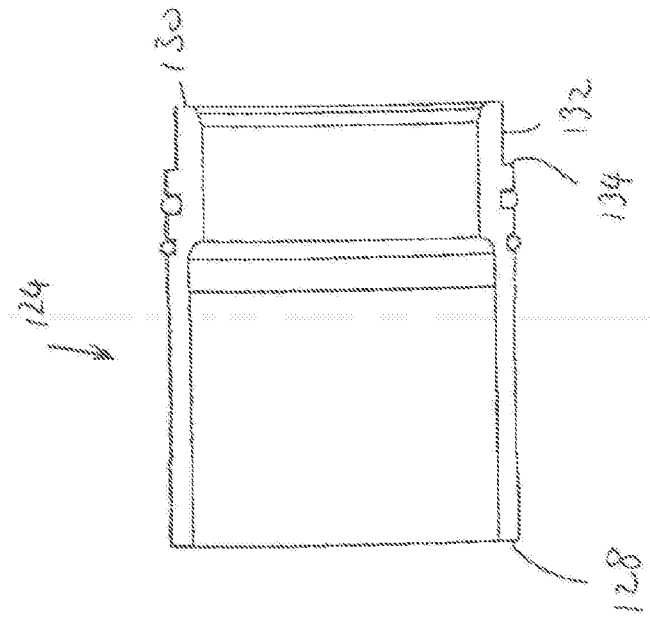


Fig 9b

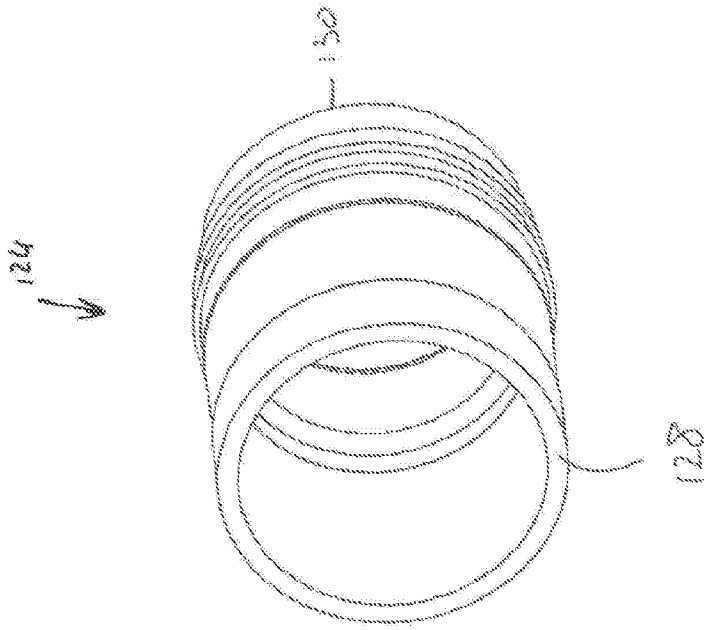
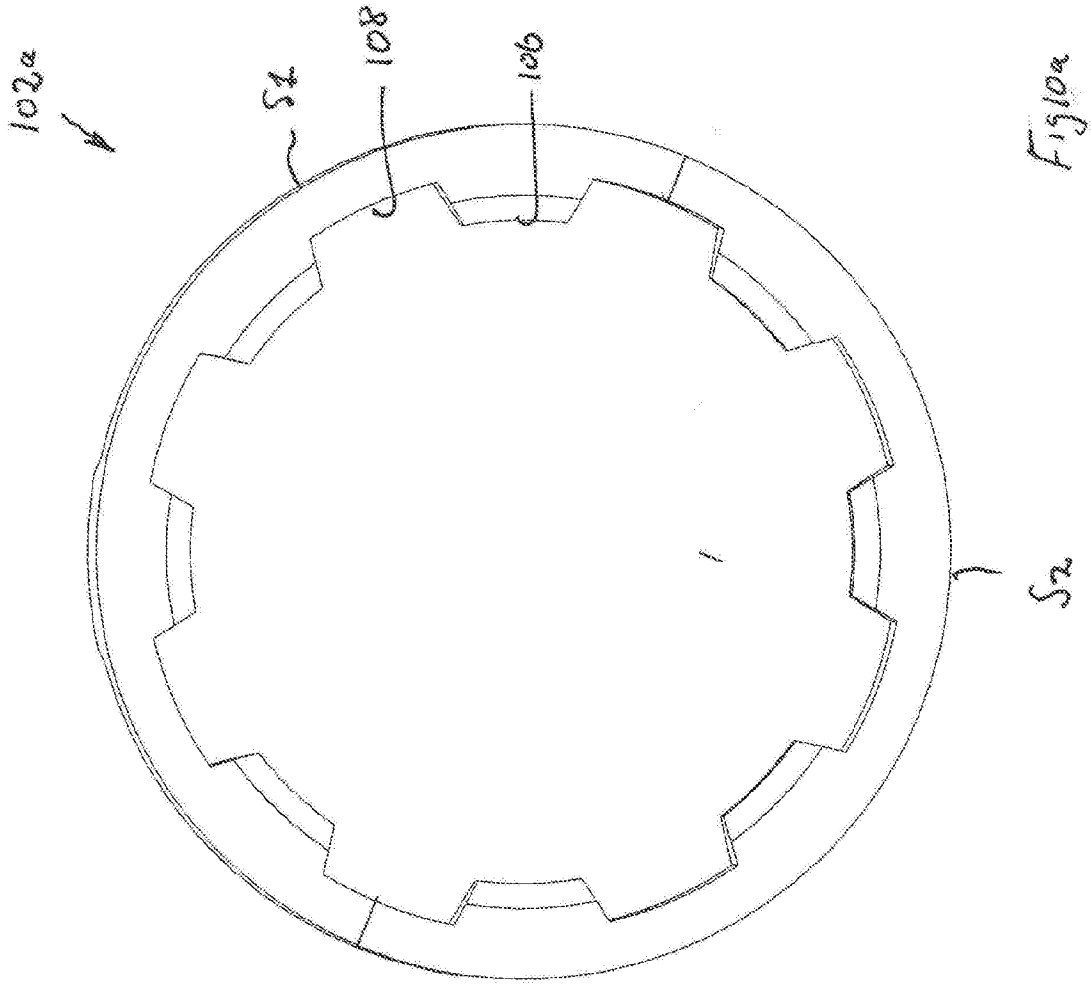


Fig 9a


102a
104
106
108
Fig 10a

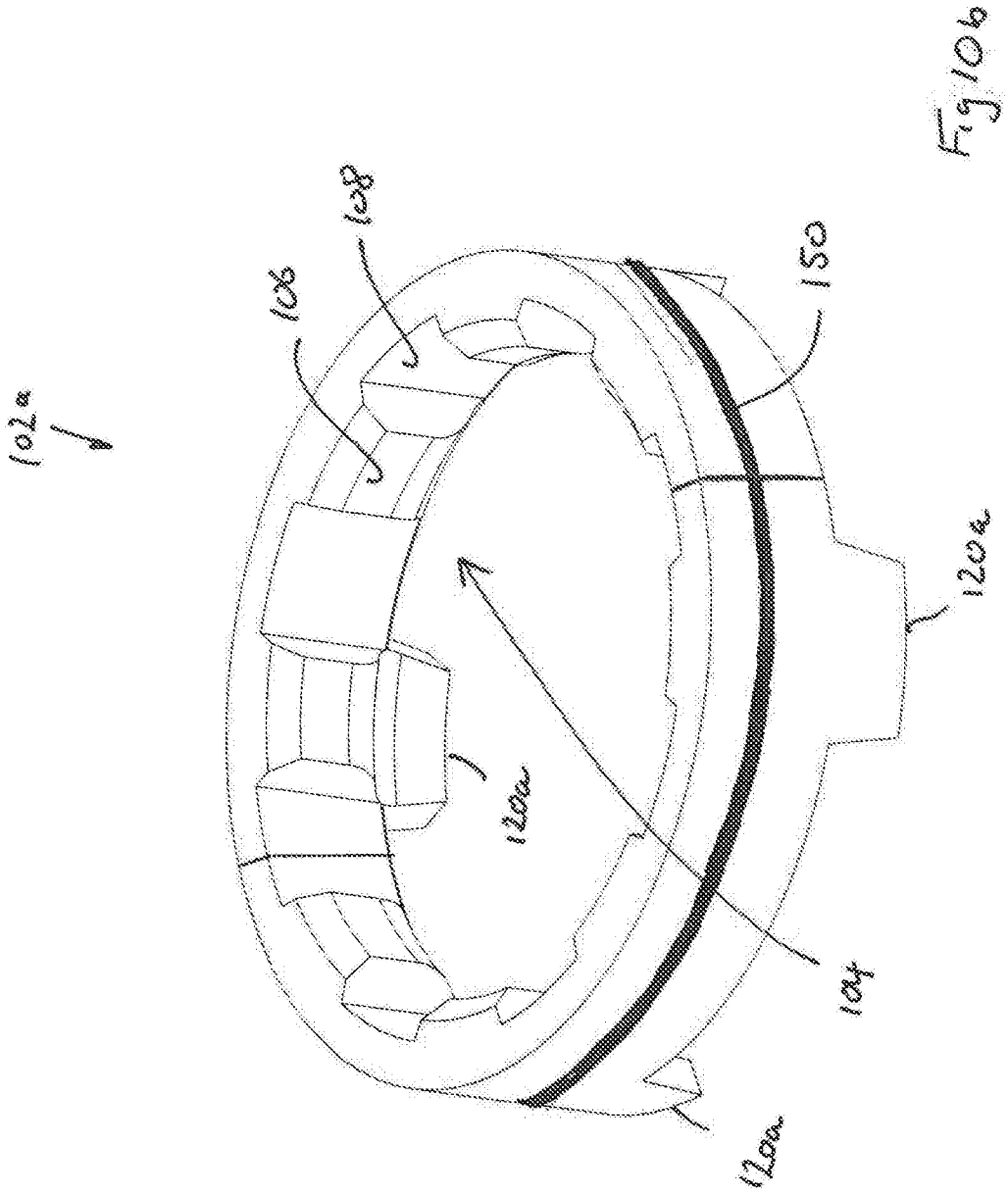


Fig 10b

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2015/000309

A. CLASSIFICATION OF SUBJECT MATTER

E21B 17/04 (2006.01) E21B 4/06 (2006.01) E21B 12/00 (2006.01)

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)

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

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

DATABASES: EPODOC, WPIAP & (EPOQUE) Public Cluster: TXTE ; IPC/CPC (E21B17/04, E21B4/06, E21B12/00) AND KEYWORDS (HOLD+ CLAMP+ GRIP+ RETAIN+ SECUR+ LOCK+ COUPL+ RING+ ANNULAR+ COLLAR+ SLEEV+ CYLIND+ ROTAT+ TURN+ SPIN+ WIND+ TWIST+ SW#NG+ REVOLV+SECOND+ FURTHER+ ANOTHER+ ALTERNAT+ POSITION+ TRANSL+ DIRECTION+ DETENT+ SNIB+ LATCH+ CATCH+ RING+ ANNULAR+ COLLAR+ SLEEV+ CYLIND+ TOOTH+ FEMALE+ MALE+ GROOV+ CASTELLAT+ CHANNEL+ MORTIC+ INTERLOCK+ ABUT+ COMPLEMENT+) OR SIMILAR KEYWORDS

AUSPAT: APPLICANT AND INVENTOR NAME ; ESPACENET: APPLICANT/INVENTOR SEARCH OF ALL RELEVANT DOCUMENTS

APPLICANT(S)/INVENTOR(S) NAME SEARCHED IN INTERNAL DATABASES PROVIDED BY IP AUSTRALIA

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	Documents are listed in the continuation of Box C	

[X] Further documents are listed in the continuation of Box C [X] See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"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	Date of mailing of the international search report
3 July 2015	03 July 2015

Name and mailing address of the ISA/AU	**Authorised officer**
AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA Email address: pct@ipaustralia.gov.au	Shadreck Mushaikwa AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No. 0262832204

INTERNATIONAL SEARCH REPORT C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		International application No. **PCT/AU2015/000309**
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2012/0186883 A1 (PURCELL) 26 July 2012 Abstract, figures 8, 17 - 23, pages 3 & 4, paras. [0055-0064]	1 - 25
X	WO 1998/058154 A1 (SDS DIGGER TOOLS PTY. LTD) 23 December 1998 Abstract, figs. 1-9, page 8 para. 4, pg. 9 -11	1, 15, 20
X	US 2013/0008722 A1 (GILBERT et al.) 10 January 2013 Abstract, page 3 para. [0064], figs. 1-35, para. [0076-80], pg 4-5	1, 15, 20
A	US 2007/0254516 A1 (STOETZER) 01 November 2007 whole document	1 - 25
A	US 2006/0096787 A1 (UNDERWOOD et al.) 11 May 2006 whole document	1 - 25

INTERNATIONAL SEARCH REPORT Information on patent family members	International application No. **PCT/AU2015/000309**

This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document/s Cited in Search Report		**Patent Family Member/s**	
Publication Number	**Publication Date**	**Publication Number**	**Publication Date**
US 2012/0186883 A1	26 July 2012	None	
WO 1998/058154 A1	23 December 1998	AU 753351 B2	17 Oct 2002
		AU 8004398 A	04 Jan 1999
		AU 8004498 A	04 Jan 1999
		WO 9858153 A1	23 Dec 1998
		ZA 9805216 A	07 Jan 1999
		ZA 9805220 A	07 Jan 1999
US 2013/0008722 A1	10 January 2013	None	
US 2007/0254516 A1	01 November 2007	None	
US 2006/0096787 A1	11 May 2006	US 7267185 B2	11 Sep 2007

End of Annex

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.