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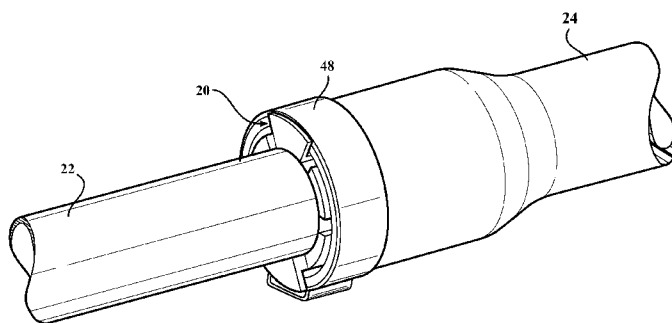


FIG. 1

(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 CONNECTOR ASSEMBLY

CROSS REFERENCE TO RELATED APPLICATION

[0001] This PCT Patent Application claims the benefit of U.S. Provisional Patent Application Serial No. 61/700,538 filed September 13, 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 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 to PEX adapters and CPVC to PEX adapters for fluidly connecting PEX tubing with copper and CPVC piping respectively. However, many of these adapter designs are costly, difficult to install (for example, some designs require adhesives or welding) or do not provide a sufficiently reliable seal between the copper or CPVC piping and the PEX tubing. There remains a significant and continuing need for an improved adapter or connector assembly which overcomes any one or more 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 pipe of one material, such as copper or chlorinated polyvinyl chloride (CPVC), with a tube of another material, such as cross-linked polyethylene (PEX). The quick connector assembly includes a housing with an open bore which extends from a first end to a second end. The housing includes a plurality of deflectable fingers with teeth extending into the open bore. To connect the pipe to the housing, a user inserts the pipe through the first end of the housing. Then, the user inserts a crimping ring over one end of the tube and inserts the end of the tube and crimping ring over the second end of the housing. The user then uses a crimping tool to crimp the tube onto the outer surface of the housing to establish a fluid-tight seal and also to deflect the fingers inwardly until the teeth bite into the pipe. With that, a very secure connection is established between the pipe and tube without the use of welding, soldering, adhesives or any special equipment except for the crimping tool. 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 pipe and the tube. Even further, this design may be scaled to accommodate pipes and tubes of any desirably type and size.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] 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:

[0006] Figure 1 is a perspective and elevation view of an exemplary quick connector assembly attached to a copper or CPVC pipe and a PEX reducer;

[0007] Figure 2 is a perspective and elevation view of the exemplary quick connector assembly of Figure 1;

[0008] Figure 3 is a side elevation view of the exemplary quick connector assembly of Figure 2;

[0009] Figure 4 is a cross-sectional view of the exemplary quick connector assembly of Figure 2;

[0010] Figure 5 is a perspective, fragmentary and cross-sectional view showing the copper or CPVC pipe inserted within the exemplary quick connector assembly of Figure 2 before insertion into the PEX reducer;

[0011] Figure 6 is a perspective and elevation view showing an exemplary crimping ring and an exemplary crimping tool for crimping the crimping ring and the PEX reducer onto the exemplary quick connector assembly of Figure 2; and

[0012] Figure 7 is a cross-sectional view of the exemplary quick connector of Figure 2 connected with and establishing fluid communication between the copper or CPVC pipe and the PEX reducer.

DESCRIPTION OF THE ENABLING EMBODIMENT

[0013] 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 Figure 1. In the exemplary embodiment, the first tube **22** is either of a 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 a reducer of a cross-lined polyethylene (PEX) material, such as PEX-A, PEX-B or PEX-C, and is hereinafter referred to as “the PEX reducer”. Specifically, the exemplary reducer **24** is a PEX three

quarter inch (3/4") to one half inch (1/2") reducer. However, it should be appreciated that the second tube **24** could alternately be a tube with a generally constant diameter, any other size of reducer or an expander. 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 new PEX tubing. However, it should be appreciated that the copper or CPVC pipe **22** and the PEX reducer **24** could be made 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.

[0014] Referring now to Figure 4, 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**. The inner surface of the housing **26** includes a ring-groove, which supports an O-ring **32** for establishing the fluid tight seal between the copper or CPVC pipe **22** (shown in Figure 1) and the housing **26**. The housing **26** of the exemplary quick connector assembly **20** also includes a plurality of metal teeth **34** which extend radially inwardly from an inner surface of the housing **26** to engage or bite into the copper or CPVC pipe **22**, thereby restricting pull-out of the copper or CPVC pipe **22**, as will be discussed in further detail below. 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**.

[0015] 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 suitable 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. The

housing **26** is preferably made 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 different materials and through any suitable forming process.

[0016] Referring now 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 from approximately the axial midpoint of the housing **26** to the first end **28**. In the exemplary embodiment, each of the fingers **36** includes a pair of 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**.

[0017] As best shown in Figure 5, 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 to allow the copper or CPVC pipe **22** to be inserted past the radially inwardly extending teeth **34** on the fingers **36**. The angling of the teeth **34** causes the fingers **36** to automatically deflect in response to insertion of the copper or CPVC pipe **22** into the housing **26**. In the exemplary embodiment, the housing **26** includes six fingers **36** which are generally uniformly spaced from one another. However, it should be appreciated that the housing **26** could alternately include any suitable number of fingers **36**, and the fingers **36** could have variable widths and spacing.

[0018] 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** that extends radially inwardly from the inner surface and the other flange **40** being an outer flange **40** that extends 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 4, when the copper or CPVC pipe **22** is properly inserted into the housing **26**, its

end abuts the inner flange **38** of the housing **26**. As best shown in Figure 7, the outer flange **40** extends circumferentially around the housing **26** and provides for a fluid tight seal between the housing **26** and the PEX tube **24** once the PEX tube **24** is crimped onto the outer surface of the housing **26**.

[0019] 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** if it has passed the O-ring **32** in an axial direction. As such, these windows **44** provide a safety feature to ensure that the user inserts the copper or PVC pipe **22** into the proper location within the housing **26**.

[0020] Referring still to Figure 4, two of the fingers **36** include tabs **42** that extend radially outwardly at the first end **28** of the housing **26** to present a stopping point or location for the PEX reducer **24** and a crimping ring **48** when they are inserted over the housing **26**. As such, insertion of the copper or CPVC pipe **22** into the housing **26** is made simple by the inner flange **38** on the second end **30** of the housing **26**, and insertion of the housing **26** into the PEX reducer **24** is made simple by the tabs **42** on the first end **28** of the housing **26**.

[0021] Each of the fingers **36** includes a plurality of ribs **46** which are spaced axially from one another and extend radially outwardly from the outer surfaces of the fingers **36** of the housing **26**. As best shown in Figure 7, when the PEX reducer **24** and the crimping ring **48** are crimped onto the housing **26**, they act on the ribs **46** to urge the teeth **34** against the outer surface of 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**. Further, the crimping of the PEX reducer **24** onto the ribs **46** also restricts pull-out of the housing **26** from the PEX reducer **24**. In other

words, the crimping of the PEX reducer **24** has the effect of locking both the copper or CPVC pipe **22** and the PEX reducer **24** into engagement with the housing **26**.

[0022] The process of attaching the copper or CPVC pipe **22** to the PEX reducer **24** with the exemplary quick connector assembly **20** is described as follows. First, a user inserts the copper or CPVC pipe **22** into the housing **26** through the open first end **28** until he or she feels the end of the pipe **22** contact the inner flange **38**. This will ensure that the copper or CPVC pipe **22** is sealed against the O-ring **32** within the housing **26**. During this process, the fingers **36** may deflect radially outwardly as the end of the copper or CPVC pipe **22** passes the teeth **34**. The user can double check 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**. If the end of the copper or CPVC pipe **22** is visible, then the user continues by sliding a crimping or clamping ring **48** over the larger end of the PEX reducer **24** and then then inserting the second end **30** of the housing **26** into the larger end of the PEX reducer **24** until the PEX reducer **24** abuts the tabs **42** at the ends of the fingers **36**. The user then uses a crimping tool **50** (shown in Figure 6) on the crimping or clamping ring **48** to crimp or clamp the PEX reducer **24** against the housing **26**. The crimping or clamping connection of the PEX reducer **24** about the ribs **46** of the fingers **36** biases the teeth **34** on the fingers **36** 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 crimping or clamping engagement of the PEX reducer **24** onto the housing **26** establishes a fluid tight seal between the housing **26** and the PEX reducer **24**. This entire process is very quick and requires no adhesives, soldering or other specialty tools other than the crimping or clamping tool. Additionally, the resulting connection between the copper or CPVC pipe **22** is more secure than the connections established by using other known adapters or connector assemblies. Even further, the

exemplary quick connector assembly **20** does not require any brass, lead or other metals to be exposed to the fluids flowing through the copper or CPVC pipe **22** and the PEX reducer **24**. A similar process may be followed to join a copper or CPVC pipe **22** with any other type of PEX tube.

[0023] Another aspect of the present invention is a method of establishing fluid communication between a first tube, such as a copper or CPVC pipe **22**, and a second tube, such as a PEX reducer **24**. The method includes the step of preparing a housing **26** with an open bore which extends from an open first end **28** to an open second end **30** and has a plurality of fingers **36** that are spaced circumferentially from one another and also a plurality of radially inwardly extending teeth **34** that extend from the fingers **36** into the open bore and wherein at least one of the fingers **36** has a radially outwardly extending rib **46**. 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**. If the teeth **34** are angled towards the second end **30** of the housing, then the fingers **36** of the housing **26** may deflect when the end of the first tube **22** passes the teeth **34** in the axial direction. The method then proceeds with the step of inserting a crimping ring **48** over a portion of the second tube **24**. The method continues with the step of inserting the second end **30** of the housing **26** into the second tube **24** until the ribs **46** on the housing **26** are aligned with the crimping ring **48**. The method then proceeds with the step of crimping the crimping ring **48** around the ribs **46** of the housing **26** to urge the teeth **34** on the fingers **36** into the first tube **22** in the open bore of the housing **26** to restrict pull-out of the first tube **22** from the open bore of the housing **26**. The method may further include the step of establishing a fluid-tight seal between the first tube **22** and the housing **26** with an O-ring **32**. The method may also proceed with the step of establishing a fluid-tight seal between the second tube **24** and a radially outwardly extending flange **40** on the housing **26**.

[0024] 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 and a second tube, 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 and said at least one of said fingers having at least one radially outwardly extending rib for conveying a force from a crimping ring to said at least one tooth to urge said at least one tube into engagement with the first tube.

Claim 2. 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 3. The connector assembly as set forth in claim 1 wherein said plurality of fingers extend in said axial direction towards said second end.

Claim 4. The connector assembly as set forth in claim 3 wherein said at least one tooth is angled towards said second end of said housing.

Claim 5. The connector assembly as set forth in claim 3 wherein said fingers are fingers of said housing are spaced from one another by axially extending slots.

Claim 6. The connector assembly as set forth in claim 1 wherein each of said fingers includes at least one tooth.

Claim 7. 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 8. The connector assembly as set forth in claim 7 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 9. 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 crimping of the crimping ring about said fingers.

Claim 10. A method of establishing fluid communication between a first tube and a second tube, 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 has 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 and at least one of the fingers having a radially outwardly extending rib;

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

inserting a crimping ring over a portion of the second tube;

inserting the second end of the housing into the second tube until the ribs on the housing are aligned with the crimping ring; and

crimping the crimping ring around the ribs of the housing to urge the teeth on the fingers into the first tube in the open bore of the housing to restrict pull-out of the first tube from the open bore of the housing.

Claim 11. The method as set forth in claim 10 wherein the first tube is of copper or chlorinated polyvinyl chloride (CPVC) and wherein the second tube is of a cross-lined polyethylene (PEX) material.

Claim 12. The method as set forth in claim 10 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 10 further including the step of establishing a fluid-tight seal between the second tube and a radially outwardly extending flange on the housing.

Claim 14. The method as set forth in claim 10 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.

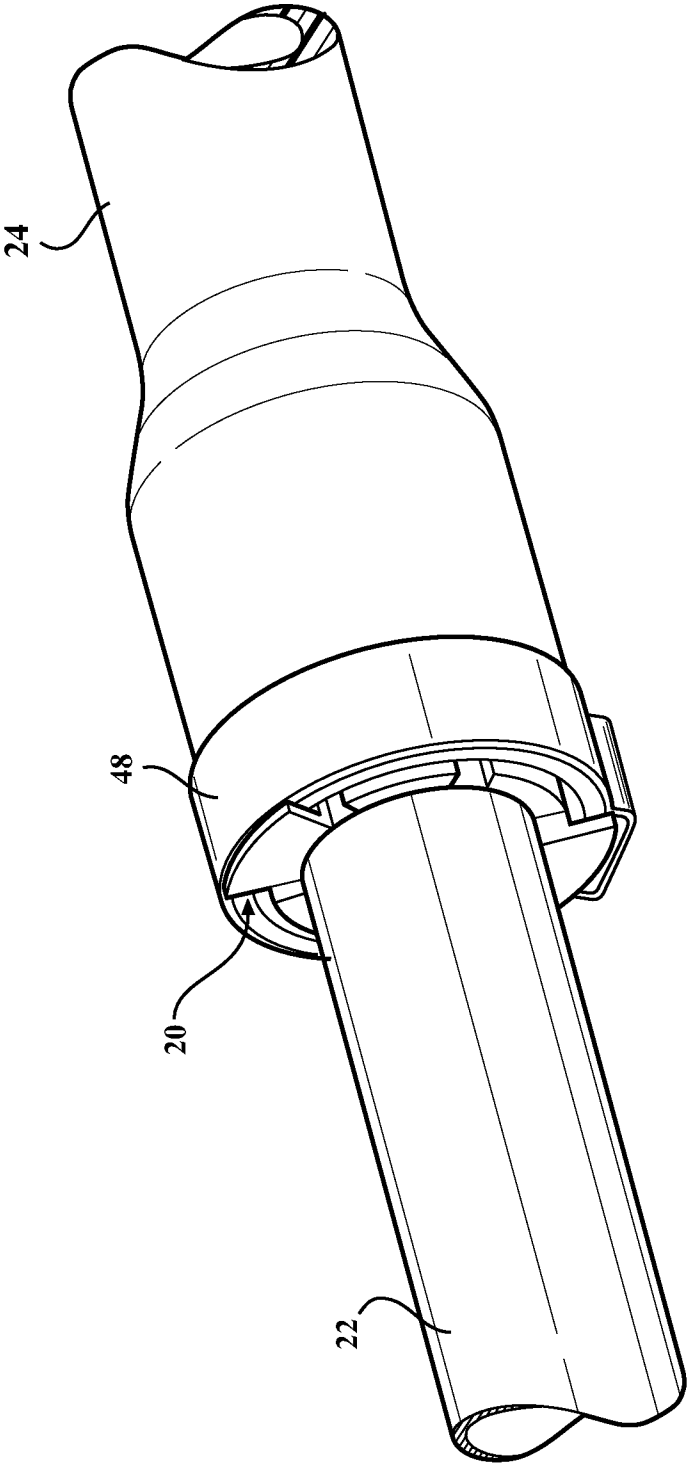
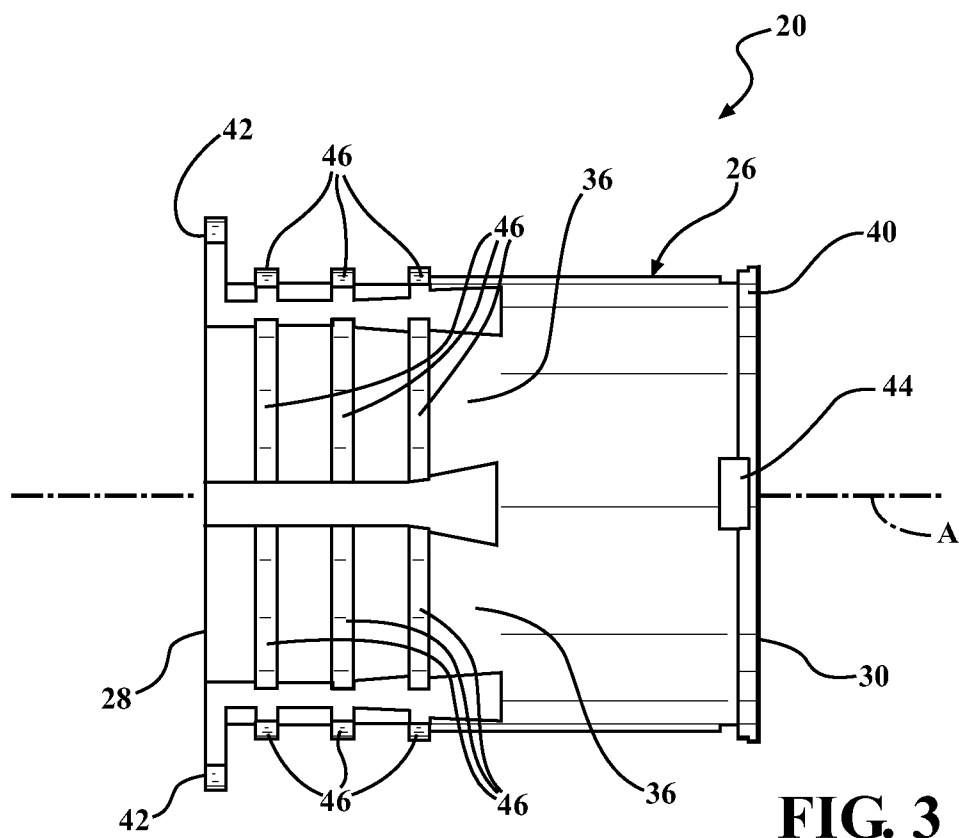
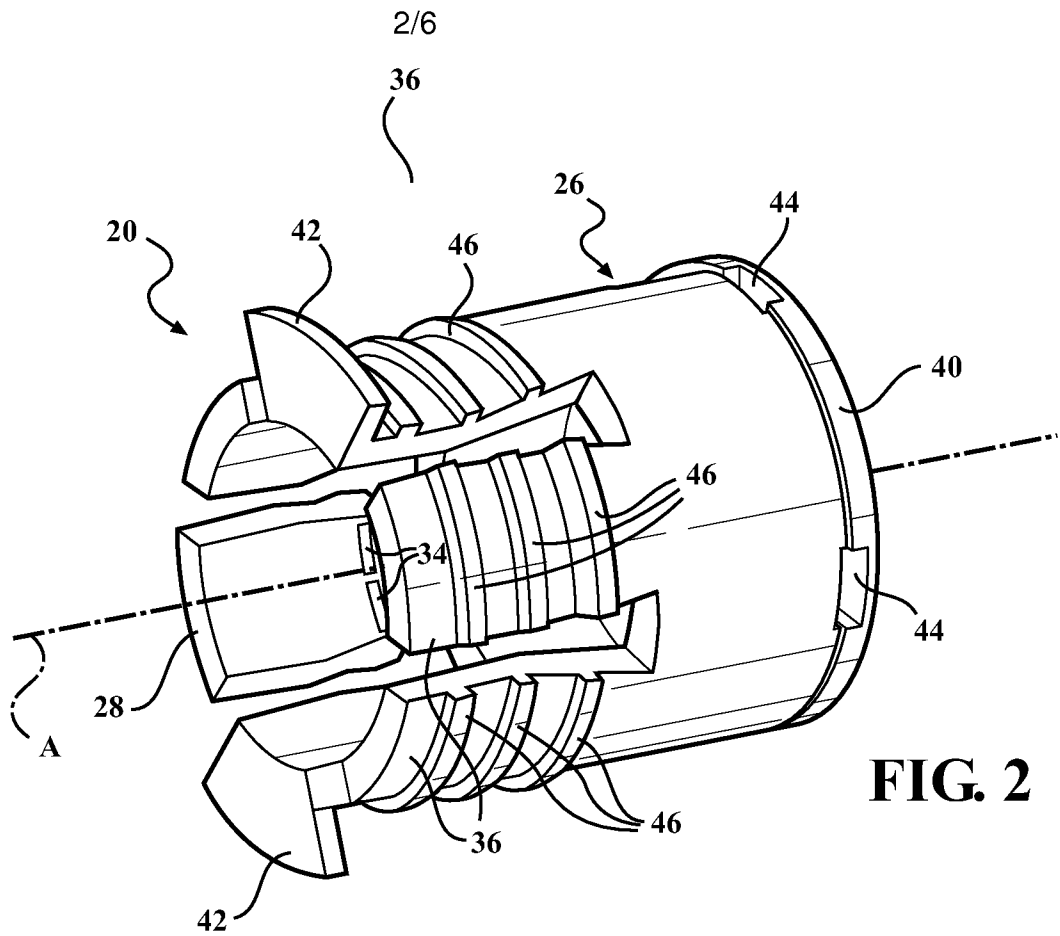


FIG. 1



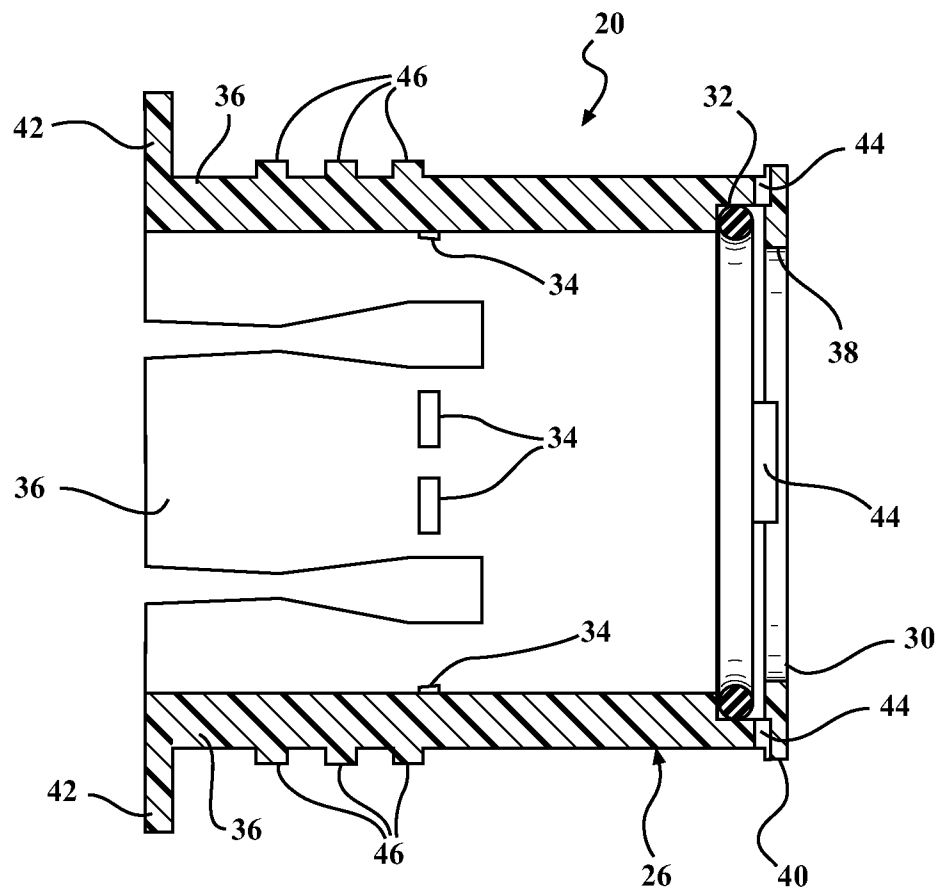


FIG. 4

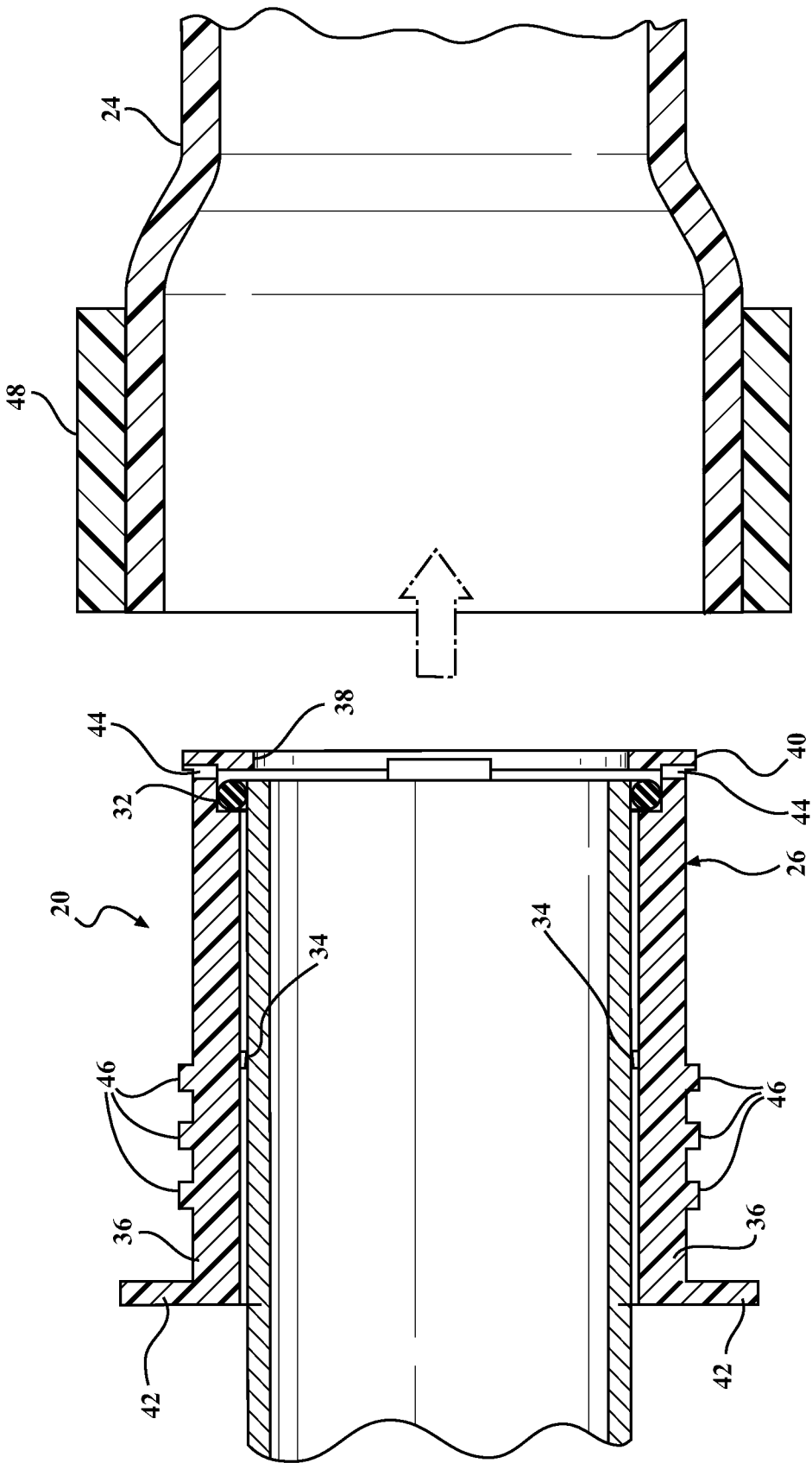
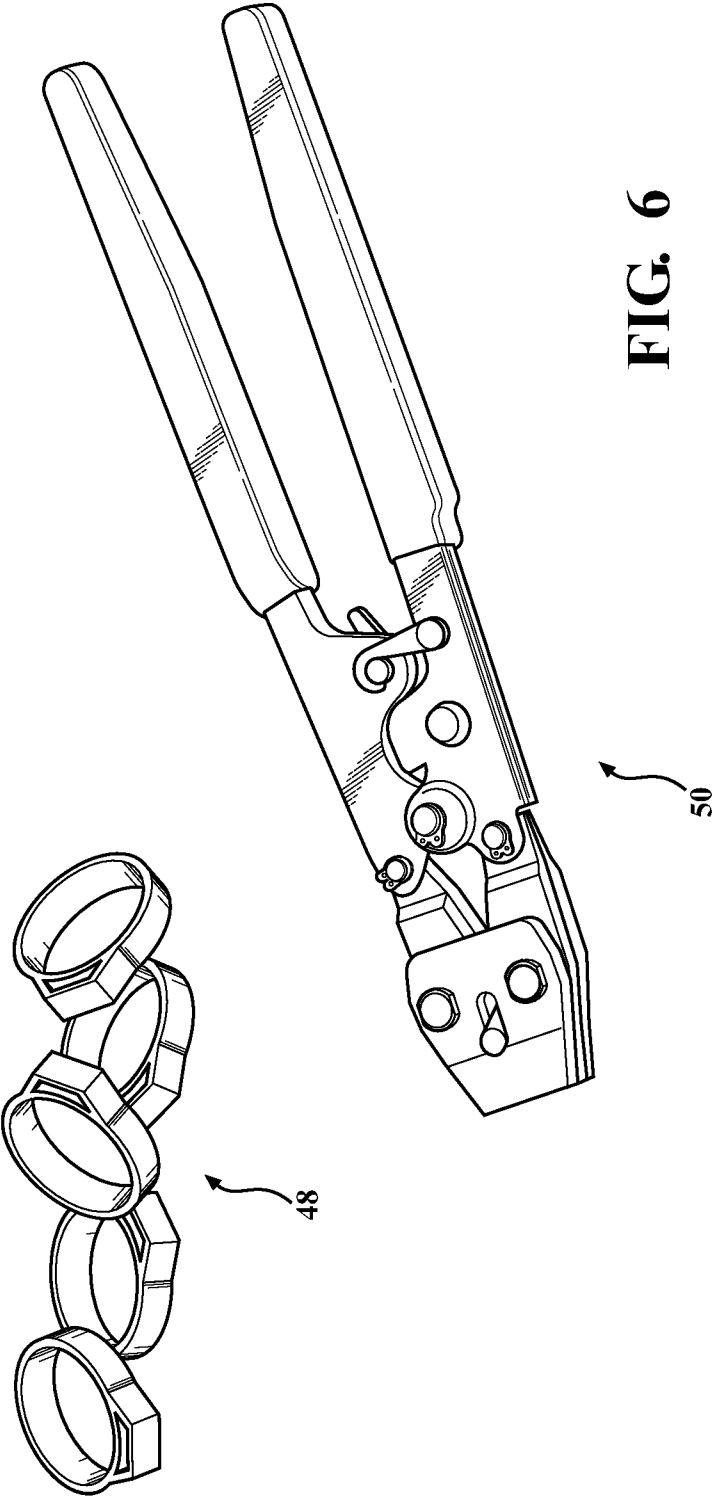


FIG. 5



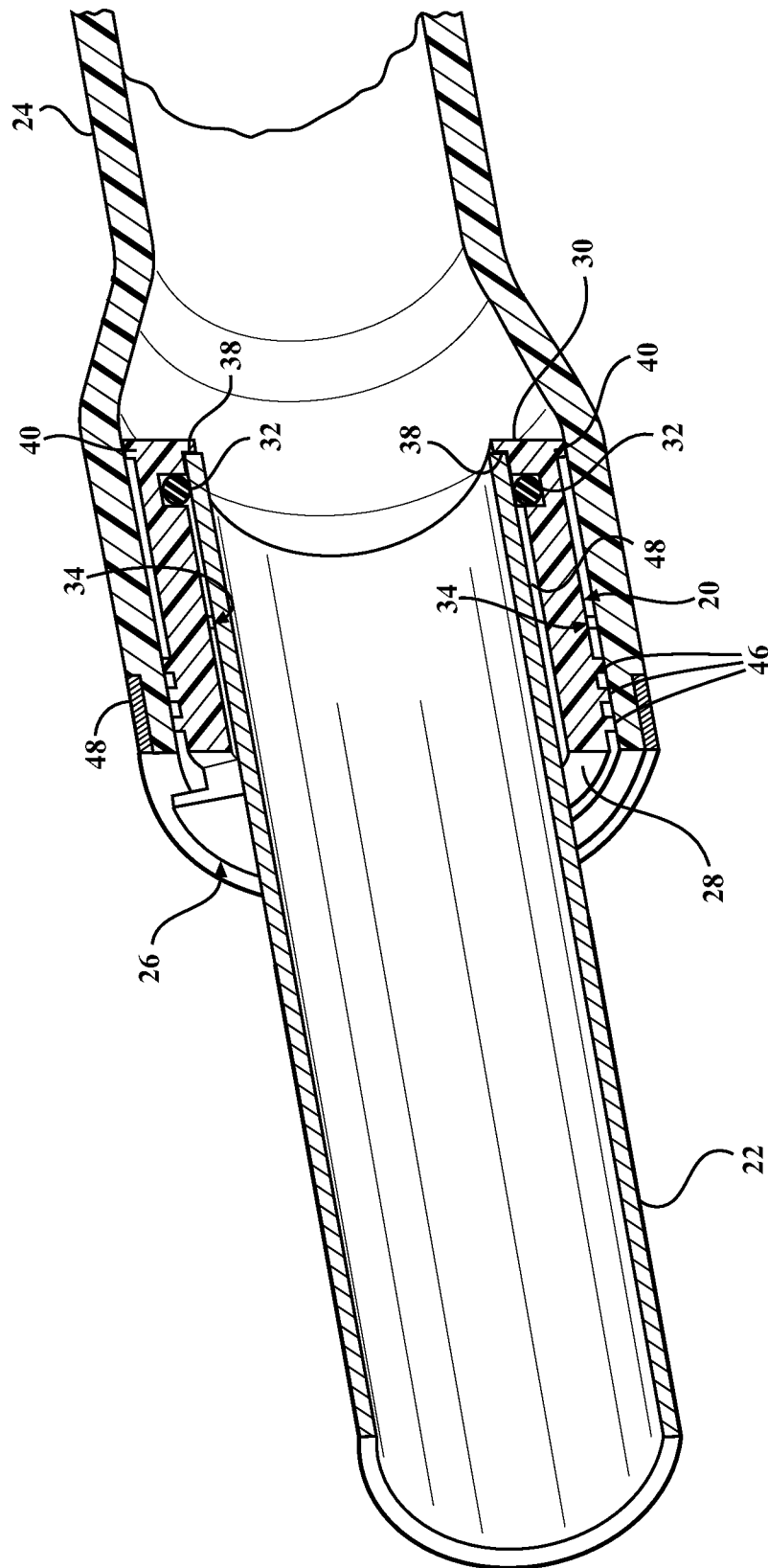


FIG. 7

INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - F16L 21/00 (2014.01)

USPC - 285/323

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) - F16J 15/00; F16L 17/02, 21/00, 21/02, 21/06, 35/00, 37/00, 37/12, 55/00 (2014.01)

USPC - 285/16, 18, 24, 39, 55, 92, 315, 322, 323, 340; 439/746

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

CPC - F16J 15/00; F16L 17/02, 21/00, 21/02, 21/06, 35/00, 37/00, 37/12, 55/00 (2013.01)

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

Orbit, Google Patents, Google, Google Scholar

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2006/037092 A2 (REHDER et al) 06 April 2006 (06.04.2006) entire document	1-6, 9
Y		7
Y	US 2011/0309614 A1 (GUEST) 22 December 2011 (22.12.2011) entire document	7
A	US 2003/0006609 A1 (YATES) 09 January 2003 (09.01.2003) entire document	1-14
A	US 7,900,972 B2 (WANG et al) 08 March 2011 (08.03.2011) entire document	1-14

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