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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
11 January 2024 (11.01.2024)

WIPO | PCT

(10) International Publication Number
WO 2024/010608 A1

(51) International Patent Classification:
F16L 13/163 (2006.01)

(21) International Application Number:
PCT/US2022/073420

(22) International Filing Date:
05 July 2022 (05.07.2022)

(25) Filing Language: English

(26) Publication Language: English

(71) Applicant: **OETIKER NY, INC.** [US/US]; 4437 Walden Avenue, Lancaster, New York 14086 (US).

(72) Inventor: **ANDERSON, Thomas A.**; 4364 Beach Ridge Road, North Tonawanda, New York 14120 (US).

(74) Agent: **VRANJES, Michael Nicholas**; Harter Secrest & Emery LLP, 1600 Bausch and Lomb Place, Rochester, NY 14604 (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, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IQ, IR, IS, IT, JM, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SC, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK,

(54) **Title:** TUBE CONNECTOR INCLUDING LOCKING CAPTURE FINGERS

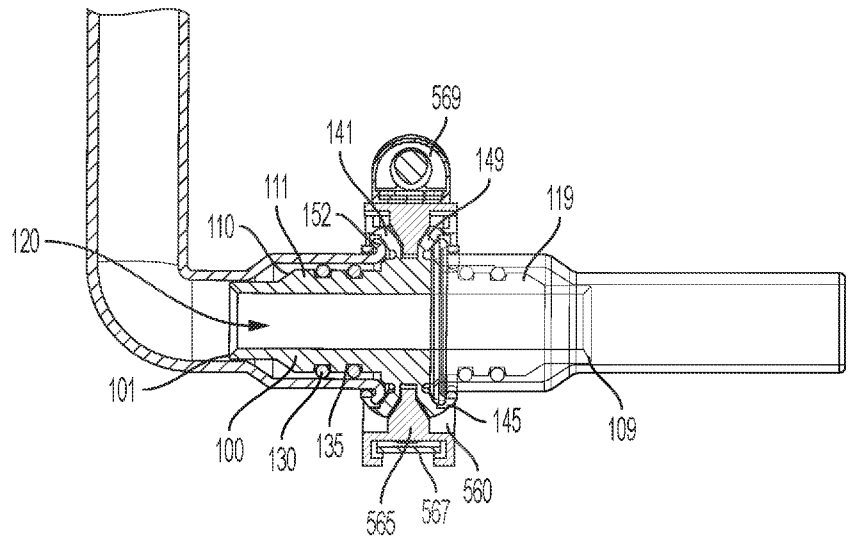

FIG. 7

(57) **Abstract:** Disclosed is a tube connector system with a through-passage that has a connector body with proximal and distal ends and a longitudinal center. A stepped outer surface of the connector body has a center step defining the functional transverse center and the greatest diameter of the connector body, at least one proximal step and distal steps of lesser diameter extending outward. The center step is designed to abut two connected pipes. O-ring seal members are circumscribed by, and partially compressed by the inner surface of connected piping to create 360-degree seals. Parallelly oriented proximal and distal capture fingers circumscribe the center step and are rolled outward over a flared lip portion and are secured by a polymer clamp assembly with an interior wedge portion pressing outward vectored force against the capture fingers from force exerted by a clamp member tightened around the diameter of the clamp structure.

WO 2024/010608 A1

[Continued on next page]

SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— *of inventorship (Rule 4.17(iv))*

Published:

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

TUBE CONNECTOR INCLUDING LOCKING CAPTURE FINGERS

FIELD

[0001] The present disclosure relates to tube connectors, and, more particularly, to a tube connector mostly interior to connected piping with external locking capture fingers.

BACKGROUND

[0002] Tube connector systems can be both larger and more cumbersome than desirable in an environment having fluid carrying pipes, particularly those connectors that are primarily exterior to connected piping. Current systems may further limit use of smart systems, smart tools, torque-sensing connection verification, and hands-free tightening. Systems may also lack double redundancy if clamps fail or a way to verify that a connection is successful before putting the tube connector system into use. Therefore, there is a need in the market for an improved tube connector to connect piping and allow fluid to travel from one pipe to the other.

SUMMARY

[0003] Disclosed is a tube connector system that has a connector body with a proximal end and a distal end. A through-passage is open through the connector body from the proximal end to the distal end and circumscribes a longitudinal center of the connector body. Present is a stepped outer surface of the connector body wherein a center step defines the functional transverse center and the greatest diameter of the connector body, at least one proximal step and at least one distal step of lesser diameter extending longitudinally from the center step and terminating respectively at the proximal and distal ends. The center step is designed to be abutted by the open ends of two connected pipes, the connected pipes of a lesser diameter than the center step, one pipe circumscribing the at least one proximal step and the other pipe circumscribing the at least one distal step, the through-passage of the connector body creating a pathway for liquid from one pipe to the other.

[0004] At least one proximal O-ring seal member and at least one distal O-ring seal member are disposed partially within connector grooved portions circumscribing the outer surface of the connector body on, respectively, at least one proximal step and at least one distal

step extended from the center step, the O-ring seal members designed to abut, be circumscribed by, and be partially compressed toward the longitudinal center by the inner surface of connected piping to create 360-degree seals.

[0005] Parallelly oriented proximal and distal capture fingers circumscribe the center step longitudinally apart from the functional transverse center of the connector body. The capture fingers are designed to be rolled outward from the transverse center of the connector body over a flared lip portion of the connected piping abutted to the center step and a compressible colored ring tube portion circumscribing each pipe and abutted to the outer surface of the flared lip portions of the connected piping. A polymer clamp structure is designed to circumscribe the center step. An interior wedge portion of the clamp structure is designed to wedge between and abut the parallelly oriented proximal and distal capture fingers and to sustain transversely inward vectored force against the center step and longitudinally outward vectored force against the capture fingers from force exerted by a clamp member tightened around the diameter of the clamp structure.

[0006] In one embodiment of the disclosed tube connector, at least one cutaway portion of each capture finger is designed to permit viewing the colored ring within an interior portion of the given capture finger when the given capture finger has been rolled outward over its section of the lip portion of connected piping and colored ring. The compressible colored ring tube portion, when viewable through the cutaway portion of each capture finger, indicates a successful closure. In some embodiments of the disclosed tube connector, the compressible colored ring tube portion is a contrasting color from one or more of a group of green, yellow, orange, turquoise, light blue, and white.

[0007] In some embodiments of the disclosed tube connector, the proximal end and the distal end of the connector body are substantially equidistant from the actual transverse center of the connector body.

[0008] In some embodiments of the disclosed tube connector, the connecter body has the center step, a first proximal step of the at least one proximal step circumscribed by two parallelly oriented O-rings, and a first distal step of the at least one distal step circumscribed by two parallelly oriented O-rings.

[0009] In some embodiments of the disclosed tube connector, the connecter body has the center step, a second proximal step extending from the first proximal step and having the

proximal end of the connector body, and a second distal step extending from the first distal step and having the distal end of the connector body.

[0010] In some embodiments of the disclosed tube connector, an outer groove portion of the polymer and radially collapsible clamp structure is designed to be circumscribed by and secured by a screw clamp.

[0011] In some embodiments of the disclosed tube connector, the tube connector is designed to be, upon installation, more than 85% interior to the connected pipe members.

[0012] In some embodiment of the disclosed tube connector, the center step defines the functional transverse center and the actual transverse center of the tube connector.

[0013] In inventive concept, to include the system and its corresponding method, now will be described more fully hereinafter with reference to the accompanying drawings, which are intended to be read in conjunction with both this summary, the detailed description, and any preferred and/or particular embodiments specifically discussed or otherwise disclosed. Inventive concepts may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided by way of illustration only and so that this disclosure will be thorough, complete, and will fully convey the full scope of the inventive concepts to those skilled in the art.

BRIEF DESCRIPTION OF THE DRAWINGS

[0001] Various embodiments are disclosed, by way of example only, with reference to the accompanying schematic drawings in which corresponding reference symbols indicate corresponding parts, in which:

Figure **1** is a side cutaway view of the representative tube connector system;

Figure **2** is a side cutaway view of the tube connector system illustrated in Figure **1** installed within a representative pipe system;

Figure **3** is a perspective view of the tube connector system illustrated in Figure **1** installed within the representative pipe system;

Figure **4** is a perspective view of connector fingers of the tube connector system illustrated in Figure **1** installed within the representative pipe system;

Figure **5** is a side view of the tube connector system illustrated in Figure **1** installed within the representative pipe system and secured by a clamp structure and clamp member;

Figure **6** is a partial cutaway side view of the tube connector system illustrated in Figure **1** installed within the representative pipe system and secured by the clamp structure and clamp member;

Figure **7** is a complete cutaway side view of the tube connector system illustrated in Figure **1** installed within the representative pipe system and secured by the clamp structure and clamp member;

Figure **8** is a partial cutaway perspective view of the tube connector system illustrated in Figure **1** installed within the representative pipe system and secured by the clamp structure and clamp member;

Figure **9** is another partial cutaway perspective view of the tube connector system illustrated in Figure **1** installed within the representative pipe system and secured by the clamp structure and clamp member;

Figure **10** is a back perspective view of the tube connector system illustrated in Figure 1 installed within the representative pipe system and secured by the clamp structure and clamp member;

Figure **11** is a top perspective view of the tube connector system illustrated in Figure **1** installed within the representative pipe system and secured by the clamp structure and clamp member;

Figure **12** is a perspective view of the tube connector system illustrated in Figure **1** installed within the representative pipe system before securing by the clamp structure and clamp member;

Figure **13** is an axial view of a polymer clamp member;

Figure **14** is a perspective view of the polymer clamp member;

Figure **15** is a side view of the tube connector system illustrated in Figure **1** installed within one side of the representative pipe system;

Figure **16** is a cutaway side view of the tube connector system illustrated in Figure **1** installed within one side of the representative pipe system;

Figure **17** is a cutaway side view of the tube connector system illustrated in Figure **1** installed within one side of the representative pipe system secured by the clamp structure and clamp member;

Figure **18** is a back perspective view of the representative pipe system illustrating the compressible colored ring tube portion;

Figure **19** is a side view of the representative pipe system illustrating the compressible colored ring tube portion; and,

Figure **20** is a side cutaway perspective view of the representative pipe system.

DETAILED DESCRIPTION

[0002] Following are more detailed descriptions of various related concepts related to, and embodiments of, methods and apparatus according to the present disclosure. It should be appreciated that various aspects of the subject matter introduced above and discussed in greater detail below may be implemented in any of numerous ways, as the subject matter is not limited to any particular manner of implementation. Examples of specific implementations and applications are provided primarily for illustrative purposes.

[0003] FIGS. **1-20** illustrate a disclosed representative tube connector system **10** that has a substantially cylindrical connector body **100** with a proximal end **101** and a distal end **109**. Further, the tube connector **10** may be made through injection molding, though other manufacturing methods may be used. A through-passage **120** is open through the connector body **100** from the proximal end **101** to the distal end **109** and circumscribing a longitudinal center **105** of the connector body **100**. Present is a stepped outer surface **110** of the connector body **100** wherein a center step **115** defines the functional transverse center **125** and the greatest diameter of the connector body **100**. At least one proximal step **111** and at least one distal step **119** of lesser diameter extend longitudinally from the center step **115** and terminate respectively at the proximal end **101** and distal end **109**. The functional transverse center **125** of the connector body **100** is a portion of the connector body **100** that is between connected pipes and may also be the actual transverse center **125** of the connector body **100** between the proximal end **101** and the distal end **109** of the connector body **100**. The center step **115** is designed to be abutted by the open ends of two connected pipes, the connected pipes of a lesser diameter than the center step **115**, one pipe circumscribing the at least one proximal step **111** and the other pipe circumscribing the at least one distal step **119**, the through-passage **120** of the connector body **100** creating a pathway for liquid from one pipe to the other.

[0004] FIGS. **1-20** further illustrate at least one each O-ring seal member **130** disposed partially within connector grooved portions **135** circumscribing the outer surface **103** of the connector body **100** on at least one proximal step **111** and at least one distal step **119** extended from the center step **115**, the O-ring seal members **130** designed to abut, be circumscribed by,

and be partially compressed toward the longitudinal center **105** by the inner surface of connected piping to create 360-degree seals. Parallelly oriented proximal capture fingers **141** and distal capture fingers **149** circumscribe the center step **115** longitudinally apart from the functional transverse center **125** of the connector body **100**, the capture fingers **141**, **149** designed to be operably malleable enough to be rolled outward from the transverse center **125** of the connector body **100** over a flared lip portion **152** of the connected piping, the flared lip portion **152** of the connected piping labeled in this disclosure for illustration though apart from the inventive concept as a portion of the connecting piping, abutted to the center step **115** and a compressible colored ring tube portion **350**, as initially illustrated in FIG. **3**, circumscribing each pipe and abutted to the outer surface of the flared lip portions **152** of the connected piping.

[0005] FIGS. **1-20** further illustrate views of the tube connector system **10** with the addition of, as initially illustrated in FIGS. **5-14** and **17**, a polymer clamp structure **560** designed to circumscribe the center step **115**. An interior wedge portion **565** of the clamp structure **560** is designed to wedge between and abut the parallelly oriented proximal capture fingers **141** and distal capture fingers **149** and to sustain transversely inward vectored force against the center step **115** and longitudinally outward vectored force against the capture fingers **141**, **149** from force exerted by a clamp member **568** tightened around the diameter of the clamp structure **560**.

[0006] FIGS. **1-20** further illustrate that in one representative embodiment of the disclosed tube connector system **10**, at least one cutaway portion **145** of each capture finger **141**, **149** is designed to permit viewing the colored ring tube portion **350** within an interior portion of the given capture finger **141**, **149** when the given capture finger **141**, **149** has been rolled outward over its section of the lip portion **152** of connected piping and colored ring tube portion **350**. The compressible colored ring tube portion **350**, when viewable through the cutaway portion **145** of each capture finger **141**, **149** indicates a successful closure. In the representative embodiment of the disclosed tube connector system **10**, the compressible colored ring tube portion **350** is a contrasting color from one or more of a group of green, yellow, orange, turquoise, light blue and white. A contrasting color is a color that makes it easy for a person to see that color because of at least one or more of its differences, such as white against black, and brightness, such as viewing fluorescent green.

[0007] FIGS. **1-20** further illustrate that in one representative embodiment of the disclosed tube connector system **10**, the proximal end **101** and the distal end **109** of the

connector body **100** are substantially equidistant from the actual transverse center **125** of the connector body **100**. Some other embodiments of the tube connector system **10** may be asymmetrical where the transverse center **125** is functional instead of actual. In the representative embodiment, the transverse center **125** is both actual and functional.

[0008] FIGS. **1-20** further illustrate that in one representative embodiment of the disclosed tube connector **10**, the connecter body **100** has the center step **115**, a first proximal step **111A** of the at least one proximal step **111** circumscribed by two parallelly oriented O-rings, and a first distal step **119A** of the at least one first distal step **119** circumscribed by two parallelly oriented O-rings **130**. The disclosed tube connector system **10**, inclusive of the connector fingers **141**, **149**, may be at least one or more of polymer and metal, and may have components where some are polymer and some are metal.

[0009] FIGS. **1-20** further illustrate that in one representative embodiment of the disclosed tube connector system **10**, the connecter body has the center step **105**, a second proximal step **111B** extending from the first proximal step **111A** and having the proximal end **101** of the connector body **100** and a second distal step **119B** extending from the first distal step **119A** and having the distal end **109** of the connector body **100**.

[0010] FIGS. **1-20** further illustrate that in one representative embodiment of the disclosed tube connector system **10**, the polymer clamp structure **560** has radially collapsible flexible extenders **563**. In one representative embodiment of the disclosed tube connector system **10**, an outer groove portion **567** of the polymer and radially collapsible clamp structure **560** is adapted to be circumscribed by and secured by a screw clamp **569**. Other clamp types may be used, to include universal locking systems, lock clamps, finger locks, ties such as zip ties, crimping locks, and other locks known to those skilled in the art to secure tubes to piping.

[0011] FIGS. **1-20** further illustrate that in one representative embodiment of the disclosed tube connector system **10**, the connector body **100** is adapted to be, upon installation, more than 85% interior to the connected pipe members, thereby affording further compactness, burst resistance, and less chance for debris collection. One embodiment of the tube connector **10** is substantially 86% interior to the connecting pipe members once installed.

[0012] FIGS. **21A-21C** disclosed a representative tube connector method, the method including **2100** installing within the open proximal end **101** of the first pipe member to the distal end **109** of the connector body **100**, the connector body **100** having the proximal end **101** and the distal end **109**, the through-passage **120** through the connector body **100** from the

proximal end **101** to the distal end **109** of the connector body **100** designed to allow passage of material flowing from the first pipe member to and through the second pipe member. The method includes **2105** abutting the first pipe member to the center step **115** defining the functional transverse center **125** and the greatest diameter of the connector body **100**, the first pipe member circumscribing an at least one distal step **119** of lesser diameter than the center step **115** extending longitudinally from the center step **115** to the distal end **109** of the connector body **100**. The method includes **2110** placing the clamp member **568** and clamp structure **560** over the connector body **100** to circumscribe the connector body **100** and abutting the second pipe member to the center step **115** defining the functional transverse center **125** and the greatest diameter of the connector body **100**, the second pipe member circumscribing an at least one proximal step **111** of lesser diameter than the center step **115** extending longitudinally from the center step **115** to the proximal end **101** of the connector body **100**. The method including **2115** compressing partially, therefore, toward the longitudinal center **105** with respective interior surfaces of the pipe members at least one proximal O-ring seal member **130** and at least one distal O-ring seal member **130** disposed partially within connector grooved portions **135** circumscribing the outer surface of the connector body **100** on, respectively, at least one proximal step **111** and at least one distal step **119** extended from the center step **115**, creating a 360-degree seal, therefore, with the O-ring seal members **130** by way of the inner surface of connected piping.

[0013] FIGS. **21A-21C** further illustrates that the tube connector method includes **2120** rolling outward from the functional transverse center **125** of the connector body **100** parallelly oriented proximal capture fingers **141** and distal capture fingers **149** circumscribing the center step **115** longitudinally apart from the functional transverse center **125** of the connector body **100**, the capture fingers **141**, **149** rolling over the flared lip portion **152** of the connected piping abutted to the center step **115** and the compressible colored ring tube portion **350** circumscribing each pipe and abutted to the outer surface of the flared lip portions **152** of the connected piping. The method includes **2125** clamping the polymer clamp structure **560** designed to circumscribe the center step **115**, wedging an interior wedge portion **565** of the clamp structure **560** between and abutting the parallelly oriented proximal capture fingers **141** and distal capture fingers **149**, creating and sustaining transversely inward vectored force against the center step **115** and longitudinally outward vectored force against the capture

fingers **141**, **149**, the longitudinally outward vectored force preventing release of the capture fingers **141**, **149**.

[0014] FIGS. **21A-21C** further illustrate that the tube connector method may further include **2130**, viewing the colored ring through at least one cutaway portion **145** of each capture finger **141**, **149**, confirming the given capture finger **141**, **149** has been rolled outward as designed over its section of the flared lip portion **152** of connected piping and compressible colored ring tube portion **350**.

[0015] FIGS. **21A-21C** further illustrate that the tube connector method may further include **2135**, collapsing radially collapsible polymer clamp structures **560** having flexible extenders **563** around the center step **115** of the connector body **100**.

[0016] FIGS. **21A-21C** further illustrate that the tube connector method may further include **2140**, circumscribing and securing with the screw clamp **569** the collapsible clamp structure **560.**

[0017] The following patents are incorporated by reference in their entireties: US6773039B2, US10072783B2, US10203058, US10627030B2, US10823321, US3475793B2, US5226680, US2004/0255432A1, US20220065375, DE202008016177, EP3159590, KR101340284, and KR2001009544.

[0018] While inventive concepts have been described above in terms of specific embodiments, it is to be understood that the inventive concepts are not limited to these disclosed embodiments. Upon reading the teachings of this disclosure, many modifications and other embodiments of the inventive concepts will come to mind of those skilled in the art to which these inventive concepts pertain, and which are intended to be and are covered by both this disclosure and the appended claims. It is indeed intended that the scope of the inventive concepts should be determined by proper interpretation and construction of the appended claims and their legal equivalents, as understood by those of skill in the art relying upon the disclosure in this specification and the attached drawings.

REFERENCE NUMERALS

10 Tube Connector System

100 Connector Body

101 Proximal End

105 Longitudinal Center

109 Distal End

110 Stepped Outer Surface

111 Proximal Step

111A First Proximal Step

111B Second Proximal Step

115 Center Step

119 Distal Step

119A First Distal Step

119B Second Distal Step

120 Through-Passage

125 Transverse Center

130 O-Ring Seal Member

135 Connector Grooved Portions

141 Proximal Capture Fingers

149 Distal Capture Fingers

145 Cutaway Portion

152 Flared Lip Portion

350 Compressible Colored Ring Tube Portion

560 Clamp Structure

565 Interior Wedge Portion

567 Outer Groove Portion

568 Clamp Member

569 Screw Clamp Member

2100-2140 Associated Method.

CLAIMS

What is Claimed Is:

1. A tube connector system comprising:

a through-passage through the connector body from the proximal end to the distal end and circumscribing a longitudinal center of the connector body;

a stepped outer surface of the connector body wherein a center step defines the functional transverse center and the greatest diameter of the connector body, at least one proximal step and at least one distal step of lesser diameter extending longitudinally from the center step and terminating respectively at the proximal and distal ends;

the center step adapted to be abutted by the open ends of two connected pipes, the connected pipes of a lesser diameter than the center step, one pipe circumscribing the at least one proximal step and the other pipe circumscribing the at least one distal step, the through-passage of the connector body creating a pathway for liquid from one pipe to the other;

at least one proximal O-ring seal member and at least one distal O-ring seal member disposed partially within connector grooved portions circumscribing the outer surface of the connector body on, respectively, at least one proximal step and at least one distal step extended from the center step, the O-ring seal members adapted to abut, be circumscribed by, and be partially compressed toward the longitudinal center by the inner surface of connected piping to create 360-degree seals;

parallelly oriented proximal and distal capture fingers circumscribing the center step longitudinally apart from the functional transverse center of the connector body, the capture fingers adapted to be rolled outward from the transverse center of the connector body over a flared lip portion of the connected piping abutted to the center step and a compressible colored ring tube portion circumscribing each pipe and abutted to the outer surface of the respective flared lip portions of the connected piping; and,

a polymer clamp structure adapted to circumscribe the center step, an interior wedge portion of the clamp structure adapted to wedge between and abut the parallelly oriented proximal and distal capture fingers and to sustain transversely inward vectored force against the center step and longitudinally outward vectored force against the

capture fingers from force exerted by a clamp member tightened around the diameter of the clamp structure.

2. The tube connector of claim 1, wherein at least one cutaway portion of each capture finger is adapted to permit viewing the colored ring within an interior portion of the given capture finger when the given capture finger has been rolled outward over its section of the flared lip portion of connected piping and compressible colored ring tube portion.

3. The tube connector of claim 1, wherein the compressible colored ring tube portion, when viewable through the cutaway portion of each capture finger, indicates a successful closure.

4. The tube connector of claim 3, wherein the compressible colored ring tube portion is a contrasting color from one or more of a group of green, yellow, orange, turquoise, light blue, and white.

5. The tube connector of Claim 1, wherein proximal end and the distal end of the connector body are substantially equidistant from the actual transverse center of the connector body.

6. The tube connector of Claim 1, wherein the connecter body has the center step, a first proximal step of the at least one proximal step circumscribed by two parallelly oriented O-rings, and a first distal step of the at least one distal step circumscribed by two parallelly oriented O-rings.

7. The tube connector of Claim 6, wherein the connecter body has the center step, a second proximal step extending from the first proximal step and having the proximal end of the connector body and a second distal step extending from the first distal step and having the distal end of the connector body.

8. The tube connector of Claim 1, wherein the polymer clamp structure has radially collapsible flexible extenders.

9. The tube connector of Claim 1, wherein an outer groove portion of the polymer and radially collapsible clamp structure is adapted to be circumscribed by and secured by a screw clamp.

10. The tube connector of Claim 1, wherein the tube connector is adapted to be, upon installation, more than 85% interior to the connected pipe members.

11. A tube connector method comprising:

installing within an open proximal end of a first pipe member a distal end of a connector body, the connector body having a proximal end and a distal end, a through-passage through the connector body from the proximal end to the distal end of the connector body adapted to allow passage of material flowing from the first pipe member to and through a second pipe member;

abutting to the first pipe member a center step defining the functional transverse center and the greatest diameter of the connector body, the first pipe member circumscribing an at least one distal step of lesser diameter than the center step extending longitudinally from the center step to the distal end of the connector body;

placing a clamp member and polymer clamp structure over the tube connector to circumscribe the tube connector;

abutting the second pipe member to the center step defining the functional transverse center and the greatest diameter of the connector body, the second pipe member circumscribing an at least one proximal step of lesser diameter than the center step extending longitudinally from the center step to the proximal end of the connector body;

compressing partially, therefore, toward the longitudinal center, with respective interior surfaces of the pipe members, at least one proximal O-ring seal member and at least one distal O-ring seal member disposed partially within connector grooved portions circumscribing the outer surface of the connector body on, respectively, the at least one proximal step and at least one distal step extended from the center step, creating a 360-degree seal, therefore, with the O-ring seal members by way of the inner surface of connected piping;

rolling outward from the functional transverse center of the connector body parallelly oriented proximal and distal capture fingers circumscribing the center step

longitudinally apart from the functional transverse center of the connector body, the capture fingers rolling over a flared lip portion of the connected piping abutting the center step and a compressible colored ring tube portion circumscribing each pipe and abutting the outer surface of the respective flared lip portions of the connected piping; and,

clamping a polymer clamp structure adapted to circumscribe the center step, wedging an interior wedge portion of the clamp structure between and abutting the parallelly oriented proximal and distal capture fingers, creating and sustaining transversely inward vectored force against the center step and longitudinally outward vectored force against the capture fingers, the longitudinally outward vectored force preventing release of the capture fingers.

12. The tube connector method of claim 11, the method further including viewing the colored ring through at least one cutaway portion of each capture finger, confirming the given capture finger has been rolled outward as designed over its section of the flared lip portion of connected piping and compressible colored ring tube portion.

13. The tube connector method of Claim 11, the method further including collapsing radially collapsible polymer clamps structures having flexible extenders around the center step of the connector body.

14. The tube connector of Claim 11, the method further including circumscribing and securing with a screw clamp the collapsible clamp structure.

15. A tube connector system comprising:

a connector body with a proximal end and a distal end;

a through-passage through the connector body from the proximal end to the distal end and circumscribing a longitudinal center of the connector body;

a stepped outer surface of the connector body wherein a center step defines the transverse center and the greatest diameter of the connector body, a first and second proximal step and a first and second distal step of lesser diameter extending longitudinally from the center step and terminating respectively at the proximal and distal ends;

the center step adapted to be abutted by the open ends of two connected pipes, the connected pipes of a lesser diameter than the center step, one pipe circumscribing the first and second proximal step and the other pipe circumscribing the first and second distal step, the through-passage of the connector body creating a pathway for liquid from one pipe to the other;

at least one proximal O-ring seal member and at least one distal O-ring seal member disposed partially within grooved portions circumscribing the outer surface of the connector body on, respectively, the first proximal step and the first distal step extended from the center step, the O-ring seal members adapted to abut, be circumscribed by, and be partially compressed toward the longitudinal center by the inner surface of connected piping to create 360-degree seals;

parallelly oriented proximal and distal capture fingers circumscribing the center step longitudinally apart from the functional transverse center of the connector body, the capture fingers adapted to be rolled outward from the transverse center of the connector body over a flared lip portion of the connected piping abutted to the center step and a compressible colored ring tube portion circumscribing each pipe and abutted to the respective outer surface of the flared lip portions of the connected piping; and,

a polymer clamp structure adapted to circumscribe the center step, an interior wedge portion of the clamp structure adapted to wedge between and abut the parallelly oriented proximal and distal capture fingers and to sustain transversely inward vectored force against the center step and longitudinally outward vectored force against the capture fingers from force exerted by a clamp member tightened around the diameter of the clamp structure.

16. The tube connector of claim 15, wherein at least one cutaway portion of each capture finger is adapted to permit viewing the colored ring within an interior portion of the given capture finger when the given capture finger has been rolled outward over its section of the flared lip portion of connected piping and compressible colored ring tube portion.

17. The tube connector of claim 15, wherein the compressible colored ring tube portion when viewable through the cutaway portion of each capture finger indicates a successful closure.

18. The tube connector of claim 17, wherein the compressible colored ring tube portion is a contrasting color from one or more of a group of green, yellow, orange, turquoise, light blue, and white.

19. The tube connector of Claim 15, wherein the tube connecter has the center step, the first proximal step circumscribed by two parallelly oriented O-rings, and the first distal step circumscribed by two parallelly oriented O-rings.

20. The tube connector of Claim 15, wherein the tube connector is adapted to be, upon installation, more than 85% interior to the connected pipe members.

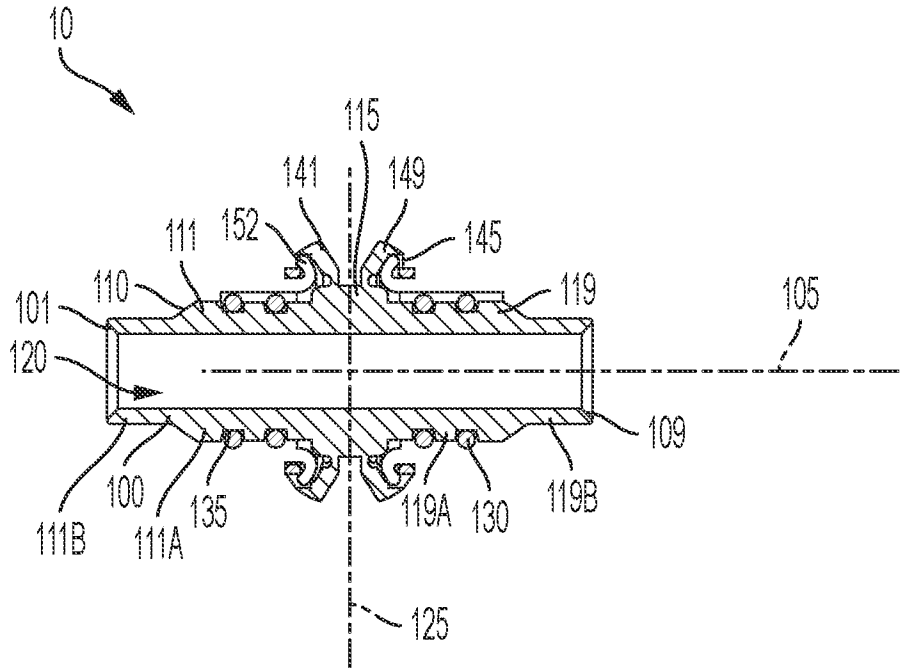
10
115
141
149
111
152
145
110
119
105
101
120
109
100
135
119A
130
119B
111B
111A
125

FIG. 1

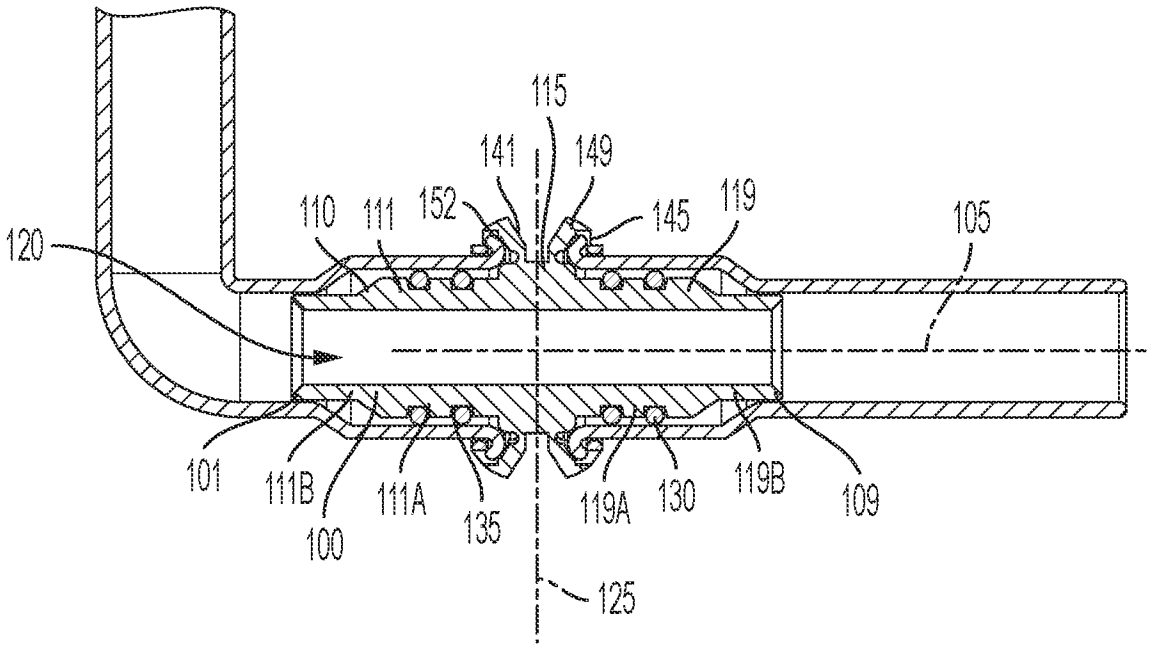
115
141
149
110
111
152
145
119
105
120
101
111B
111A
119A
130
119B
109
100
135
125

FIG. 2

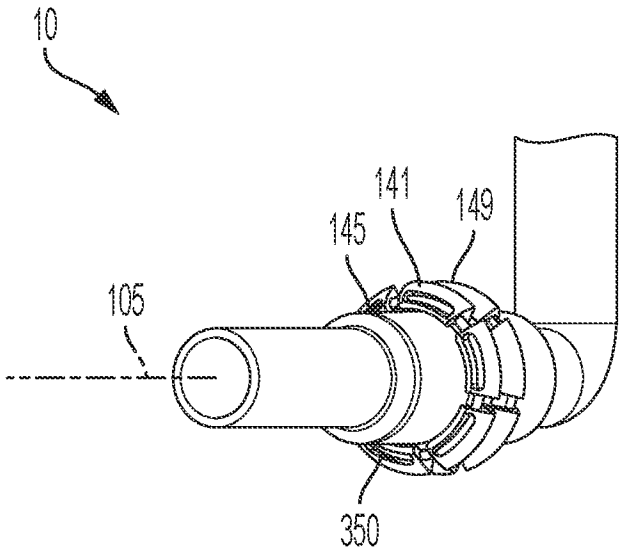

FIG. 3

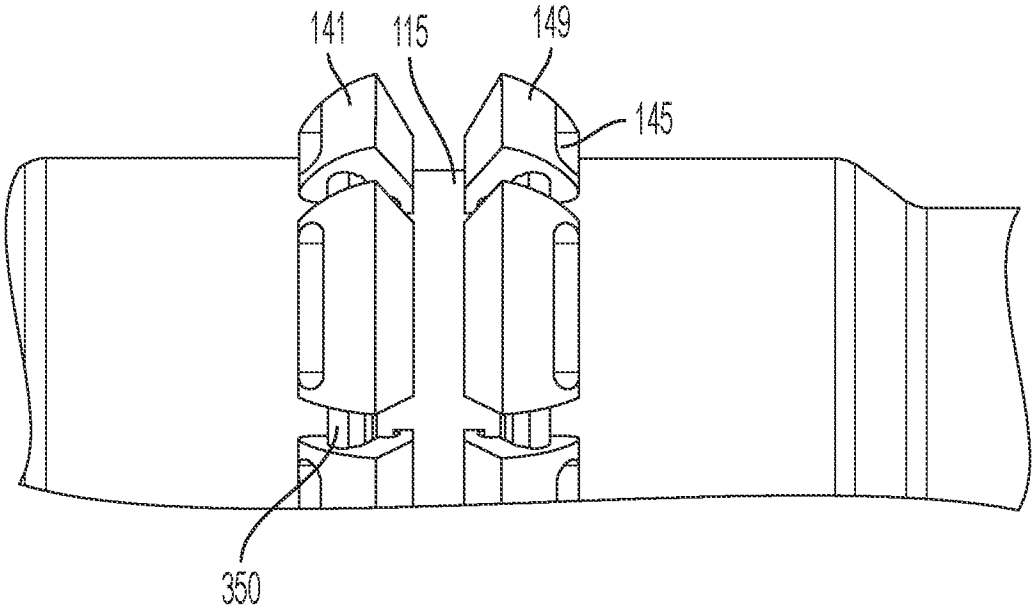

FIG. 4

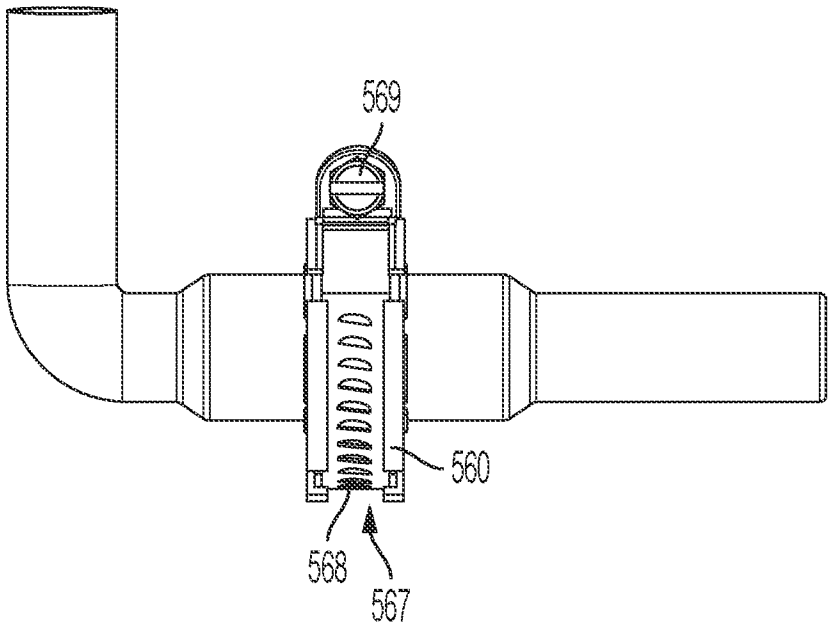
569
560
568
567

FIG. 5

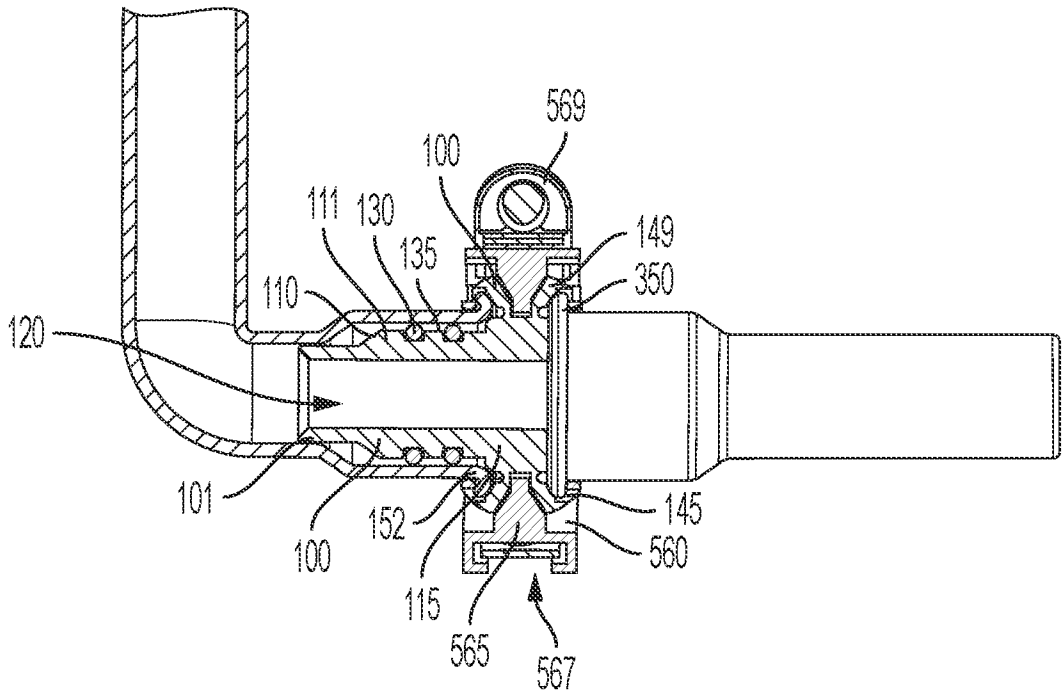
569
100
111
130
135
149
350
110
120
101
100
152
145
560
115
565
567

FIG. 6

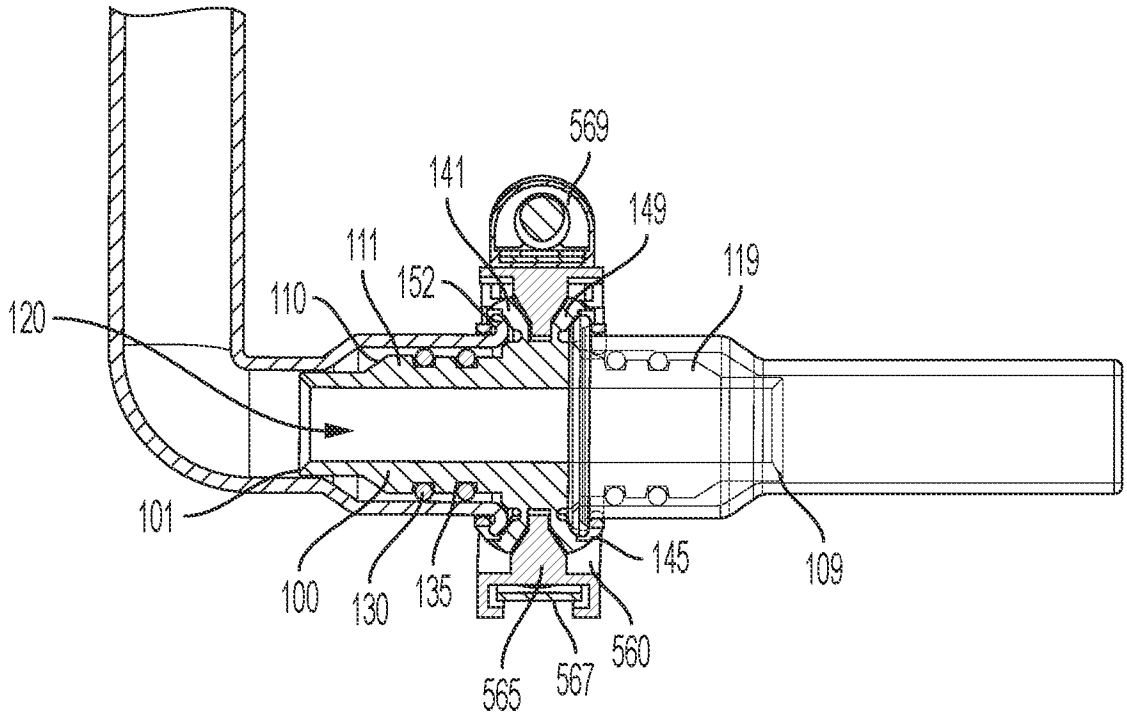
569
141
149
111
152
110
119
120
101
100
130
135
145
109
560
565
567

FIG. 7

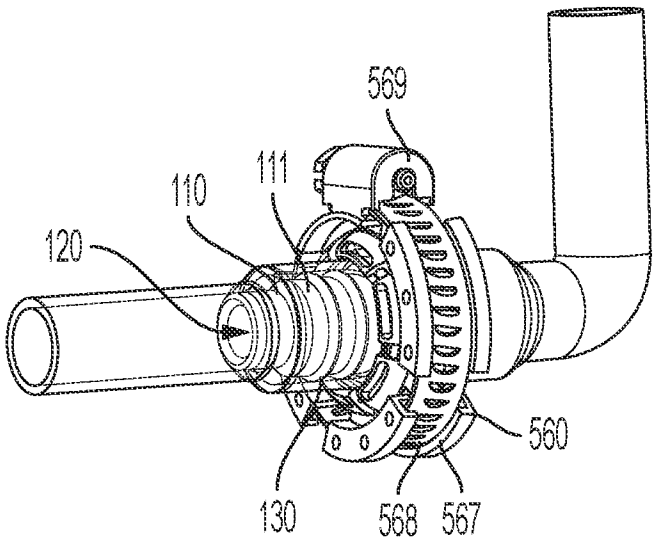
569
111
110
120
560
130
568
567

FIG. 8

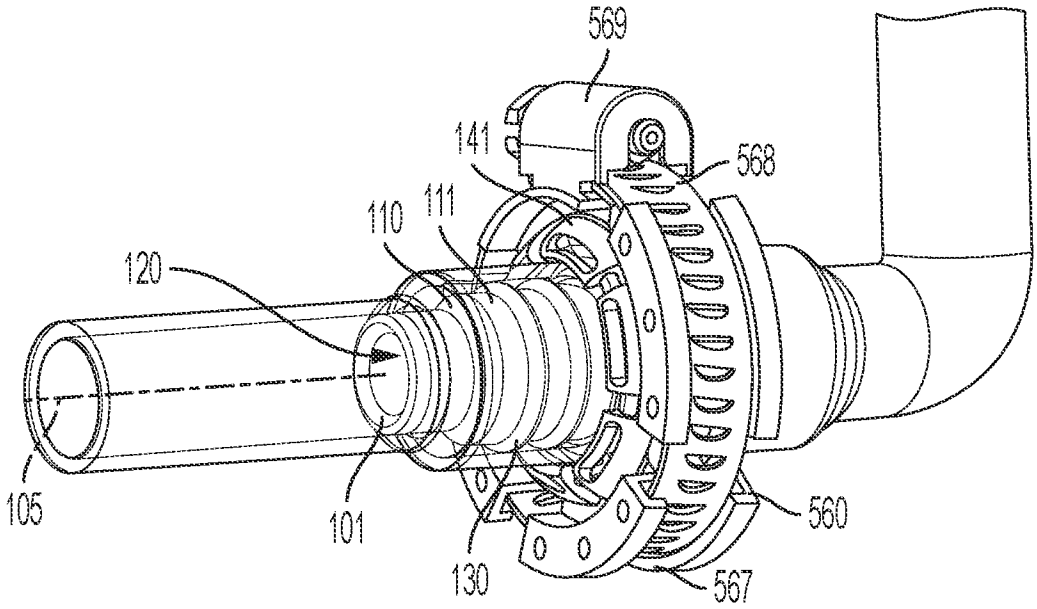
569
141
568
111
110
120
105
101
130
560
567

FIG. 9

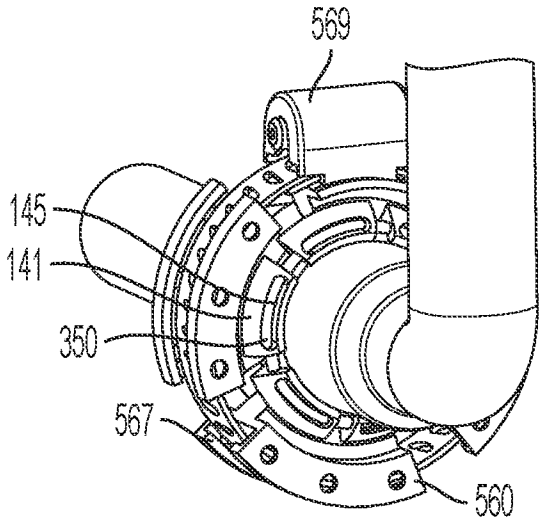
569
145
141
350
567
560

FIG. 10

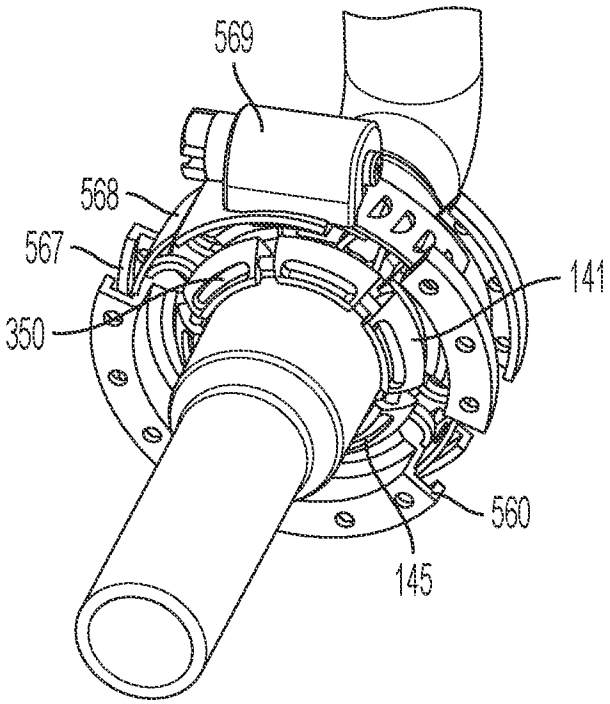
569
568
567
350
141
560
145

FIG. 11

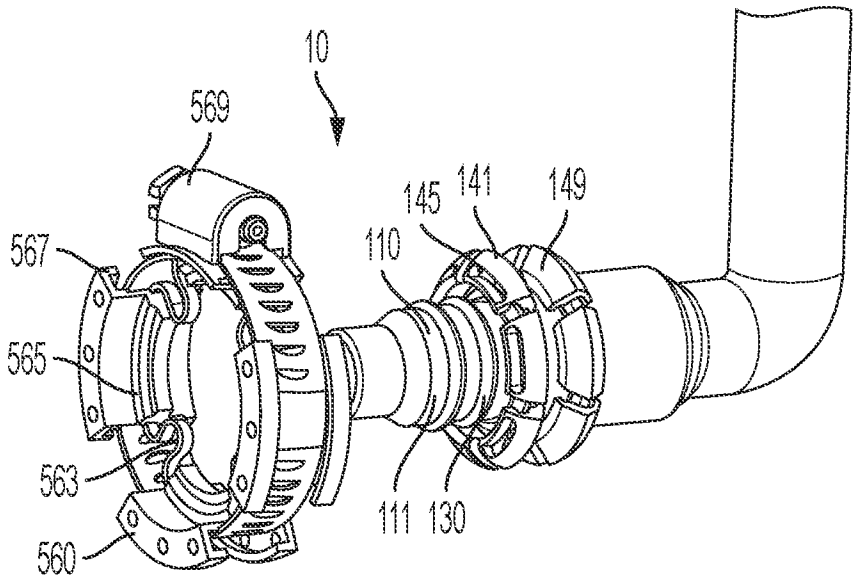
10
569
567
565
563
560
145
141
149
110
111
130

FIG. 12

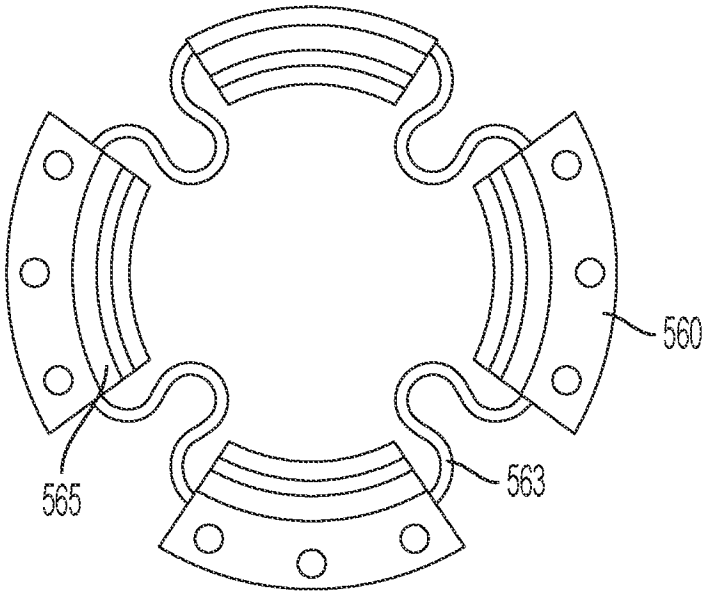

FIG. 13

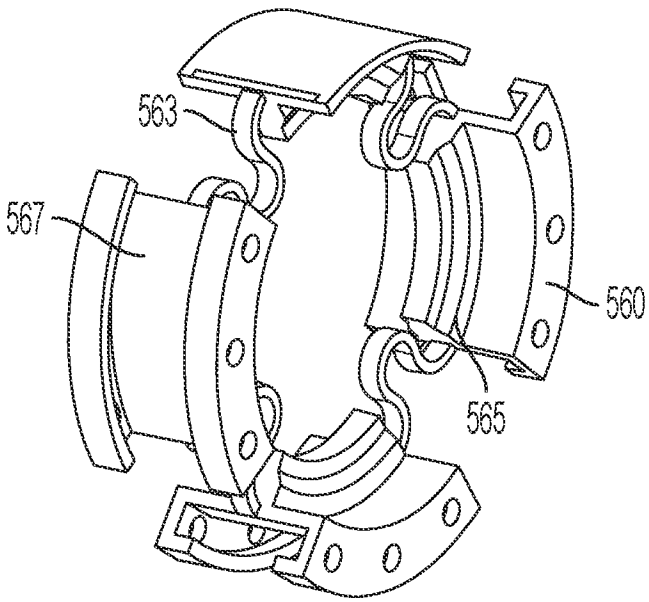

FIG. 14

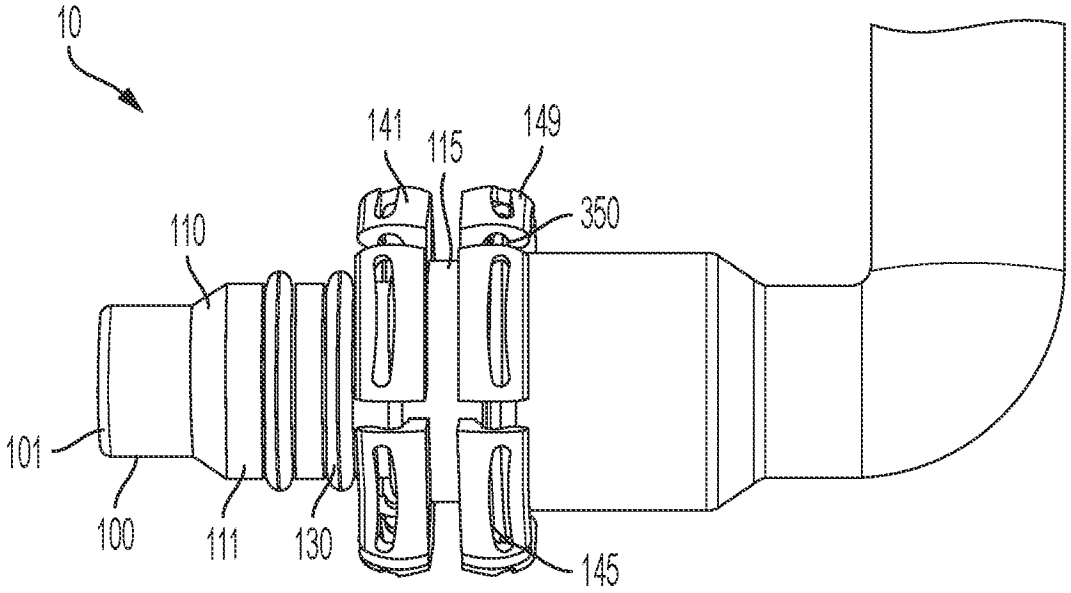
10
141
115
149
350
110
101
100
111
130
145

FIG. 15

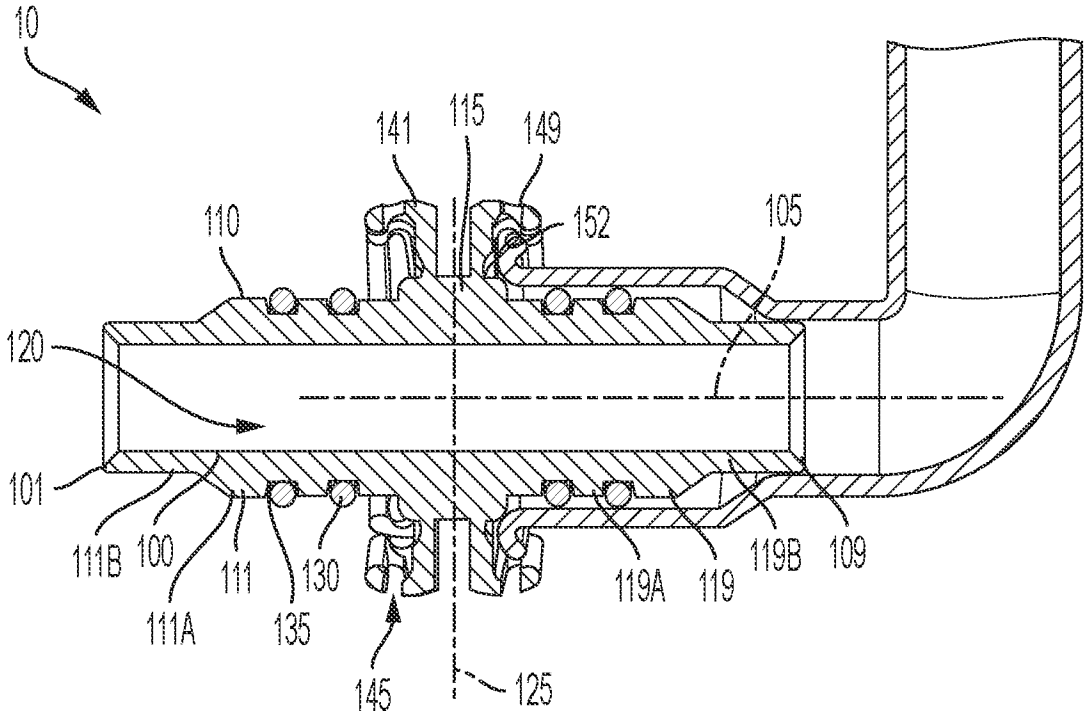
10
141
115
149
152
105
110
120
101
111B
100
111
130
119A
119
119B
109
111A
135
145
125

FIG. 16

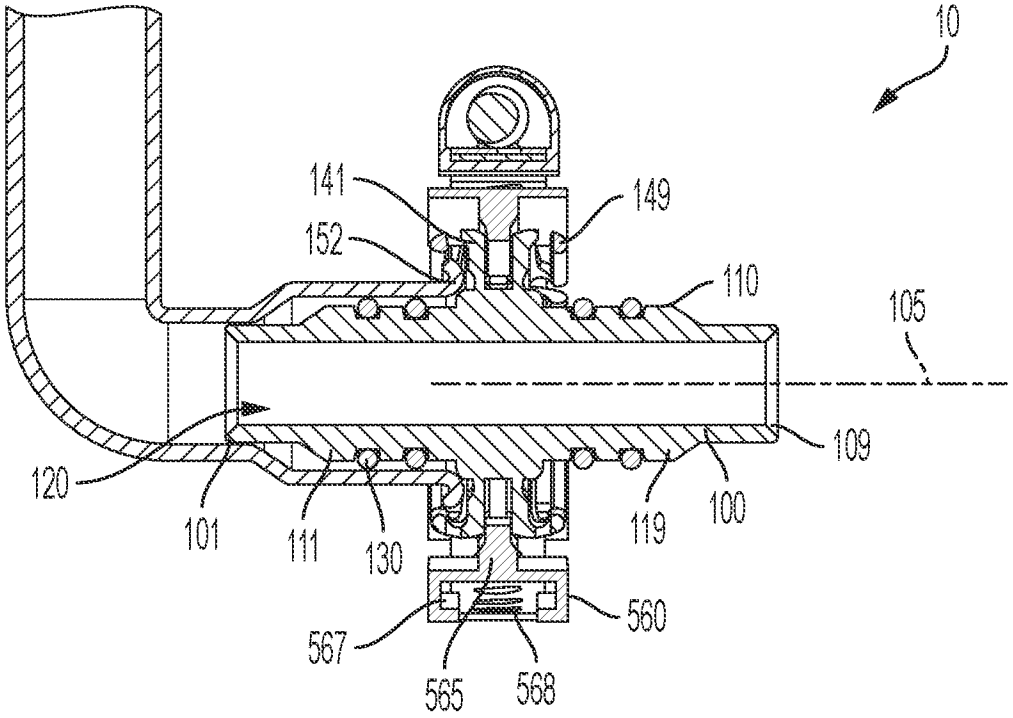
10
141
149
152
110
105
109
120
101
111
130
119
100
560
567
565
568

FIG. 17

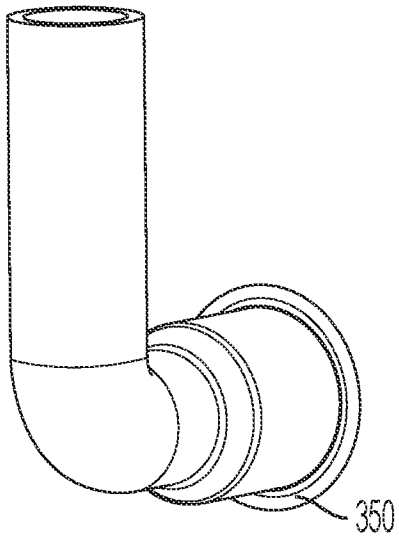
350

FIG. 18

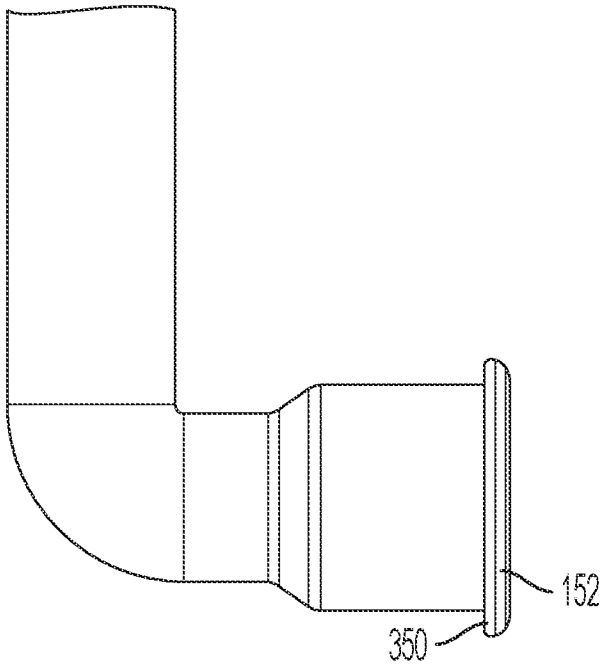

FIG. 19

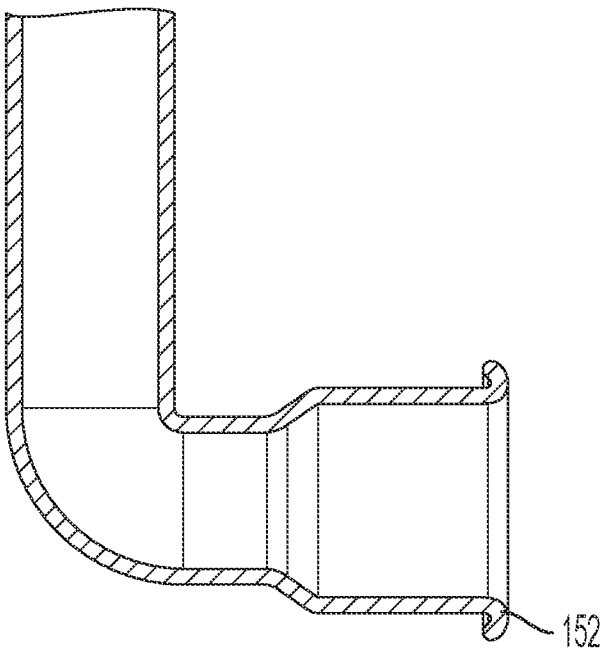

FIG. 20

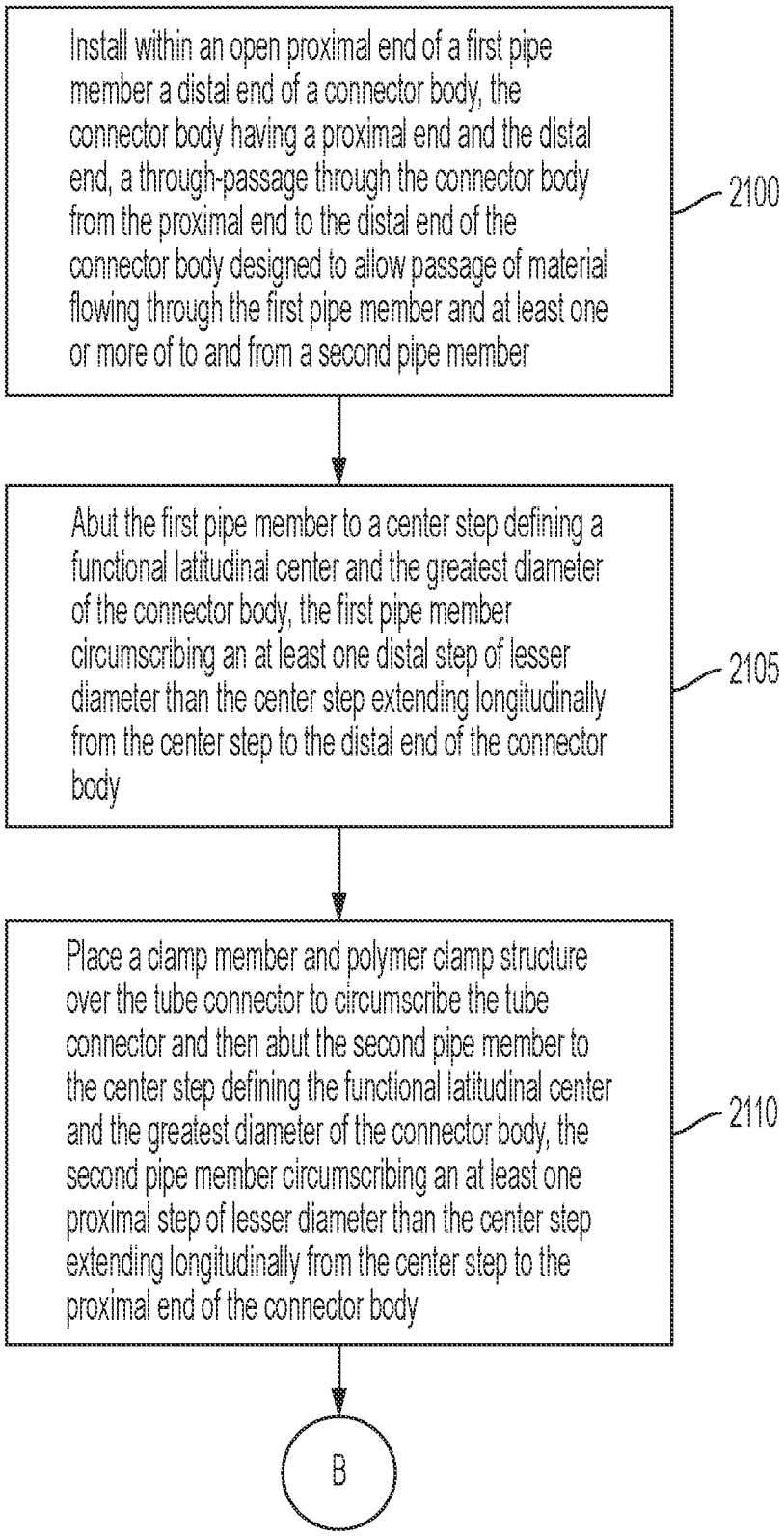
Install within an open proximal end of a first pipe member a distal end of a connector body, the connector body having a proximal end and the distal end, a through-passage through the connector body from the proximal end to the distal end of the connector body designed to allow passage of material flowing through the first pipe member and at least one or more of to and from a second pipe member
2100
Abut the first pipe member to a center step defining a functional latitudinal center and the greatest diameter of the connector body, the first pipe member circumscribing an at least one distal step of lesser diameter than the center step extending longitudinally from the center step to the distal end of the connector body
2105
Place a clamp member and polymer clamp structure over the tube connector to circumscribe the tube connector and then abut the second pipe member to the center step defining the functional latitudinal center and the greatest diameter of the connector body, the second pipe member circumscribing an at least one proximal step of lesser diameter than the center step extending longitudinally from the center step to the proximal end of the connector body
2110
B

FIG. 21A

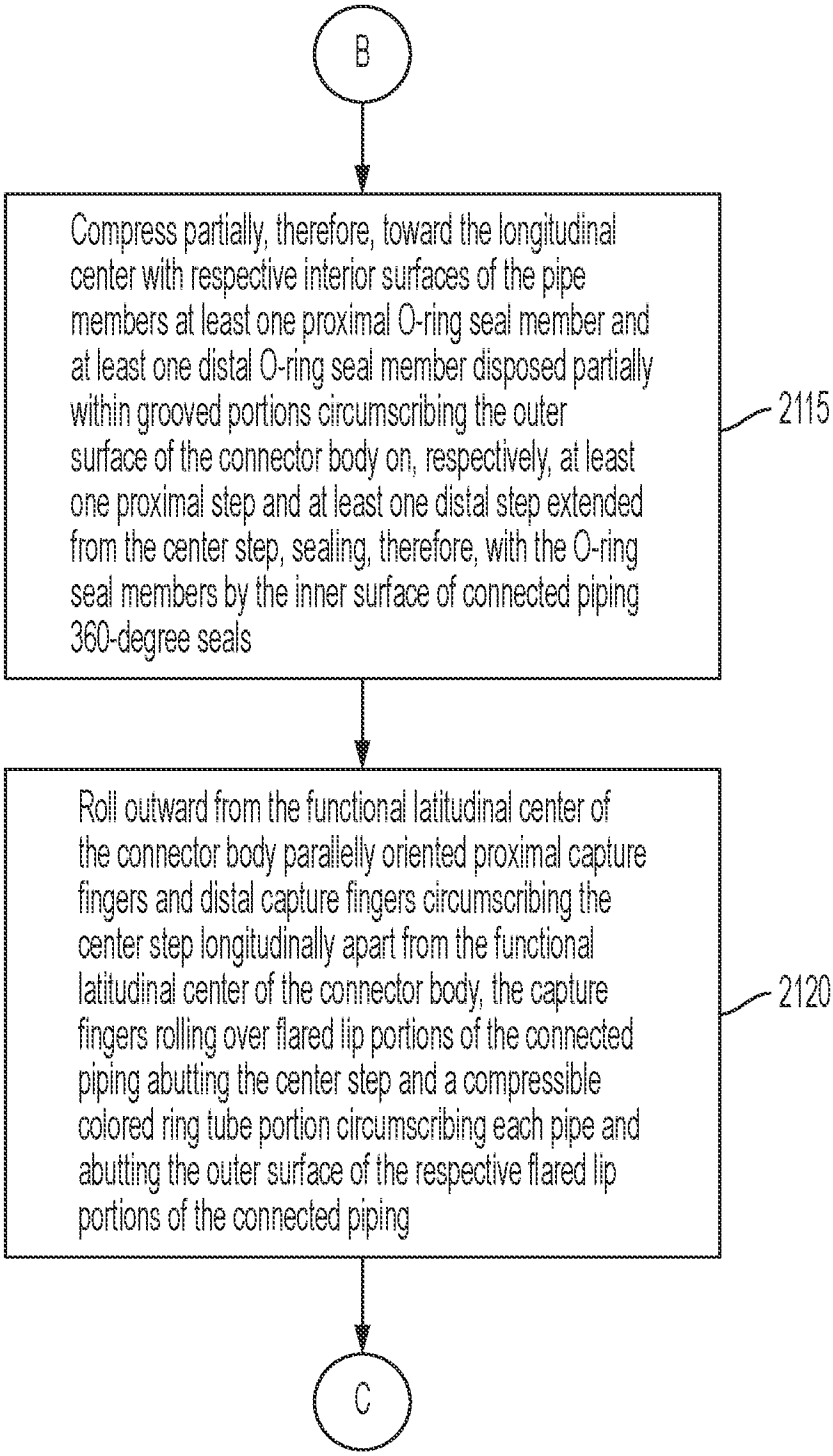
B
Compress partially, therefore, toward the longitudinal center with respective interior surfaces of the pipe members at least one proximal O-ring seal member and at least one distal O-ring seal member disposed partially within grooved portions circumscribing the outer surface of the connector body on, respectively, at least one proximal step and at least one distal step extended from the center step, sealing, therefore, with the O-ring seal members by the inner surface of connected piping 360-degree seals
2115
Roll outward from the functional latitudinal center of the connector body parallelly oriented proximal capture fingers and distal capture fingers circumscribing the center step longitudinally apart from the functional latitudinal center of the connector body, the capture fingers rolling over flared lip portions of the connected piping abutting the center step and a compressible colored ring tube portion circumscribing each pipe and abutting the outer surface of the respective flared lip portions of the connected piping
2120
C

FIG. 21B

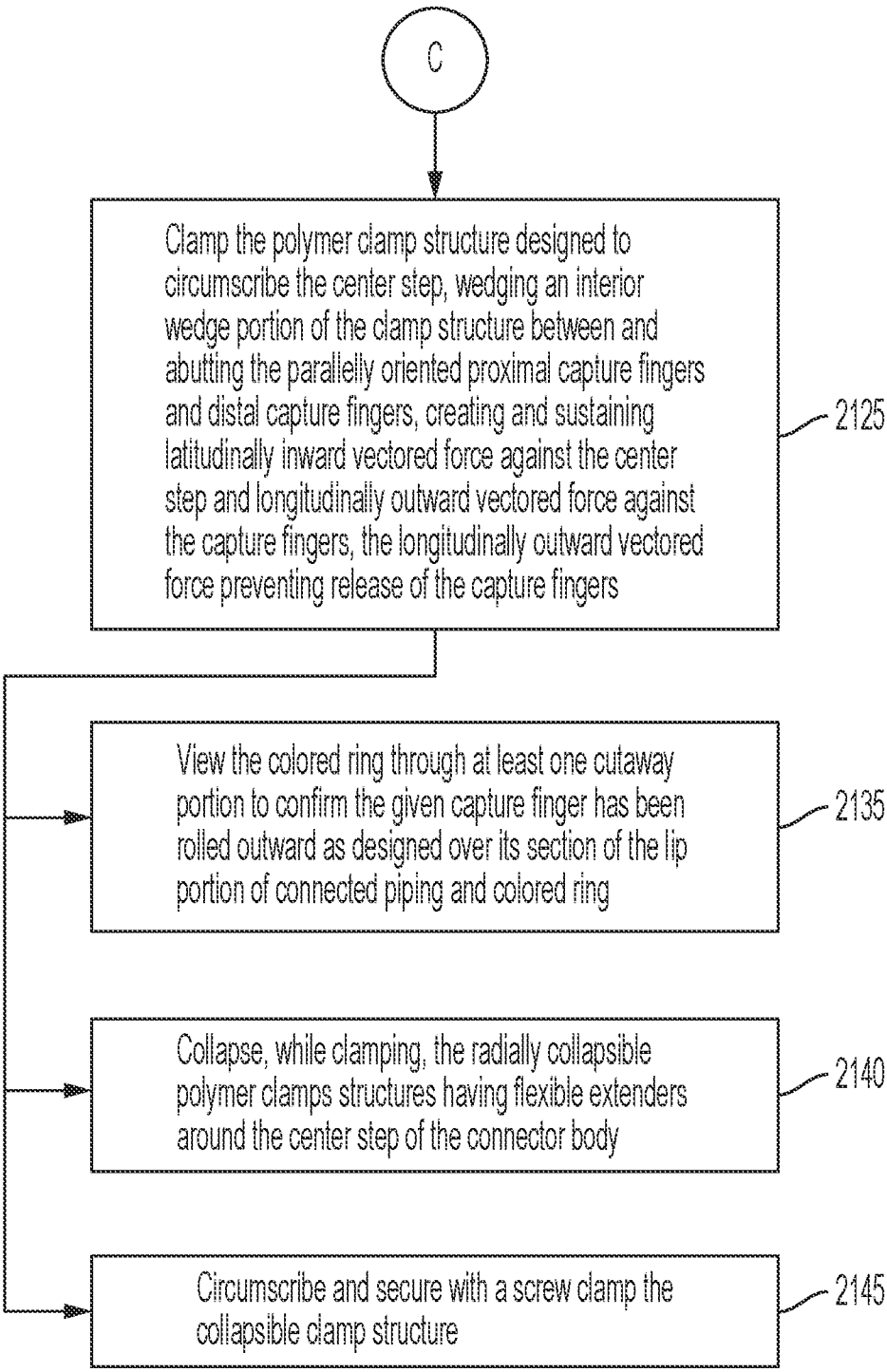
C
Clamp the polymer clamp structure designed to circumscribe the center step, wedging an interior wedge portion of the clamp structure between and abutting the parallelly oriented proximal capture fingers and distal capture fingers, creating and sustaining latitudinally inward vectored force against the center step and longitudinally outward vectored force against the capture fingers, the longitudinally outward vectored force preventing release of the capture fingers
2125
View the colored ring through at least one cutaway portion to confirm the given capture finger has been rolled outward as designed over its section of the lip portion of connected piping and colored ring
2135
Collapse, while clamping, the radially collapsible polymer clamps structures having flexible extenders around the center step of the connector body
2140
Circumscribe and secure with a screw clamp the collapsible clamp structure
2145

FIG. 21C

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2022/073420

A. CLASSIFICATION OF SUBJECT MATTER
INV. F16L13/163
ADD.

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)
F16L

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 513 292 B1 (HEWING GMBH [DE]) 21 February 1996 (1996-02-21) column 3, line 1 - column 6, line 6; figures 1-12	1-20
A	US 2002/163191 A1 (MUENSTER WILFRIED [DE] ET AL) 7 November 2002 (2002-11-07) cited in the application paragraph [0037] - paragraph [0066]; figures 1-13	1-20
A	EP 3 159 590 B1 (COMAP [FR]) 12 September 2018 (2018-09-12) paragraph [0057] - paragraph [0084]; figures 1-11	1-20

-/--

[x] Further documents are listed in the continuation of Box C.

[x] See patent family annex.

* Special categories of cited documents :

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

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

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

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

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

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

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

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

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
27 January 2023	07/02/2023

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Möbius, Henning

1

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2022/073420

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 03/038328 A1 (SIEMENS AG [DE]; RUPPEL CHRISTIAN [DE]) 8 May 2003 (2003-05-08) cited in the application page 4, line 39 - page 6, line 39; figures 1-6	1-20

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2022/073420

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0513292 B1	21-02-1996	AT 134430 T	15-03-1996
		CA 2074938 A1	31-05-1992
		DE 9016310 U1	21-02-1991
		DK 0513292 T3	01-07-1996
		EP 0513292 A1	19-11-1992
		ES 2086008 T3	16-06-1996
		GR 3019654 T3	31-07-1996
		PT 8889 T	31-01-1994
		US 5378023 A	03-01-1995
		WO 9209840 A1	11-06-1992
US 2002163191 A1	07-11-2002	DE 19935246 A1	07-12-2000
		US 2002163191 A1	07-11-2002
EP 3159590 B1	12-09-2018	EP 3159590 A1	26-04-2017
		ES 2699355 T3	08-02-2019
		FR 3042579 A1	21-04-2017
		HU E040560 T2	28-03-2019
		PL 3159590 T3	30-04-2019
		RU 2016140118 A	13-04-2018
WO 03038328 A1	08-05-2003	CN 1605005 A	06-04-2005
		DE 10150897 A1	15-05-2003
		EP 1436541 A1	14-07-2004
		JP 2005507066 A	10-03-2005
		KR 20040047896 A	05-06-2004
		US 2004255432 A1	23-12-2004
		WO 03038328 A1	08-05-2003