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(54) Title: SLEEVE RETENTION FOR CUTTING PICK ASSEMBLY

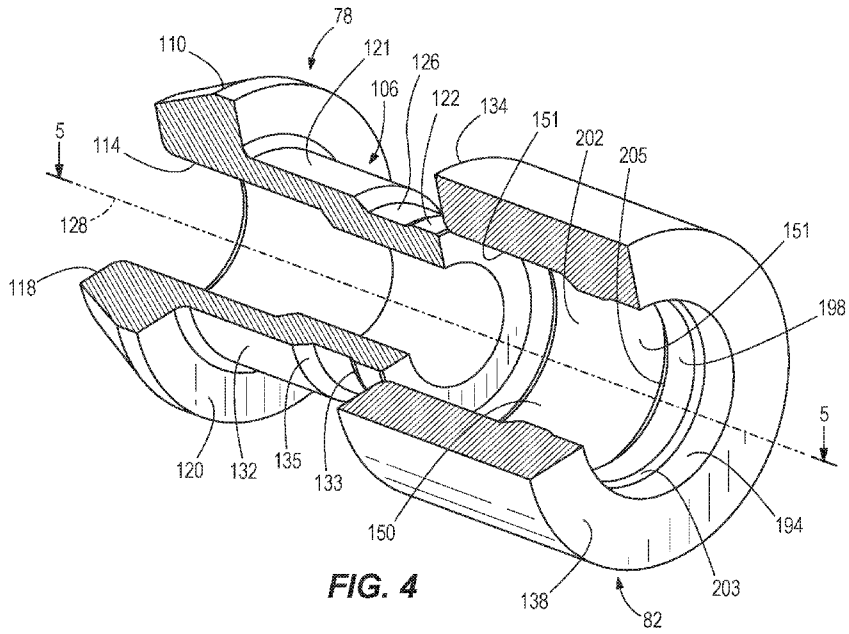

FIG. 4

(57) Abstract: A cutting assembly is configured to be coupled to a drum that is rotatable about an axis. The cutting assembly includes a block having a leading surface and an inner surface. The inner surface forms a block bore extending along an axis through the leading surface and at least partially through the block. The cutting assembly also includes a sleeve having a sleeve shank with an outer surface, a flange, and a sleeve bore extending through the flange and at least partially through the sleeve shank. During installation of the sleeve to the block, an interface between the outer surface of the sleeve shank and the inner surface of the block bore transitions from an interference fit to a clearance fit.

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[Continued on next page]

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SLEEVE RETENTION FOR CUTTING PICK ASSEMBLY

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to U.S. Provisional Patent Application No. 62/730,209, filed September 12, 2018, the content of which is incorporated herein by reference.

BACKGROUND

[0002] The present disclosure relates to bits or picks for cutting rock, and particularly to sleeve retention for a cutting pick assembly.

[0003] Cutting heads (e.g., for continuous mining and entry development machines) include multiple cutting pick assemblies. In some embodiments, each cutting pick assembly includes a holder block coupled to a rotating drum. The holder block includes a slot for receiving a sleeve. The sleeve in turn includes a bore for receiving a pick.

SUMMARY

[0004] In one independent aspect, a cutting assembly is configured to be coupled to a drum that is rotatable about an axis. The cutting assembly includes a block having a leading surface and an inner surface. The inner surface forms a block bore extending along an axis through the leading surface and at least partially through the block. The cutting assembly includes a sleeve having a sleeve shank with an outer surface, a flange, and a sleeve bore. The sleeve bore extends through the flange and at least partially through the sleeve shank. The sleeve shank is positionable within the block bore. The cutting assembly includes a step positioned on one of the inner surface of the block bore and the outer surface of the sleeve shank. The cutting assembly includes a protrusion positioned on the other of the inner surface of the block bore and the outer surface of the sleeve shank. The protrusion engages the step to maintain the sleeve shank within the block bore.

[0005] In another independent aspect, a cutting assembly is configured to be coupled to a drum that is rotatable about an axis. The cutting assembly includes a block having a leading surface and an inner surface. The inner surface forms a block bore extending along an axis through the leading surface and at least partially through the block. The cutting assembly also includes a sleeve having a sleeve shank with an outer surface, a flange, and a sleeve bore

extending through the flange and at least partially through the sleeve shank. During installation of the sleeve to the block, an interface between the outer surface of the sleeve shank and the inner surface of the block bore transitions from an interference fit to a clearance fit.

[0006] In yet another independent aspect, a cutting assembly is configured to be coupled to a drum that is rotatable about an axis. The cutting assembly includes a block having a leading surface and an inner surface. The inner surface forms a block bore extending along an axis through the leading surface and at least partially through the block. The cutting assembly also includes a sleeve having a sleeve shank with an outer surface, a flange, and a sleeve bore extending through the flange and at least partially through the sleeve shank. The sleeve moves from a first position to a second position relative to the block during installation of the sleeve to the block. An interface between the outer surface of the sleeve shank and the inner surface of the block bore provides a compressive force on the sleeve shank when in the first position. The compressive force is decreased when in the second position.

[0007] Other aspects will become apparent by consideration of the detailed description and accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] FIG. 1 is a perspective view of a rock excavating machine.

[0009] FIG. 2 is a perspective view of a portion of a cutting head of the rock excavating machine of FIG. 1.

[0010] FIG. 3 is a perspective view of a cutting pick assembly that is coupled to the cutting head of FIG. 2.

[0011] FIG. 4 is a partial section view of a sleeve and a holder block of the cutting pick assembly of FIG. 3.

[0012] FIG. 5 is a section view of the sleeve of FIG. 4 viewed along section 5--5.

[0013] FIG. 6 is a section view of the sleeve and the holder block of FIG. 4 viewed along section 5--5, with the sleeve in a disassembled position.

[0014] FIG. 7 is a section view of the sleeve and the holder block of FIG. 4 viewed along section 5--5, with the sleeve in an intermediate position.

[0015] FIG. 8 is a section view of the sleeve and the holder block of FIG. 4 viewed along section 5--5, with the sleeve in another intermediate position engaging a portion of the block in an interference fit.

[0016] FIG. 9 is a section view of the sleeve and the holder block of FIG. 4 viewed along section 5--5, with the sleeve in a fully inserted position.

[0017] FIG. 10 is a section view of the sleeve and the holder block according to another embodiment.

[0018] FIG. 11 is a section view of the sleeve and the holder block according to yet another embodiment.

DETAILED DESCRIPTION

[0019] Before any embodiments 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. The use of "including," "comprising" or "having" and variations thereof herein is meant to encompass the items listed thereafter and equivalents thereof as well as additional items. The terms "mounted," "connected" and "coupled" are used broadly and encompass both direct and indirect mounting, connecting and coupling. Further, "connected" and "coupled" are not restricted to physical or mechanical connections or couplings, and can include electrical or hydraulic connections or couplings, whether direct or indirect. Also, electronic communications and notifications may be performed using any known means including direct connections, wireless connections, etc. Terms of degree, such as "substantially," "about," "approximately," etc. are understood by those of ordinary skill to refer to reasonable ranges outside of the given value, for example, general tolerances associated with manufacturing, assembly, and use of the described embodiments.

[0020] FIG. 1 illustrates a mining machine, such as a continuous miner 10, including a frame 14 that is supported for movement by tracks 18. The continuous miner 10 further includes a boom 22 and a cutter head 26 supported on the boom 22. In the illustrated embodiment, the frame 14 also includes a gathering head 30 and a conveyor 34 extending from a first or front end of the frame 14 toward a second or rear end of the frame 14. The boom 22 includes an end supporting the cutter head 26, and the boom 22 can pivot (e.g., by a pair of actuators 58) to adjust the position of the cutter head 26.

[0021] As shown in FIG. 2, in the illustrated embodiment the cutter head 26 is formed as an elongated drum 62 including cutting pick assemblies 66 secured to an outer surface of the drum 62. In the illustrated embodiment, the outer surface of the drum 62 includes multiple pedestals 68, and each cutting pick assembly 66 is secured to one of the pedestals 68. The drum 62 defines a drum axis 70 (FIG. 1) about which the drum 62 rotates. The cutting pick assemblies 66 can be positioned on the surface of the drum 62 in a predetermined pattern to facilitate efficient rock cutting.

[0022] Referring to FIG. 3, each cutting pick assembly 66 includes a pick or bit 74, a sleeve 78, and a holder block 82. The bit 74 includes a first portion 86 having a tip 88 for engaging a mine face to remove material, a second portion or bit shank 90, and a shoulder 94 positioned between the tip 88 and the bit shank 90.

[0023] As shown in FIGS. 3 and 4, the sleeve 78 includes a sleeve shank 106, a flange 110, and a bore 114 (FIG. 4) extending through both the sleeve shank 106 and the flange 110. The flange 110 is positioned adjacent a forward or leading end of the sleeve 78 and includes an abutment surface 118 and a bearing surface 120. The bit shank 90 (FIG. 3) is positioned within the bore 114, and the bit shoulder 94 engages or abuts the abutment surface 118 of the sleeve 78. In one embodiment, the bit shank 90 is received in the sleeve bore 114 by a clearance fit and is retained by a clip (not shown). In other embodiments, the bit shank 90 may be press fit within the sleeve bore 114.

[0024] As shown in FIG. 5, the sleeve shank 106 includes an outer surface 121 having a sleeve protrusion 122 (e.g., a first portion) positioned adjacent an end of the shank 106 opposite the flange 110, and a recess 126 (e.g., a second portion) positioned between the sleeve protrusion 122 and the flange 110 with respect to an axis 128 of the sleeve bore 114. The sleeve protrusion

122 extends 360-degrees about the axis 128 and has a first outer diameter OD1. The first outer diameter OD1 is constant along the axis 128. In other embodiments, the sleeve protrusion 122 can taper along the axis 128 and/or the sleeve protrusion 122 can be discontinuous about the axis 128 (e.g., a plurality of sleeve protrusions 122 positioned about the axis 128). In further embodiments, the sleeve protrusion 122 can be positioned away from the end of the shank 106. The illustrated recess 126 extends 360-degrees about the axis 128 and has a second outer diameter OD2 that is smaller than the first outer diameter OD1 of the sleeve protrusion 122. In other embodiments, the recess 126 can taper along the axis 128 and/or the recess 126 can be discontinuous about the axis 128 (e.g., a plurality of recesses 126 positioned about the axis 128).

[0025] In the illustrated embodiment, the sleeve shank 106 further includes a third portion 132 positioned between the recess 126 and the flange 110 with respect to the bore axis 128, and the third portion 132 has a third outer diameter OD3. The third outer diameter OD3 is larger than the first outer diameter OD1. In other embodiments, the third outer diameter OD3 can be substantially equal to the first outer diameter OD1, or the third outer diameter OD3 can be less than the first outer diameter OD1. In addition, the outer surface 121 of the sleeve shank 106 includes a first step 133 (e.g., a first transition portion) between the sleeve protrusion 122 and the recess 126 along the axis 128 and a second step 135 (e.g., a second transition portion) between the recess 126 and the third portion 132 along the axis 128. In some embodiments, the recess 126 includes the first and second steps 133, 135. In further embodiments, the sleeve protrusion 122 includes the first step 133.

[0026] Referring again to FIGS. 3 and 4, the holder block 82 includes a lower surface 142 (FIG. 3) secured to the one of the pedestals 68 (FIG. 2) of the drum 62. The holder block 82 includes a block bore or slot 150 (FIG. 4) extending through a forward or leading surface 134. The holder block 82 also includes apertures 136 for supporting fluid nozzle (not shown) providing spray envelopes 160, 188 (FIG. 3) that encompasses surfaces of the bit 74. In the embodiment of FIG. 4, the holder block 82 and the slot 150 have circular profiles. In some embodiments (FIG. 3), the holder block 82 includes a lateral opening 170 extending between sides of the holder block 82. The slot 150 extends between the leading surface 134 and the lateral opening 170, and a rear opening (not shown) may extend between a rearward or trailing surface 138 of the block and the lateral opening 170.

[0027] As best shown in FIG. 6, the block bore 150 is defined by an inner surface 151 and includes a first portion 194 adjacent the trailing surface 138 and a block protrusion 198 (e.g., a second portion) positioned between the first portion 194 and the leading surface 134. The first portion 194 has a first inner diameter ID1 that is larger than a second inner diameter ID2 of the block protrusion 198. The first inner diameter ID1 and the second inner diameter ID2 are constant along the axis 128. Also, the block protrusion 198 extends 360-degrees about the axis 128. In other embodiments, the block protrusion 198 can taper along the axis 128 and/or the block protrusion 198 can be discontinuous about the axis 128 (e.g., a plurality of block protrusions 198 positioned about the axis 128).

[0028] In the illustrated embodiment, the block bore 150 further includes a third portion 202 positioned between the block protrusion 198 and the leading surface 134, and the third portion 202 further includes a third inner diameter ID3. The third inner diameter ID3 is larger than the first inner diameter ID1. In other embodiments, the third inner diameter ID3 can be substantially equal to the first inner diameter ID1, or the third inner diameter ID3 can be less than the first inner diameter ID1. In addition, the inner surface 151 of the block bore 150 includes a third step 203 (e.g., a third transition portion) between the first portion 194 and the block protrusion 198 along the axis 128 and a fourth step 205 (e.g., a fourth transition portion) between the block protrusion 198 and the third portion 202 along the axis 128. In some embodiments, the block protrusion 198 includes the third and fourth steps 203, 205.

[0029] As shown in FIGS. 6-9, the sleeve shank 106 is illustrated being inserted within the block bore 150 through the leading surface 134 of the holder block 82. In particular, FIG. 6 illustrates an initial stage of installation with the sleeve shank 106 passing relatively easily through the third portion 202 of the block bore 150. The third outer diameter OD3 of the sleeve shank 106 is slightly less than the third inner diameter ID3 of the block bore 150 (e.g., an interface between the sleeve shank 106 and the block bore 150 includes a clearance fit), thus providing relatively easily sliding movement of the sleeve shank 106 into the block bore 150. When the sleeve shank 106 is positioned as shown in FIG. 6, substantially no forces (e.g., compressive forces) act on the sleeve shank 106 by the inner surface 151 of the block bore 150.

[0030] FIG. 7 illustrates another stage of installation where the end of the sleeve shank 106 (e.g., an end of the sleeve protrusion 122) engages the fourth step 205 of the block protrusion

198. The first outer diameter OD1 of the sleeve protrusion 122 is greater than the second inner diameter ID2 of the block protrusion 198, thus requiring additional axial force along the axis 128 to move the sleeve 78 into the position shown in FIG. 8 than the axial force required to move the sleeve shank 106 from the position shown in FIG. 6 to the position shown in FIG. 7. With continued reference to FIG. 8, the interface between the sleeve shank 106 and the block bore 150 (e.g., engagement between the sleeve protrusion 122 and the block protrusion 198) includes an interference fit. In other words, a press-fit portion or zone 206 (FIG. 8) is created between the sleeve shank 106 and the block bore 150 as the sleeve protrusion 122 slides past the block protrusion 198. The interference fit between the sleeve protrusion 122 and the block protrusion 198 provides a compressive force F acting on the sleeve shank 106 by the inner surface 151 of the block bore 150.

[0031] With further insertion of the sleeve shank 106 into the block bore 150, the sleeve protrusion 122 slides past the block protrusion 198 to be received within the first portion 194 of the block bore 150 (FIG. 9). As such, the sleeve 78 is fully inserted into the block 82. In the fully inserted position, the bearing surface 120 of the flange 110 engages the leading surface 134 of the holder block 82. Each portion 194, 198, 202 of the block bore 150 interfaces with the associated portion 122, 126, 132 of the sleeve shank 106 as a clearance fit when in the fully inserted position. Stated another way, the first outer diameter OD1 of the sleeve protrusion 122 is slightly smaller than the first inner diameter ID1 of the first portion 194 of the block bore 150, the second outer diameter OD2 of the recess 126 of the sleeve shank 106 is slightly smaller than the second inner diameter ID2 of the block protrusion 198, and the third outer diameter OD3 of the third portion 132 of the sleeve shank 106 is slightly smaller than the third inner diameter ID3 of the third portion 202 of the block bore 150.

[0032] The clearance fit interface between the sleeve shank 106 and the block bore 150 when in the fully inserted position decreases the compressive force F acting on the sleeve shank 106 in the press-fit zone 206 (FIG. 8). In one embodiment, the compressive force F is decreased to provide a substantially stress-free state of the sleeve shank 106. In other embodiments, the compressive force F can be decreased to provide a relatively small compressive force acting on the sleeve shank 106. In further embodiments, the interface between the sleeve shank 106 and the block bore 150 can include some portions having a clearance fit and some portions having an interference fit when in the fully inserted position. With continued reference to FIG. 9,

engagement between the first step 133 of the sleeve protrusion 122 and the third step 203 of the block protrusion 198 prevents inadvertent dislodging of the sleeve 78 from the holder block 82 since removal of the sleeve 78 from the holder block 82 requires the sleeve protrusion 122 to pass through the press-fit zone 206.

[0033] Furthermore, the clearance fit interface between the sleeve shank 106 and the block bore 150 when in the fully inserted position allows for rotation of the sleeve shank 106 relative to the holder block 82. Such rotation of the sleeve shank 106—and ultimately the bit 74—relative to the holder block 82 facilitates wear on the bit 74 to be evenly distributed during operation of the machine 10.

[0034] Conventional blocks may be secured to a cutting drum by welding while a sleeve is positioned within the block bore in an interference fit or press fit (e.g., the sleeve is in compression while the inner surface of the block is in tension). However, heat generated by the welding process can be sufficient to relieve the residual stresses, thereby creating a fit or engagement that permits the sleeve to be easily dislodged from the block bore. In contrast, the sleeve shank 106 can only be inserted or extracted by passing through the press-fit zone 206, yet the sleeve shank 106 is not in a stressed condition in the fully installed position. As a result, heat will not relax the stresses and modify the engagement of the sleeve shank 106 and block bore 150. In some embodiments, the stress induced on the sleeve protrusion 122 of the sleeve shank 106 and the block protrusion 198 of the block bore 150 by the interference fit does not exceed the yield strength of the sleeve shank 106 or the block 82, thereby avoiding plastic deformation.

[0035] FIG. 10 illustrates another embodiment of a sleeve 478. The sleeve 478 is similar to the sleeve 78 with similar features identified by reference numbers incremented by 400. The illustrated sleeve 478 includes at least one elongated slot or notch 502 formed in a wall of a sleeve shank 506. The notch 502 extends through a first portion 522 and a recess 526 of the sleeve shank 506 along a bore axis 528, and also extends partially into a third portion 532 of the sleeve shank 506 along the bore axis 528. The notch 502 permits greater resilient deformation of a rear portion of the sleeve shank 506 during insertion and extraction of the sleeve 478 without exceeding the yield strength of the sleeve 478. Accordingly, the interference fit between a sleeve protrusion 522 of the sleeve shank 506 and the block protrusion 198 may be more pronounced.

[0036] In other embodiments, the interfacing features between the sleeve 78 and the holder block 82 can be oriented in an opposite configuration. For example, at least one of the protrusion 122, the recess 126, the third portion 132, the first step 133, the second step 135, etc. can be formed on the holder block 82 and at least one of the first portion 194, the protrusion 198, the third portion 202, the third step 203, the fourth step 205, etc. can be formed on the sleeve 78. FIG. 11 illustrates another embodiment of a sleeve 678 and a holder block 682. The sleeve 678 is similar to the sleeve 78 and the holder block 682 is similar to the holder block 82 with similar features identified by reference numbers incremented by 600. The holder block 682 includes a protrusion 722 having steps 633, 635, a first portion 794, and a third portion 802 with the first portion 794 positioned between the protrusion 722 and the third portion 802 along an axis 728. The sleeve 678 includes a recess 626 having steps 803, 805, a first portion 807, and a third portion 732 with the first portion 807 positioned between the recess 626 and the third portion 732 along the axis 728. During installation, the sleeve 678 and the holder block 682 transition from an interference fit (e.g., engagement between the step 803 of the sleeve 678 and the protrusion 722 of the holder block 682) to a clearance fit (e.g., when the protrusion 722 of the holder block 682 is received within the recess 626 of the sleeve 678).

[0037] Although the cutting bit assembly 66 has been described above with respect to a continuous mining machine 10, it is understood that the cutting bit assembly 66 could be incorporated onto various types of cutter heads and various types of mining machines.

[0038] Although aspects are described in detail above with reference to certain preferred embodiments, variations and modifications exist within the scope and spirit of one or more independent aspects as described. Various features and advantages of the invention are set forth in the following claims.

CLAIMS

What is claimed is:

1. A cutting assembly configured to be coupled to a drum that is rotatable about an axis, the cutting assembly comprising:

a block including a leading surface and an inner surface, the inner surface forming a block bore extending along an axis through the leading surface and at least partially through the block;

a sleeve including a sleeve shank having an outer surface, a flange, and a sleeve bore, the sleeve bore extending through the flange and at least partially through the sleeve shank, the sleeve shank positionable within the block bore;

a step positioned on one of the inner surface of the block bore and the outer surface of the sleeve shank; and

a protrusion positioned on the other of the inner surface of the block bore and the outer surface of the sleeve shank, the protrusion engaging the step to maintain the sleeve shank within the block bore.

2. The cutting assembly of claim 1, wherein the protrusion is a sleeve protrusion positioned on the outer surface of the sleeve shank, wherein the inner surface of the block bore includes a block protrusion having the step, wherein the block protrusion includes an inner diameter and the sleeve protrusion includes an outer diameter, and wherein the outer diameter is greater than the inner diameter.

3. The cutting assembly of claim 2, wherein the sleeve protrusion slides past the block protrusion as an interference fit during installation of the sleeve to the block.

4. The cutting assembly of claim 3, wherein the sleeve forms a clearance fit with the block bore after the sleeve protrusion slidably engages the block protrusion.

5. The cutting assembly of claim 4, wherein the sleeve forms a clearance fit with the block bore before the sleeve protrusion slidably engages the block protrusion.

6. The cutting assembly of claim 1, wherein the protrusion is a sleeve protrusion positioned on the outer surface of the sleeve shank, wherein the inner surface of the block bore includes a

block protrusion having the step, wherein the sleeve shank includes a recess positioned between the sleeve protrusion and the flange along the axis, and wherein the recess receives the block protrusion.

7. The cutting assembly of claim 6, wherein the inner surface of the block bore includes a portion, wherein the block protrusion is located between the portion and the leading surface along the axis, and wherein the portion receives the sleeve protrusion.

8. The cutting assembly of claim 1, wherein the inner surface of the block bore includes a block protrusion having the step, wherein the block protrusion includes a constant inner diameter along the axis.

9. The cutting assembly of claim 8, wherein the block protrusion angularly extends 360-degrees about the axis.

10. The cutting assembly of claim 1, wherein the protrusion is a sleeve protrusion positioned on the outer surface of the sleeve shank, wherein the sleeve protrusion includes a constant outer diameter along the axis.

11. The cutting assembly of claim 10, wherein the sleeve protrusion angularly extends 360-degress about the axis.

12. The cutting assembly of claim 1, wherein the protrusion is a sleeve protrusion positioned on the outer surface of the sleeve shank, wherein the sleeve includes a notch extending through the sleeve protrusion, and wherein the notch enables resilient movement of the sleeve protrusion during installation of the sleeve to the block.

13. The cutting assembly of claim 1, further comprising a bit including a tip, a bit shank, and a shoulder position between the tip and the bit shank, wherein the bit shank is positioned within the sleeve bore, and wherein the shoulder abuts the flange of the sleeve.

14. A cutting assembly configured to be coupled to a drum that is rotatable about an axis, the cutting assembly comprising:

a block including a leading surface and an inner surface, the inner surface forming a block bore extending along an axis through the leading surface and at least partially through the block; and

a sleeve including a sleeve shank having an outer surface, a flange, and a sleeve bore extending through the flange and at least partially through the sleeve shank,

wherein during installation of the sleeve to the block, an interface between the outer surface of the sleeve shank and the inner surface of the block bore transitions from an interference fit to a clearance fit.

15. The cutting assembly of claim 14, wherein the clearance fit allows for rotational movement of the sleeve relative to the block about the axis.

16. The cutting assembly of claim 14, wherein the inner surface of the block bore includes a block protrusion and the outer surface of the sleeve shank includes a sleeve protrusion, and wherein the interference fit includes engagement between the block protrusion and the sleeve protrusion.

17. The cutting assembly of claim 16, wherein the outer surface of the sleeve shank includes a recess positioned between the sleeve protrusion and the flange along the axis, and wherein the clearance fit includes the block protrusion received within the recess.

18. The cutting assembly of claim 17, wherein the inner surface of the block bore includes a portion, wherein the block protrusion is positioned between the portion and the leading surface along the axis, and wherein the clearance fit includes the sleeve protrusion received within the portion of the block bore.

19. The cutting assembly of claim 14, further comprising a bit including a tip, a bit shank, and a shoulder position between the tip and the bit shank, wherein the bit shank is positioned within the sleeve bore, and wherein the shoulder abuts the flange of the sleeve.

20. A cutting assembly configured to be coupled to a drum that is rotatable about an axis, the cutting assembly comprising:

a block including a leading surface and an inner surface, the inner surface forming a block bore extending along an axis through the leading surface and at least partially through the block; and

a sleeve including a sleeve shank having an outer surface, a flange, and a sleeve bore extending through the flange and at least partially through the sleeve shank,

wherein the sleeve moves from a first position to a second position relative to the block during installation of the sleeve to the block, wherein an interface between the outer surface of the sleeve shank and the inner surface of the block bore provides a compressive force on the sleeve shank when in the first position, and wherein the compressive force is decreased when in the second position.

21. The cutting assembly of claim 20, wherein the inner surface of the block bore includes a block protrusion and the outer surface of the sleeve shank includes a sleeve protrusion, and wherein the compressive force is provided by engagement between the block protrusion and the sleeve protrusion.

22. The cutting assembly of claim 21, wherein the outer surface of the sleeve shank includes a recess positioned between the sleeve protrusion and the flange along the axis, and wherein the compressive force is decreased when the block protrusion is received within the recess.

23. The cutting assembly of claim 22, wherein the inner surface of the block bore includes a portion, wherein the block protrusion is located between the portion and the leading surface along the axis, and wherein the compressive force is decreased when the sleeve protrusion is received within the portion of the block bore.

24. The cutting assembly of claim 20, wherein the second position is a fully inserted position of the sleeve shank within the block bore.

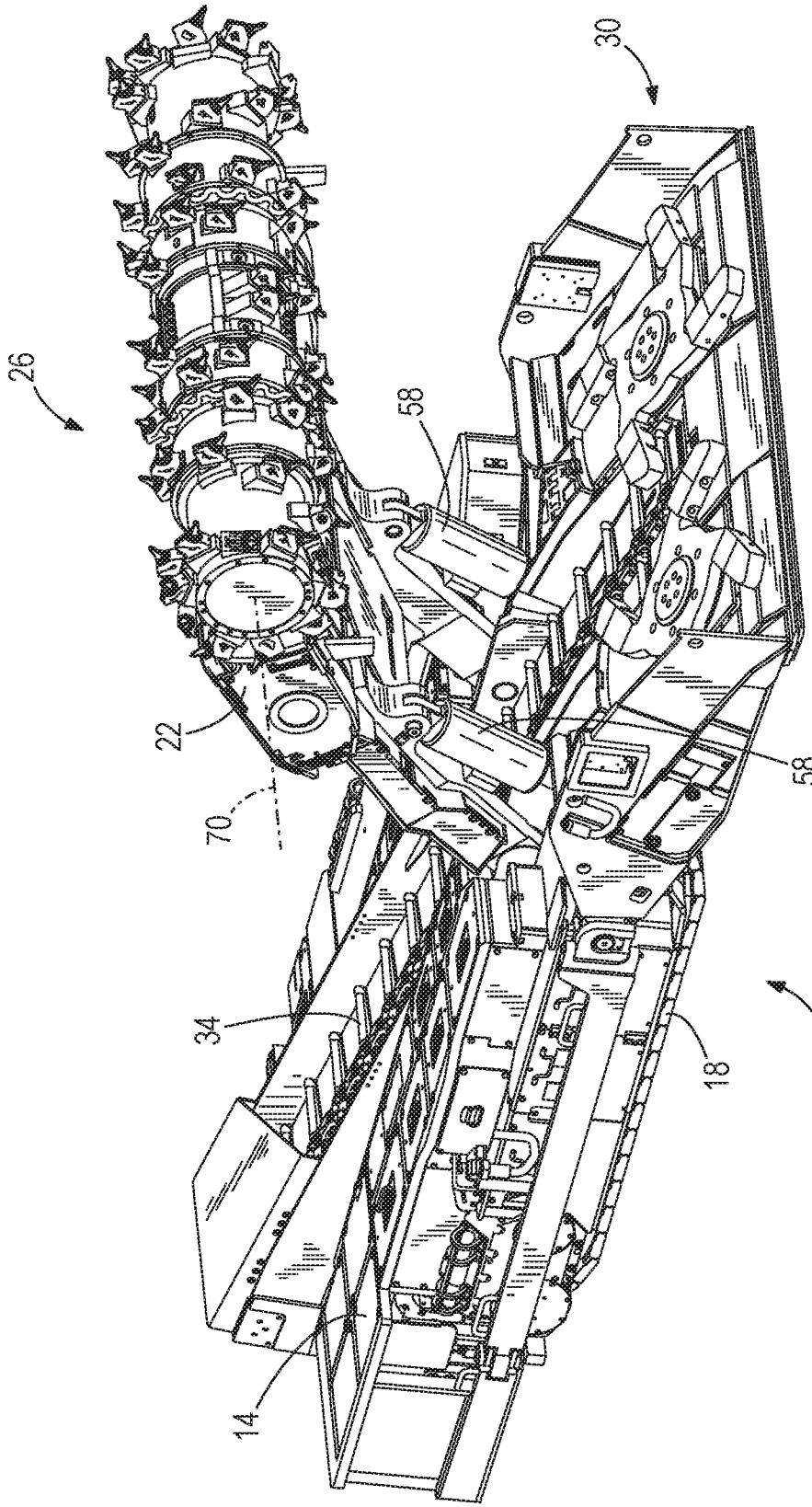


FIG. 1

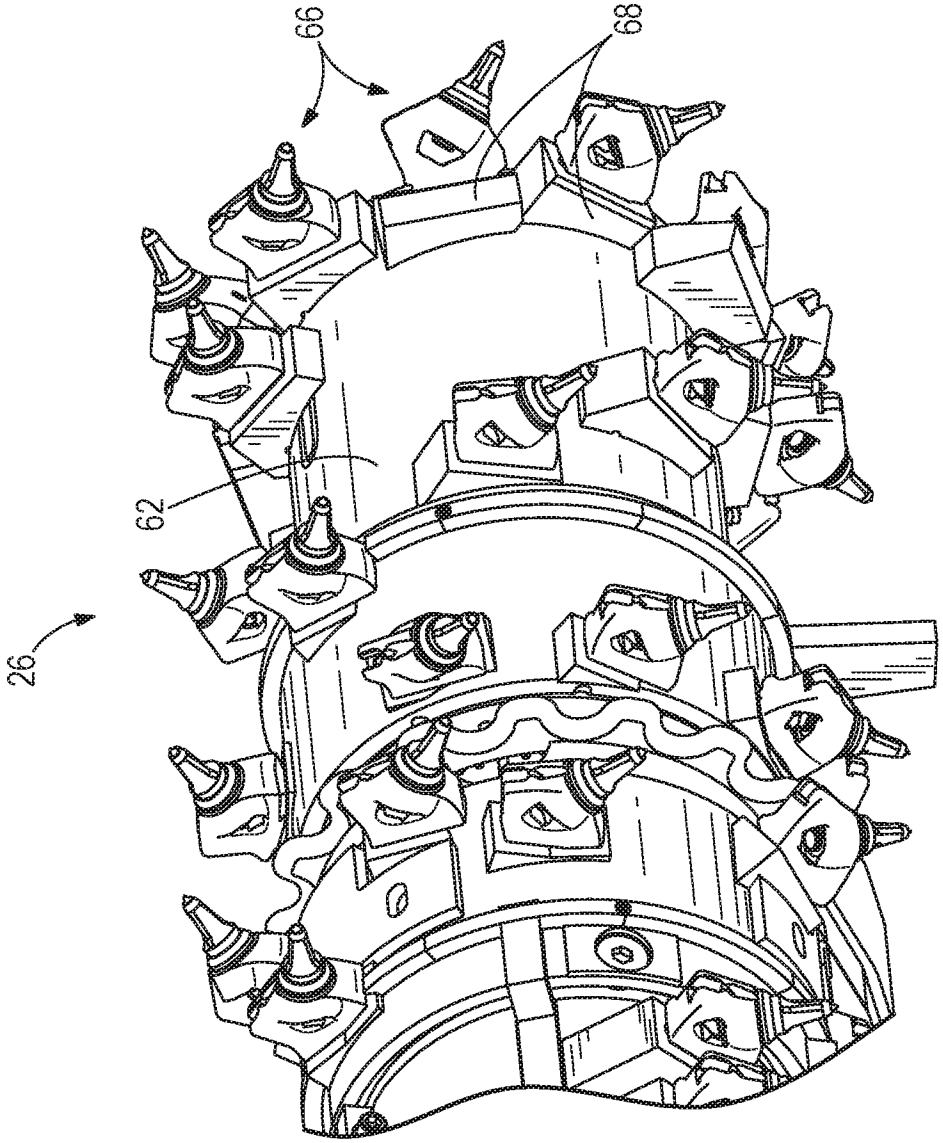


FIG. 2

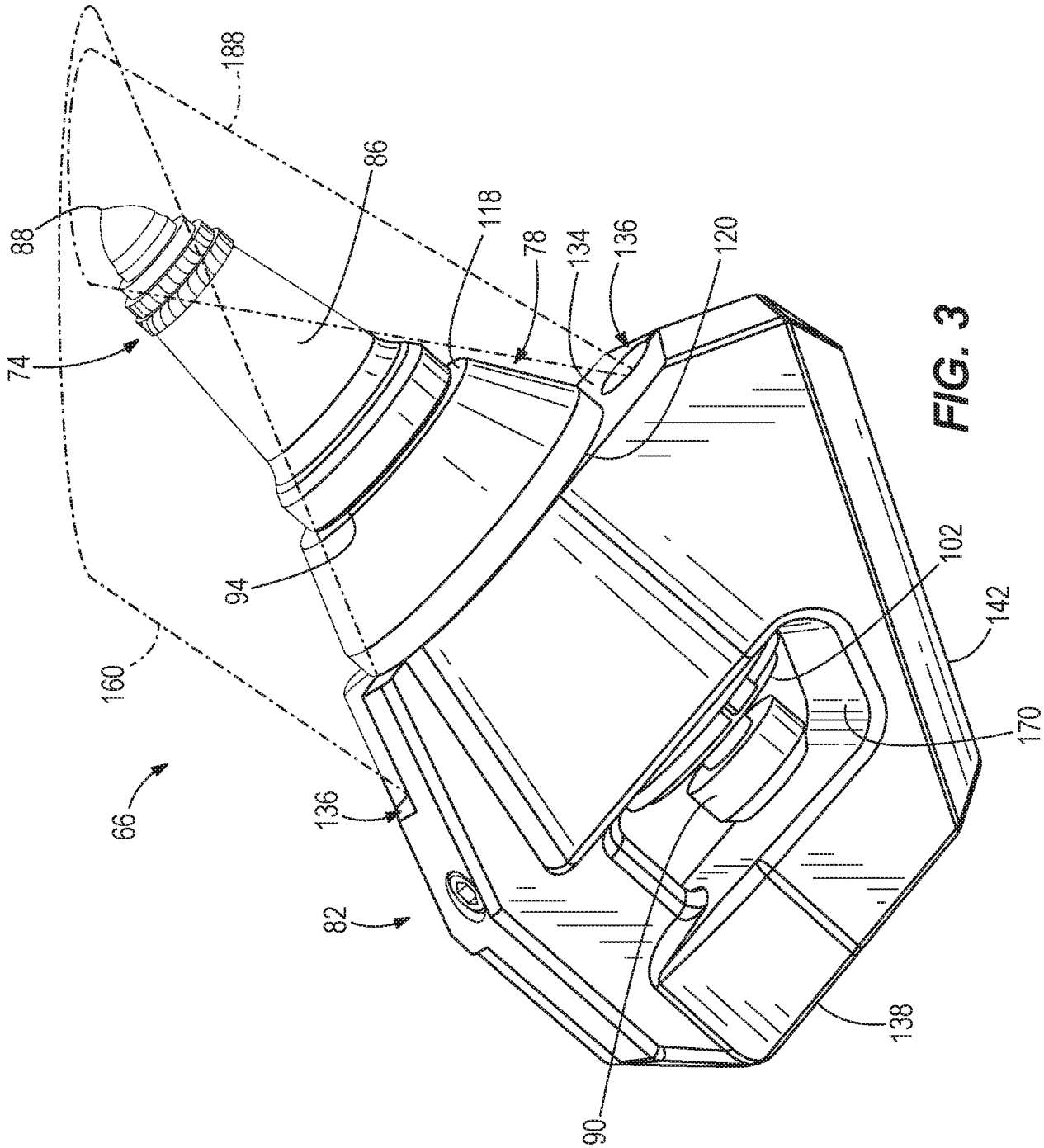
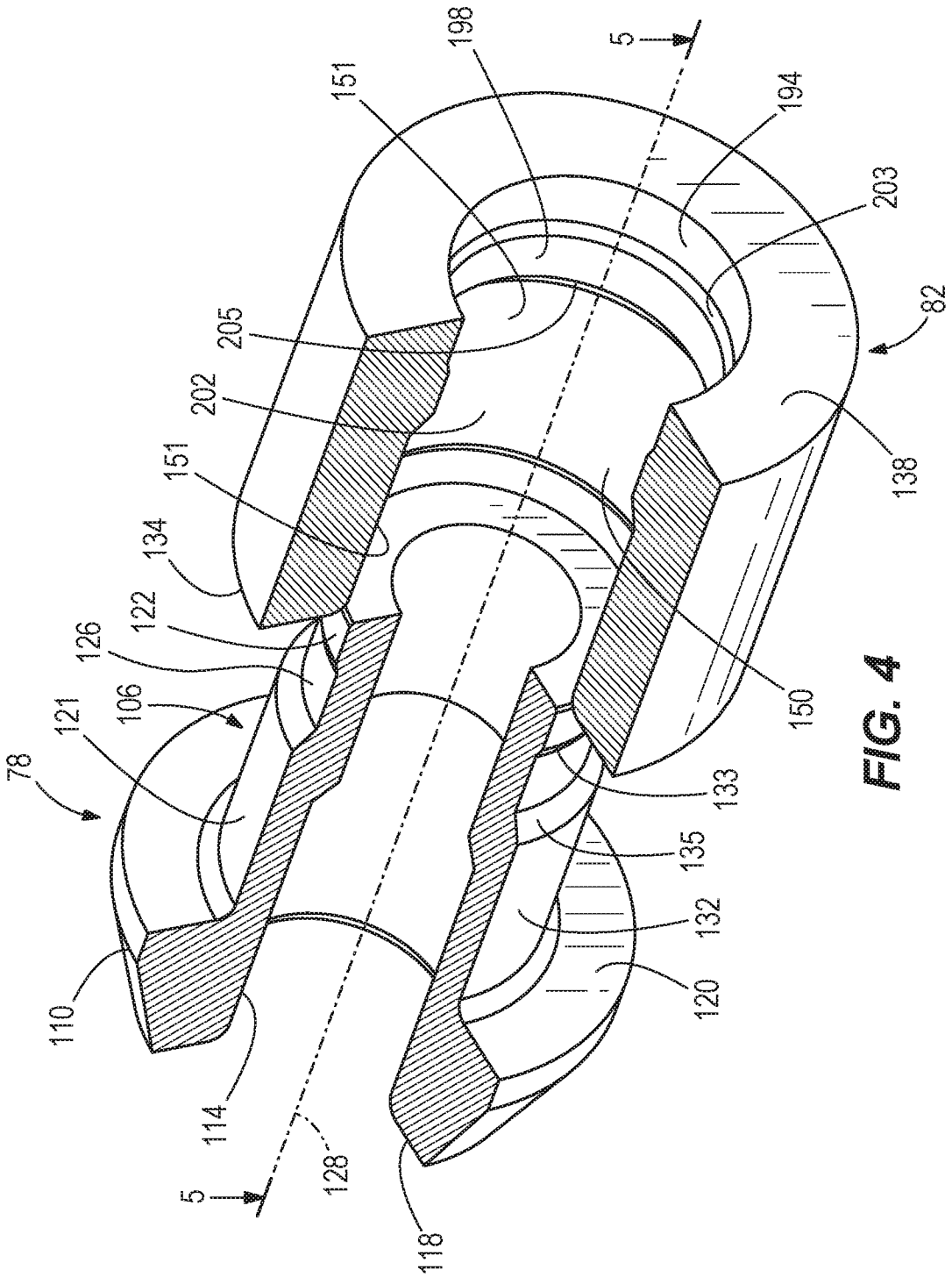


FIG. 3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120
114
128
5
118

FIG. 4

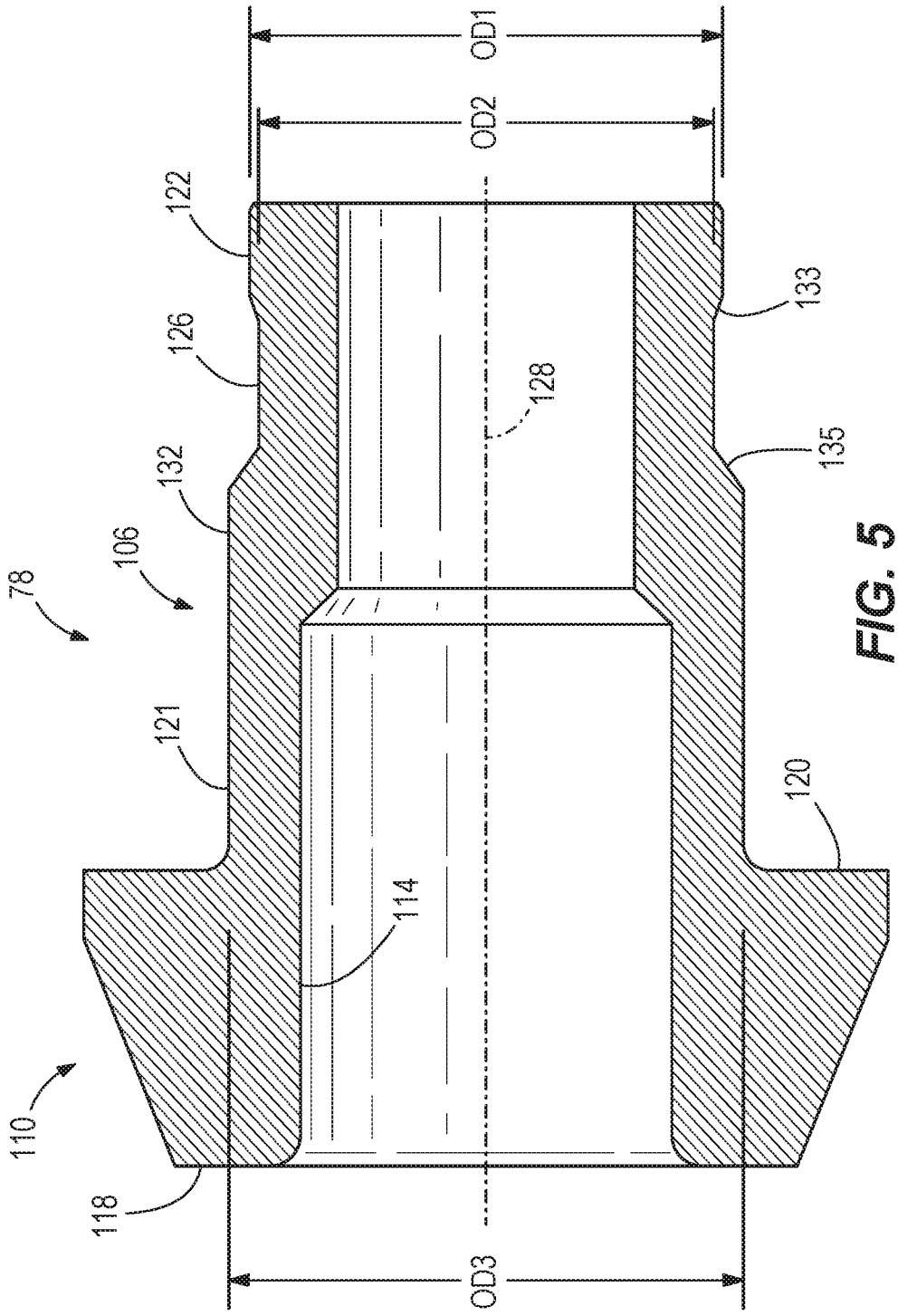
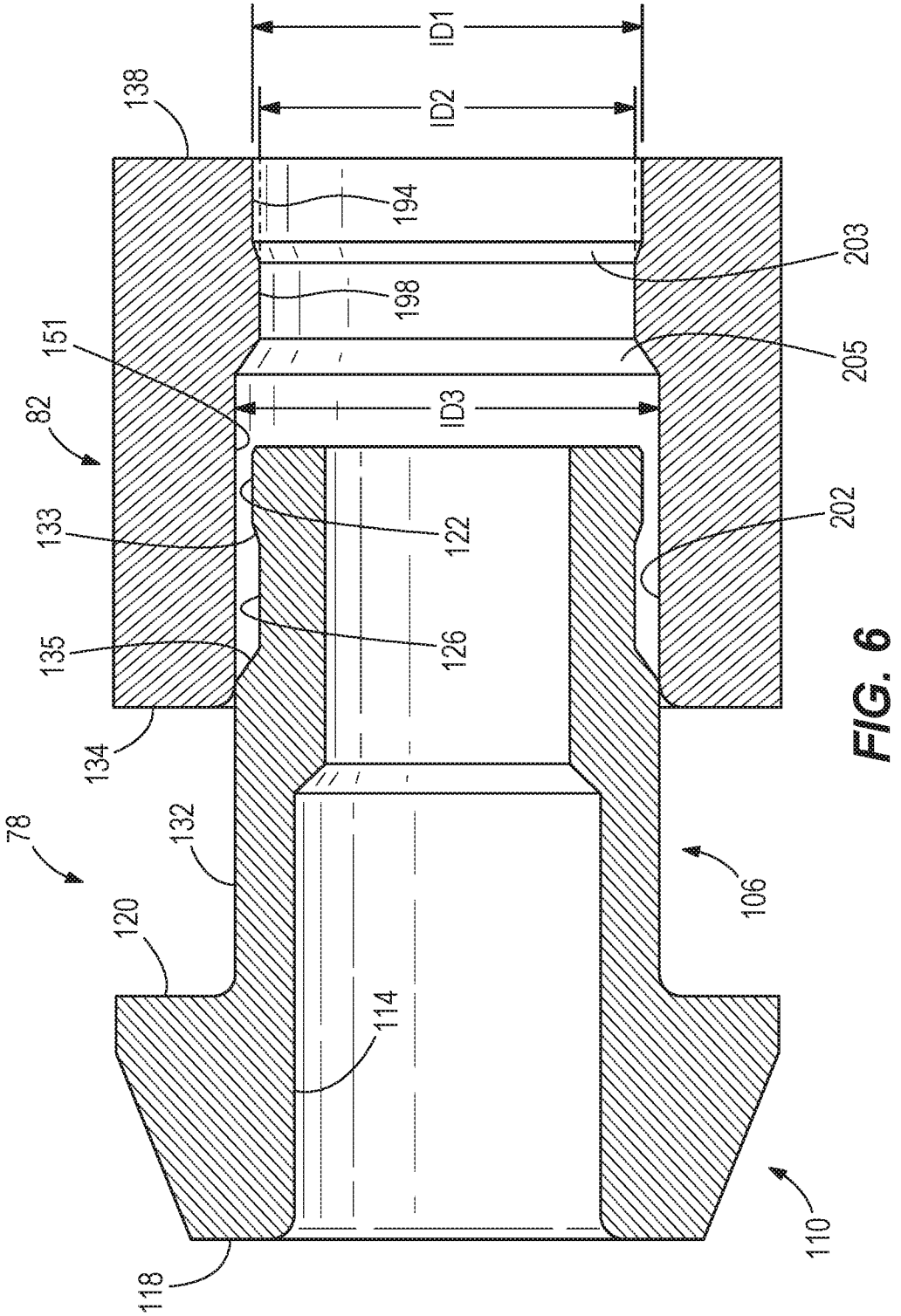


FIG. 5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ID2
ID3
138
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114
118
110

FIG. 6

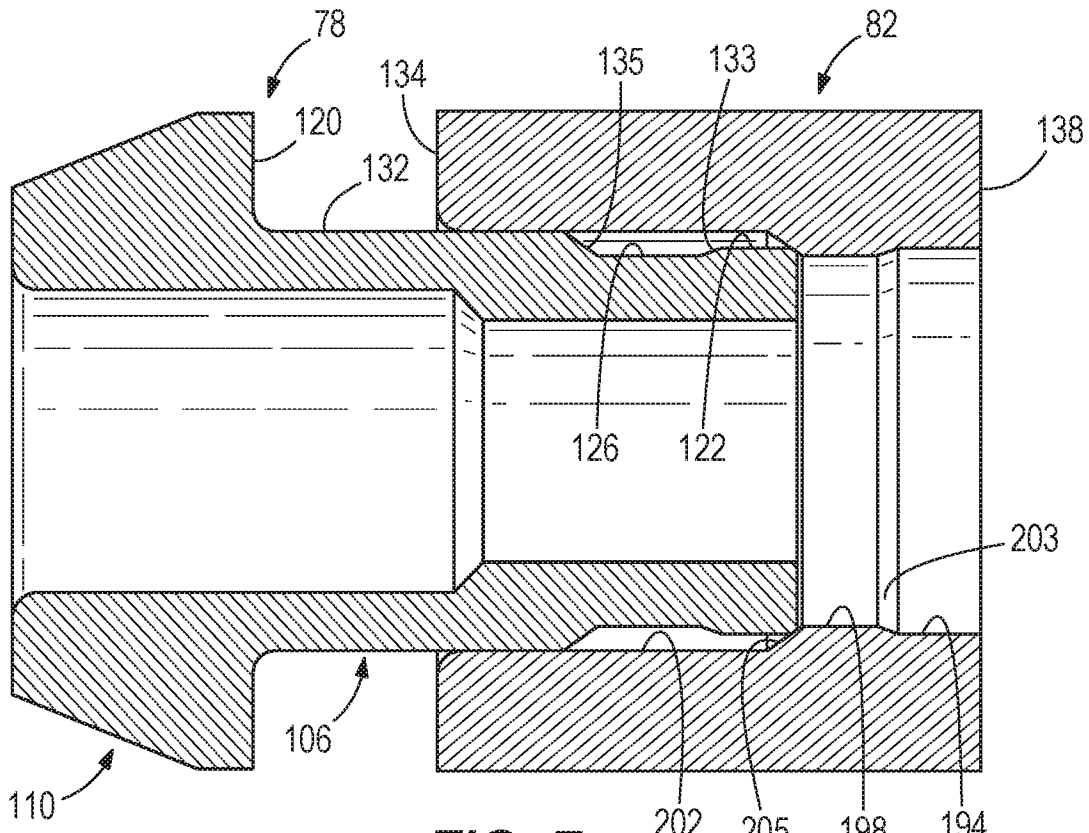
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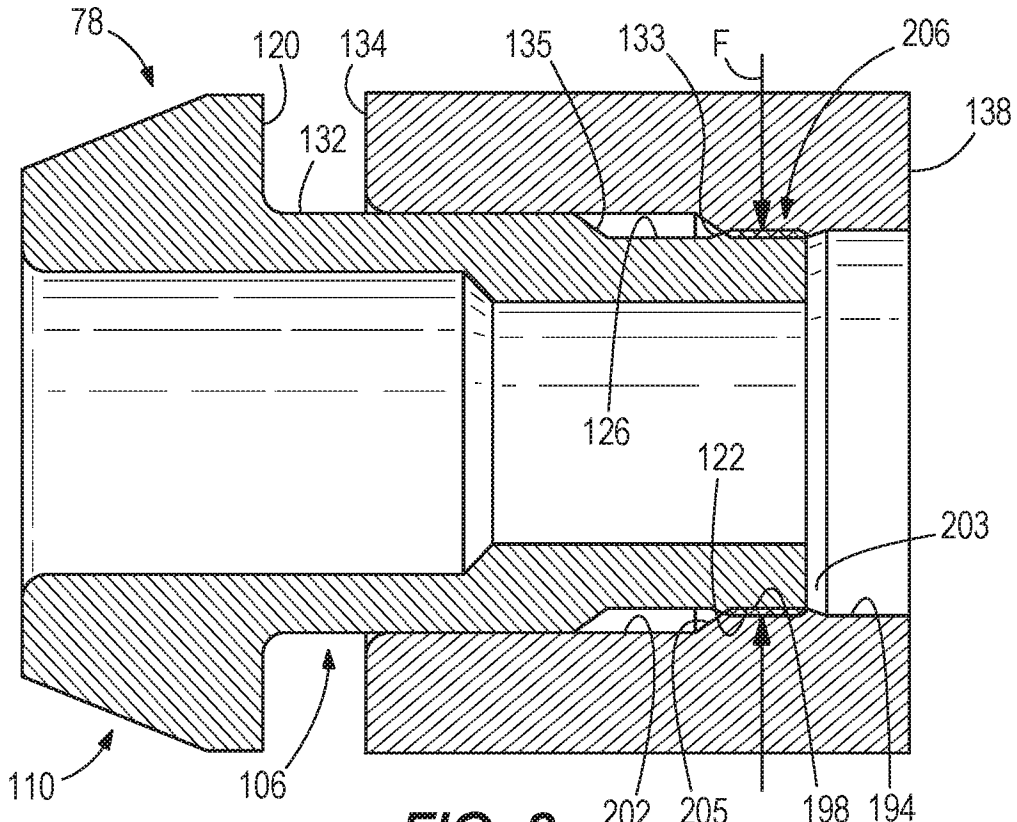
FIG. 7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203
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198
194

FIG. 8

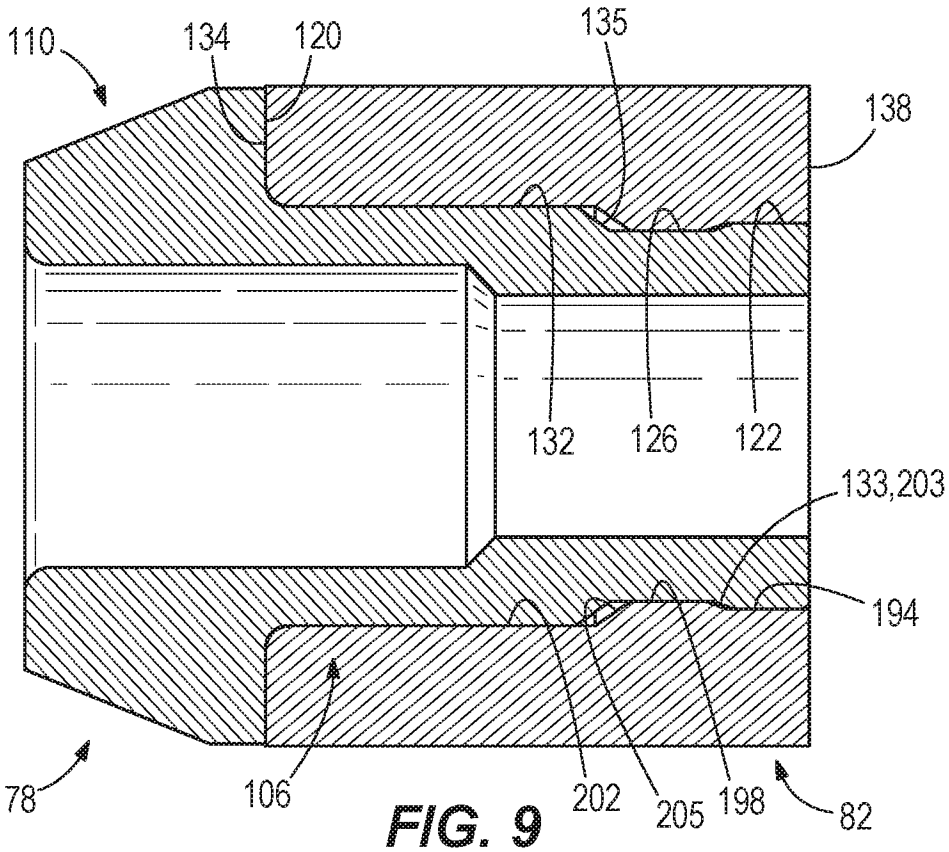
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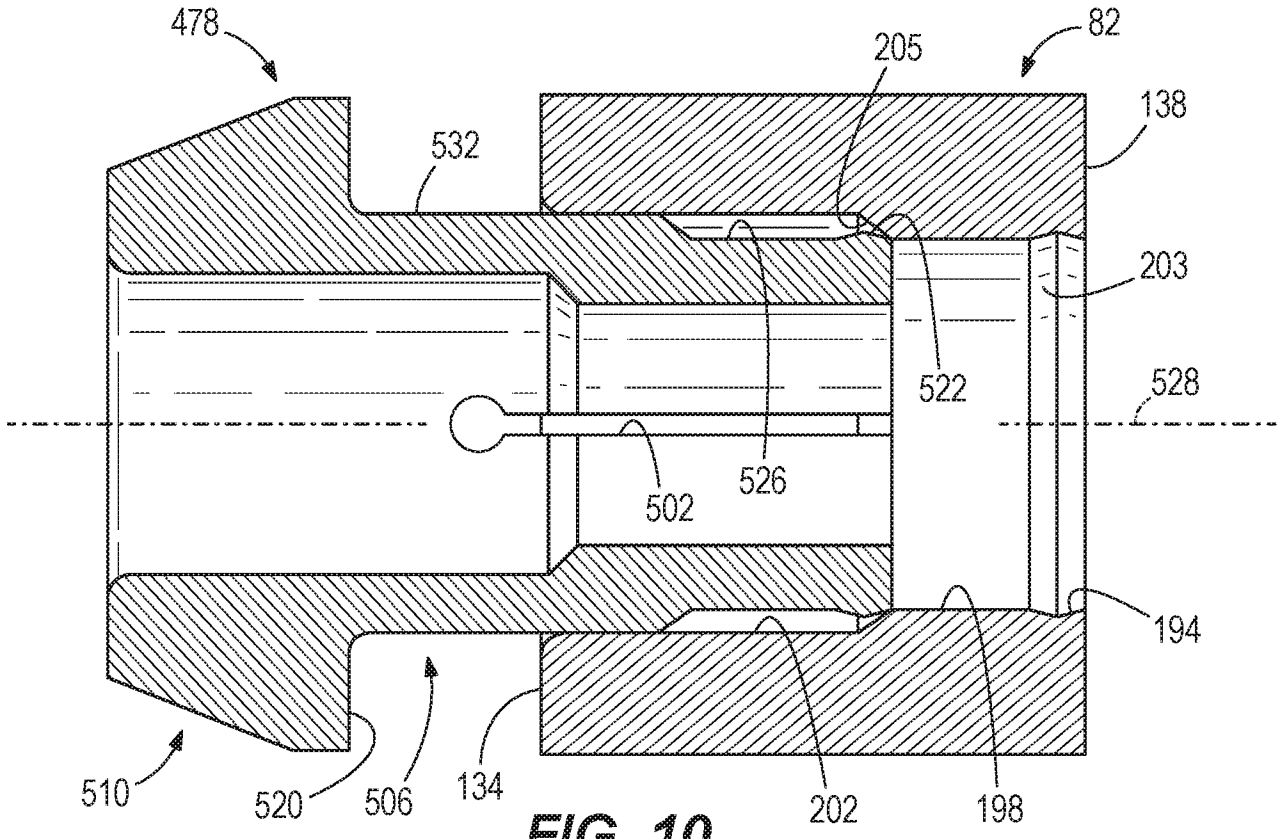
FIG. 9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202
198

FIG. 10

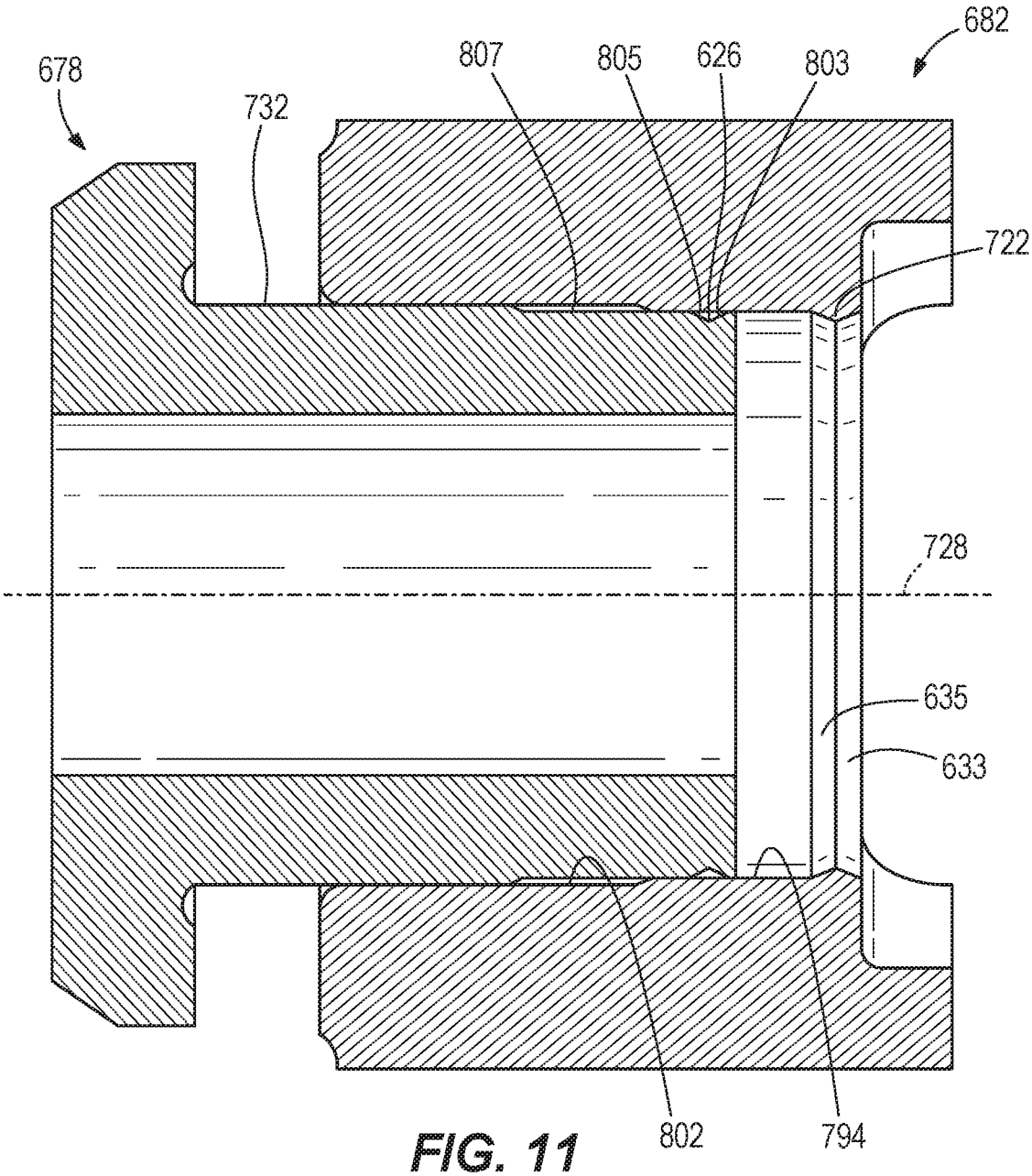

FIG. 11

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 19/50838

A. CLASSIFICATION OF SUBJECT MATTER

IPC - E02F 9/28, E21B 10/43, E21C 35/19, E21C 35/193 (2019.01)

CPC - E02F 9/28, E21C 35/1933, E21C 2035/1806, E21C 35/18, E21C 35/19

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)
See Search History document

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

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 7,992,945 B2 (Hall et al.) 9 August 2011 (09.09.2011), entire document, especially Fig. 2-3, 3a, col. 3 ln. 28-29, 35-36, 45-46, 49, 60	1-24
A	US 4,489,986 A (Dziak) 25 December 1984 (25.12.1984), entire document	1-24
A	US 5,503,463 A (Ojanen) 2 April 1996 (02.04.1996), entire document	1-24
A	US 8,414,085 B2 (Hall et al.) 9 April 2013 (09.04.2013), entire document	1-24

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
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"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
21 October 2019	29 NOV 2019
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