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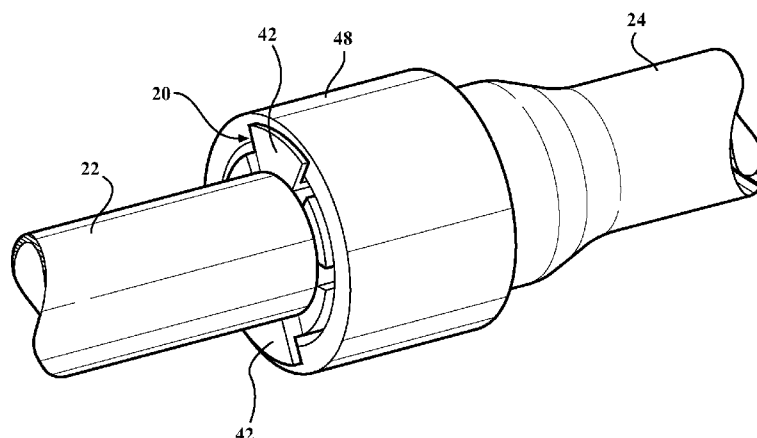


FIG. 1

(57) Abstract: A connector assembly for connecting and establishing fluid communication between a first tube of a first material and a second tube of a second material that is different than the first material is provided. The connector assembly includes a housing with an open bore which extends from an open first end to an open second end. The housing has a plurality of fingers which are spaced circumferentially from one another and are deflectable in a radial direction. At least one of the fingers has at least one radially extending tooth that extends into the open bore of the housing for biting into the first tube in response to the second tube contracting about the fingers.



PIPE OR TUBE CONNECTOR ASSEMBLY

CROSS REFERENCE TO RELATED APPLICATION

[0001] This PCT Patent Application claims the benefit of U.S. Provisional Patent Application Serial No. 61/676,012 filed July 26, 2012, entitled "Pipe Connector Assembly," the entire disclosure of the application being considered part of the disclosure of this application, and hereby incorporated by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0002] The present invention is related to connector assemblies for fluidly connecting pipes or tubes of different materials to one another.

2. Related Art

[0003] The plumbing systems of many buildings in the United States include one or more of copper, chlorinated polyvinyl chloride (CPVC) and/or cross-linked polyethylene (PEX) pipes or tubes. Many plumbers prefer to work with pipes formed of PEX over the other materials for a number of reasons including, for example, flexibility, cost effectiveness, corrosion-resistance and resistance to bursting from freezing. Some pipe manufacturers produce copper or CPVC to PEX adapters for fluidly connecting PEX tubing with copper or CPVC piping. However, many of these adapter designs are costly, laborious to install (for example, some designs require adhesives or welding) or are otherwise unreliable. There remains a significant and continuing need for an improved connector assembly which overcomes any or all of the disadvantages associated with other known adapters.

SUMMARY OF THE INVENTION

[0004] At least one aspect of the present invention provides for an improved quick connector assembly which can be used to more easily fluidly connect a first tube of a first material, such as copper or chlorinated polyvinyl chloride (CPVC), with a second tube of a different material, such as cross-linked polyethylene (PEX). The quick connector assembly includes a housing with an open bore which extends from an open first end to an open second end. The housing has a plurality of fingers which are deflectable in a radial direction. At least one of the fingers includes at least one radially inwardly extending tooth which extends into the open bore.

[0005] To connect the first tube to the housing, a user inserts the first tube through the first end. Then, once the first tube is in place, the user expands an end of the second tube and inserts it over the second end of the housing. Contraction of the second tube about the housing establishes a fluid-tight seal and also deflects the fingers inwardly so that the teeth on the fingers bite into the first tube to prevent removal of the first tube from the housing. With that, a very secure and fluid-tight connection is established between the first and second tubes without the use of welding, soldering, adhesives or any special equipment except for the expander which expands the end of the second tube. Additionally, all of the components of the quick connector assembly may be formed of materials other than brass, lead or other materials which could contaminate the fluid flowing between the first and second tubes. Even further, this design may be scaled to accommodate pipes and/or tubes of any desirable sizes.

[0006] According to another aspect of the present invention, the housing has a thickened portion which is aligned axially with the teeth. This is advantageous because it increases the biasing force of the teeth against the first tube to more securely retain the first tube within the open bore of the housing.

[0007] According to yet another aspect of the present invention, the teeth are angled towards the second end of the housing. This feature allows for easier insertion of the first tube into the open bore of the housing while also more securely retaining the first tube within the open bore of the housing.

[0008] According to still another aspect of the present invention, the fingers of the housing are separated from one another by slots. As such, the housing (apart from the teeth) may be made as one integral piece of material.

[0009] According to a further aspect of the present invention, an O-ring seal is disposed in the open bore of the housing to establish a fluid-tight seal between the housing and the first tube.

[0010] According to yet a further aspect of the present invention, the housing has at least one window positioned axially between the O-ring and the second end of the housing to provide a visual indication that the seal between the housing and the first tube has been established.

[0011] According to still a further aspect of the present invention, the housing has a radially outwardly extending flange for establishing a fluid-tight seal between the housing and the second tube after the second tube contracts around the housing.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] These and other features and advantages of the present invention will be readily appreciated, as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

[0013] Figure 1 is a perspective and elevation view of an exemplary quick connector assembly attached to a copper or CPVC pipe and a PEX tube;

[0014] Figure 2 is a perspective and elevation view of the exemplary quick connector assembly of Figure 1;

[0015] Figure 3 is a side view of the exemplary quick connector assembly of Figure 1;

[0016] Figure 4 is a cross-sectional view of the exemplary quick connector assembly;

[0017] Figure 5 is a perspective and fragmentary view showing the end of the PEX tube as being expanded before inserting the quick connector therein; and

[0018] Figure 6 is a sectional view of the exemplary quick connector assembly of Figure 1 and attached to the copper or CPVC pipe and the PEX tube.

DESCRIPTION OF THE ENABLING EMBODIMENT

[0019] Referring to the Figures, wherein like numerals indicate corresponding parts throughout the several views, an exemplary quick connector assembly **20** is shown in engagement with and establishing fluid communication between a first tube **22** of a first material and a second tube **24** of a second material that is different than the first material. In the exemplary embodiment, the first tube **22** is a pipe of either copper or a chlorinated polyvinyl chloride (CPVC) material and is hereinafter referred to as the “copper or CPVC pipe”. The second tube **24** of the exemplary embodiment is of a cross-lined polyethylene (PEX) material and is hereinafter referred to as the “PEX tube”. As such, the exemplary quick connector assembly **20** may find uses in the plumbing systems of many residential, industrial or commercial buildings by serving as a bridge between an existing copper or CPVC pipe **22** in the building and a new PEX tube **24**. However, it should be appreciated that the first and second tubes **22, 24** could be of a range of different materials, and the quick connector assembly **20** could also find uses in a range of applications other than the plumbing systems of buildings.

[0020] Referring now to Figure 2, the exemplary quick connector assembly **20** includes a housing **26** which extends along an axis **A** from an open first end **28** to an open second end **30**. As shown in Figure 4, the inner surface of the housing **26** includes a ring-groove, which supports and retains an O-ring **32** for establishing the fluid tight seal between the copper or CPVC pipe **22** and the housing **26** as discussed above. Referring now to Figure 4, the exemplary quick connector assembly **20** includes a plurality of teeth **34** which extend radially inwardly from the inner surface to engage or bite into the copper or CPVC pipe **22** and restrict pull-out of the copper or CPVC pipe **22** from the housing **26**, as will be discussed in further detail below. The housing **26** is preferably overmolded around a portion of the teeth **34** to establish the connection between the teeth **34** and the housing **26**. However, it should be appreciated that the teeth **34** could be attached to the housing **26** through any desirable process. The teeth **34** are preferably formed of a corrosion resistant metal such as stainless steel but may be formed of any suitable metal or any other suitable type of material. In the exemplary embodiment, the teeth **34** are angled towards the second end **30** of the housing **26** to further improve their effectiveness at resisting pull-out of the copper or CPVC pipe **22** from the housing **26**. The housing **26** is preferably of a polymeric material and is preferably formed through an injection molding process. However, it should be appreciated that the housing **26** may be formed of a range of suitable materials and through a range of different forming processes.

[0021] Referring back to Figure 2, the exemplary housing **26** also includes a plurality of circumferentially spaced slits which extend in an axial direction from the first end **28** of the housing **26** to approximately an axial midpoint of the housing **26**. Between adjacent ones of the slits, the housing **26** has fingers **36** which extend axially to the first end **28** of the housing **26**. As shown, in the exemplary embodiment, each of the fingers **36** includes a pair of the above-discussed teeth **34** for biting into the copper or CPVC pipe **22**.

However, it should be appreciated that the fingers **36** may have any number of teeth **34**. As shown in Figure 5, the housing **26** is made of a deflectable material, and thus, the fingers **36** are deflectable in a radially outward direction to allow insertion of the copper or CPVC pipe **22** into the housing **26** and past the teeth **34**. In other words, the fingers **36** are bendable at their ends opposite of the first end **28** to allow the copper or CPVC pipe **22** to be inserted past the radially inwardly extending teeth **34** on the fingers **36**. In the exemplary embodiment, the housing **26** includes six fingers **36**. However, it should be appreciated that the housing **26** could alternately include any desirable number of fingers **36**.

[0022] Referring back to Figure 4, the second end **30** of the housing **26** includes a pair of flanges **38, 40** with one of the flanges **38** being an inner flange **38** and extending radially inwardly from the inner surface and the other flange **40** being an outer flange **40** and extending radially outwardly from the outer surface. The inner flange **38** defines a stopping point for the insertion of the pipe **22** into the housing **26**. For example, as shown in Figure 6, when the copper or CPVC pipe **22** is properly installed into the housing **26**, its end abuts the inner flange **38** of the housing **26**. The outer flange **40** extends circumferentially continuously around the housing **26**. As such, as shown in Figure 6 and discussed in further detail below, the outer flange **40** on the housing **26** allows for a fluid tight seal between the housing **26** and the end of the PEX tube **24** when the PEX tube **24** is contracted about the housing **26**.

[0023] The housing **26** also includes a plurality of windows **44** which are circumferentially spaced from one another and are disposed axially between the O-ring **32** and the inner flange **38** to provide a visual indication to a user when the copper or CPVC pipe **22** is properly inserted into the housing **26**, i.e. the end of the copper or CPVC pipe **22** will be visible through the windows **44** when it has passed the O-ring **32**. As such, these

windows **44** provide a safety feature to ensure that the copper or PVC pipe **22** is properly inserted into and sealed with the housing **26**.

[0024] Referring back to Figure 2, two of the fingers **36** include a tab **42** that extends radially outwardly at the first end **28** of the housing **26** to present a stopping point for the PEX tube **24** and a PEX expansion ring **48** when they are inserted over the housing **26**. As such, the tabs **42** on the first end **28** of the housing **26** provide the stopping point for the PEX tube **24** and PEX expansion ring **48**, and the inner flange **38** on the second end **30** of the housing **26** provides the stopping point for the copper or CPVC pipe **22**.

[0025] Additionally, each of the fingers **36** includes a thickened portion **46** which is aligned axially with the teeth **34** and has a shoulder that faces towards the second end **30** of the housing **26**. When the PEX tube **24** is in engagement with the outer surface of the housing **26**, the end of the PEX tube **24** is contracted about the thickened portion **46** of the fingers **36** to urge the teeth **34** in a radially inward direction and against the copper or CPVC pipe **22**. This provides a force to resist pull-out of the copper or CPVC pipe **22** from the housing **26**. Additionally, the thickened portions **46** of the fingers **36** resist pull out of the housing **26** from the PEX tube **24** once the PEX tube **24** has contracted about the housing **26**.

[0026] The process of fluidly connecting a copper or CPVC pipe **22** with a PEX tube **24** using the exemplary quick connector assembly **20** is described as follows. First, a user, such as a plumber, inserts the copper pipe **22** into the housing **26** through the open first end **28**. The copper pipe **22** is inserted such that it seals with the O-ring **32** disposed in the housing **26** and abuts the inner flange **38**. During this process, the fingers **36** will resiliently deflect outwardly as the end of the copper or CPVC pipe **22** passes the teeth **34**. The user should then ensure that the copper or CPVC pipe **22** is properly inserted into and sealed with the housing **26** by checking to see if the end of the copper or CPVC pipe **22** is visible

through the windows **44**. Next, the user slides a PEX expansion ring **48** over one end of the PEX tube **24** and uses an expansion tool (not shown) to expand the end of the PEX tube **24** and the PEX expansion ring **48** to a predetermined width such that its inner diameter is greater than the outer diameter of the housing **26** at the thickened portions **46**. For example, Figure 5 shows the PEX tube **22** and the PEX expansion ring **48** after expansion. The adjacent ends of the PEX tube **24** and PEX expansion ring **48** are then inserted over the second end **30** of the housing **26** until at least one of them abuts the tabs **42** at the ends of the fingers **36**. The PEX tube **24** and PEX expansion ring **48** then are allowed to contract about the outer surface of the housing **26**. As shown in Figure 6, contraction of the PEX tube **24** and the PEX expansion ring **48** about the thickened portions **46** of the fingers **36** biases the teeth **34** against the outer surface of the copper or CPVC pipe **22**. This locks the housing **26** in engagement with the copper or CPVC pipe **22**. Additionally, the PEX tube **24** contraction about the outer flange **40** at the second end **30** of the housing **26** establishes a fluid tight seal between the housing **26** and the PEX tube **24**. Even further, the contraction of the PEX tube **24** about the thickened portion **46** of the fingers **36** causes the shoulders on the thickened portions **46** to cooperate with the PEX tube **24** and prevent the PEX tube **24** from being pulled off of the housing **26**. This entire process is very quick and requires no adhesives, soldering or other specialty tools other than the PEX expander, which many plumbers who work with PEX tubing already will have. The resulting connection between the copper or CPVC pipe **22** and the PEX tube **24** is more secure and fluid-tight than the connections established by using other known adapters or connector assemblies. Even further, the connector assembly does not require any brass, lead or other metals which could contaminate the fluid flowing between the copper or PVC pipe **22** and the PEX tube **24**.

[0027] Another aspect of the present invention provides for a method of establishing fluid communication between a first tube **22** of a first material, such as copper or CPVC,

and a second tube **24** of a second material, such as PEX, that is different than the first material. The method of the exemplary embodiment includes the step of preparing a housing **26** that has an open bore which extends from an open first end **28** to an open second end **30** and a plurality of fingers **36** that are spaced from one another and a plurality of radially inwardly extending teeth **34** that extend from the fingers **36** into the open bore. In the exemplary embodiment, the method continues with the step of inserting the first tube **22** into the open bore of the housing **26** through the open first end **28** and establishing a fluid-tight seal between the first tube **22** and the housing **26** with an O-ring **32**. Preferably, the teeth **34** are angled towards the second end **30** of the housing such that inserting the first tube **22** into the open bore causes the fingers **36** to deflect radially outwardly. The exemplary method proceeds with the step of expanding an open end of the second tube **24** and an expansion ring **48** of the second material. The exemplary method then continues with the step of contracting, or collapsing, the second tube **24** and the expansion ring **48** around the fingers **36** of the housing **26** to urge the teeth **34** into engagement with the first tube **22** in the open bore of the housing **26** to restrict removal of the first tube **22** from the open bore of the housing **26**. The second tube **24** also contracts about a radially outwardly extending flange **40** on the housing **26** to establish a fluid-tight seal between the second tube **24** and the housing **26**.

[0028] Obviously, many modifications and variations of the present invention are possible in light of the above teachings and may be practiced otherwise than as specifically described while within the scope of the appended claims.

CLAIMS

Claim 1. A connector assembly for connecting and establishing fluid communication between a first tube of a first material and a second tube of a second material that is different than the first material, comprising:

- a housing with an open bore which extends from an open first end to an open second end;
- said housing including a plurality of fingers that are spaced circumferentially from one another and are deflectable in a radial direction; and
- at least one of said fingers having at least one radially inwardly extending tooth that extends into said open bore of said housing for biting into the first tube in response to the second tube contracting about the fingers.

Claim 2. The connector assembly as set forth in claim 1 wherein said housing has a thickened portion that is axially aligned with said teeth.

Claim 3. The connector assembly as set forth in claim 1 wherein said at least one tooth is angled towards said second end of said housing.

Claim 4. The connector assembly as set forth in claim 1 wherein each of said fingers includes at least one tooth.

Claim 5. The connector assembly as set forth in claim 1 wherein said fingers of said housing are separated from one another by slots.

Claim 6. The connector assembly as set forth in claim 1 further including an O-ring seal in said open bore of said housing for establishing a fluid-tight seal between the first tube and said housing.

Claim 7. The connector assembly as set forth in claim 6 wherein said housing presents at least one window that is disposed axially between said O-ring seal and said second end of said housing for providing a visual indication to a user that the first tube has passed said O-ring seal.

Claim 8. The connector assembly as set forth in claim 1 wherein said housing includes a radially outwardly extending flange for establishing a fluid-tight seal between the second tube and said housing after contraction of the second tube around said housing.

Claim 9. A method of establishing fluid communication between a first tube of a first material and a second tube of a second material that is different than the first material, said method comprising the steps of:

preparing a housing with an open bore which extends from an open first end to an open second end and a plurality of fingers that are spaced circumferentially from one another and a plurality of radially inwardly extending teeth that extend from the fingers into the open bore;

inserting the first tube into the open bore of the housing through the open first end;

expanding an open end of the second tube;

inserting the housing into the expanded open end of the second tube; and

contracting the second tube around the fingers of the housing to urge the teeth into engagement with the first tube in the open bore of the housing to restrict removal of the first tube from the open bore of the housing.

Claim 10. The method as set forth in claim 9 wherein the first material of the first tube is copper or chlorinated polyvinyl chloride (CPVC) and wherein the second material of the second tube is a cross-lined polyethylene (PEX) material.

Claim 11. The method as set forth in claim 10 further including the steps of expanding an expansion ring of PEX with the expansion of the open end of the PEX tube and contracting the PEX expansion ring about the PEX tube.

Claim 12. The method as set forth in claim 9 further including the step of establishing a fluid-tight seal between the first tube and the housing with an O-ring.

Claim 13. The method as set forth in claim 9 further including the step of contracting the second tube about a radially outwardly extending flange on the housing to establish a fluid-tight seal between the second tube and the housing.

Claim 14. The method as set forth in claim 9 wherein the teeth are angled towards the second end of the housing and further including the step of resiliently deflecting the fingers of the housing outwardly in response to the first tube passing the teeth.

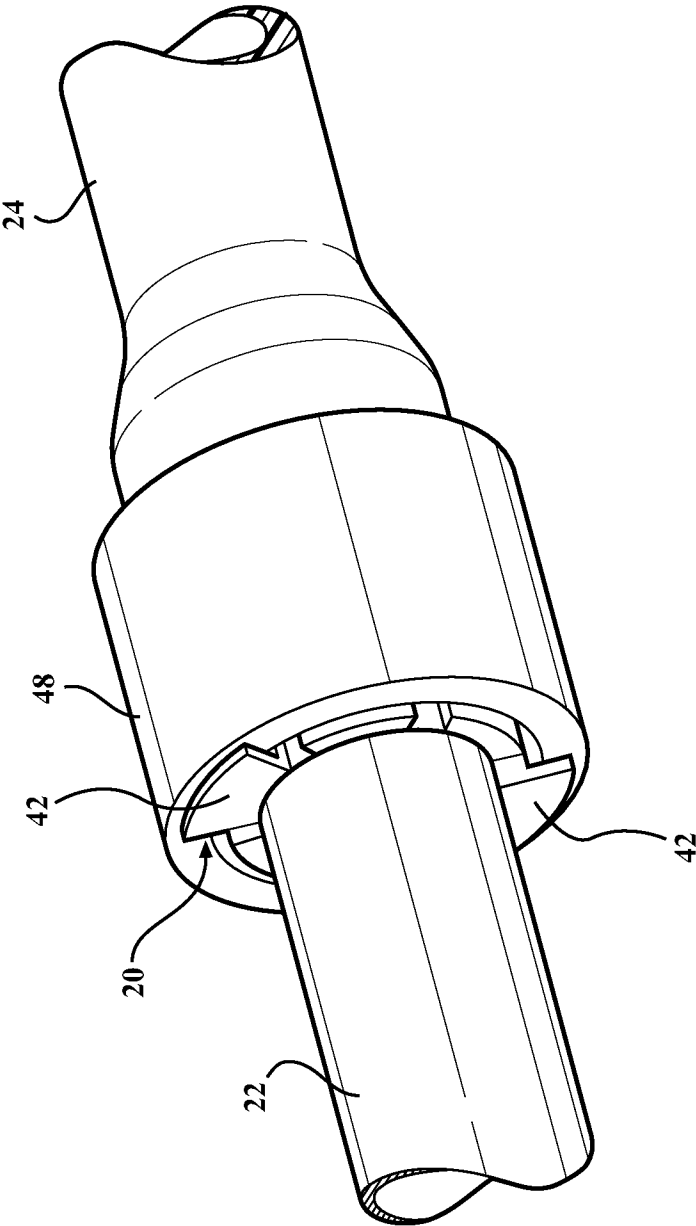
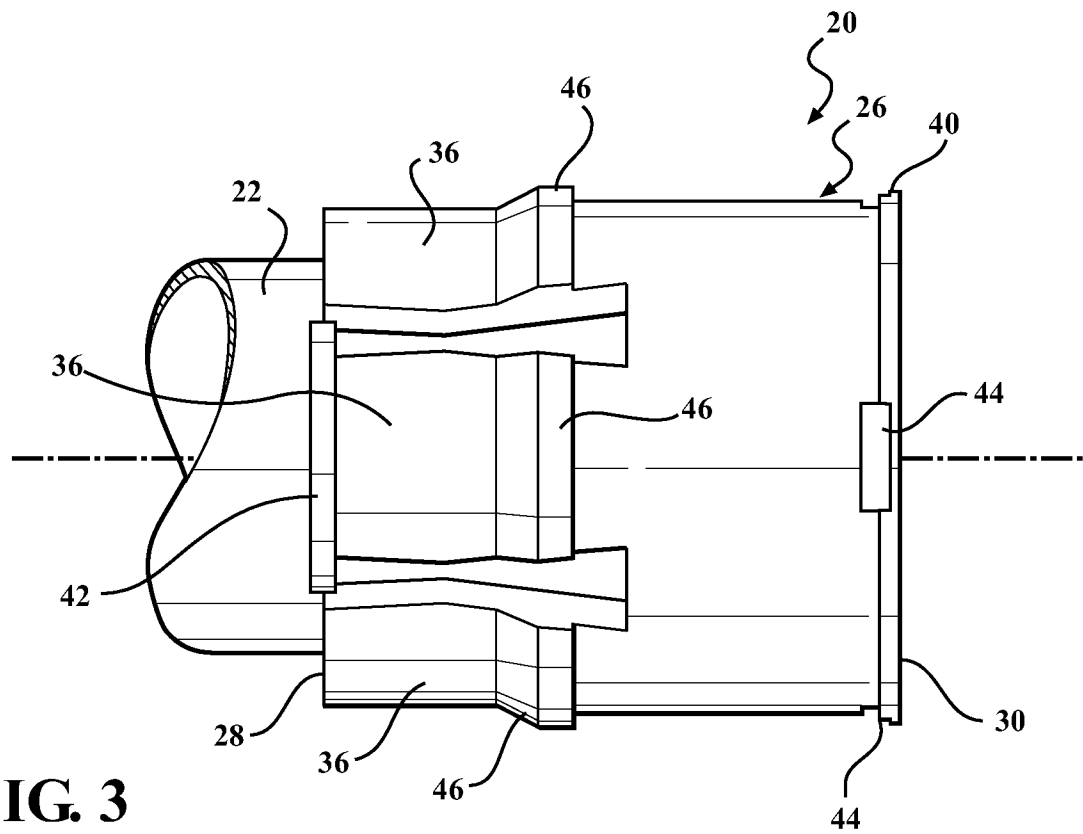
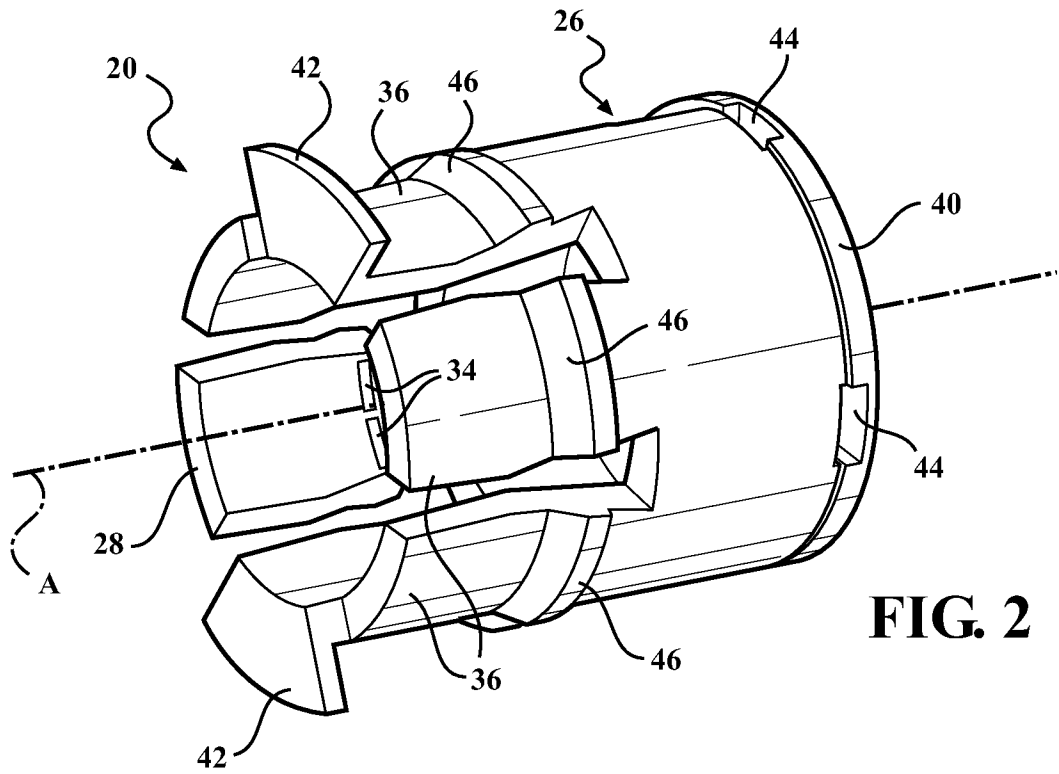
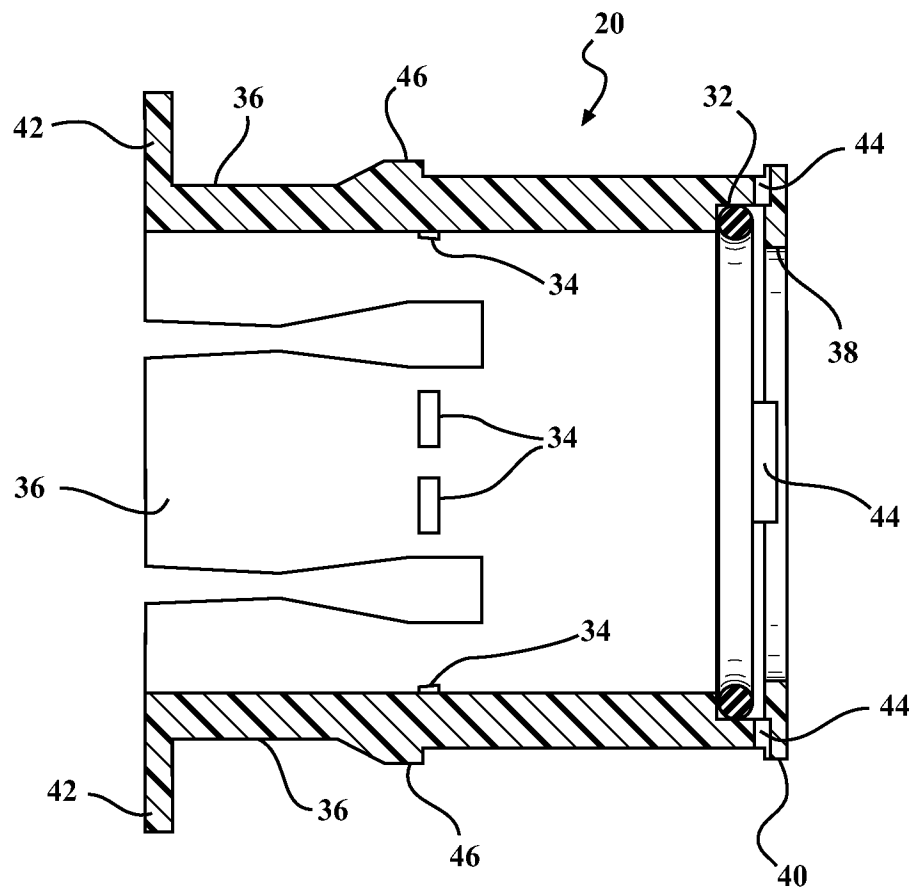


FIG. 1



**FIG. 4**

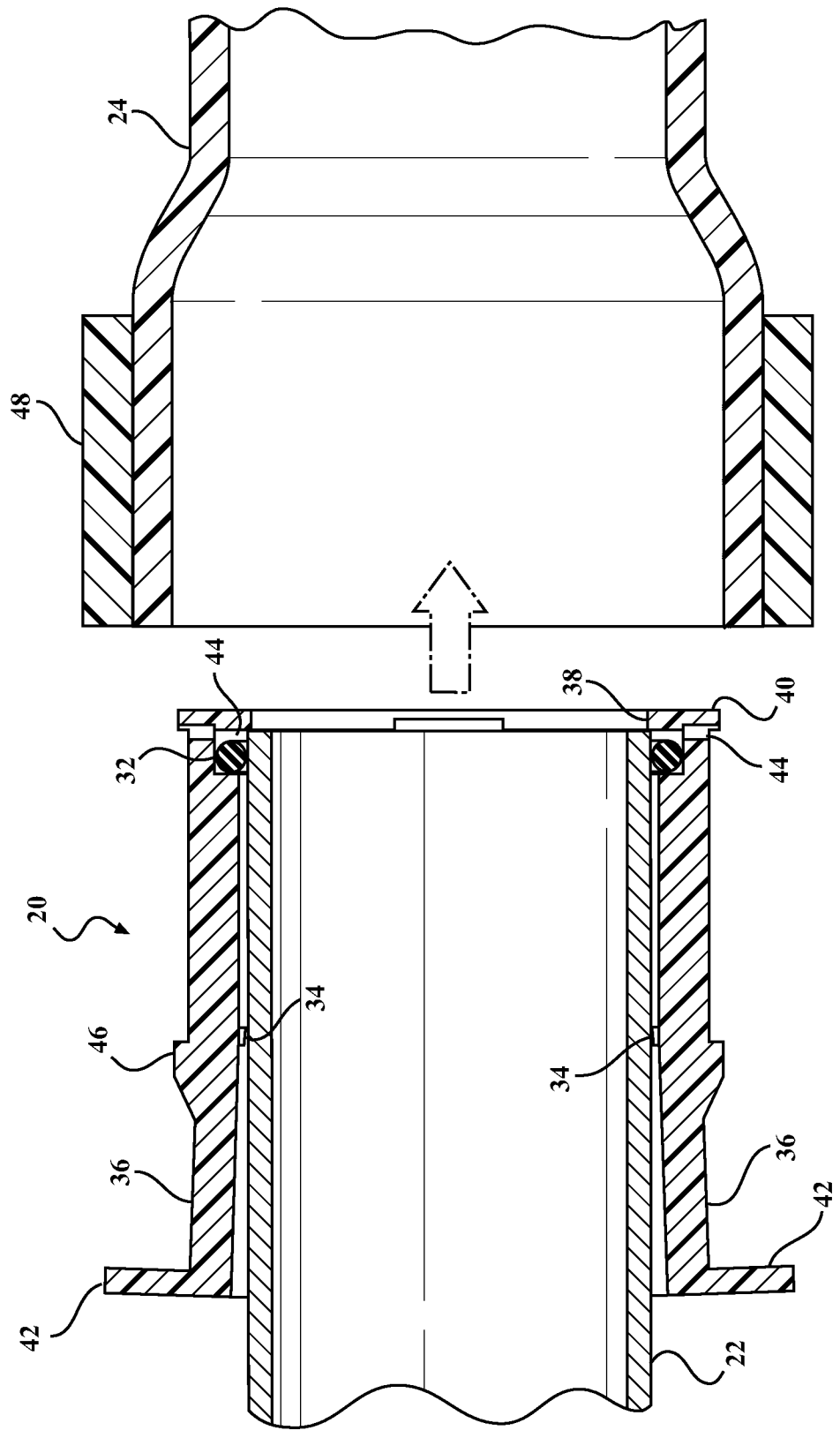


FIG. 5



FIG. 6

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US13/52276

A. CLASSIFICATION OF SUBJECT MATTER IPC(8) - F16L 19/028; F16L 47/06 (2013.01) USPC - 285/340, 148.13 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) IPC(8): F16L 47/06; F16L 19/028 (2013.01) USPC: 285/148.13, 238-259, 340; 138/89, 100, 155 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) MicroPatent (US Granted, US Applications, EP-A, EP-B, WO, JP, DE-G, DE-A, DE-T, DE-U, GB-A, FR-A); Google; Google Scholar; ProQuest; IP.com keywords: connector, coupling, flange, pipe, tube, teeth, tooth, projection, finger, copper, CPVC, chlorinated polyvinyl chloride, PEX		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6,464,266 B1 (O'NEILL J. E. et al.) October 15, 2002; figures 1-5; column 2, lines 55-65; column 3, lines 10-40	1-14
A	US 2011/0156383 A1 (BOBST U. et al.) June 30, 2011; entire document	1-14
A	US 7,090,257 B2 (WERTH A. A.) August 15, 2006; entire document	1-14
A	US 8,123,257 B1 (BAER R. L. et al.) February 28, 2012; entire document	1-14
A	US 7,566,079 B1 (CALLAHAN D. et al.) July 28, 2009; entire document	1-14
A	US 2006/0082156 A1 (RUNYAN G. L.) April 20, 2006; entire document	1-14
A	US 2010/0066075 A1 (CROMPTON D. B.) March 18, 2010; entire document	1-14
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Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201		Authorized officer: Shane Thomas PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774