



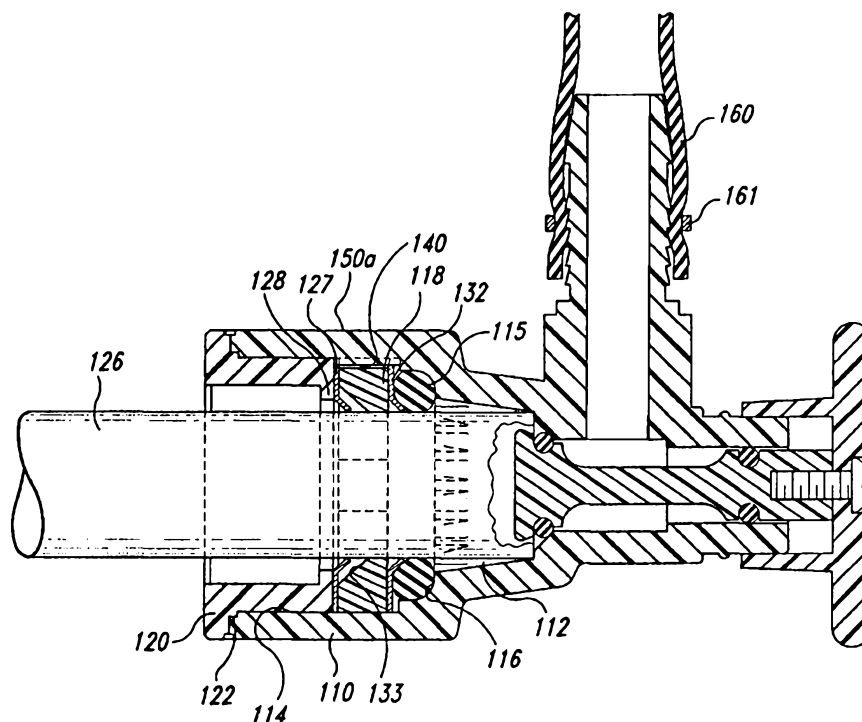
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<p>(21) International Application Number: PCT/US99/30149</p> <p>(22) International Filing Date: 17 December 1999 (17.12.99)</p> <p>(30) Priority Data:</p> <table border="0"> <tr> <td>09/216,376</td> <td>18 December 1998 (18.12.98)</td> <td>US</td> </tr> <tr> <td>09/425,909</td> <td>21 October 1999 (21.10.99)</td> <td>US</td> </tr> </table> <p>(71) Applicant (for all designated States except US): ACCOR TECHNOLOGY, INC. [US/US]; Suite 210W, 1800 – 112th Avenue N.E., Bellevue, WA 98004 (US).</p> <p>(72) Inventors; and</p> <p>(75) Inventors/Applicants (for US only): O'NEILL, Jerry, E. [US/US]; 221 – 7th Avenue South, Kirkland, WA 98033 (US). WHITNEY, Charlie [US/US]; P.O. Box 331, Rock Island, WA 98850 (US).</p> <p>(74) Agents: BAYNHAM, Robert, J. et al.; Seed and Berry LLP, Suite 6300, 701 Fifth Avenue, Seattle, WA 98104–7092 (US).</p>	09/216,376	18 December 1998 (18.12.98)	US	09/425,909	21 October 1999 (21.10.99)	US	<p>(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).</p> <p>Published</p> <p><i>With international search report.</i></p> <p><i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i></p>
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(54) Title: TUBE COUPLING

(57) Abstract

A fluid coupling having an outer housing (10) with an internal bore (12), an O-ring (15) fitted within the bore (12), a spacer bushing (18) fitted against the O-ring, a gripper ring (27) fitted against the axially outer side of the spacer ring (18), the gripper ring (27) having axially and radially inwardly protruding circumferentially spaced gripping teeth (29), the teeth (29) arranged for providing a twist when subjected to simultaneous rearward axial and rotational forces, and an end bushing (20) holding the gripper ring (27), spacer bushing (18), and O-ring (15) within the outer housing (10). A fluid coupling having an outer housing (10) with internal bore (12), an O-ring seal (15) fitted within the bore (12), a spacer bushing (18)



fitted against the seal (15), a first gripper ring (127) fitted against the axially outer side of the spacer ring, a second gripper ring (132) fitted against the O-ring seal, the gripper rings (127, 132) having axially and radially inwardly protruding circumferentially spaced gripping teeth (29), in one embodiment the teeth (29) arranged for providing a twist when subjected to simultaneous rearward axial and rotational forces, and an end bushing (18) holding the gripper rings (127, 132), spacer Bushing (18), and O-ring (15) within the outer housing (10).

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TUBE COUPLING

TECHNICAL FIELD

This invention pertains to removable couplings of the type for
5 securing a plastic or copper tube by pressing on the tube without the need
for welding or solder.

BACKGROUND OF THE INVENTION

U.S. Patent No. 4,911,406 shows a tube coupling in which a
metal or plastic tube can be coupled in a fluid-tight connection to a valve or
10 the like simply by pressing the tube into the coupling. The tube is held into
the coupling by a flexible gripper ring having teeth, which bite into the tube
to prevent the tube from being pushed out by the fluid pressure in the
coupling. The teeth are arranged such that the tube can be removed from
the coupling by unscrewing the coupling but cannot be removed simply by
15 axially pulling the tube without rotation of the tube. An O-ring seal is
provided to prevent leakage of fluid outside of the coupling around the tube.

One of the advantages of the invention of the patent
4,911,406 is that by screwing the tube out of the gripper ring there is
minimal damage to the surface of the tube. This then enables other
20 advantageous arrangements of the seal and the gripper ring within the
coupling.

With the introduction of softer plastic tubing, such as,
polybutylene or PEX [cross-linked polyethylene, plastic] to the plumbing
industry, the demands on the holding power of the gripper ring have
25 increased. The softer tubing material can cause the teeth of the gripper
ring to gouge grooves in the tubing when the tubing is subjected to high
numbers of repeated cycles at higher hydrostatic pressures.

SUMMARY OF THE INVENTION

It is a first improvement of the invention to reverse the position of a gripper ring in the coupling from the position shown in the patent 4,911,406. In the embodiments of this invention, the seal, such as
5 an O-ring seal, is arranged axially inward of the gripper ring in the outer housing of the coupling. This is followed by a spacer bushing which holds the ring in place and the gripper ring, with its teeth, is on the axially outer side of the spacer bushing.

It is a second improvement of the invention of U. S. Patent No.
10 4,911,406, to provide two or more gripper rings for increasing the holding power of the rings in the coupling for use with the softer tubing. The two or more gripper rings co-act on the tubing in a synergistic effect distributing the load between them to substantially increase the holding power of the rings in the softer tubing. It is believed that the softness of the tubing
15 allows movement of the teeth in the plastic until the load on the rings is distributed over more of the rings thus increasing the ultimate holding power of the rings.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is an axial section of the coupling embodying the
20 principles of the invention.

Figure 2 is an exploded view of the coupling shown in Figure 1.

Figure 3 is a fragmentary section of the gripper ring showing one of the gripper teeth.

25 Figure 4 is a generic illustration of what could be a test cap or a valve or other coupling device product embodying the principles of the invention.

Figure 5 shows the O-ring seal and gripper ring arrangement of this invention within the valve of the type shown in patent 4,911,406.

Figure 6 is an axial section of the coupling embodying the principles of the invention with multiple gripper rings for use, for example, with a valve.

Figure 7 is an exploded view of the coupling shown in
5 Figure 6.

Figure 8 is a fragmentary section of the gripper ring showing one of the gripper teeth.

Figure 9 is a generic illustration of uses for the coupling with what could be a valve, a shower head, a tub faucet coupling, a tube
10 coupling, or any other application or use for this unique coupling.

Figure 10 shows another embodiment of the invention with three gripper rings. This view is intended to show that the number of gripper rings can be any multiple of two or more.

Figure 11 shows still another embodiment of the coupling used
15 for a test cap. These various views are intended to show that the coupling has a wide variety of uses and configurations not all of which are shown for purposes of brevity.

Figure 12 shows another embodiment of the coupling.

DETAILED DESCRIPTION OF THE INVENTION

20 As best shown in Figure 1, the unique coupling is shown in one form as a generic coupling but could be a test cap. A test cap, for example, is used in the plumbing industry for checking temporarily on the pressure of a plumbing system to see if all of the joints are free from leaks and that the proper pressure may be maintained. Usually then the test cap
25 is removed and a permanent valve soldered or bonded onto the tube. The many applications for the coupling is further shown generically in phantom lines in Figure 4, in which the phantom line box is a test cap coupling, a valve, an end unit like a shower-head, a coupling for joining two pieces of tubing together, etc. Figure 5 shows more specifically the invention for the

valve. The details of these different applications are obvious to one of ordinary skill in the art and the details of U.S. Patent No. 4,911,406 are incorporated herein by reference thereto.

In all of the couplings of Figures 1-5, the invention includes an
5 outer housing 10 having an inner bore 12 with a side wall 14. The inner
bore has a seal support surface 16 against which is fitted a conventional O-
ring seal 15. The seal is held in the bore by a spacer bushing 18. The
spacer bushing has circumferentially spaced axial grooves 33, as best
shown in Figure 2. A metallic gripper ring 27 is provided with
10 circumferentially spaced axially and radially inwardly protruding teeth 29.
The spacer bushing has a flat 36 aligned with a flat 30 on the gripper ring
27. The inside wall of the housing has a protruding flat 31 to receive the
flats on the bushing and gripper ring. The gripper ring is also provided with
a notch 39 and the spacer bushing provided with a notch 41, which
15 notches engage a protrusion 40 (Fig. 1) on the inside wall 14 of the outer
housing 10. The flats on the inner bushing and the gripper ring and the
notches are provided to assure proper installation of the gripper ring and
inner bushing within the housing.

An end bushing 20 is positioned against the gripper ring and
20 holds the O-ring, spacer bushing, and gripper ring tightly together so that
the teeth of the gripper ring extend into the inner bore 12. The end bushing
is held within the internal bore of the outer housing 10 by sonic welds 22.
The end bushing is provided with guide ribs 28 for guiding a plastic or
copper tube 26 into the coupling. The tube end inserted into the coupling
25 is shown in phantom lines in Figure 1. Inner ribs 35 are provided in the side
wall 14 of the internal inner bore 12. In general, the gripper ring is made
from a full hard stainless steel, the coupling parts from plastic, such as,
acetal, or for larger couplings, metal, and the tubes or pipe made from
copper or conventional PVC used in plumbing polybutylene, CPVC, PEX or
30 other metals and plastics used in plumbing.

As best shown in Figure 1, the coupling is assembled by placing the O-ring against the ring support surface 16, the spacer bushing is aligned with its flat 36 against the flat 31 of the outer housing and slid into place against the O-ring, the gripper ring is then placed against the spacer bushing with its flat 30 aligning the teeth 29 into the grooves 33 of the spacer bushing. Then the end bushing is placed within the outer housing and welded into place by sonic welding 22. For metal couplings, the outer housing can be secured by any suitable permanent attachment such as crimped or interfering threads. When a tube 26 is to be inserted in the coupling or the coupling inserted over a tube, the tube and the coupling are moved axially to one another with the tube engaging the teeth. The teeth extend into the inner bore of the housing a distance further than the outer diameter of the tube 26 so that the teeth are deflected by the tube as the tube and housing are moved axially to one another. This creates an immediate gripping engagement of the teeth even before any fluid pressure is applied in the coupling. The tube is inserted until it tightly engages the end wall 50 of the bore 12. This can be felt by the user of the coupling since the tube can be pushed to move axially, albeit tightly, until the end of the tube stops against the end wall 50 and cannot be pushed any further relative to the outer housing.

The O-ring seal maintains the fluid seal around the tube. The tube cannot be solely axially withdrawn by fluid pressure without destroying the coupling and will maintain quite a high fluid pressure. The tube can be removed by unscrewing the coupling relative to the tube. The teeth 29 in the gripper ring can be manufactured with a slight twist or by using the full hard stainless steel or equivalent material, such as manganese, or composites, and a ring thickness of no greater than about .012 inches, preferably .008 inches, then the twist can be created by the forces acting on the teeth as the tube 26 is simultaneously rotated and pulled out of the housing. By rotating the tube while pulling, edges of the

gripper teeth will move within the grooves 30 causing friction on one edge of the teeth allowing the teeth to twist and the tube screw out of the gripper ring. If the tube is initially not inserted past the gripper ring, or is not inserted through the O-ring seal, leakage will be apparent almost
5 immediately when the pressure is applied to the plumbing system. Thus, an advantage of this embodiment is it gives an immediate visual check on the proper placement of the tube within the coupling or the position of the test cap over the coupling.

Figure 4 shows a phantom version of a coupling to illustrate
10 that the coupling could be a test cap as shown in Figure 1, a valve in U.S. Patent No. 4,911,406, or simply a mirror image of the right side coupling 50 being on the left side to simply join two tubes together.

Figure 5 shows an embodiment using the valve or housing 50a of patent 4,911,406 as the coupling. Another advantageous feature of the
15 invention is illustrated in Fig. 5 by showing that pre-cut lengths of tubing or hose 60 can be bonded and crimped as at 61 or otherwise permanently secured to the valve to provide a complete connection from the plumbing system to an appliance or other plumbing fixture. Thus, installation can be made more economically and faster having a complete pre-cut plumbing
20 connection already made-up and available.

As best shown in Figure 6, the unique coupling is shown with multiple gripper rings in one form as a valve. However, while a valve has been shown in the embodiment of Figure 6, this is for illustration purposes only and the coupling can be used for a valve, such as shown in U.S.
25 Patent No. 4,911,406 or any other use for a coupling. This is shown generically in phantom lines in Figure 9, in which the phantom line box is a valve, a coupling for joining two pieces of tubing together, a shower head, a tub faucet coupling, or any other use where a soft tubular plumbing material is to be joined to more tubing or to some plumbing fixture. These
30 different applications or uses for the coupling are obvious to one of ordinary

skill in the art and the details of U.S. Patent No. 4,911,406 are incorporated herein by reference thereto.

In the couplings of Figures 6-11, the invention includes an outer housing 110 having an inner bore 112 with a side wall 114. The inner bore has a seal support surface 116 against which is fitted a conventional O-ring seal 115. The seal is held in the bore by a spacer bushing 118. The spacer bushing has circumferentially spaced axial grooves 133, as best shown in Figure 7. A metallic gripper ring 127 is provided with circumferentially spaced axially and radially inwardly protruding teeth 129. A second identical gripper ring 132 is provided against the O-ring seal and thus on the opposite side of the spacer bushing 118. The spacer bushing has a flat 136 aligned with a flat 130 on the gripper rings 127, 132. The inside wall of the housing has a protruding flat 131 to receive the flats on the bushing and gripper rings. The gripper rings are also provided with a notch 139 and the spacer bushing provided with a notch 141, which notches engage a protrusion or key 140 (Fig. 6) on the inside wall 114 of the outer housing 110. The flats on the inner bushing and the gripper rings and the notches are provided to assure proper installation of the gripper rings and inner bushing within the housing.

An end bushing 120 is positioned against the gripper ring 127 and holds the O-ring, spacer bushing, and gripper rings tightly together so that the teeth of the gripper rings extend into the inner bore 112. The end bushing is held within the internal bore of the outer housing 110 by sonic welds 122 [Fig. 10]. The end bushing is provided with guide ribs 128 for guiding a plastic or copper tube 126 into the coupling. In the alternative, these ribs can be eliminated so that existing old repaired plumbing tubing with existing ferrules can be fitted into larger diameter of the end bushing 120. The tube end inserted into the coupling is shown in Figure 6. Inner ribs 135 [Fig. 7] are provided in the side wall 114 of the internal inner bore 112. In general, the gripper rings are made from a full hard stainless steel,

the coupling parts from plastic, such as, acetal, or for larger couplings, metal, and the tubes or pipe made from copper, conventional PVC, polybutylene, PEX, or other metals and plastics used in plumbing.

As best shown in Figure 6, the coupling is assembled by
5 placing the O-ring against the ring support surface 116, the gripper ring 132 is placed against the O-ring, the spacer bushing is aligned with its flat 136 against the flat 131 of the outer housing and slid into place against the gripper ring 132, the gripper ring 127 is then placed against the opposite
10 side of the spacer bushing with its flat 130 aligning the teeth 129 into the grooves 133 of the spacer bushing. Then the end bushing is placed within the outer housing and welded into place by sonic welding 122. For metal couplings, the outer housing can be secured by any suitable permanent attachment such as crimped or interfering threads. When a tube 126 is to be inserted in the coupling or the coupling inserted over a tube, the tube
15 and the coupling are moved axially to one another with the tube engaging the teeth. The teeth of both rings extend into the inner bore of the housing a distance further than the outer diameter of the tube 126 so that the teeth are deflected by the tube as the tube and housing are moved axially to one another. This creates an immediate gripping engagement of the teeth even
20 before any fluid pressure is applied in the coupling. The tube is inserted until it tightly engages the end wall 150 [Fig. 10] of the bore 112. This can be felt by the user of the coupling since the tube can be pushed to move axially, albeit tightly, until the end of the tube stops against the end wall 150 and cannot be pushed any further relative to the outer housing.

25 The O-ring seal maintains the fluid seal around the tube. The tube cannot be solely axially withdrawn by fluid pressure without destroying the coupling and will maintain quite a high fluid pressure. The tube can be removed by unscrewing the coupling relative to the tube, although with softer plastic tubing the teeth may dig into the tubing more
30 deeply and the gouged surface of the tubing may be damaged when the

coupling is unscrewed. In this case, a new tube may be needed or the damaged section of the original tube can be cut-off and the remaining undamaged end of the tubing can then be re-inserted into the coupling. The teeth 129 in the gripper rings can be manufactured with a slight twist
5 or by using the full hard stainless steel or equivalent material, such as manganese, or composites, and a ring thickness of no greater than about .012 inches, preferably .008 inches, then the twist can be created by the forces acting on the teeth as the tube 126 is simultaneously rotated and pulled out of the housing. By rotating the tube while pulling, edges of the
10 gripper teeth will move within the grooves 130 causing friction on one edge of the teeth allowing the teeth to twist and the tube screw out of the gripper ring.

In the embodiments shown, if the tube is initially not inserted past the gripper ring, or is not inserted through the O-ring seal, leakage will
15 be apparent almost immediately when the pressure is applied to the plumbing system. Thus, an advantage of this embodiment is it gives an immediate visual check on the proper placement of the tube within the coupling or the position of the valve over the coupling.

Figure 8 shows a typical gripper ring.

20 Figure 9 shows a phantom version of a coupling to illustrate that the coupling could be a valve, a coupling joining two tubes, a faucet coupling, a shower head, a test cap, or any other plumbing fixture using a push on coupling.

Figure 10 shows another embodiment with the same features
25 of the invention but with more gripper rings [three, namely, 127, 177, and 187 being shown] and more spacers 118, 178, and 188.

Figure 11 shows an embodiment using the coupling as a test cap. A test cap is used in a plumbing system to see if all of the joints are free from leaks and that the proper pressure may be maintained. Usually

then the test cap is removed and a permanent cap soldered or bonded onto the tube.

Figure 12 shows another embodiment similar to Figs. 10 and 11 but with a spacer 118a placed between the o-ring and the gripper ring.

5 While two and three gripper rings have been shown in the drawing, any multiple of gripper rings can be used within the spacing of the coupling.

10 While the preferred embodiments have been illustrated and described, it should be apparent that variations will be apparent to one skilled in the art. Accordingly, the invention is not to be limited to the specific embodiments shown in the drawings.

CLAIMS

1. A fluid conduit coupling for removably holding a tube therein comprising:
 - an outer housing having an internal bore with a circumferential side wall,
 - a seal support surface in said bore,
 - a seal engaged in said support surface,
 - at least one spacer bushing retaining said seal in said support surface, said spacer bushing having an axially inner side and an axially outer side,
 - a gripper ring having radially and axially inwardly protruding circumferentially spaced gripper teeth having inner edges protruding inwardly into said internal bore, said gripper ring lying adjacent the axially outer side of said spacer bushing, said teeth having a twist when subjected to an axial outwardly directed and rotational force for allowing the unscrewing and removal of a tube inserted in said coupling, said gripper ring held in said outer housing to preclude rotational movement of the gripper ring, and
 - said spacer bushing being secured in said internal bore.
2. The coupling of claim 1, said gripper ring lying against the axially inner side of the spacer bushing and against the seal.
3. The coupling of claim 1, said gripper ring lying against the axially outer side of said spacer bushing, said axially inner side of said spacer bushing engaging said seal.
4. The coupling of claim 1 including a second gripping ring located axially of said first gripper ring, said first and second gripper rings being separated by a spacer bushing.

5. The coupling of claim 4, wherein said spacer bushing separating said first and second gripper rings is a second spacer bushing.

6. The coupling of claim 1 wherein said securing means includes an end bushing welded to said outer housing.

7. The coupling of claim 1,
said gripper ring having a flat on its circumference,
said spacer ring having a flat on its circumference, and
said flats engaging a mating flat protrusion in the internal bore of
said outer housing.

8. The coupling of claim 6, said internal bore having
circumferentially spaced inner ribs,
said end bushing having circumferentially spaced tube guide ribs.

9. The coupling of claim 1, said spacer bushing having
circumferentially spaced grooves, the gripper teeth of said gripper ring aligned
and fitted within said grooves.

10. The coupling of claim 7, said spacer bushing having
circumferentially spaced grooves, the gripper teeth of said gripper ring aligned
and fitted within said grooves.

11. A fluid conduit coupling comprising:
an outer housing having an internal bore with a circumferential side
wall,
a seal support surface in said bore,
a seal engaged in said support surface,

a spacer bushing retaining said seal in said support surface, said spacer bushing having an axially inner side and an axially outer side,

a first gripper ring located axially outward of the seal and having radially and axially inwardly protruding circumferentially spaced gripper teeth having inner edges protruding inwardly into said internal bore, said gripper ring lying adjacent said spacer bushing, said teeth arranged for providing a twist when subjected to simultaneous rearward axial and rotational forces,

a second gripper ring also having radially and axially inwardly protruding circumferentially spaced gripper teeth having inner edges protruding inwardly into said internal bore, and

means for securing said spacer bushing in said internal bore.

12. The coupling of claim 11 wherein said securing means includes an end bushing welded to said outer housing.

13. The coupling of claim 11, each said gripper ring having a flat on its circumference,

said spacer ring having a flat on its circumference, and

said flats engaging a mating flat protrusion in the internal bore of said outer housing.

14. The coupling of claim 11, said spacer bushing having circumferentially spaced grooves, the gripper teeth of said first gripper ring aligned and fitted within said grooves.

15. A fluid conduit coupling comprising:

an outer housing having an internal bore with a circumferential side wall,

a seal in said bore,

a spacer bushing having an axially inner side and an axially outer side,

a first circular continuous gripper ring having radially and axially inwardly protruding circumferentially spaced gripper teeth having inner edges protruding inwardly into said internal bore, said teeth protruding into said bore for holding a tube against axial movement, said gripper ring mounted against rotation,

at least one additional gripper ring also having radially and axially inwardly protruding circumferentially spaced gripper teeth having inner edges protruding inwardly into said internal bore, and

said spacer bushing and gripper rings being held in said internal bore.

16. The coupling of claim 10, wherein there are more than two gripper rings in said coupling.

17. The coupling of claim 15, said spacer bushing having circumferentially spaced grooves, the gripper teeth of said first gripper ring aligned and fitted within said grooves.

18. The coupling of claim 15, wherein the teeth of each of said gripper rings are arranged for providing a twist when subjected to simultaneous rearward axial and rotational forces

19. The coupling of claim 15, wherein the configuration of the gripper rings in the bore are an axially inner seal, then an outward first gripper ring, then an outward spacer bushing, then a next outward second gripper ring.

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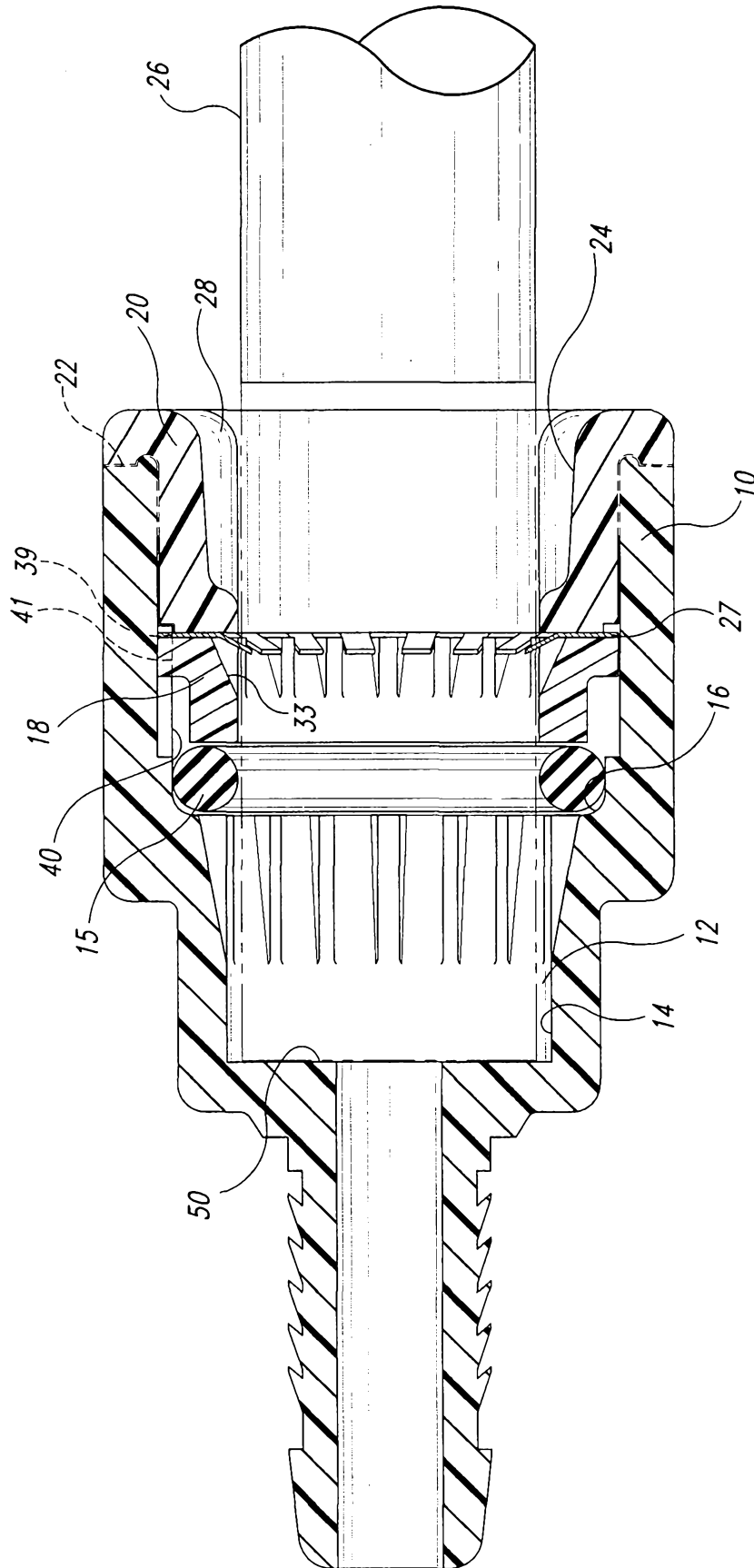


Fig. 1

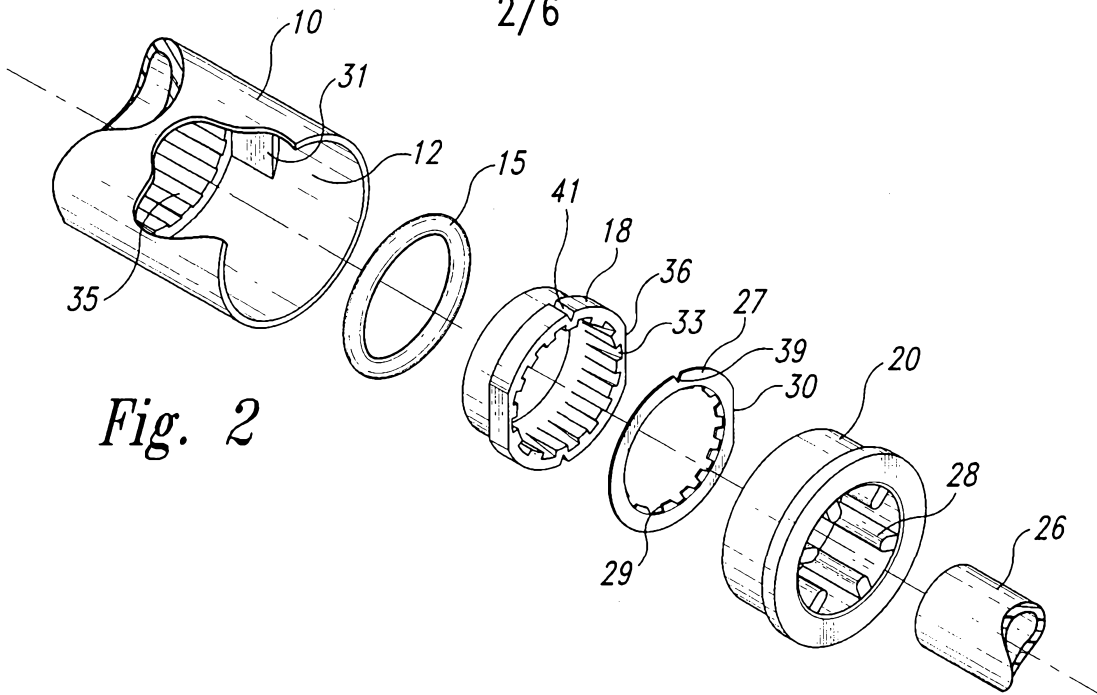


Fig. 2

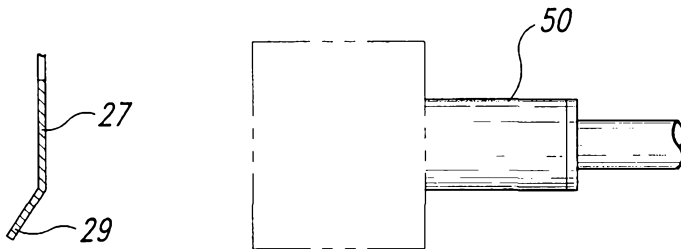


Fig. 3

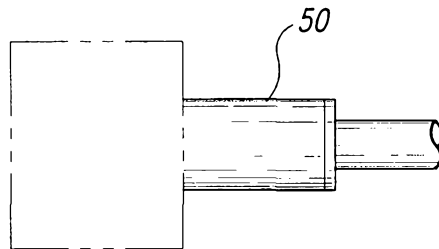


Fig. 4

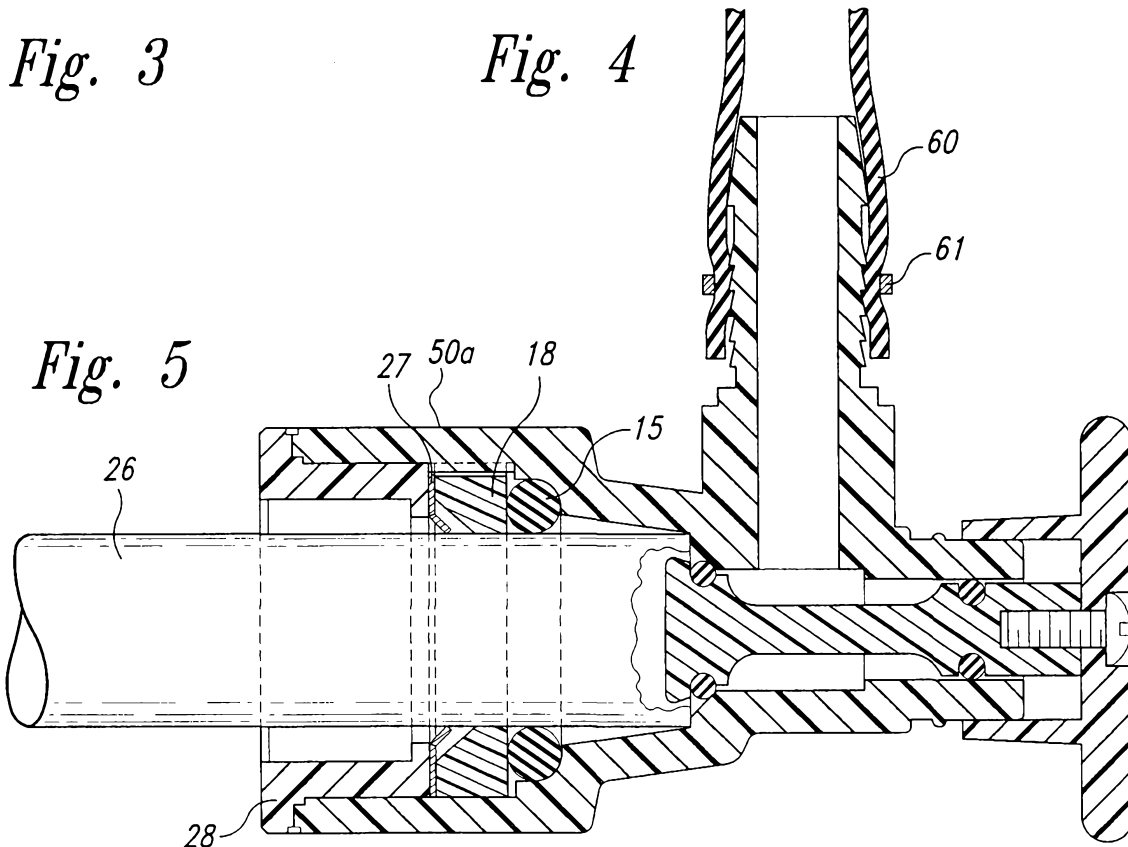


Fig. 5

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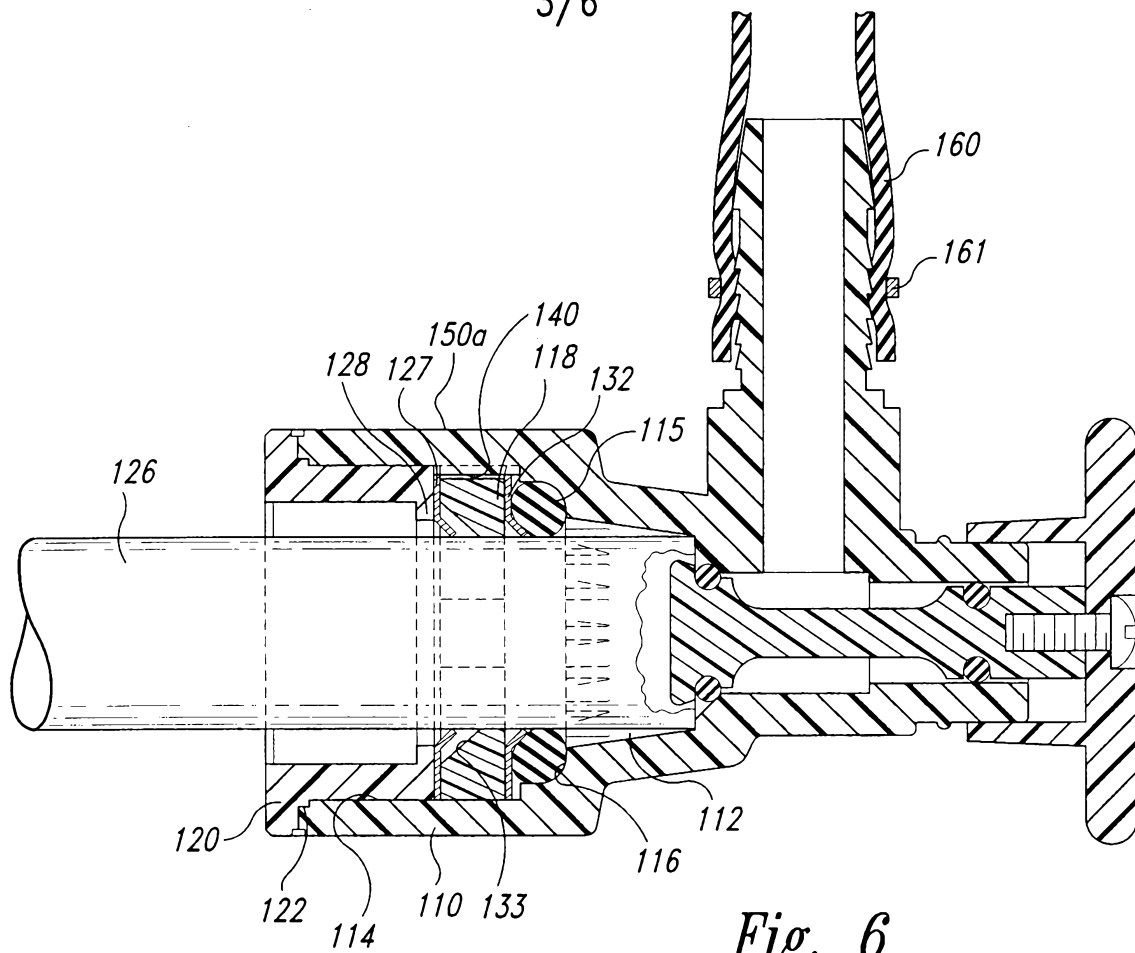


Fig. 6

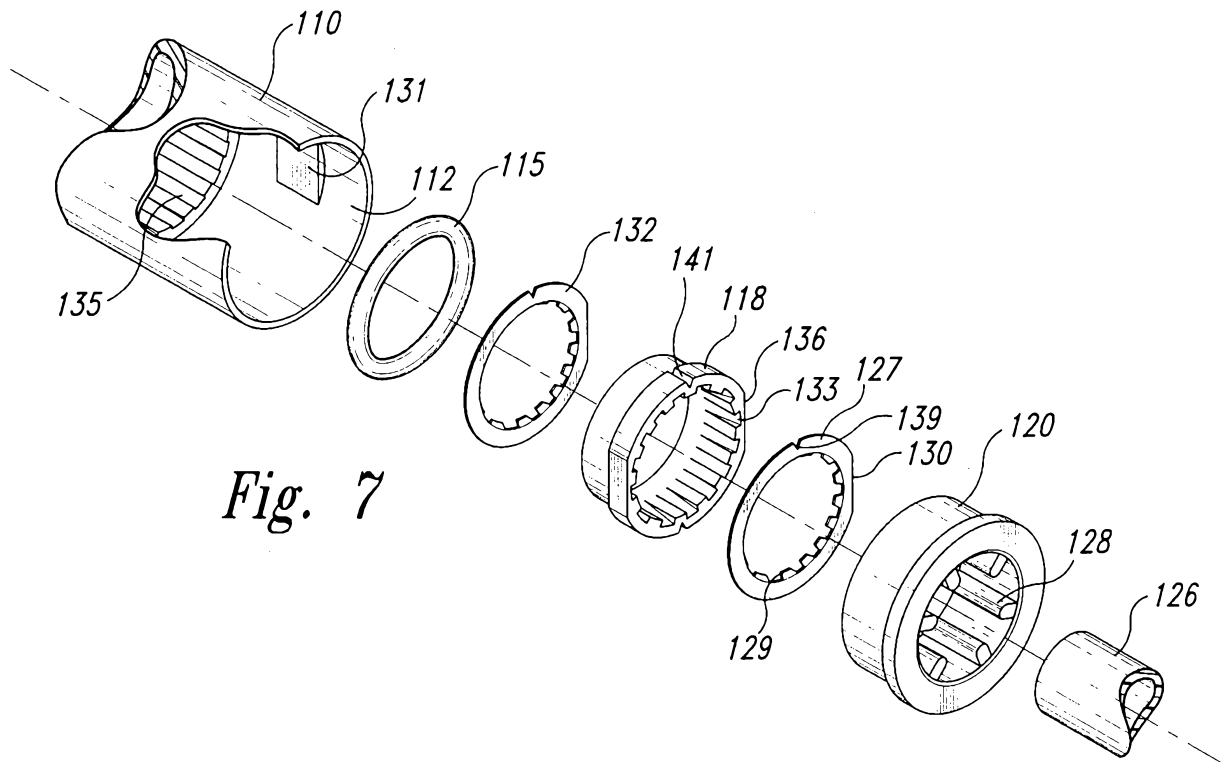


Fig. 7

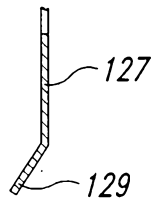


Fig. 8

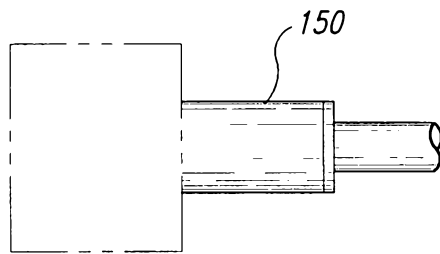


Fig. 9

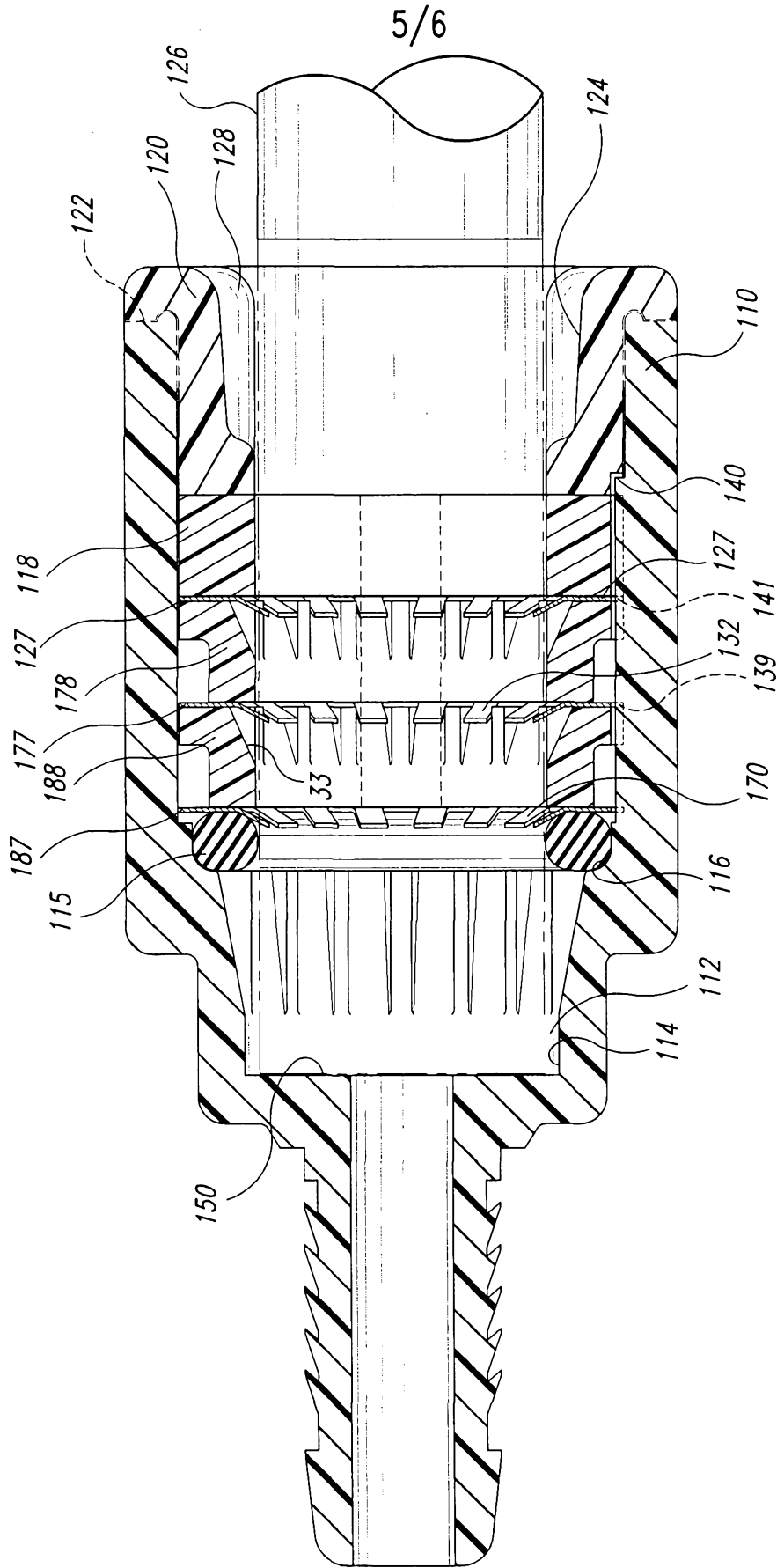


Fig. 10

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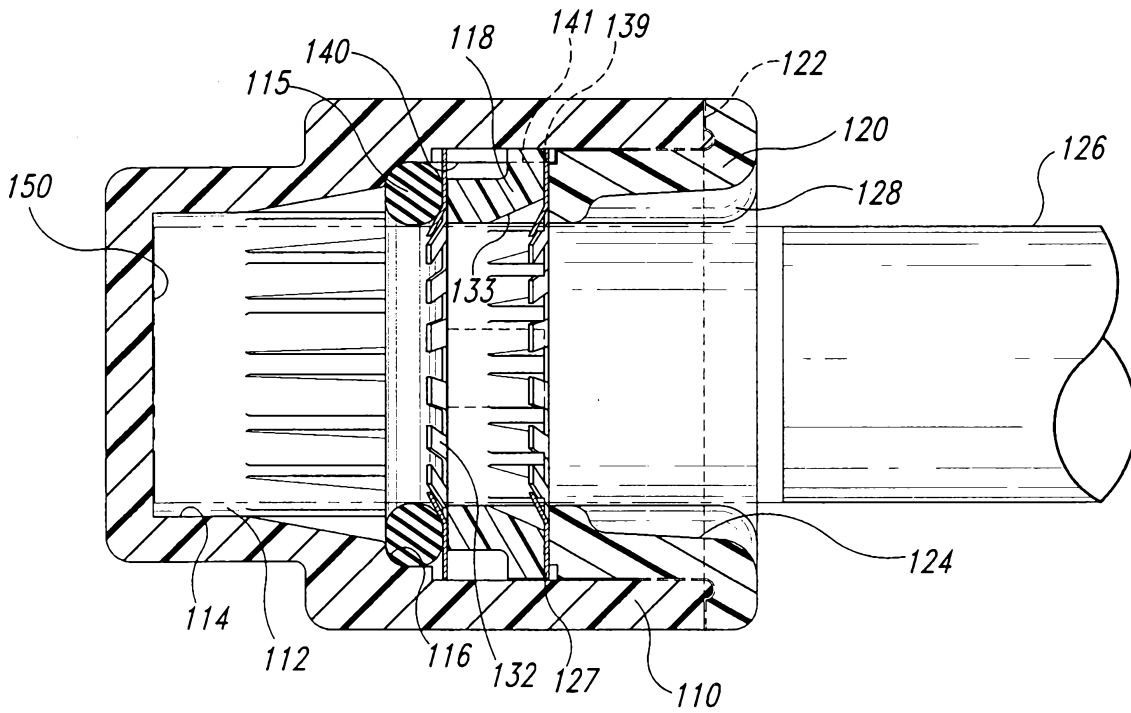


Fig. 11

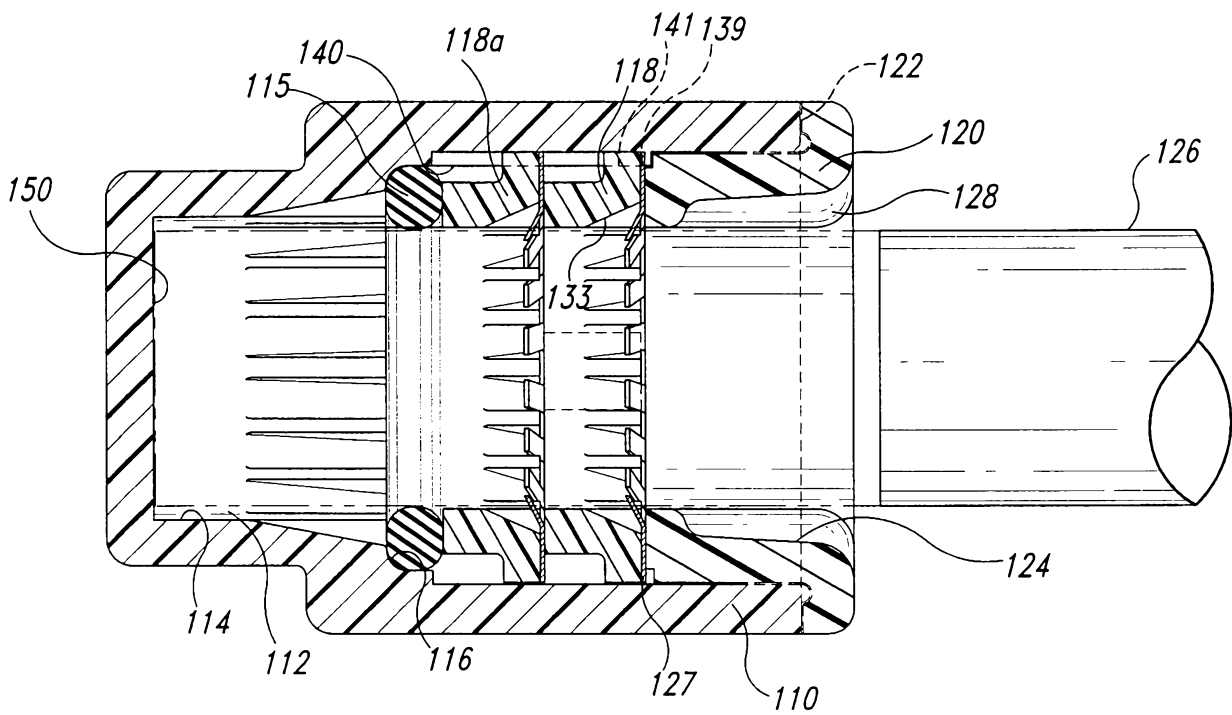


Fig. 12