



(51) International Patent Classification:
A61B 17/70 (2006.01)

(21) International Application Number:
PCT/US2008/052880

(22) International Filing Date:
27 May 2008 (27.05.2008)

(25) Filing Language: English

(26) Publication Language: English

(71) Applicant (for all designated States except US): **WARSAW ORTHOPEDIC, INC.** [US/US]; 2500 Silveus Crossing, Warsaw, Indiana 46581 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **REZACH, William, A.** [US/US]; 344 Farmers Trail, Atoka, Tennessee 38004 (US). **SITES, Terry** [US/US]; 9409 North 400 East, North Manchester, Indiana 46962 (US). **SCHUMACHER, Ryan E.** [US/US]; 1301 East Clark Street, Warsaw, Indiana 46580 (US). **MORRISON, Matthew M.** [US/US]; 8774 Lybrook Cove, Cordova, Tennessee 38018 (US). **BEERY, Joshua D.** [US/US]; 5530 West 1400 North, North Manchester, Indiana 46962 (US). **TAYLOR, Harold Sparr** [US/US]; 689 East Drive, Memphis, Tennessee 38112 (US). **BARKER, Boyd, T., Jr.** [UY/US]; 7460 Dorrington Cove, Bartlett, Tennessee 38133-2612 (US).

(74) Agents: **WILLIS, Thomas, L., Jr.** et al.; 710 Medtronic Parkway MS LC340, Minneapolis, MN 55432 (US).

(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, BR, BW, BY, BZ, CA, CH, 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, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, 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, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

- with international search report (Art. 21(3))
- with amended claims (Art. 19(1))

[Continued on next page]

(54) Title: CONNECTING DEVICE FOR ORTHOPEDIC SURGERY

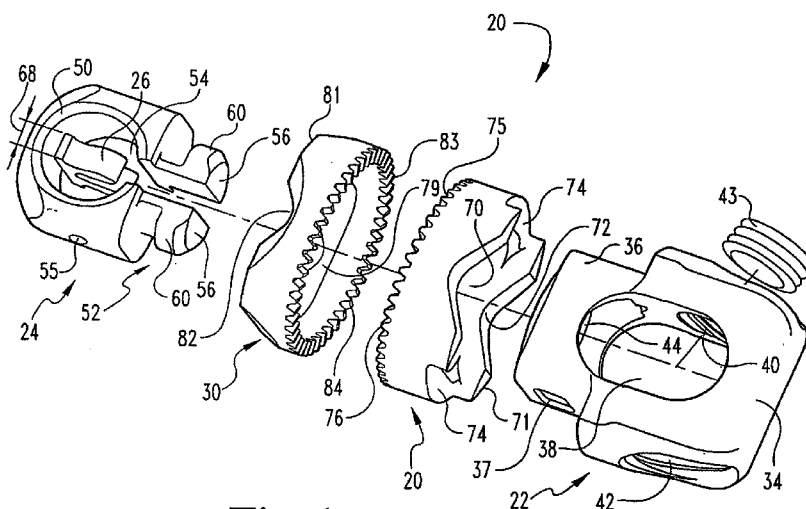


Fig. 1

(57) Abstract: A connecting device is provided for use in orthopedic surgery, for example to connect a spinal rod and a vertebral screw or hook. The connector generally includes a receiver member (22) for receiving an elongated member (R), and a 'grommet member' (24) for receiving a bone fixation member (25). The grommet member is inserted into the receiver member so that the receiver member and grommet member are rotatably connected. One or more disks (28,30) may be placed between the receiver member and grommet member to assist in locking the device.



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considered void (Rule 26bis.2(d))*

CONNECTING DEVICE FOR ORTHOPEDIC SURGERY

FIELD OF THE INVENTION

5 This invention concerns devices used in orthopedic implants. More particularly, this invention concerns connectors between parts of an orthopedic implant, such as an orthopedic rod and an elongated screw.

BACKGROUND OF THE INVENTION

10 There are a variety of known devices for connecting various parts of an orthopedic implant together. Among these are included connectors featured with TSRH-3D products of Medtronic Sofamor Danek, Inc. Such devices commonly include a part for holding an elongated member, such as a spinal rod, and a second member for holding a bone fixation element, such as a pedicle screw or hook. The two parts are connected together,
15 preferably with the ability to rotate with respect to each other. Such devices are shown, for example, in U.S. Patent No. 6,183,473 to Ashman and U.S. Patent No. 5,643,263 to Simonson.

SUMMARY OF THE INVENTION

20 In one embodiment, an apparatus includes a receiver member having a channel therethrough, at least one aperture for a closure member, and an opening transverse to the channel, and a grommet member having a passage therethrough and a transverse extension,

25 wherein the extension is inserted through the transverse opening of the receiver member so that the grommet member is rotatably connected to the receiver member. The extension can be compressible, and/or can include at least one prong. In an embodiment having at least two prongs, a clip can be positioned between the prongs. The extension may have a groove to accommodate a portion of a retaining ring or one or more retaining pins. The
30 receiver member may include an internal countersunk portion defining a ledge, which ledge can be integral or a part of an insert connected to the receiver member. One or more

intermediate members, such as disks, can be placed between the receiver member and the grommet member.

In another embodiment, an apparatus includes a receiver member having a body portion with a channel for accommodating a part of an elongated member and at least one opening for locking member, as well as an extension portion extending from the body portion substantially transversely to the channel. The extension portion has a hole therethrough communicating with the channel. A generally U-shaped grommet member having at least two prongs and a passage for accommodating a part of a bone fixation member is provided, with the prongs being inserted into the hole through the extension portion of the receiver member so that the grommet member is rotatably connected to the receiver member. A fixing member is lodged between at least two of the prongs, whereby the grommet member is prevented from being removed from the receiver member. First and second disks are also provided connected respectively to the receiver member and the grommet member and adjacent each other. The first disk has a first surface with a groove for contacting the elongated member and a second surface having radial splines. The second disk has a first surface having a groove for contacting the bone fixation member and a second surface having radial splines. The second surfaces of the first and second disk face each other.

In yet another embodiment, an apparatus includes a receiver member defining a channel to receive a part of an elongated member and a grommet member defining a passage to receive a part of a bone implant member. The receiver member includes an aperture to receive a closure member and an opening transverse to the channel. The grommet member includes an extension transverse to the passage. The extension is inserted through the opening of the receiver member so that the grommet member is non-threadedly and rotatably connected to the receiver member along a rotation axis. Additionally, the apparatus includes a first disk adjacent the receiver member and a second disk adjacent the grommet member. The first disk includes a first surface with a contact portion for contacting an elongated member and a second roughened surface. Additionally, the second disk includes a first surface with a groove for contacting a bone implant member and a second roughened surface. In certain embodiments, the second surfaces of the first and second disks face each other.

In even another embodiment, an apparatus includes a receiver member defining a channel therethrough to receive an elongated member and a grommet member defining a passage therethrough to receive a part of a bone implant member. The receiver member includes at least one aperture in communication with the channel to receive a closure member, with the channel extending along a longitudinal axis and the aperture extending along a vertical axis. The grommet member is configured to rotatably engage the receiver member along a rotation axis to connect a bone implant member to an elongated member. The apparatus further includes a closure member configured to be inserted through the aperture to substantially lock an elongated member in the channel and a bone implant member in the passage. In certain embodiments, the vertical axis is substantially perpendicular to the longitudinal axis and the rotation axis.

In a further embodiment, an apparatus includes a receiver member for holding a part of an elongated member and a grommet member for holding a part of a bone implant member. The receiver member includes a channel therethrough to receive an elongated member and at least one aperture to receive a closure member. Additionally, the grommet member includes a passage therethrough to receive a bone implant member. The grommet member is rotatably connected to the receiver member along a connection axis. The apparatus further includes a first disk positioned adjacent the receiver member and a second disk positioned adjacent the grommet member. The first disk has a first surface with at least one angled contact portion for contacting an elongated member positioned in the channel and a second surface having radial splines. In certain embodiments, at least a portion of the angled contact portion extends adjacent the channel. The second disk has a first surface with a groove for contacting a bone fixation member positioned in the passage and a second surface having radial splines. The second surfaces of the first and second disks face each other and the radial splines of the second surfaces are configured to matingly engage each other.

Other embodiments are considered to be within the scope of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an exploded perspective view of one embodiment of an apparatus according to the present invention.

FIG. 2 is a front view of one embodiment of a clip useful in connection with the embodiment shown in FIG. 1.

FIG. 3 is a cross-sectional view of the assembled embodiment of the apparatus depicted in FIG. 1, but without the embodiment of the clip shown in FIG. 2.

FIG. 4 is a cross-sectional perspective view of another embodiment of an apparatus according to the present invention.

FIG. 5 is a perspective view of one embodiment of a retaining clip useful in connection with the embodiment shown in FIG. 4.

FIG. 6 is a side view of another embodiment of a retaining clip useful in connection with the embodiment shown in FIG. 4.

FIG. 7 is a partially exploded perspective view of another embodiment of an apparatus according to the present invention.

FIG. 8 is a perspective view of a member useful in the embodiment shown in FIG. 7.

FIG. 9 is a cross-sectional view of another embodiment of an apparatus according to the present invention.

FIG. 10 is a perspective view of a member useful in the embodiment shown in FIG. 9.

FIG. 11 is a cross-sectional view of another embodiment of an apparatus according to the present invention.

FIG. 12 is a perspective view of one embodiment of an apparatus according to the present disclosure.

FIG. 13 is another perspective view of the embodiment shown in FIG. 12.

FIG. 14 is an exploded perspective view of the embodiment shown in FIG. 12.

FIG. 15 is a front view of the embodiment shown in FIG. 12.

FIG. 16 is a front cross-sectional view of the embodiment shown in FIG. 12

DESCRIPTION OF THE PREFERRED EMBODIMENT

For the purposes of promoting an understanding of the principles of the invention,
reference will now be made to the embodiment illustrated in the drawings and specific
language will be used to describe the same. It will nevertheless be understood that no
limitation of the scope of the invention is thereby intended, such alterations and further
modifications in the illustrated device, and such further applications of the principles of
the invention as illustrated therein, being contemplated as would normally occur to one
skilled in the art to which the invention relates.

Referring generally to FIGS. 1-3, embodiments of a connector 20 are shown.
Connector 20 generally includes a receiver member 22, and a grommet member 24. A
fixing member 26 can be provided for interacting with grommet member 24, as will be
discussed below. In a specific embodiment, disks 28 and/or 30 can also be provided, and
if present are generally between receiver member 22 and grommet member 24. As will be
described further below, receiver member 22 is designed to accommodate at least a part of
an elongated member, such as spinal rod R, and grommet member 24 is designed to
accommodate at least a part of a bone fixation member, such as a shank 25 of a pedicle or
other orthopedic screw, hook, bolt or similar device. Shank 25 could also be a part of or
connected to other implant items such as a connector, clamp or other device.

Receiver member 22, in one embodiment, includes a body portion 34 and an
extension portion 36. Extension portion 36 can include one or more indentations or
pockets 37, which in the illustrated embodiment are milled in an oval or elongated shape.
An elongated aperture 38 extends through receiver member 22, and is sized to
accommodate at least a portion of an elongated member. Holes 40 and 42 are provided in
body portion 34 for a locking member. In the illustrated embodiment, holes 40 and 42 are
threaded, and each is adapted to accommodate a set screw 43, to be threaded in and locked
against an elongated member (e.g. rod R) within channel 38. The surgeon can use either
of holes 40 and 42 for a locking member such as set screw 43, whichever may offer a
more convenient access. Alternatively, both of holes 40 and 42 may be used by a surgeon
to lock connector 20. It will be appreciated that only a single hole (e.g. hole 40 or hole 42)
may be provided in another embodiment. A hole 44 is provided in extension portion 36,

with hole 44 being substantially transverse to channel 38. Hole 44 includes a countersunk region 45 defining a ledge 46.

Grommet member 24 includes a body portion 50 and an extending grommet portion 52. Body portion 50 has a passage 54 therethrough for accommodating at least a portion of a bone anchor or fixation member, such as a shank 25 of a bone screw, a bone hook, a bone bolt or other anchoring member. Body portion 50 also may include one or more protrusions 55 extending from one or more side surfaces. In the embodiment shown in FIG. 1, grommet portion 52 includes two prongs 56, which attach to body portion 50 so that grommet member 24 is substantially U-shaped. In the embodiment shown in FIG. 3, grommet portion 52 includes four prongs 56 (one of which is not shown in the cross-sectional view of FIG. 3), each spaced about ninety degrees from two adjacent prongs 56.

Each of prongs 56 have a flange 60 that extends generally laterally to its respective prong 56. Flanges 60, taken together, have an outer diameter when grommet member 24 is unstressed (i.e. when prongs 56 are not being subjected to forces tending to move prongs 56 toward or away from each other) that is slightly larger than the inner diameter of hole 44, but is slightly smaller than the countersunk region 45 associated with hole 44. It will be seen that grommet portion 24 can be otherwise constructed, such as by providing a spring-loaded or biased member or shape-memory member in place of or in addition to prongs 56. Such a biased member could be C-shaped, substantially circular, or of other appropriate shape.

Grommet member 24 is connected to receiver member 22 by inserting extension portion 52 (prongs 56 in the embodiment of FIGS. 1 and 3) into hole 44. Prongs 56 in that embodiment can be squeezed together either by external pressure directly applied by an assembler, or by the action of hole 44 on flanges 60. Grommet member 24 can resume its unstressed form when flanges 60 move past ledge 46, e.g. prongs 56 of grommet member 24 snap into place with respect to receiver member 22. Grommet member 24 thus may snap-fit within receiver member 22 so that it is rotatably connected to receiver member 22. Preferably, one or more of flanges 60 cannot move past ledge 46 without pressing one or more of prongs 56 toward each other.

For embodiments of grommet member 24 having separate prongs 56, grommet member 24 can be locked within receiver member 22 by way of a fixing member 26, shown in FIG. 2 as a clip. Clip 26 is shown having a base portion 64 and two extending

lobes 66. After grommet member 24 has been inserted within receiver member 22 as described above, and grommet member 24 has resumed its unstressed form, clip 26 can be inserted between prongs 56 of grommet member 24. Clip 26 occupies some or all of the space between prongs 56 to block the ability of prongs 56 to move toward each other, thus inhibiting or preventing removal of grommet member 24 from receiver member 22. Clip 26, in one embodiment, may have a width 68 (FIG. 1) that is approximately equal to or slightly larger than the gap between prongs 56 when prongs 56 and grommet portion 52 is in its unstressed state. If clip 26 is removed from between prongs 56, grommet member 24 can be compressed, so that the outer dimension of prongs 56 (and their extensions 60, if any) is smaller than the diameter of hole 44, and thus extension portion 52 of grommet member 24 can be removed from receiver member 22. For example, if grommet member 24 and receiver member 22 are subjected to stress tending to move them apart, then the edges of hole 44 could act on prongs 56 tending to force them together.

Alternatively, a fixing member 26 could comprise a block, such as a ball, cylinder, planar solid or other relatively solid structure. For example, with reference to the embodiment of FIG. 3, a ball having a diameter approximately the same as the distance between two non-adjacent prongs 56 can be placed or pressed into the center area surrounded by prongs 56. In this way, the ball effectively limits or prevents prongs 56 from moving toward each other, and grommet member 24 is maintained within receiver member 22. As another example, a cylinder or block could be placed or pressed endwise or lengthwise between prongs 56 of the embodiment of FIG. 1, or in the center area surrounded by prongs 56 of the embodiment of FIG. 3. If necessary or desired, an adhesive or other substance or agent, such as a bead or other formation of silicone, can be placed over or around the ball, cylinder, block or other fixing member and adjacent or between one or more of prongs 56 to maintain the clip, block or other fixing member in place. Fixing member 26, whether in the form of a clip, block or other structure, can be made of a shape-memory material, such as the nickel-titanium alloy known as NITINOL®, that can assume a fixing shape or size during or after implantation of grommet member 24 and receiver member 22.

In specific embodiments, one or more washers, disks or other intermediate members may be provided adjacent or around receiver member 22 and/or grommet member 24, and substantially between channel 38 in receiver member 22 and passage 54

in grommet member 24. As shown generally in the embodiment of FIG. 1, examples of disks 28 and 30 are illustrated. Disk 28 in this embodiment is associated with receiver member 22. Disk 28 has a substantially cylindrical exterior, although it may be of any of a variety of shapes or configurations, and has a hole 70 therethrough to accommodate at least a portion of extension portion 36 of receiver member 22. In a particular embodiment, hole 70 and extension portion 36 may be keyed together or both may have a similarly dimensioned square, rectangular, polygonal, rounded, tapered or other shape to ease the fitting together of receiver member 22 and disk 28, and/or to limit or prevent rotation with respect to each other.

On a first side 71 of disk 28, a channel 72 is formed. Channel 72 may have a portion that is approximately the same diameter as a spinal rod in channel 38, or may have a V-shaped cross section or other configuration. On that same side 71, disk 28 may further include one or more lateral openings 74 to accommodate a portion of body portion 34 of receiver member 22. Thus, when disk 28 is in use, it can slide onto extension portion 36 so that disk 28 fits relatively closely and/or snugly against body portion 34. A bead or other formation of silicone or other friction-increasing or adhesive substance may be placed in indentations 37 of receiver member 22, to assist in maintaining disk 28 connected to receiver member 22. Disk 28, when configured in this way and fitted to receiver member 22, is substantially not rotatable with respect to receiver member 22 due to the fit between body portion 34 and opening 74, and potentially between extension portion 36 and hole 70. On a second side 75 of disk 28, roughening or other surface features intended for or amenable to making secure connections may be placed. In one particular embodiment, a set of radial splines or ridges 76 extend from hole 70 to an outer edge of disk 28.

A disk 30 associated with grommet member 24 may be provided in addition to or alternatively to disk 28. Disk 30 in the illustrated embodiment includes a hole 79 of approximately the same size and shape as body portion 50 of grommet member 24, so that body portion 50 can be inserted into or through hole 79. Stops, bosses or other extensions, such as protrusions 55, can be provided on grommet member 24 so that its connection to disk 30 is maintained. Similar to disk 28 and receiver member 22, in a particular embodiment hole 79 and body portion 50 may be keyed together or may both have a similarly dimensioned square, rectangular, polygonal, rounded, tapered or other shape to

ease the fitting together of grommet member 24 and disk 30, and/or to limit or prevent rotation with respect to each other. As with the connection between disk 28 and receiver member 22, the connection between disk 30 and grommet member 24 can be enhanced by placing a bead or other formation of silicone or other friction-increasing or adhesive substance between disk 30 and grommet member 24. On one side 81 of disk 30, a channel or groove 82 is provided, and in one embodiment channel 82 may have a portion of approximately the same diameter as a portion of a bone fixation member (e.g. shank 25) extending through passage 54 in grommet member 24, or it may have a V-shaped cross-section or other configuration. A second side 83 of disk 30 may be roughened or include other surface features intended for or amenable to making secure connections, such as with a series of radial ridges or splines 84. In embodiments in which both disks 28 and 30 are used and have splines 76 and 84, respectively, splines 84 of disk 30 can engage with splines 76 disk 28, to prevent relative rotation of disks 28 and 30 with respect to each other when their respective roughened or splined sides are engaged.

It is preferred, but not necessary, that the structure of connector 20 be assembled prior to use in orthopedic surgery so that connector 20 may be quickly and easily implanted. Accordingly, in the embodiment in which disks 28 and 30 are used, disk 28 is fitted around extension portion 36 of receiver member 22. If used, a bead of silicone can preferably be placed in one or more of indentations 37 or elsewhere between disk 28 and receiver member 22 prior to fitting disk 28 around receiver member 22. Disk 30 is connected either to disk 28, by engaging their respective roughened or splined sides, or to grommet member 24 by inserting body portion 50 into hole 79, to a point up to the position where disk 30 is stopped by protrusion(s) 55, if they are present. Again, if used, a bead of silicone can preferably be placed between disk 30 and grommet member 24 prior to fitting disk 30 around grommet member 24. Grommet member 24 is connected to receiver member 22 by inserting grommet portion 52 into hole 44 of receiver member 22. If disks 28 and/or 30 are used but not previously assembled to receiver member 22 and grommet member 24, then grommet portion 52 of grommet member 24 can be inserted through hole 79 of disk 30, through opening 74 of disk 28, and into hole 44 of receiver member 22. Fixing member 26 (e.g. clip or block) is inserted between the prongs 56 of grommet member 24. At this point, preferably receiver member 22 and grommet member 24 are rotatable with respect to each other around an axis of hole 44. That is, disks 28 and

30 are separable by a sufficient space to allow them to rotate with respect to each other. Disks 28 and 30 are not rotatable with respect to receiver member 22 and grommet member 24, respectively, in the illustrated embodiment, although it will be understood that variations of disks 28 and/or 30 that are rotatable with respect to receiver member 22 and grommet member 24 are contemplated. Thus, prior to implantation when disks 28 and 30 are spaced sufficiently, grommet member 24 (connected to disk 30) is rotatable with respect to receiver member 22 (connected to disk 28).

Connector 20 (whether with or without disks 28 and 30) is used to connect a fixation member (via shank 25 or similar structure) and a longitudinal member (e.g. rod R). For example, a pedicle screw or hook may be fixed in or on a vertebra. Connector 20 can be placed over a shank (e.g. shank 25) of the pedicle screw or hook, with the shank being inserted through passage 54 in grommet member 24. Connector 20 can then be pivoted around the axis of the shank, and receiver member 22 can be rotated with respect to grommet member 24, substantially around an axis of hole 44 of receiver member 22. A rod can be inserted through channel 38 of receiver member 22. Any final adjustments the surgeon desires, such as adjustment to the positions of vertebral bodies, part(s) of connector 20, or the longitudinal member or fixation member, may be made.

A locking member, such as set screw 43, is then inserted into at least one of holes 40, 42 in receiver member 22. If the locking member is set screw 43 and at least one of holes 40, 42 is threaded, then set screw 43 is threaded into one of holes 40, 42. It will be understood that a second locking member (e.g. a second set screw) may be inserted into the other of holes 40, 42 for redundancy, but a single locking member in one of holes 40, 42 is believed to be sufficient to lock connector 20. Set screw 43 or other appropriate locking member presses the rod toward disk 28, e.g. set screw 43 is threaded down on the rod within channel 38, and tends to press the rod toward disk 28. The rod contacts disk 28 in channel 70, thereby forcing disk 28 toward and against disk 30. The shank of the pedicle screw 25 or other bone attachment member that extends through passage 54 in grommet member 24 is then sandwiched between channel 82 in disk 30 and the wall of passage 54 through grommet member 24. Connector 20 is thus locked, and the rod and pedicle screw 25 or other bone attachment member are immobilized with respect to each other.

Referring now generally to FIGS. 4-6, another embodiment of a connector 120 is shown. Throughout the description that follows, items that are similar to previously-described items are denoted by a number with a changed or added initial digit. Connector 120 includes a receiver member 122 that is similar to receiver member 22 identified
5 above. Specifically, receiver member 122 includes a body portion 134, an extension portion 136, indentations 137, an aperture 138 and holes 140, 142 and 144. On the inside of extension portion 136, a groove 148 is provided. Grommet member 124 includes a body portion 150, a grommet portion 152, a passage 154 and protrusions 155. In this
0 embodiment, grommet portion 152 is substantially cylindrical, with the exception of a circumferential groove 153. Grommet portion 152 has an outer diameter slightly less than the inner diameter of hole 144 of receiver member 122.

A retaining ring 185 is also provided in this embodiment. In a specific embodiment, retaining ring 185 may be substantially C-shaped and expandable and/or compressible. Retaining ring 185 may be dimensioned to fit at least partially within a
5 portion of groove 153 of grommet member 124 and groove 148 of receiver member 122, in one of an expanded, contracted or unstressed state. Thus, retaining ring 185 may have an unstressed outer diameter larger than the diameter of hole 144 but smaller than the diameter of groove 148 of receiver member 122, and an unstressed inner diameter less
0 than the diameter of grommet portion 152 but greater than the diameter of groove 153 of grommet member 124. It will be appreciated that retaining ring 185 may be circular or of another shape, and may be made of a shape-memory material (such as the nickel-titanium alloy sold as NITINOL® or other alloys), or may be made of other sturdy biocompatible materials. As seen in FIG. 6, an alternative embodiment of retaining ring 185' is an undulating ring. Although not shown in FIG. 4, connector 120 may also include disks
5 similar or identical to disks 28 and 30 described above.

Assembly and use of connector 120 is similar to that described above for connector 20. Grommet member 124 is connected to receiver member 122, through disks 28, 30 if they are used, by inserting grommet portion 152 into hole 144. Retaining ring 185 may be placed in groove 153 in grommet 124 prior to insertion. For example, if retaining ring 185
0 is a compressible C-shaped ring, it is compressed into groove 153 for insertion with extension portion 152 through hole 144. As another example, if retaining ring 185 is a shape-memory ring that expands when brought to or close to body temperature, it is placed

in groove 153 in a compressed state for insertion with extension portion 152 through hole 144. When retaining ring 185 is adjacent groove 148 in receiver member 122, retaining ring 185 is allowed to expand through relief of compression stress or through a change of shape of a shape-memory material. Retaining ring 185 is at least partially within groove 153 and groove 148, limiting or preventing removal of grommet member 124 from receiver member 122. Grommet member 124 is rotatable with respect to receiver member 122, and connector 120 is locked by a set screw (e.g. set screw 43) or other locking member in essentially the same manner described above with respect to connector 20.

Referring now generally to FIGS. 7-8, another embodiment of a connector 220 is shown. Connector 220 includes a receiver member 222 and a grommet member 224 (similar to grommet member 124), and in specific embodiments also includes disks 228 and 230. Disks 228 and 230, in the illustrated embodiment, are substantially identical to disks 28 and 30 described above. Receiver member 222 includes a body portion 234 that is substantially identical to body portion 34 of receiver member 22 described above. Extension portion 236 of receiver member 222 is generally C-shaped, having a gap 223 communicating with hole 244. Countersunk region 245 and ledge 246 are in extension portion 236. Grommet member 224 has a body portion 250 that is substantially identical to body portion 50 of grommet member 24. Extension portion 252 of grommet member 224 is in the general shape of a T-nut, having a narrow neck portion 252a and a laterally extended end portion 252b. End portion 252b includes outwardly extending bosses 251 on each side.

Also provided in this embodiment is a retaining clip 286 that is generally C-shaped, with arms 287 and a center protrusion 289. Protrusion 289 is generally sized and shaped to fit in part or all of gap 223 of receiver member 222, and arms 287 have an inner diameter equal to or slightly smaller than the outer diameter of extension portion 236 of receiver member 222.

As noted above with respect to connector 20, it is preferred, but not necessary, that the structure of connector 220 be assembled prior to use in orthopedic surgery.

Accordingly, in the embodiment in which disks 228 and 230 are used, disk 228 is fitted around extension portion 236 of receiver member 222. Disk 230 is connected either to disk 228, by engaging their respective roughened sides, or to grommet member 224 by inserting body portion 250 into hole 280. Grommet member 224 is inserted into extension

portion 236 of receiver member 222. This is accomplished by moving grommet member 224 away from a central axis of receiver member 222, so that end portion 252b of grommet member 224 is adjacent gap 253 in receiver member 222. Grommet member 224 is moved toward receiver member 222 so that extension portion 252 moves through gap 223, until end portion 252b is substantially above ledge 246 in receiver member 222. Grommet member 224 is then moved toward the central axis of receiver member 222, i.e. end portion 252b is “dropped in” to countersunk region 245 of receiver member 222. Clip 286 is then placed around extension portion 236 of receiver member 222, filling gap 253 with protrusion 289. In one embodiment, arms 287 are pressed against extension portion 236, so that arms 287 deflect apart. Additional pressure on clip 286 forces arms 287 around extension portion 236 until arms 287 fit around extension portion 236 and protrusion 289 enters gap 253. Preferably, there is significant friction between arms 287 of clip 286 and extension portion 236. Clip 286 thus inhibits or prevents removal of grommet member 224 from receiver member 222.

At this point, preferably receiver member 222 and grommet member 224 are rotatable with respect to each other, similar to connector 20 after receiver member 22 and grommet member 24 are connected. That is, disks 228 and 230 are separable by a sufficient space to allow them to rotate with respect to each other. Disks 228 and 230, in this particular illustrated embodiment, are not rotatable with respect to receiver member 222 and grommet member 224, respectively. Consequently, prior to implantation when disks 228 and 230 are spaced sufficiently, grommet member 224 (connected to disk 230) is rotatable with respect to receiver member 222 (connected to disk 228). Connector 220 is placed and locked with an elongated member and fixation member substantially as described above with respect to connector 220.

A further alternative embodiment of a connector 320 is generally shown in FIGS. 9-10. Connector 320 is substantially identical to connector 120, with the exception that in place of retaining ring 185, retaining pins 385 are provided, as will be further described. Receiving member 322 is similar or identical to receiving member 122, having body portion 334, extension portion 336, opening 338, and holes 340, 342, 344, and further includes a pair of small holes 390 that are substantially parallel to channel 338 of receiver member 322. Grommet member 324 is similar or identical to grommet member 124, having an extension portion 352 with a groove 353. When grommet member 324 is

inserted into hole 344 of receiver member 322, groove 353 in grommet member 324 substantially lines up with or overlaps at least a portion of holes 390 of receiver member 322. Pins 385 are then inserted into holes 390 so that at least a portion of pins 385 rest at least partially within groove 353 of grommet member 324. In this way, pins 385 prevent or hinder removal of grommet member 324 from receiver member 322. Holes 390 may be covered or partially filled with an adhesive or other substance or agent, such as a bead or other formation of silicone, to maintain pins 385 in place. Connector 320 is connected to an elongated member, for example a spinal rod, and a fixation member, such as bone screw 25, and locked substantially as described above.

A further example of an embodiment of a connector 420 is generally shown in FIG. 11. Connector 420 is substantially identical to connector 20, with the exception that it includes an insert 495 that fits within receiving member 422. Receiving member 422 is similar or identical to receiving member 22, having body portion 434, extension portion 436, opening 438, and holes 440, 442, 444. Insert 495 includes a countersunk portion 445 and a ledge 446. In one particular embodiment, a curved surface 444a is provided in receiving member 422, and insert 495 has an outer surface 495a that is complementarily configured, so that insert 495 is retained within receiving member 422. It will be understood that conic, stepped, spring-biased or other configurations for insert 495 and/or surface 444a can be provided, or that portions of insert 495 or receiving member 422 can be made of shape-memory material to allow fitting together. Insert 495 may be substantially fixed relative to receiver member 422, or receiver member 422 and insert 495 may be rotatable and/or otherwise movable with respect to each other.

Grommet member 424 is similar or identical to grommet member 24, having an extension portion 452 and prongs 456. When grommet member 424 is inserted into hole 444 of receiver member 422 and insert 495, e.g. by squeezing together prongs 456 either by external pressure directly applied by an assembler, or by the action of hole 444 and/or insert 495 on flanges 460. Grommet member 424 resumes its unstressed form when flanges 460 move past ledge 446, e.g. prongs 456 of grommet member 424 snap into place with respect to insert 495 and receiver member 422. Grommet member 24 is then rotatably connected to insert 495 and/or receiver member 422. Further assembly and implantation of connector 420 is as described above with respect to other embodiments.

While one example of the use of connectors 20, 120, 220, 320, 420 described above is in the spinal field, it will be appreciated that the disclosed connectors can be used in a variety of orthopedic surgical procedures and/or with a variety of orthopedic surgical implants. Of course, any of connectors 20, 120, 220, 320, 420 can be sized or otherwise configured to be used in one or more parts of the spine (e.g. cervical, thoracic, lumbar or sacral), or with spinal implants such as intervertebral cages or spacers, rod connectors, bone plates, bone-growth promoting substances, or with other devices or therapeutic substances. The parts described herein are preferably made of biocompatible material such as stainless steel, titanium, certain hard plastics, shape-memory materials and/or other sturdy materials. Further, while individual embodiments of a connector have been described herein, it is understood that features, parts or aspects of one embodiment could be incorporated into another embodiment.

Additionally, while the implantation of connectors 20, 120, 220, 320, 420 has been described above as inserting an elongated member (e.g. a rod) into the connector after placing the connector over a fixation member (e.g. screw or hook), it will be appreciated that other methods can be used. For example, a surgeon may pre-fit one or more connectors 20, 120, 220, 320 and/or 420 to a rod, fixation member, or other spinal implant device before inserting such connectors into the body or placing such connectors on or with other implant devices. Thus, after fixation members are placed on or in the spine or at another surgical site, a rod with such pre-fitted connectors can be placed in the surgical site so that the pre-fitted connectors connect to respective fixation members. Similarly, such pre-fitted connectors could have fixation members pre-connected to them. Once the surgical site is properly prepared, the rod with pre-fitted connectors and fixation members can be introduced, with fixation members connected to vertebrae or other bones, appropriate adjustments made to bone, connectors, rod or fixation members, and the connectors locked when such adjustments are completed.

Any or all of the structures described herein can be provided in a sterile pack for providing necessary parts, or a variety of parts, to a surgeon. For example, one or more predetermined types or sizes of receiver member, grommet member, disks (if desired) and/or set screws may be provided in a single sterile package or kit. A surgeon can choose the sizes or types of structures he or she wishes to use during surgery. Alternatively, sterile kits containing a single predetermined size or type of receiver member, grommet

member, disks (if desired) and/or set screws may be provided, so that waste of unneeded parts is limited or eliminated. Packages or kits of the structures described herein can also include or be provided with spinal rods, fixation members (e.g. screws, bolts, hooks, clamps, or the like), other connectors, instrumentation (e.g. rod benders, cutters, pushers, reducers or other rod handling tools; screwdrivers or other implanting tools; forceps, grippers or other holding tools; drills, bits, awls, reamers, guides, taps or other hole making tools; gauges or other measuring or sizing tools; or others) or other implants or devices useful in orthopedic surgery.

Referring generally to FIGS. 12-16, embodiments of a connector 520 are shown. Connector 520 generally includes a receiver member 522 and a grommet member 524. A bolt 526 can be provided for interacting with receiver member 522 and grommet member 524 to rotatably connect the two pieces together along a rotation or connection axis C. In certain embodiments, connector 520 can include disks 528 and/or 530, which if present are generally between receiver member 522 and grommet member 524. Receiver member 522 is designed to accommodate at least a part of an elongated member, such as spinal rod R, and grommet member 524 is designed to accommodate at least a part of a bone implant or fixation member, such as a shank 525 of a pedicle or other orthopedic screw, hook, bolt or similar device. Shank 525 could also be a part of or connected to other implant items such as a connector, clamp or other device. As illustrated, shank 525 can include an internal driving bore 527 to receive a driving tool to insert the implant into the bone.

Receiver member 522, in certain embodiments, includes a body portion 534 and an extension portion 536. Extension portion 536 may include one or more indentations or pockets 537, which in the illustrated embodiment are milled in an oval or elongated shape. Body portion 534 of receiver member 522 defines an elongated channel 538 extending along a longitudinal axis L, sized to accommodate at least a portion of an elongated member (e.g. rod R). In certain embodiments, channel 538 can create an imaginary cylinder I extending outward of receiver member 522 along longitudinal axis L, having substantially the same cross-sectional dimension as channel 538. Additionally, in certain embodiments, channel 538 is at least slightly angled or slanted such that a height axis H of channel 538 is transverse to a vertical axis V (described below) and not perpendicular to connection axis C. Receiver member 522 may further include a stepped surface segment

539 on a lower or bottom side to allow for the proper positioning of a washer or disk member, as will be discussed in greater detail.

Body portion 534 can define a hole 540 to receive a locking or closure member, such as a set screw 543, to exert a force on an elongated member positioned in channel 538, such as spinal rod R. In the illustrated embodiment, hole 540 is threaded and is adapted to accommodate break off set screw 543, such that screw 543 is threaded in and locked against an elongated member (e.g. rod R) within channel 538. In other embodiments, additional holes can be included in receiver member 522 and may be used by a surgeon to lock connector 520. In the illustrated embodiment, hole 540 extends along a vertical axis V. In certain embodiments, vertical axis V is substantially perpendicular to longitudinal axis L and connection axis C to provide for a vertically inserted and positioned set screw, and thus a minimally or potentially less invasive procedure utilizing connector 520.

In the illustrated embodiment, an opening or hole 544 is defined by extension portion 536, with hole 544 extending along connection axis C and being substantially transverse to channel 538. As illustrated, hole 544 can include a countersunk region 545 defining a ledge 546. Additionally, receiver member 522 may optionally define an access hole 542 in communication with channel 538. In certain embodiments, hole 542 extends generally along connection axis C to allow for in-line access of bolt 526 during assembly of connector 520. Additionally, hole 542 may be aligned with hole 544 defined by extension portion 536 along connection axis C.

Grommet member 524 includes a body portion 550 and a grommet or extension portion 552. In the illustrated embodiment, extension portion 552 includes internal threads 556. Body portion 550 defines a passage 554 therethrough for accommodating at least a portion of a bone anchor or fixation member, such as a shank 525 of a bone screw, a bone hook, a bone bolt or other anchoring member. In the illustrated embodiment, extension portion 552 is sized and configured to be received in hole 544 of receiver member 522.

Bolt 526 includes head portion 558 and externally threaded portion 560. As illustrated, threaded portion 560 can engage internal threads 556 of extension portion 552 of grommet member 524. Additionally, bolt 526 may be threaded to a position where head portion 558 is positioned adjacent ledge 546 of countersunk region 545. In this

respect, bolt 526 can maintain connection between grommet member 524 and receiver member 522, thus inhibiting or preventing removal of grommet member 524 from receiver member 522. As illustrated, bolt 526 may define a receiving bore 559 to receive the head of a driving tool during assembly of connector 520. In the illustrated embodiment, bore 559 is a blind hole. In other embodiments, bore 559 can be a thru-hole extending a longitudinal length of bolt 526. Additionally, bolt 526 may optionally include overburns on head portion 558 adjacent bore 559 to prevent deformation of bolt 526 during assembly of connector 520.

Grommet member 524 is connected to receiver member 522 by inserting extension portion 552 into hole 544, so that grommet member 524 is rotatably engaged with receiver member 522. Additionally, threaded portion 560 of bolt 526 is threadingly advanced along threads 556 of extension portion 552, along connection axis C, such that head portion 558 is positioned adjacent ledge 546. In certain embodiments, a torque of about 15 in-lbs can be applied to bolt 526 to ensure that grommet member 524 will not disassemble from receiver member 522.

In certain embodiments, one or more washers, disks or other intermediate members may be provided adjacent and/or around receiver member 522 and/or grommet member 524, and substantially between channel 538 in receiver member 522 and passage 554 in grommet member 524. In the illustrated embodiment, disk 528 is associated with receiver member 522. Disk 528 has a hole 570 therethrough to accommodate at least a portion of extension portion 536 of receiver member 522. In certain embodiments, hole 570 and extension portion 536 may be keyed together or both may have a similarly dimensioned square, rectangular, polygonal, rounded, tapered or other shape to ease the fitting together of receiver member 522 and disk 528, and/or to limit or prevent rotation with respect to each other.

In the illustrated embodiment, disk 528 includes a first side 571 and an opposite second side 575, with first side 571 contacting an elongated member, such as spinal rod R, and second side 575 contacting another disk. First side 571 includes angled contact portions 572 for contacting an elongated member positioned in channel 538. As illustrated, contact portions 572 may angle or slant generally downward and generally in a direction from grommet member 524 toward receiver member 522. In certain embodiments, angled contact portions 572 extend into imaginary cylinder I created by

channel 538 of receiver member 522. Additionally, in certain embodiments, first side 571 may include a stepped surface segment 573 to matingly engage stepped surface segment 539 of receiver member 522, to allow for the proper angling direction of contact portions 572 and thus the proper positioning of disk 528 relative to receiver member 522.

5 Additionally, on side 571, disk 528 may further include one or more lateral openings 574 to accommodate a portion of body portion 534 of receiver member 522. Thus, when disk 528 is in use, it can slide onto extension portion 536 so that disk 528 fits relatively closely and/or snugly against body portion 534. A bead or other formation of silicone or other friction-increasing or adhesive substance may be placed in indentations
0 537 of receiver member 522 to assist in maintaining disk 528 adjacent receiver member 522. In certain embodiments, disk 528 is substantially not rotatable with respect to receiver member 522 due to the fit between body portion 534 and opening 574, and stepped surfaces 539 and 573. On a second side 575 of disk 528, roughening or other surface features intended for or amenable to making secure connections may be placed. In
5 certain embodiments, a set of radial splines or ridges 576 extend from hole 570 to an outer edge of disk 528 on side 575.

 A disk 530 associated with grommet member 524 may be provided in addition to disk 528. Disk 530 in the illustrated embodiment includes a hole 579 of approximately the same size and shape as body portion 550 of grommet member 524, so that body portion
0 550 can be inserted into or through hole 579. In certain embodiments, body portion 550 of grommet member 524 also may include one or more stops, bosses, extensions or protrusions (not shown) extending from one or more side surfaces to enhance the connection between disk 530 and grommet member 524. Similar to disk 528 and receiver member 522, hole 579 and body portion 550 may be keyed together or may both have a
5 similarly dimensioned square, rectangular, polygonal, rounded, tapered or other shape to ease the fitting together of grommet member 524 and disk 530, and/or to limit or prevent rotation with respect to each other. Additionally, as with the connection between disk 528 and receiver member 522, the connection between disk 530 and grommet member 524 can be enhanced by placing a bead or other formation of silicone or other friction-increasing or
0 adhesive substance between disk 530 and grommet member 524.

 In the illustrated embodiment, disk 530 includes a first side 581 for contacting a bone implant held by grommet member 524, such as a bone screw having a shank 525,

and a second opposite side 583 for contacting disk 528. On side 581 of disk 530, a channel or groove 582 is provided, and in certain embodiments groove 582 may have a portion of approximately the same diameter as a portion of a bone fixation member (e.g. shank 25) extending through passage 554 in grommet member 524. However, it is contemplated that groove 582 may include various other configurations, such as a V-shaped cross-section as an example. Second side 583 of disk 530 may be roughened or include other surface features intended for or amenable to making secure connections, such as with a series of radial ridges or splines 584. In embodiments in which both disks 528 and 530 are used and have splines 576 and 584, respectively, splines 584 of disk 530 can engage with splines 576 of disk 528, to prevent relative rotation of disks 528 and 530 with respect to each other when their respective roughened or splined sides are engaged.

Assembly and use of connector 520 is similar to that described above for connectors 20, 120, 220, 320 and 420. Additionally, the structure of connector 520 can be assembled prior to use in orthopedic surgery so that connector 520 may be quickly and easily implanted. Accordingly, in embodiments in which disks 528 and 530 are used, disk 528 is fitted around extension portion 536 of receiver member 522. In certain embodiments, stepped surface segment 573 of disk 528 is positioned in engagement with stepped surface segment 539 of receiver member 522 to ensure the proper positioning and orientation of disk 528 relative to receiver member 522. The proper orientation of disk 528 can include contact portions 572 angled toward and/or into imaginary cylinder I in a direction generally away from hole 544 of receiver member 522 and toward a bottom or lower surface of receiver member 522. If used, a bead of silicone can be placed in one or more of indentations 537 or elsewhere between disk 528 and receiver member 522 prior to fitting disk 528 around receiver member 522. Disk 530 is connected either to disk 528, by engaging their respective roughened or splined sides, or to grommet member 524 by inserting extension portion 552 into hole 544 of receiver member 522. If disks 528 and/or 530 are used but not previously assembled to receiver member 522 and grommet member 524, then extension portion 552 of grommet member 524 can be inserted through hole 579 of disk 530, through hole 570 of disk 528, and into hole 544 of receiver member 522.

Bolt 526 is advanced along threads 556 of extension portion 552 of grommet member 524 to rotatably connect grommet member 524 to receiver member 522. To advance threaded portion 560 of bolt 526 along threads 556, a driving tool can be inserted

through hole 542 of receiver member 522, with a head portion of the driving tool received in bore 559 of bolt 526. In certain embodiments, the advancement of bolt 526 relative to grommet member 524 corresponds to the advancement of angled contact portions 572 of disk 528 into imaginary cylinder I.

5 In certain embodiments, receiver member 522 and grommet member 524 can be rotatable with respect to each other around connection axis C. Additionally, disks 528 and 530 can be separable by a sufficient space to allow them to rotate with respect to each other. Disks 528 and 530 are not rotatable with respect to receiver member 522 and grommet member 524, respectively, in the illustrated embodiment, although it will be
0 understood that variations of disks 528 and/or 530 that are rotatable with respect to receiver member 522 and grommet member 524 are contemplated. Thus, prior to implantation when disks 528 and 530 are spaced sufficiently, grommet member 524 (connected to disk 530) is rotatable with respect to receiver member 522 (connected to disk 528).

5 Connector 520 is used to connect a fixation member (via shank 525 or similar structure) and an elongated member (e.g. rod R). For example, a fixation member such as a pedicle screw or hook may be fixed in or on a vertebra. Upon assembly of connector 520, connector 520 can be placed over a shank (e.g. shank 525) of the fixation member, with the shank being inserted through passage 554 in grommet member 524 corresponding
0 to a desired dorsal height. Connector 520 can then be pivoted around the axis of the shank, and receiver member 522 can be rotated with respect to grommet member 524 substantially around a connection axis C, until a desired position and orientation of connector 520 is reached. An elongated member can be inserted through channel 538 of receiver member 522. Any final adjustments the surgeon desires, such as adjustment to
5 the positions of vertebral bodies, part(s) of connector 520, or the elongated member or fixation member, may be made.

A locking member, such as set screw 543, can then be inserted into hole 540 in receiver member 522 to lock connector 520, the elongated member, and the bone implant or fixation member at the desired positions and orientations. In certain embodiments, set
0 screw 543 is threaded into hole 540. It is also contemplated that a second locking member (e.g. a second set screw) may be inserted into another hole in the receiver member to lock connector 520. In the illustrated embodiment, set screw 543 presses the elongated

member, such as spinal rod R, downward along vertical axis V toward angled contact portions 572 of disk 528, e.g. set screw 543 is threaded along vertical axis V, down on the rod within channel 538, and urges the rod toward angled contact portions 572 of disk 528. Accordingly, angled contact portions 572 receive a force from the elongated member (e.g. spinal rod R) along a direction generally parallel to vertical axis V and are configured to transmit that force into a force having a magnitude both in a direction generally parallel to vertical axis V and in a direction generally parallel to connection axis C, based on the slanting or angling of contact portions 572. Disk 528 then exerts a force generally parallel to connection axis C on disk 530, such that radial splines 576 and 584 of disks 528 and 530, respectively, matingly engage each other and, in certain embodiments, prevent rotation of grommet member 524 relative to receiver member 522. Accordingly, disk 530 exerts a force on shank 525 of the pedicle screw or other bone implant member that extends through passage 554 in grommet member 524. The bone implant member is then sandwiched between channel 582 in disk 530 and the wall of passage 554 through grommet member 524, thereby locking the pedicle screw or other selected bone implant member at the selected dorsal height. Connector 520 is thus locked, and the elongated member, such as spinal rod R, and the bone implant member, such as a pedicle screw having shank 525, may be immobilized with respect to each other.

While one example of the use of connector 520 described above is in the spinal field, it will be appreciated that the disclosed connector can be used in a variety of orthopedic surgical procedures and/or with a variety of orthopedic surgical implants. Of course, connector 520 can be sized or otherwise configured to be used in one or more parts of the spine (e.g. cervical, thoracic, lumbar or sacral), or with spinal implants such as intervertebral cages or spacers, rod connectors, bone plates, bone-growth promoting substances, or with other devices or therapeutic substances. The parts described herein are preferably made of biocompatible material such as stainless steel, titanium, certain hard plastics, shape-memory materials and/or other sturdy materials. Further, while individual embodiments of a connector have been described herein, it is understood that features, parts or aspects of one embodiment could be incorporated into another embodiment.

Additionally, while the implantation of connector 520 has been described above as inserting an elongated member (e.g. a rod) into the connector after placing the connector over a bone implant or fixation member (e.g. screw or hook), it will be appreciated that

other methods can be used. For example, a surgeon may pre-fit connector 520 to a rod, fixation member, or other spinal implant device before inserting the connector into the body or placing the connector on or with other implant devices. Thus, after fixation members are placed on or in the spine or at another surgical site, a rod with such pre-fitted connectors can be placed in the surgical site so that the pre-fitted connectors connect to respective fixation members. Similarly, such pre-fitted connectors could have fixation members pre-connected to them. Once the surgical site is properly prepared, the rod with pre-fitted connectors and fixation members can be introduced, with fixation members connected to vertebrae or other bones, appropriate adjustments made to bone, connectors, rod or fixation members, and the connectors locked when such adjustments are completed.

While the invention has been illustrated and described in detail in the drawings and foregoing description, the same is to be considered as illustrative and not restrictive in character, it being understood that only the preferred embodiment has been shown and described and that all changes and modifications that come within the spirit of the invention are desired to be protected.

What is claimed is:

1. An apparatus comprising:

5 a receiver member defining a channel to receive a part of an elongated member, said receiver member having at least one aperture to receive a closure member and an opening transverse to said channel;

a grommet member defining a passage to receive a part of a bone implant member, said grommet member having an extension transverse to said passage;

0 wherein said extension is inserted through said opening of said receiver member so that said grommet member is non-threadedly and rotatably connected to said receiver member along a rotation axis;

a first disk adjacent said receiver member, said first disk having a first surface with a contact portion for contacting an elongated member and a second roughened surface; and

5 a second disk adjacent said grommet member, said second disk having a first surface with a groove for contacting a bone implant member and a second roughened surface;

wherein said second surfaces of said first and second disks face each other.

2. The apparatus of claim 1, wherein second surfaces of said first and second disks each have radial splines.

0 3. The apparatus of claim 1, wherein said aperture is substantially perpendicular to said channel and said rotation axis.

4. The apparatus of claim 1, wherein said passage of said grommet member includes threads to engage a bone implant member.

5 5. The apparatus of claim 1, comprising a bone implant member including a shank, said shank being held within said passage of said grommet member.

6. The apparatus of claim 1, comprising a closure member configured to be received in said aperture to press an elongated member against said first disk to lock the elongated member and a bone implant member with respect to each other.

0 7. The apparatus of claim 6, wherein said closure member is a break off set screw.

8. The apparatus of claim 1, wherein said channel at least partially defines an imaginary cylinder, said imaginary cylinder extending outward of said receiver member

along said longitudinal axis, wherein said contact portion of said first surface of said first disk is angled and extends at least partially into said imaginary cylinder.

9. The apparatus of claim 1, comprising a bolt to connect said grommet member to said receiver member along said rotation axis, wherein said bolt includes a head portion and external threads, and wherein said extension of said grommet member includes internal threads configured to matingly engage said threads of said bolt.

10. The apparatus of claim 9, wherein said receiver member includes an internal countersunk portion defining a ledge adjacent said opening, said head portion of said bolt being positioned adjacent said ledge.

11. The apparatus of claim 9, wherein said receiver member defines an access hole extending along said rotation axis to access said head portion of said bolt.

12. An apparatus comprising:
a receiver member defining a channel therethrough to receive an elongated member, and at least one aperture in communication with said channel to receive a closure member, said channel extending along a longitudinal axis and said aperture extending along a vertical axis;

a grommet member defining a passage therethrough to receive a part of a bone implant member, wherein said grommet member is configured to rotatably engage said receiver member along a rotation axis to connect a bone implant member to an elongated member; and

a closure member configured to be inserted through said aperture to substantially lock an elongated member in said channel and a bone implant member in said passage;

wherein said vertical axis is substantially perpendicular to said longitudinal axis and said rotation axis.

13. The apparatus of claim 12, wherein said closure member is a break off set screw.

14. The apparatus of claim 12, comprising a bolt to connect said grommet member to said receiver member, wherein said bolt includes a head portion and threaded portion, and wherein said extension of said grommet member includes internal threads configured to matingly engage said threaded portion of said bolt.

15. The apparatus of claim 12, comprising a first disk positionable adjacent said receiver member, said first disk having a first surface with a contact portion for

contacting an elongated member positioned in said channel, and further comprising a second disk positionable adjacent said grommet member, said second disk having a first surface with a groove for contacting a bone implant member positioned in said passage.

16. The apparatus of claim 15, wherein said contact portion of said first disk is angled such that at least part of said contact portion extends adjacent said channel of said receiver member.

17. The apparatus of claim 15, wherein said first and second disks each have a second surface including a set of radial splines, said second surfaces facing each other.

18. An apparatus comprising:

a receiver member for holding a part of an elongated member, said receiver member having a channel therethrough to receive an elongated member and at least one aperture to receive a closure member;

a grommet member for holding a part of a bone implant member, said grommet member having a passage therethrough to receive a bone implant member, wherein said grommet member is rotatably connected to said receiver member along a connection axis;

a first disk positioned adjacent said receiver member, said first disk having a first surface with at least one angled contact portion for contacting an elongated member positioned in said channel and a second surface having radial splines, wherein at least a portion of said angled contact portion extends adjacent said channel; and

a second disk positioned adjacent said grommet member, said second disk having a first surface with a groove for contacting a bone fixation member positioned in said passage and a second surface having radial splines, wherein said second surfaces of said first and second disks face each other and said radial splines of said second surfaces are configured to matingly engage each other.

19. The apparatus of claim 17, wherein said channel extends along a longitudinal axis and said aperture extends along a vertical axis, and wherein said vertical axis is substantially perpendicular to said longitudinal axis and said connection axis.

20. The apparatus of claim 17, wherein said first disk includes a stepped surface segment adjacent said first surface and said receiver member includes a corresponding stepped surface segment configured to matingly engage said stepped surface segment of said first disk to ensure proper positioning of said first disk relative to said receiver member.

21. The apparatus of claim 17, comprising a bolt to connect said grommet member to said receiver member along said connection axis, wherein said bolt includes a head portion and external threads, and wherein said extension of said grommet member defines a hole to receive said bolt and includes internal threads configured to matingly engage said threads of said bolt.

22. The apparatus of claim 17, comprising a bone implant member to be received in said passage, an elongated member to be received in said channel, and a closure member to be received in said aperture to press the elongated member against said first disk, thereby pressing said first disk against said second disk, thereby pressing said second disk against the bone implant member, to substantially lock the elongated member in said channel and substantially lock the bone implant member in said passage.

AMENDED CLAIMS

received by the International Bureau on 28 September 2008 (28.09.2008).

contacting an elongated member positioned in said channel, and further comprising a second disk positionable adjacent said grommet member, said second disk having a first surface with a groove for contacting a bone implant member positioned in said passage.

16. The apparatus of claim 15, wherein said contact portion of said first disk is angled such that at least part of said contact portion extends adjacent said channel of said receiver member.

17. The apparatus of claim 15, wherein said first and second disks each have a second surface including a set of radial splines, said second surfaces facing each other.

18. An apparatus comprising:

a receiver member for holding a part of an elongated member, said receiver member having a channel therethrough to receive an elongated member and at least one aperture to receive a closure member;

a grommet member for holding a part of a bone implant member, said grommet member having a passage therethrough to receive a bone implant member, wherein said grommet member is rotatably connected to said receiver member along a connection axis;

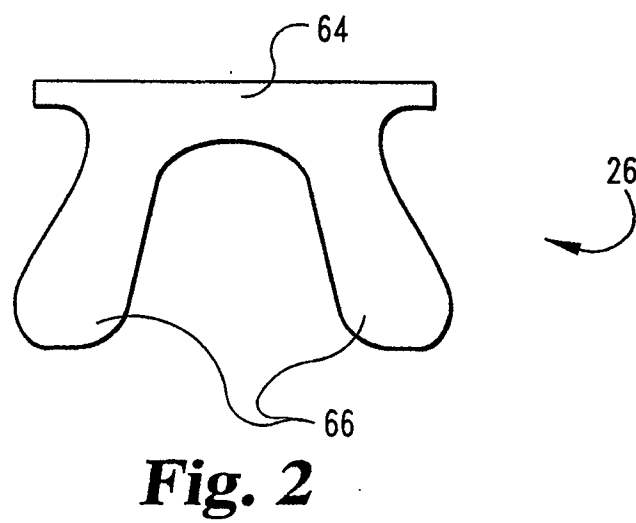
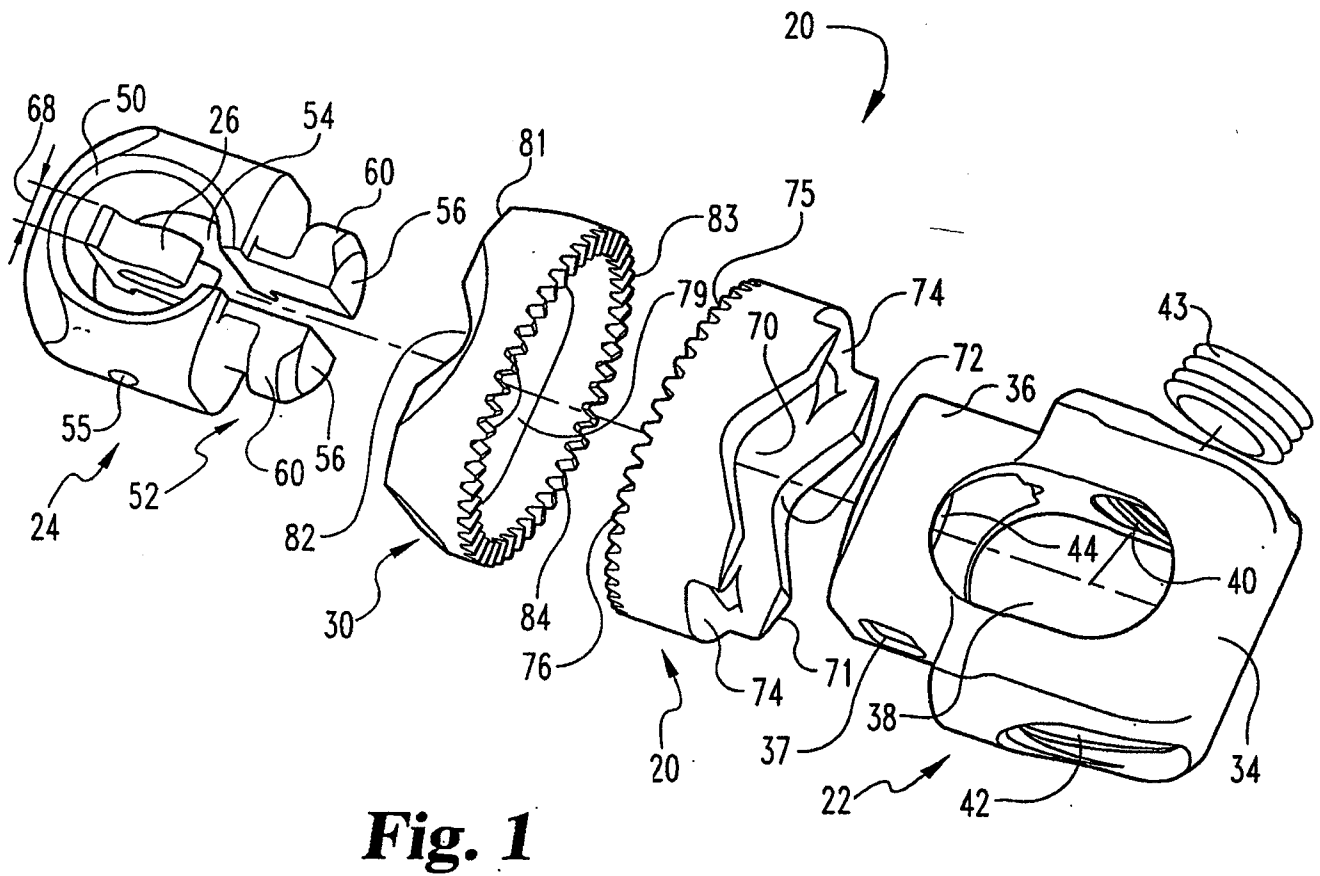
a first disk positioned adjacent said receiver member, said first disk having a first surface with at least one angled contact portion for contacting an elongated member positioned in said channel and a second surface having radial splines, wherein at least a portion of said angled contact portion extends adjacent said channel; and

a second disk positioned adjacent said grommet member, said second disk having a first surface with a groove for contacting a bone fixation member positioned in said passage and a second surface having radial splines, wherein said second surfaces of said first and second disks face each other and said radial splines of said second surfaces are configured to matingly engage each other.

19. The apparatus of claim 18, wherein said channel extends along a longitudinal axis and said aperture extends along a vertical axis, and wherein said vertical axis is substantially perpendicular to said longitudinal axis and said connection axis.

20. The apparatus of claim 18, wherein said first disk includes a stepped surface segment adjacent said first surface and said receiver member includes a corresponding stepped surface segment configured to matingly engage said stepped surface segment of said first disk to ensure proper positioning of said first disk relative to said receiver member.

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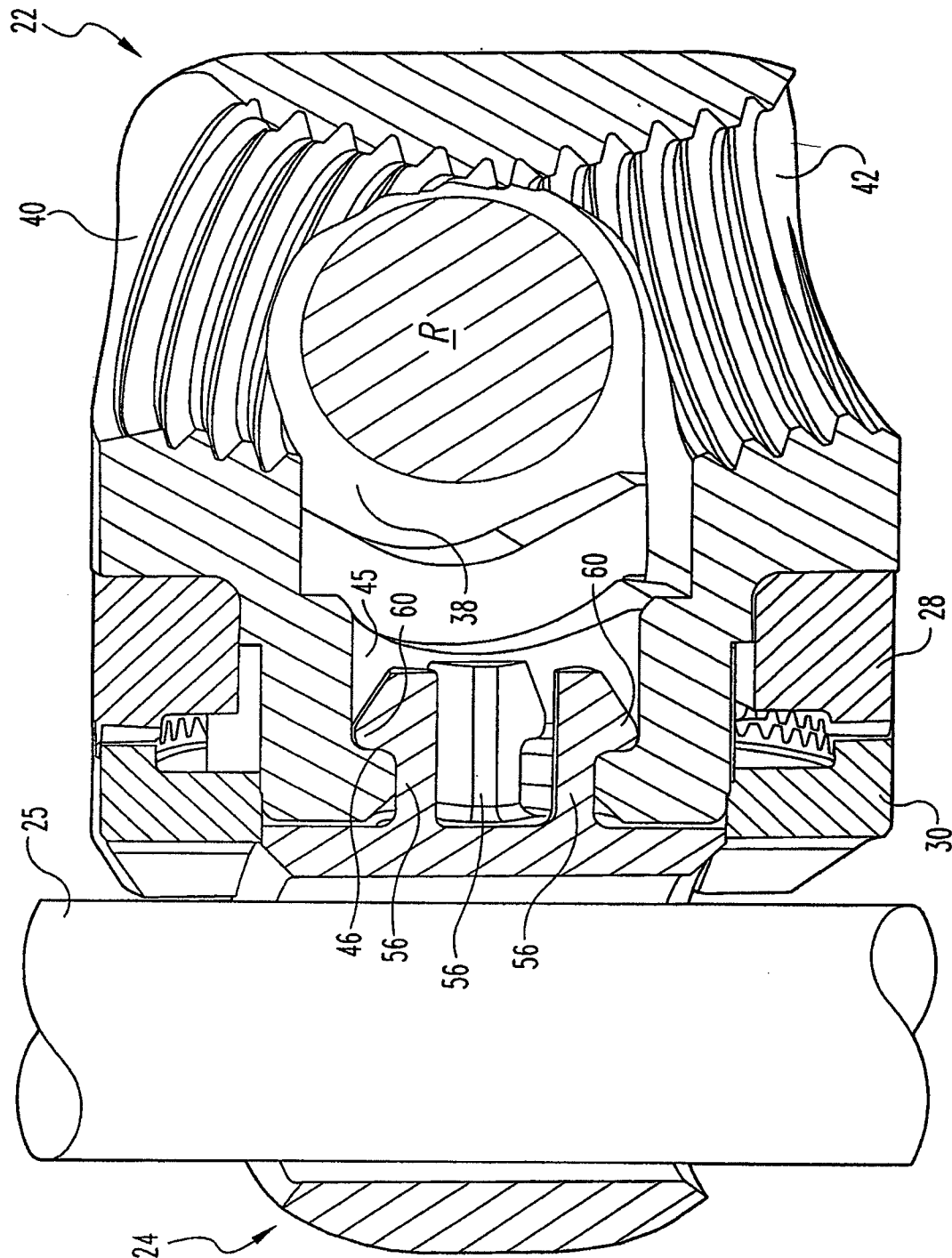


Fig. 3

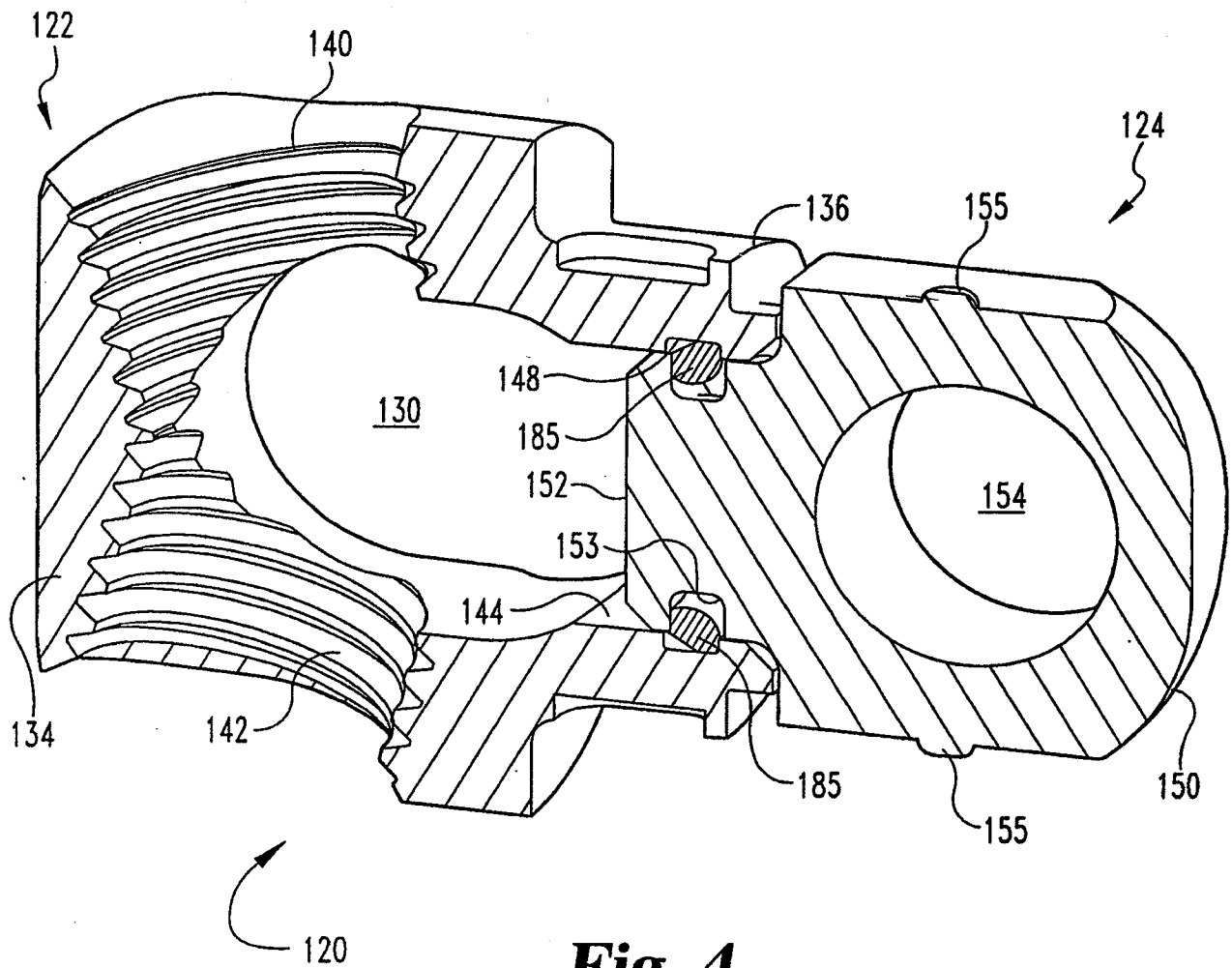


Fig. 4

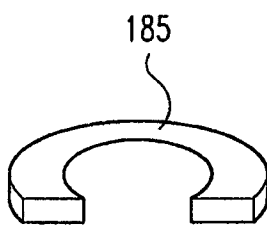


Fig. 5

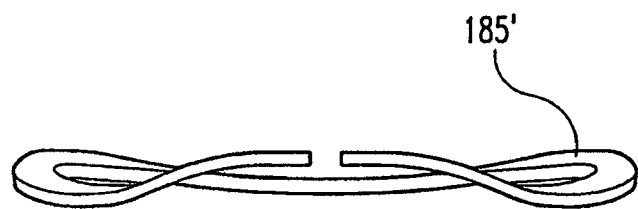


Fig. 6

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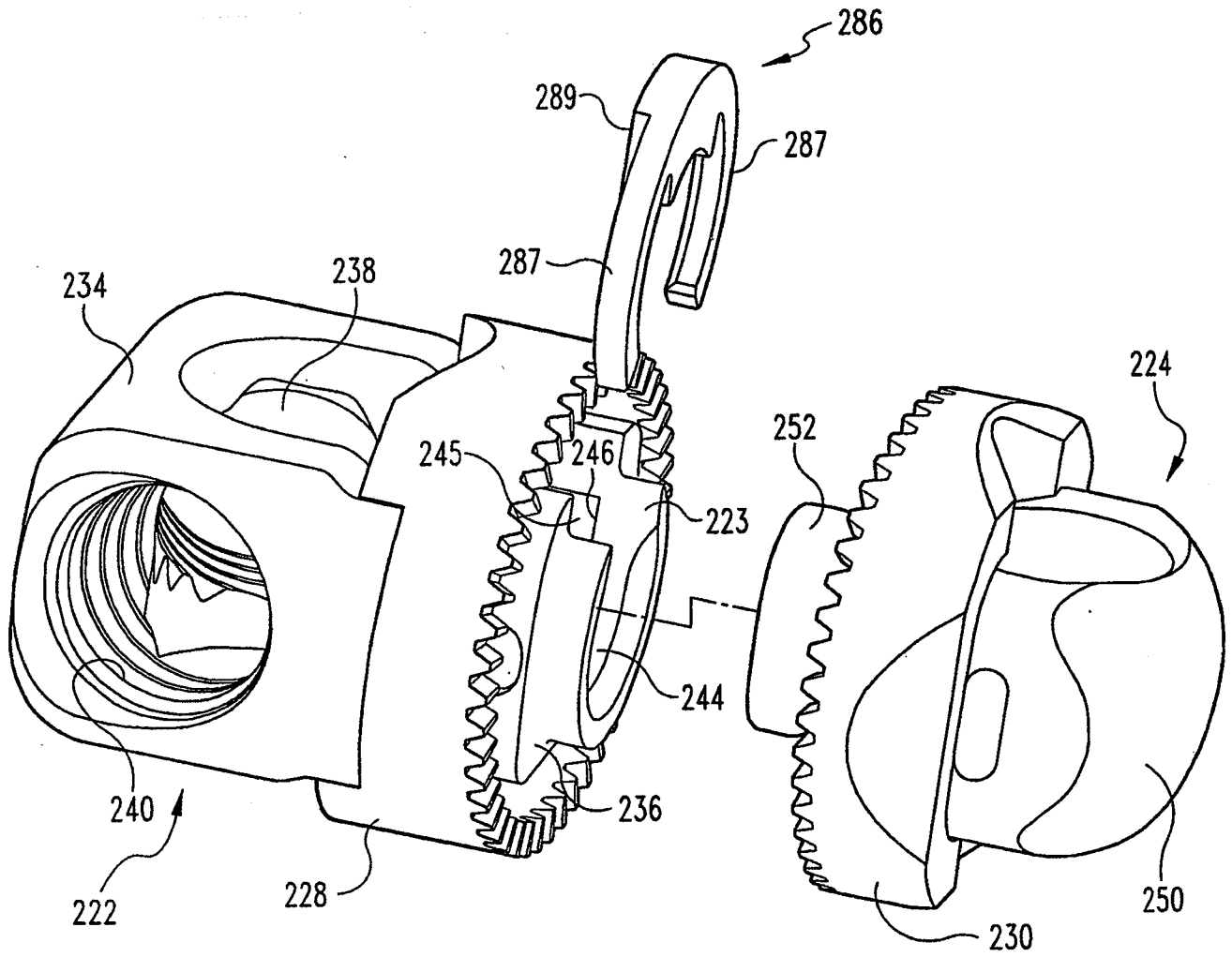


Fig. 7

220

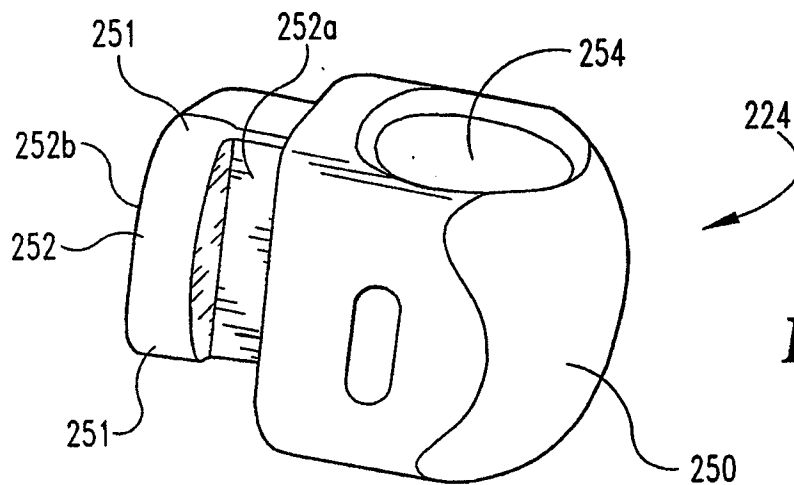


Fig. 8

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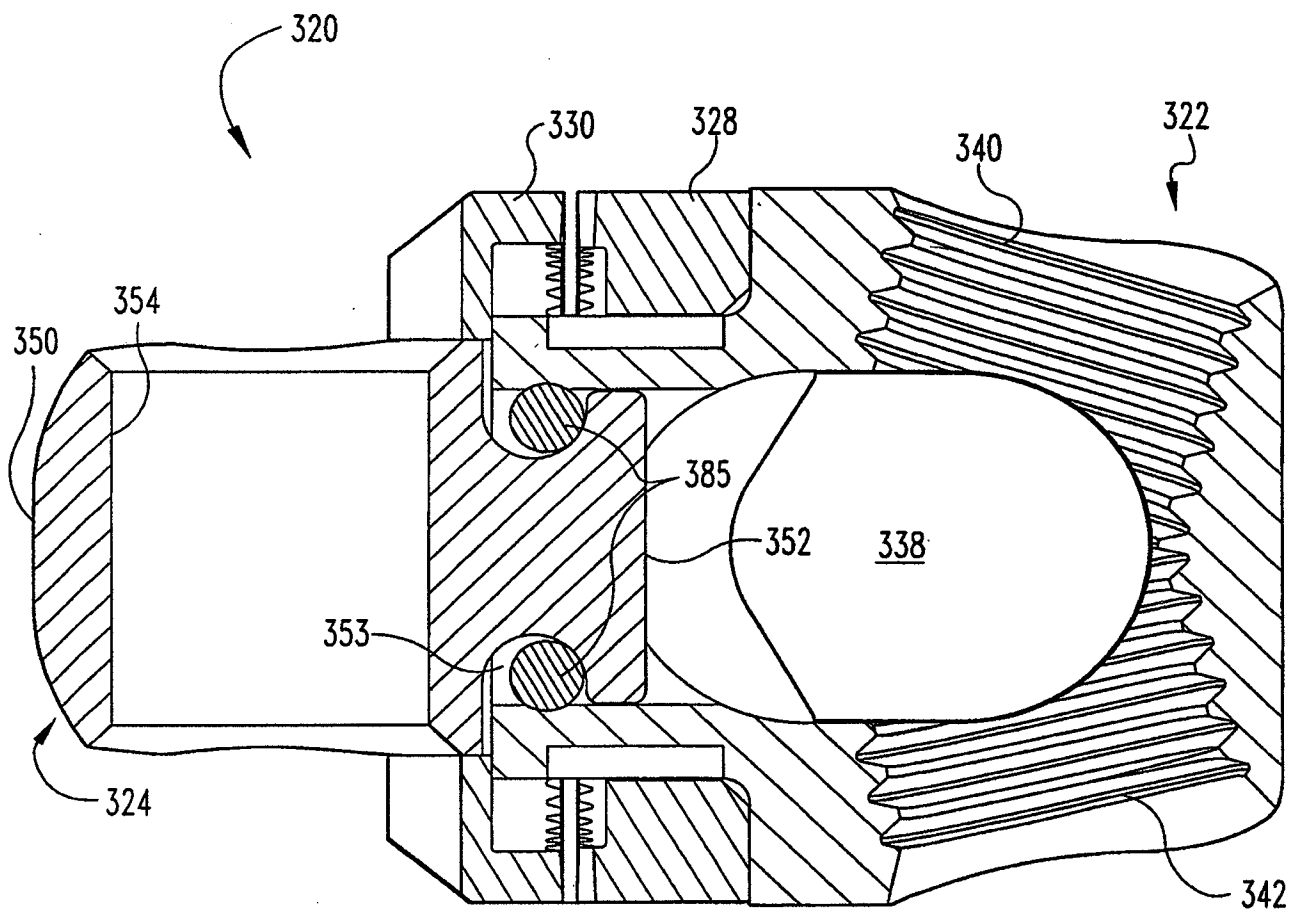


Fig. 9

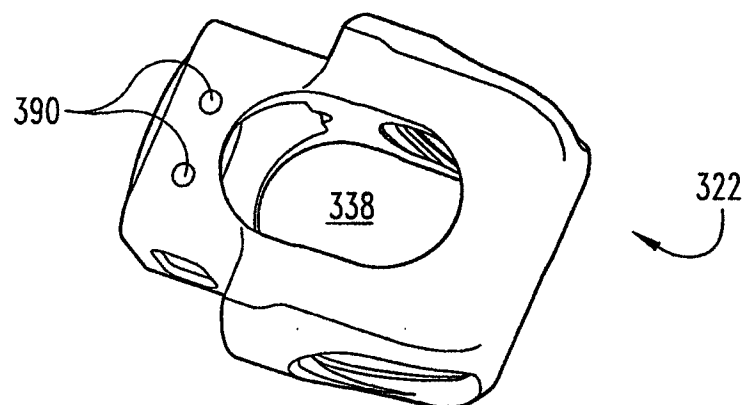


Fig. 10

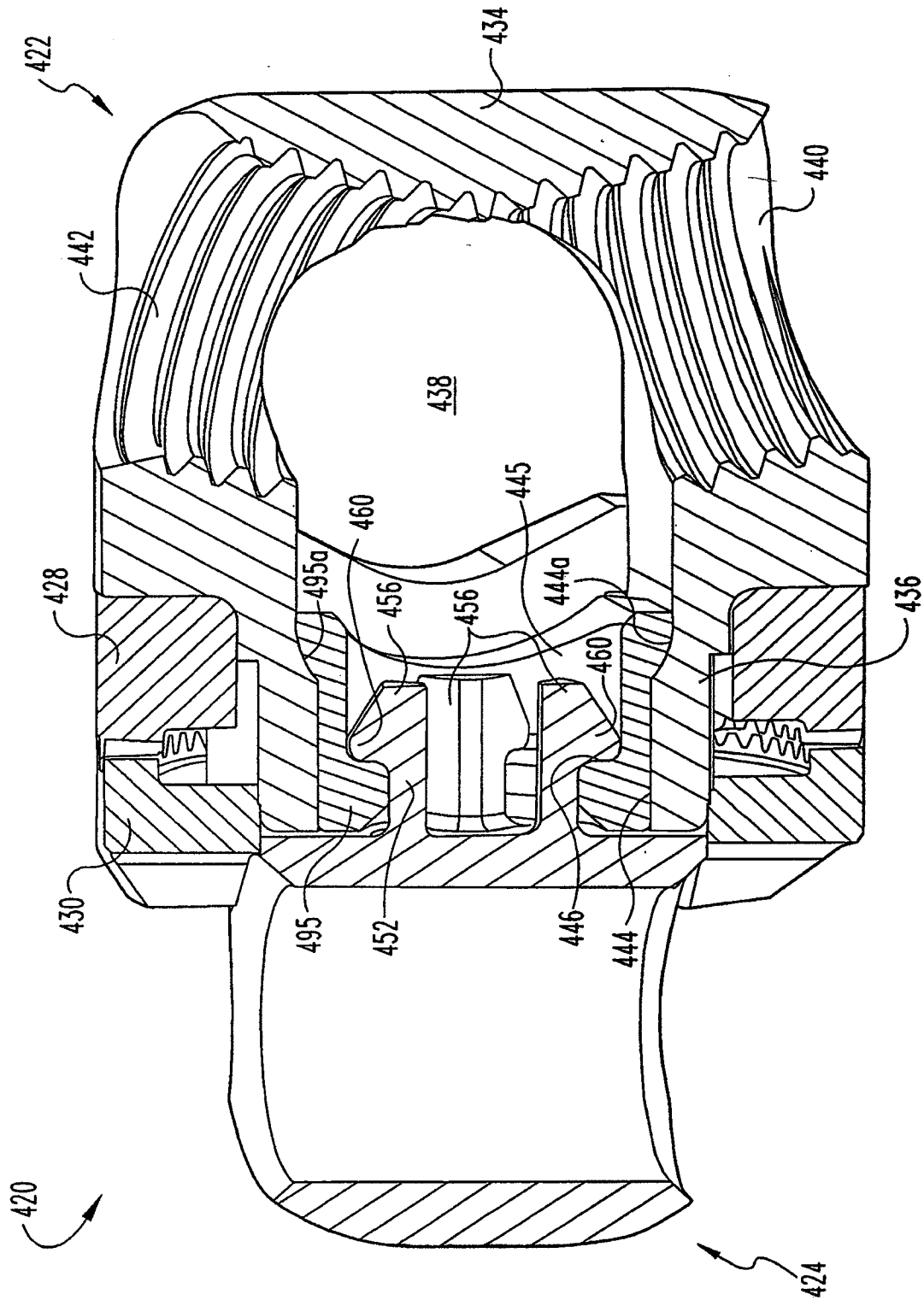


Fig. 11

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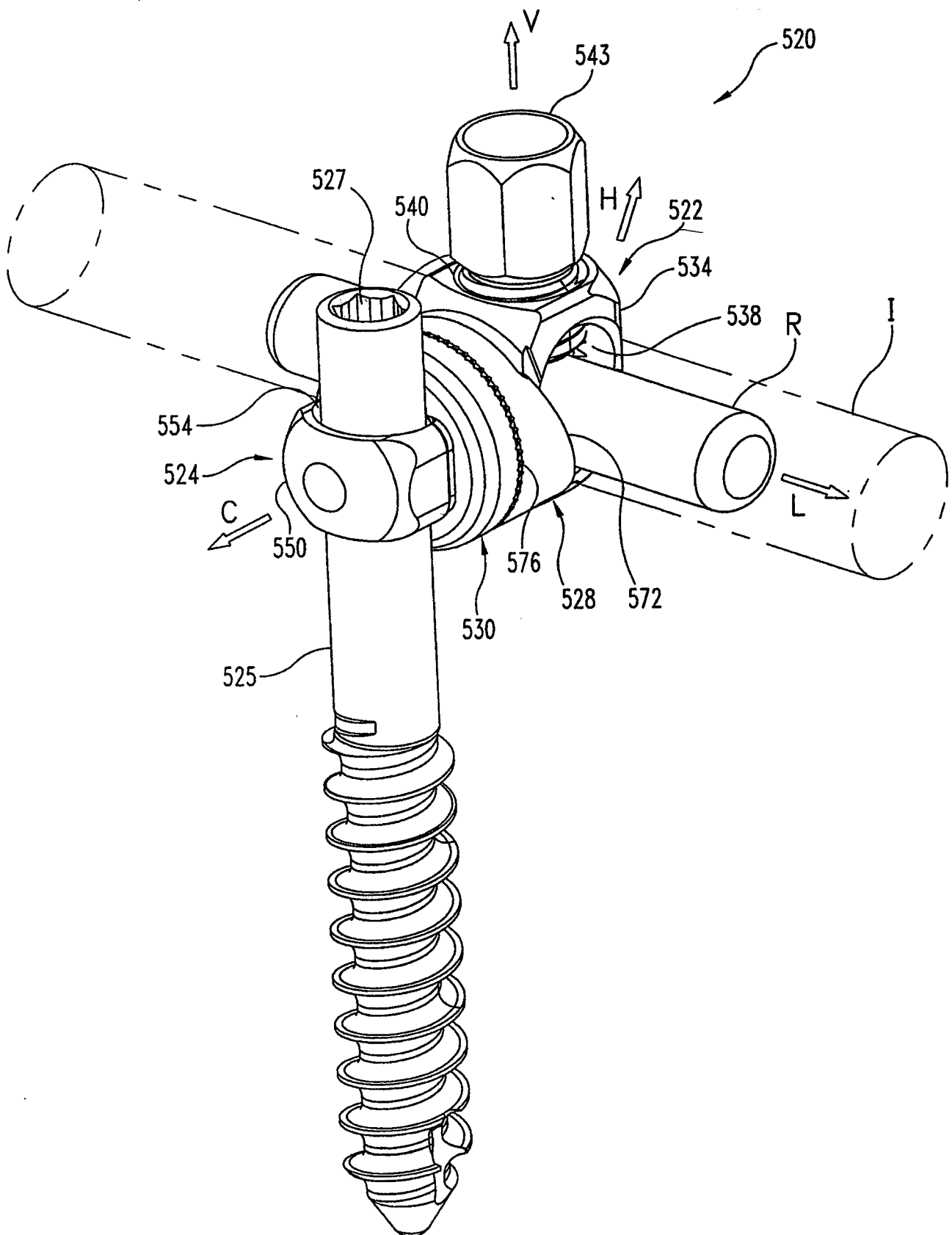


Fig. 12

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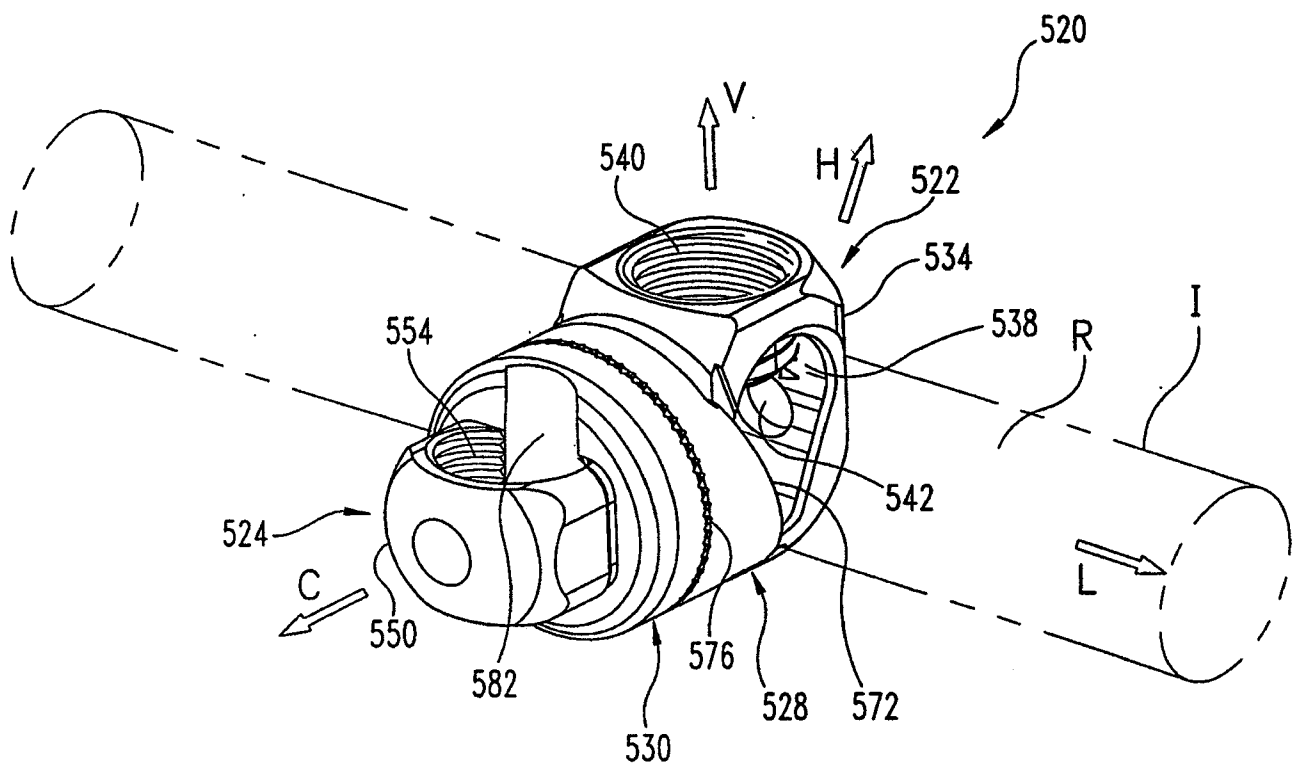


Fig. 13

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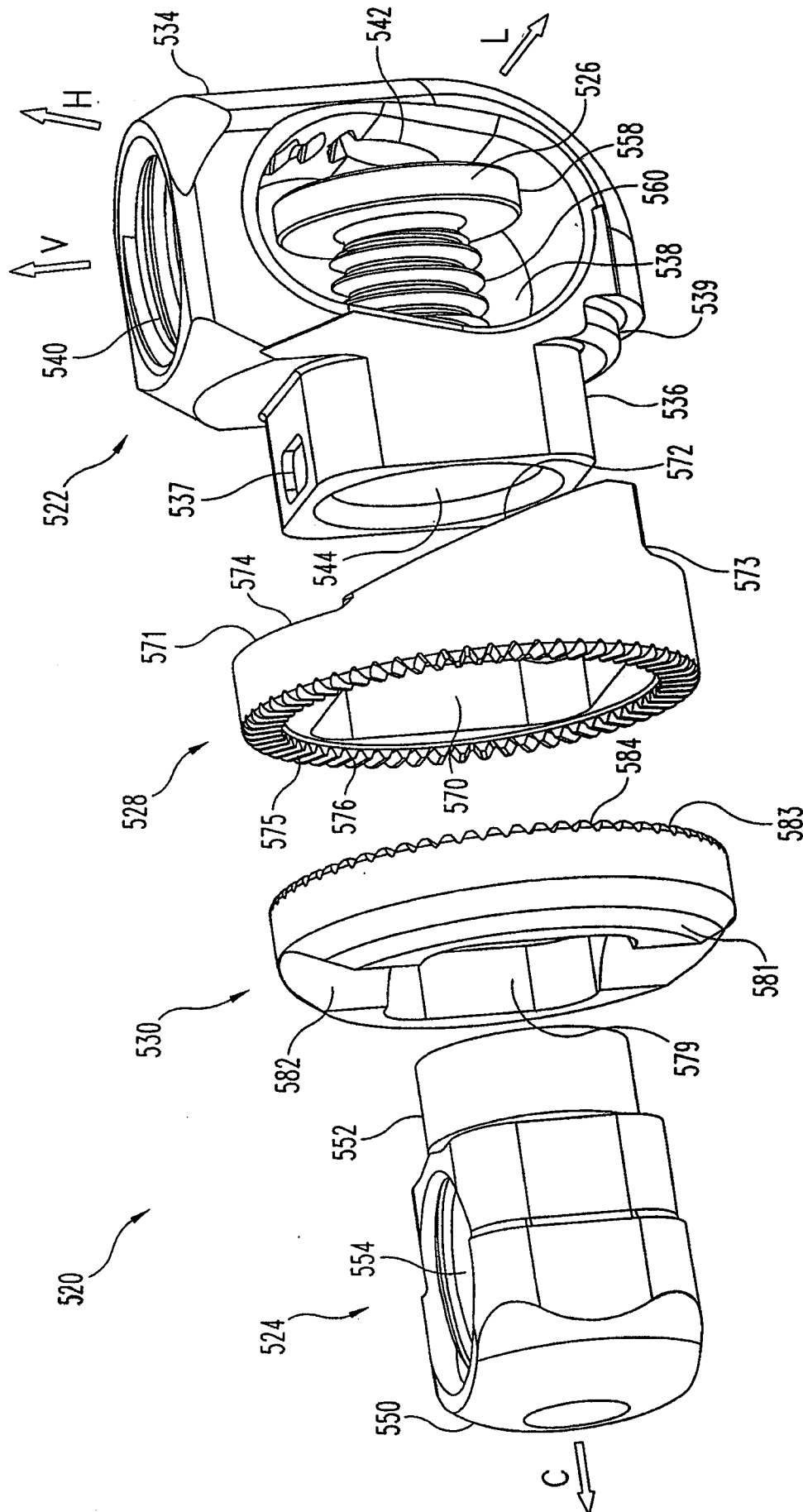


Fig. 14

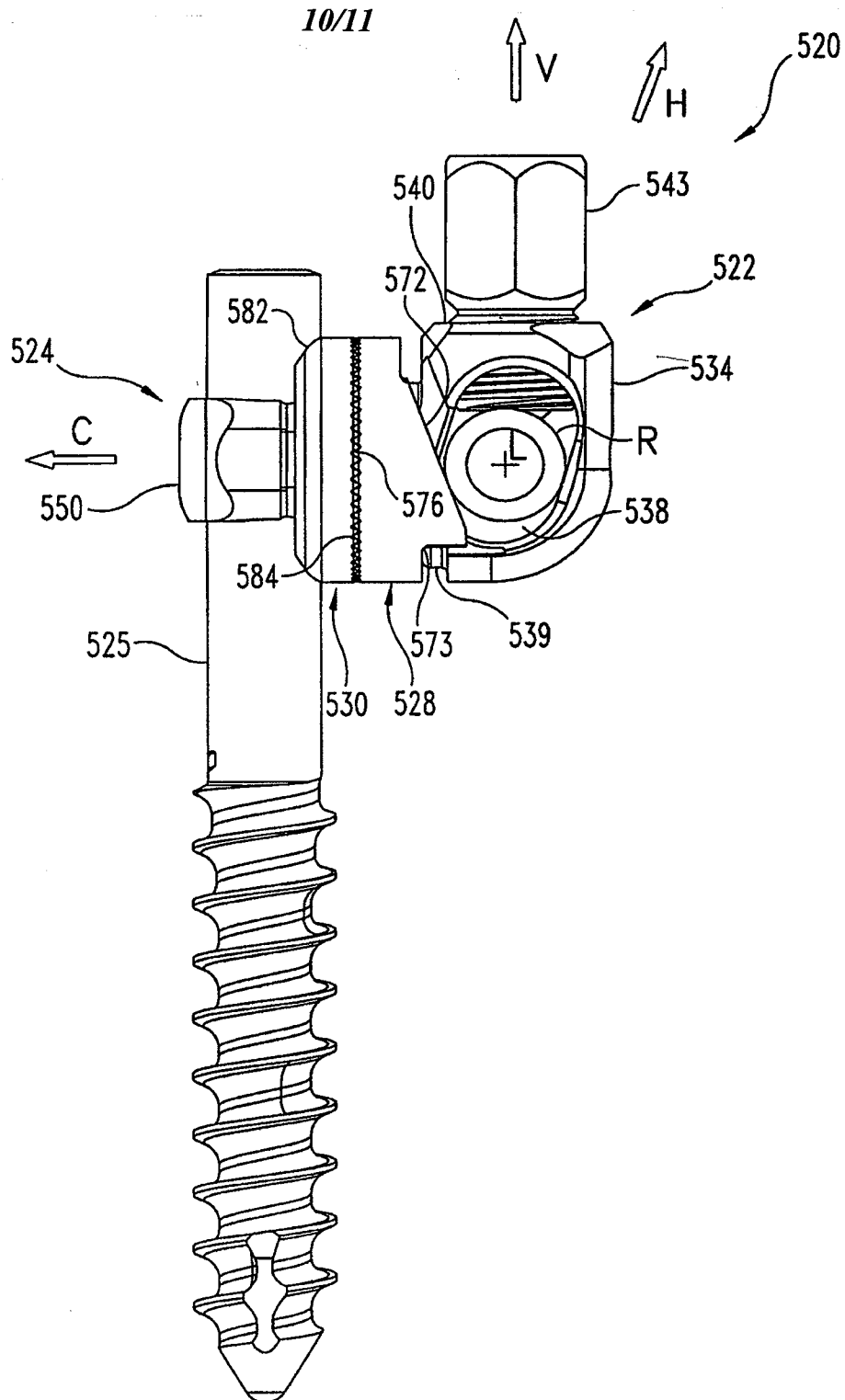


Fig. 15

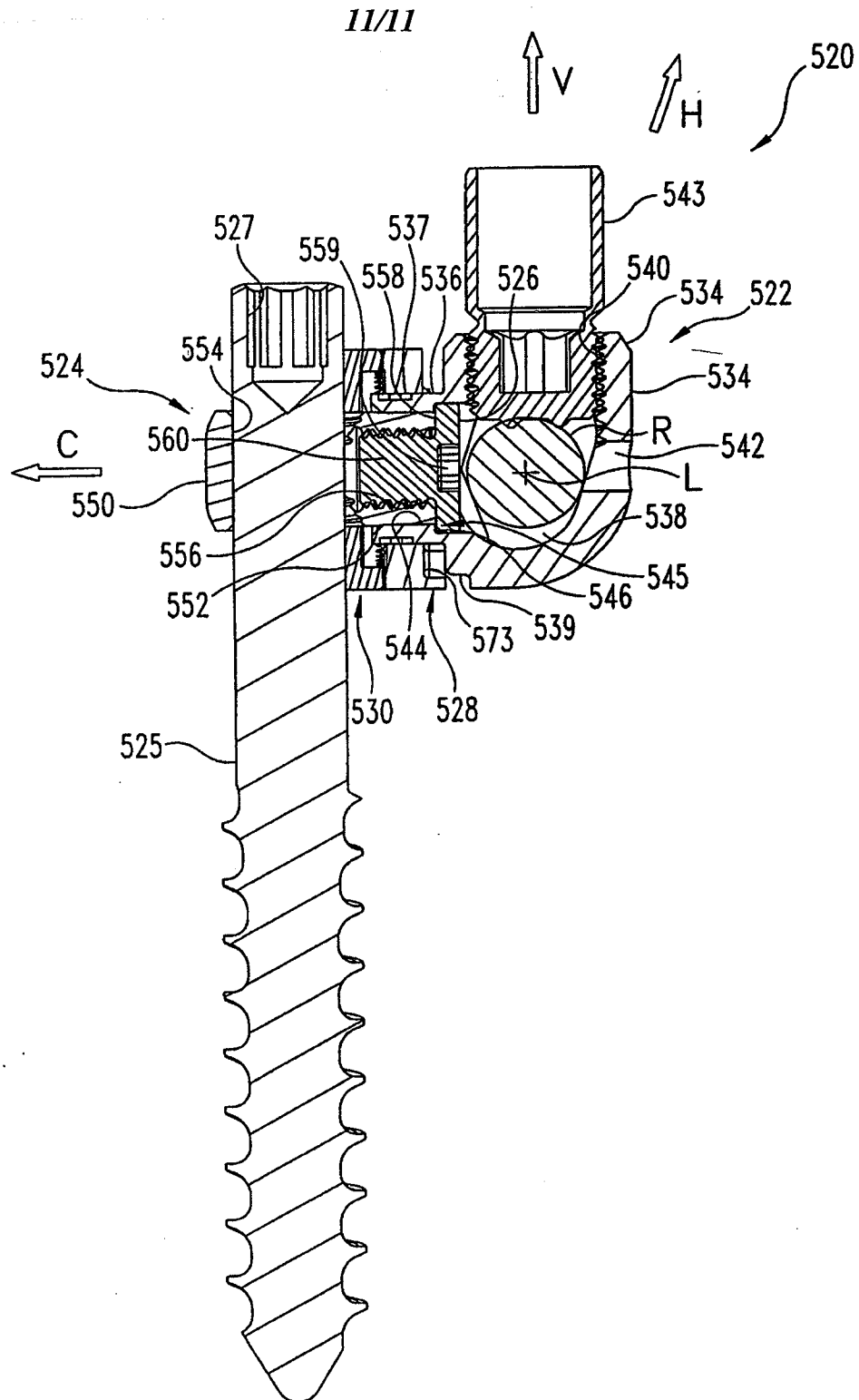


Fig. 16

INTERNATIONAL SEARCH REPORT

International application No

PCT/US2008/052880

A. CLASSIFICATION OF SUBJECT MATTER

INV. A61B17/70

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)

A61B

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 practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2005/113830 A1 (REZACH A. ET AL.)	1-8, 18,
A	26 May 2005 (2005-05-26)	22
	paragraph [0026]; figures	12
A	US 5 643 263 A (SIMONSON P.M.)	
	1 July 1997 (1997-07-01)	
	cited in the application	

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Further documents are listed in the continuation of Box C.

☒

See patent family annex.

* Special categories of cited documents:

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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

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Date of the actual completion of the international search

17 June 2008

Date of mailing of the international search report

30/06/2008

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Nice, Philip

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2008/052880

Patent document cited in search report	Publication date	Patent family member(s)	Publication date	
US 2005113830	A1	26-05-2005	US 2007162008 A1	12-07-2007
			US 2007293861 A1	20-12-2007
US 5643263	A	01-07-1997	AT 281789 T	15-11-2004
			AU 717852 B2	06-04-2000
			AU 6845996 A	12-03-1997
			CA 2226972 A1	27-02-1997
			DE 69633834 D1	16-12-2004
			DE 69633834 T2	02-02-2006
			EP 1500375 A2	26-01-2005
			EP 0957798 A1	24-11-1999
			ES 2239337 T3	16-09-2005
			JP 3862030 B2	27-12-2006
			JP 2001515367 T	18-09-2001
			WO 9706742 A1	27-02-1997
			US 5885285 A	23-03-1999