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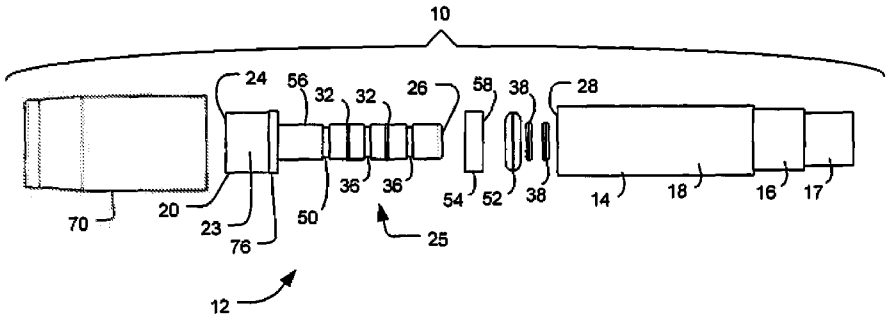
(54) Title: LOW PERMEATION HOSE COUPLING

FIG. 1



(57) Abstract: A coupling that has a body through which fluid flows and which has a proximal end and a distal end that is insertable into an end of a tubular member. The coupling has a sealing element on the body between the proximal end and the distal end and a movable member coupled to the body on a proximal side of the sealing element, the moveable member being moveable towards the distal end of the body to press the sealing element against the end of a tubular member into which the distal end has been inserted, thereby forming a face seal between the end of the tubular member and the moveable member.

LOW PERMEATION HOSE COUPLING

TECHNICAL FIELD

[0001] The present invention relates to a hose coupling, and more particularly to a coupling that may be used with a low permeation hose.

BACKGROUND

[0002] Low permeation hoses are often used in systems to eliminate or reduce escape and/or infiltration of vapors and/or gases. For example, such hoses may be used in refrigeration systems to prevent leakage of refrigerant vapors from the system into the environment. Such hoses are also common in fuel systems for preventing fuel vapors from escaping to the environment. Another application of such hoses is in connection with heating systems for supplying and returning water (or other fluid) from one or more heat exchangers. In such applications, low permeation hoses are used to prevent oxygen from entering the heating system, which can result in corrosion of various components such as pumps and valves.

[0003] Low permeation hoses typically include an inner tube for carrying a fluid, and a vapor barrier layer surrounding the inner tube. Various other layers typically may surround the vapor barrier layer, such as a braiding, an outer tube, a cover or outer sheath, etc. One such low permeation hose is disclosed

in International Patent Application PCT/US2008/78287, filed September 30, 2008, entitled "Aluminum Foil Based Hose", and incorporated herein by reference in its entirety. Another low permeation hose is disclosed in U.S. Patent No. 7,857,010, filed December 22, 2006, which also is incorporated herein by reference in its entirety.

SUMMARY

[0004] The coupling disclosed herein can provide a leak-free connection to a tubular member, such as low permeation hose. The coupling includes a movable member, such as a threaded washer, and a face sealing element, such as an O-ring. The threaded washer can be moved so as to compress the face sealing element against the end of the hose, thereby creating a face seal between the end of the hose and the O-ring. The face seal provides redundancy to any radial sealing elements between the coupling and the hose. Furthermore, the face seal generally provides a more reliable seal than radial sealing elements and can therefore be used as a primary seal between the coupling and the hose.

[0005] According to one embodiment, the present invention provides a coupling that has a body through which fluid flows. The body has a proximal end and a distal end that is insertable into an end of a tubular member. The coupling has a sealing element on the body between the proximal end and the

distal end and a movable member coupled to the body on a proximal side of the sealing element. The moveable member is moveable towards the distal end of the body to press the sealing element against the end of a tubular member into which the distal end has been inserted, thereby forming a face seal between the end of the tubular member and the moveable member.

[0006] According to one aspect, the moveable member is threaded to the coupling body and may have an annular face that presses the sealing element against the end of the tubular member.

[0007] According to another aspect, the coupling includes a shell that surrounds the sealing element, the moveable member and at least a portion of the body. The shell can be crimped to couple the tubular member to the coupling body.

[0008] According to another aspect, the coupling includes a passageway to an interior space of the coupling, the passageway providing a pathway through which an adhesive can be injected into the coupling.

[0009] According to another aspect, the present invention provides a coupling assembly having a tubular member through which fluid flows and a coupling connected to the tubular member. The tubular member has an interior wall and an end. The coupling has a body through which fluid flows, a tubular nipple portion that is inserted into the end of the tubular member, and at least

one annular sealing element for engaging the interior wall of the tubular member to form a radial seal between the nipple portion and the tubular member. The radial seal provides a first barrier to egression of fluid from the coupling assembly. The coupling also has an annular face sealing element that surrounds the body and a moveable member coupled to the body that is moveable towards the nipple portion to press the face sealing element against the end of the tubular member to effect a face seal between the face sealing element and the end of the tubular member. The face seal provides a second barrier to egression of fluid from the coupling assembly.

[0010] According to another aspect, the present invention provides a method of assembling a coupling and a tubular member. The method includes threading a moveable member onto a body, the moveable member being disposed between a proximal end of the body and a distal end of the body, placing a sealing element on the body between the moveable member and the distal end of the body, inserting the distal end of the body into an end of the tubular member, and moving the moveable member towards the distal end of the body to press the sealing element against the end of the tubular member to form a face seal between the sealing element and the end of the tubular member.

[0011] The foregoing and other features of the invention are hereinafter described in greater detail with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] Embodiments of this invention will now be described in further detail with reference to the accompanying drawings, in which:

[0013] FIG. 1 is an exploded side elevation view of a coupling and a tubular member;

[0014] FIG. 2A is a side elevation view of an assembly of a coupling and a tubular member;

[0015] FIG. 2B is a cross sectional view of the assembly of FIG. 2A taken along lines A—A;

[0016] FIG. 3A is a side elevation view of an assembly of a coupling and a tubular member;

[0017] FIG. 3B is a cross sectional view of the assembly of FIG. 2A taken along lines B—B; and

[0018] FIGS. 4A-4C illustrate steps of an exemplary method by which a coupling is connected to a tubular member.

DETAILED DESCRIPTION

[0019] Referring initially to FIGS. 1, 2A and 2B, an exemplary coupling assembly 10 in accordance with aspects of the invention is shown. The coupling assembly 10 includes a coupling 12 and a tubular member 14, such as a flexible hose, rigid pipe, or another tubular member with an internal passageway 15 through which fluid flows. As shown in FIG. 1, the tubular member 14 can be a multilayered flexible hose such a low permeation hose that is suitable for carrying refrigerant in a heating/cooling system. The tubular member 14 may have one or more barrier layers for inhibiting permeation through the walls of the tubular member. In the illustrated embodiment of FIG. 1, the tubular member 14 has a first barrier layer 16, a second barrier layer 17, and an outer layer 18. In FIGS. 2A-4C, the tubular member is shown as having only a single layer, however, it should be appreciated that a multi-layer tubular member, such as that shown in FIG. 1 could be used. In addition to the layers shown in FIG. 1, the tubular member also may include additional layers, such as adhesive layers, braiding, etc.

[0020] The coupling 12 includes a body 20 through which fluid flows, for example, by way of internal passageway 22. The body 20 has a radially enlarged portion 23, which includes proximal end 24. The proximal end of the body can be configured for connection to a component of a system in which the coupling assembly 10 is used. For example the proximal end 24 can be

configured for a threaded connection, a brazed connection, a welded connection, or connection to the system in another manner. Opposite the proximal end 24 of the body 20 is a nipple 25, which includes the distal end 26 of the body 20. The nipple 25 is configured for insertion into an end 28 of the tubular member 14 and may include one or more radially outwardly extending barbs 32 for engaging an interior wall 34 of the tubular member 14. The barbs 32 are configured to hold the tubular member 14 on the nipple 25 when the coupling 12 is being assembled to the tubular member 14 (e.g., by inhibiting movement, such as slippage, of the tubular member in the distal direction). Additional barbs can be added for additional retention.

[0021] The nipple 25 may include one or more annular grooves 36. The grooves 36 generally retain respective annular sealing elements 38 (also referred to as "radial sealing elements") on the body 20 and restrict significant axial movement of the sealing element 38 during assembly of the coupling. The annular sealing elements 38 may be elastomeric sealing elements, such as O-rings. The annular sealing elements 38 can be sized to abut the interior wall 34 of the tubular member 14 to form a radial seal between the body 20 and tubular member 14. The radial sealing elements provide a barrier to leakage of fluid from the coupling assembly 10 by inhibiting the flow of fluid between the coupling body 20 and the interior wall 34 of the tubular member 14. Additional radial sealing elements can be disposed along the portion of the body that is inserted into the tubular member to provide additional barriers to leakage.

[0022] On a proximal side of grooves 36 is an annular groove 50 for annular sealing element 52 (also referred to as a "face sealing element"). The groove 50 can generally retain the sealing element 52 on the body 20 and restrict significant axial movement of the sealing element during assembly of the coupling. The face sealing element 52 may be an annular elastomeric element such as an O-ring. The face sealing element 52 may be disposed in the groove 50 and generally restrained from significant axial movement, thereby providing a positive stop for the end 28 of the tubular member 14 during assembly of the coupling to the tubular member. As shown, the face sealing element 52 may be larger in size than the radial sealing elements 38 on the nipple 25. The face sealing element 52 also can extend radially outwardly from the body a distance sufficient to abut a face of the end of the tubular member when the body is inserted into the tubular member. This can allow the tubular member 14 to slide over the sealing elements 38, but not slide over sealing element 52 during assembly of the coupling. This also may provide for a seal that extends along a significant portion of the face of the tubular member, which may increase the robustness of the seal.

[0023] The coupling 12 also includes a moveable member 54 located on the proximal side of the sealing element 52 and on a distal side of the radially enlarged portion 23. The moveable member 54 has an annular surface 58 that faces the sealing element 52 (e.g. that faces in the direction of the distal end 26 of the body 22). The moveable member 54 is coupled to a portion 56 of the

body 20, for example, by a threaded connection. In one embodiment, the moveable member 54 is a threaded washer that is mated with threads 56a on portion 56.

[0024] The connection between the moveable member 54 and the body 20 allows the moveable member 54 to be moved relative to the body 20 towards the distal end 26. When the nipple 25 is inserted into the end 28 of a tubular member 14, the moveable member 54 can be moved or urged axially towards the distal end 26 of the body 20 to press the sealing element 52 against the end 28 of the tubular member 14. The annular surface 58 of the moveable member 54 effects a face seal between the sealing element 52 and the end 28 of the tubular member 14.

[0025] The face seal formed when the sealing element 52 pressed against the end 28 of the tube 14 by the moveable member 54 provides a barrier to the leakage of fluid from the coupling assembly by inhibiting the flow of fluid around the end 28 of the tubular member 14 and out of the coupling assembly 10. The face seal provides redundancy to any radial sealing elements between the coupling and the tubular member. Furthermore, the face seal generally provides a more reliable seal than radial sealing elements and can therefore be used as a primary seal between the coupling and the tubular member. With the face sealing, it is possible to add more force to squeeze or deform an elastomer as compared to a radial seal. This can help seal microcavities between seal 54,

hose 28 and coupling 26 and can press the elastomer molecules together to inhibit or prevent any loss or seepage of fluid molecules through elastomer material itself. Because the hose is installed over the radial sealing elements, the amount of deformation of the radial sealing elements is somewhat limited. If the hose is too tight, the radial sealing elements will be slid out of place, or deformed in an asymmetric manner, which can cause a non-uniform seal between the coupling and the hose. This can allow permeation of the fluid through microcavities between the hose, the seal and the coupling as well as through the elastomer itself.

[0026] The coupling may include a locking mechanism to prevent the loosening of the moveable member 54 after it has been drawn against the face sealing element 52, as may occur during installation of the coupling assembly 10 into a system, from vibration in the system, or otherwise. For example, the threads 56a on the threaded portion 56a of the body may be mechanically deformed or broken after the moveable member 54 is moved to press the face sealing element 52 against the end 14 of the tubular member 14. Additionally or alternatively, the coupling may include a locking element or another element to prevent loosening of the moveable member.

[0027] The radially enlarged portion 23 of the body 20 may be coupled a shell 70 that at least partially surrounds the body 20. A portion 72 of the shell 70 is configured for engagement to the body 20 for example by a threaded

connection, a brazed connection and/or welded connection, etc. When fully assembled, the portion 72 of the shell 70 configured for engagement to the body 20 may abut or engage an annular shoulder 74 on the body 20. The shell 70 may surround the moveable member 54, the face sealing element 56, and at least a portion of the nipple 25, as shown in FIG. 2B.

[0028] The shell 70 may be crimped to hold the tubular member 14 on the body 20. The crimping of the shell also may squeeze the interior wall 34 of the tubular member 14 against the radial sealing elements 38 thereby strengthening or reinforcing the seal between the coupling and the tubular member.

[0029] As shown in FIG. 2B, the shell may include one or more barbs 76 for engaging an outer wall 78 of the tubular member 14. The barbs can increase the tensile pull strength of the coupling. In an alternative embodiment, shown in FIG. 3B, the interior surface 80 of the shell 70 is shown without any barbs.

[0030] The shell 70 and the body 20 define an interior space 82 within the coupling 12. As is best shown in FIG. 2B, the interior space 82 is defined by a portion 20a of the body 20 adjacent a proximal side 54a of the moveable member 54 and a portion 70a of the interior surface of the shell 70. The shell 70 includes a passageway 84 for injecting an adhesive 86 into the interior space 82. The adhesive 86 may reinforce the face seal between the sealing

element and the end of the tubular member. The adhesive also may inhibit back-driving of the moveable member, may fill a space between the radially enlarged portion 23 the tubular member and the interior surface of the shell and/or may secure or reinforce the connection between the shell and the body. The adhesive may further reduce the likelihood of leakage from the coupling. Exemplary suitable adhesives include, for example, an elastomer-based adhesive with high temperature resistance.

[0031] Although shown as a straight coupling, it should be appreciated that other configurations of the coupling are possible, such as an elbow, T, or other shape of coupling.

[0032] With additional reference to FIGS. 4A-4C, a method of assembling the coupling 12 to the tubular member 14 is shown. Initially, the moveable member 54 is slid over the distal end 24 of the body 20 and coupled to the threaded portion 57 of the body 20 such that the moveable member 54 is disposed between the radially enlarged portion 23, which includes proximal end 24 of the body 20, and the distal end 26 of the body 20. The face sealing element 52 is then slid over the distal end 26 and seated in groove 50 so that the moveable member is between the radially enlarged portion 23 of the body 20 and the sealing element 52. Radial sealing elements 38 are then slid over the distal end 26 of the body and seated in respective grooves 36 on the nipple 25.

[0033] The distal end 26 of the body 20 is then inserted into the end 28 of the tubular member 14 until the end of the end 28 of the tubular member 14 reaches the annular sealing element 52. The position of the end of the tubular member with respect to the sealing element can be confirmed by visual inspection. The position of the tube when the distal end of the tubular member fully inserted therein is shown in FIG. 4B.

[0034] As shown in FIG. 4C, the moveable member 54 is moved towards the distal end 26 of the body 20 to press the sealing element 52 against the end 28 of the tubular member 14 to form a face seal between the sealing element 52 and the end 28 of the tubular member 14. The face seal can be confirmed by visual inspection. The barbs 32 on the nipple portion 25 of the body engage the interior wall 34 of the tubular member 14 and inhibit or resist axial movement of the tubular member 14 towards the distal end 26 of the body so that the sealing element 52 can be pressed against the end of the end 18 of the tubular member 14 to form the face seal.

[0035] The shell 70 can be telescoped over the proximal end 24 of the body 20 and may be positioned to surround the moveable member 54 and the sealing element 52. The shell is then coupled to the radially enlarged portion 23 of the body, and crimped in place to squeeze the tubular member 14 against the nipple 25, thereby securely holding the tubular member to the body 20, and further effecting the seal between the radial sealing elements 38 and the tubular

member 14. The adhesive 86 can then be injected into the interior space 82 of the coupling via passageway 84. The completed coupling and tubular member assembly is shown in FIGS. 2B and 3B.

[0036] The coupling described herein provides a robust face seal between the coupling and the tubular member that can prevent or reduce leakage or loss through the coupling as compared to a coupling that has radial sealing elements and no face sealing elements. Another benefit of the coupling is that the face sealing element provides redundancy to the coupling in the event that there is a leak passed one of the radial seal elements on the nipple. Additionally, a failure of an O-ring providing a radial seal on the nipple will not necessarily result in a reduction in performance or loss of coupling performance because the face seal can act as the seal for the coupling.

[0037] Although the principles, embodiments and operation of the present invention have been described in detail herein, this is not to be construed as being limited to the particular illustrative forms disclosed. They will thus become apparent to those skilled in the art that various modifications of the embodiments herein can be made without departing from the spirit or scope of the invention.

end of the body to press the sealing element against the end of a tubular member into which the distal end has been inserted, thereby forming a face seal between the end of the tubular member and the moveable member.

CLAIMS

1. A coupling comprising:

a body through which fluid flows having a proximal end and a distal end that is insertable into an end of a tubular member;

a sealing element on the body between the proximal end and the distal end; and

a movable member coupled to the body on a proximal side of the sealing element, the moveable member being moveable towards the distal end of the body to press the sealing element against an end of a tubular member into which the distal end has been inserted.

2. The coupling of claim 1, wherein the moveable member is coupled to the body by a threaded connection.

3. The coupling of any preceding claim, wherein the moveable member has an annular surface that faces the sealing element.

4. The coupling of any preceding claim, wherein the sealing element extends radially outwardly from the body and abuts a face of the end of the tubular member.

5. The coupling of any preceding claim, further comprising a shell that surrounds the sealing element, the moveable member and at least a portion of the body.

6. The coupling of claim 5, wherein the shell includes a barb for engaging an outer wall of a tubular member into which the distal end of the body has been inserted.

7. The coupling of claim 6, wherein a portion of the body proximal to the moveable member is radially enlarged, and the shell is coupled to the body at the radially enlarged portion.

8. The coupling of claim 7, wherein the radially enlarged portion of the body and the shell are coupled by a threaded connection or by brazing.

9. The coupling of any preceding claim, further comprising an interior space defined by a portion of the body between the proximal end of the body and a proximal side of the moveable member and an interior surface of the shell

10. The coupling of claim 9, further comprising a passageway through the shell to the interior space for injecting an adhesive into the interior space.

11. The coupling of any preceding claim, further comprising a barb for engaging an interior wall of a tubular member, the barb extending from the body between the distal end of the body and the sealing element.

12. The coupling of any preceding claim, further comprising an annular sealing element for radially sealing against an interior wall of a tubular member, the annular sealing element disposed on the body between the distal end of the body and the sealing element.

13. The coupling of claim 12, wherein the body includes a groove into which the annular sealing element is seated.

14. The coupling of any preceding claim, further comprising:

a plurality of barbs for engaging an interior wall of a tubular member, the barbs extending from the body between the distal end of the body and the sealing element, and

a plurality of annular sealing elements for radially sealing against an interior wall of a tubular member, the annular sealing elements disposed on the body between the distal end of the body and the sealing element.

15. An assembly comprising the coupling of any preceding claim and a tubular member having an end, wherein the distal end of the coupling is inserted into the end of the tubular member and the sealing element is pressed against the end of the tubular member by the moveable member, thereby

forming a face seal between the sealing element and the end of the tubular member.

16. The assembly of claim 15, further comprising an adhesive in the interior space of the coupling.

17. A method of assembling a coupling to a tubular member comprising:

threading a moveable member onto a body of the coupling, the moveable member being disposed between a proximal end of the body and a distal end of the body;

placing a sealing element on the body between the moveable member and the distal end of the body;

inserting the distal end of the body into an end of a tubular member; and

moving the moveable member towards the distal end of the body to press the sealing element against the end of the tubular member to form a face seal between the sealing element and the end of the tubular member.

18. The method of claim 17, further comprising:

telescoping a shell over the proximal end of the body, the shell surrounding the moveable member and the sealing element; and

crimping the shell to couple the tubular member to the body.

19. The method of claim 18, further comprising injecting adhesive into an interior space of the coupling via a passageway through the shell.

20. A coupling assembly comprising:

a tubular member through which fluid flows, the tubular member having an interior wall and an end; and

a coupling connected to the tubular member, the coupling comprising:

a body through which fluid flows coupled to the tubular member, the body having a tubular nipple that is inserted into the end of the tubular member; at least one annular sealing element for engaging the interior wall of the tubular member to form a radial seal between the nipple and the tubular member, said radial seal providing a first barrier to egression of fluid from the coupling assembly;

an annular face sealing element surrounding body; and

a moveable member coupled to the body and moveable towards the nipple to press the face sealing element against the end of the tubular member to effect a face seal between the face sealing element and the end of the tubular member, the face seal providing a second barrier to egression of fluid from the coupling assembly.

FIG. 1

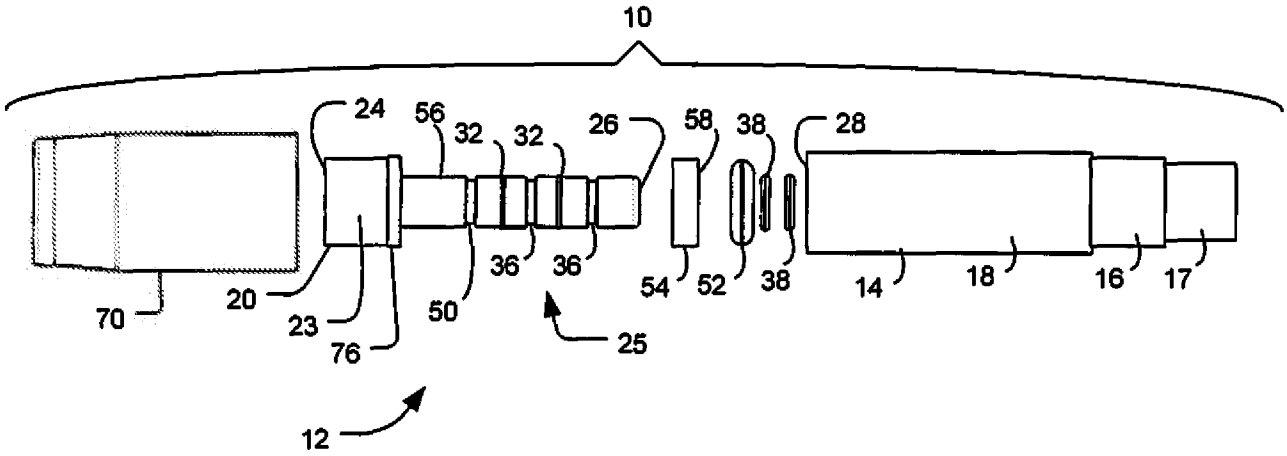


FIG. 2A

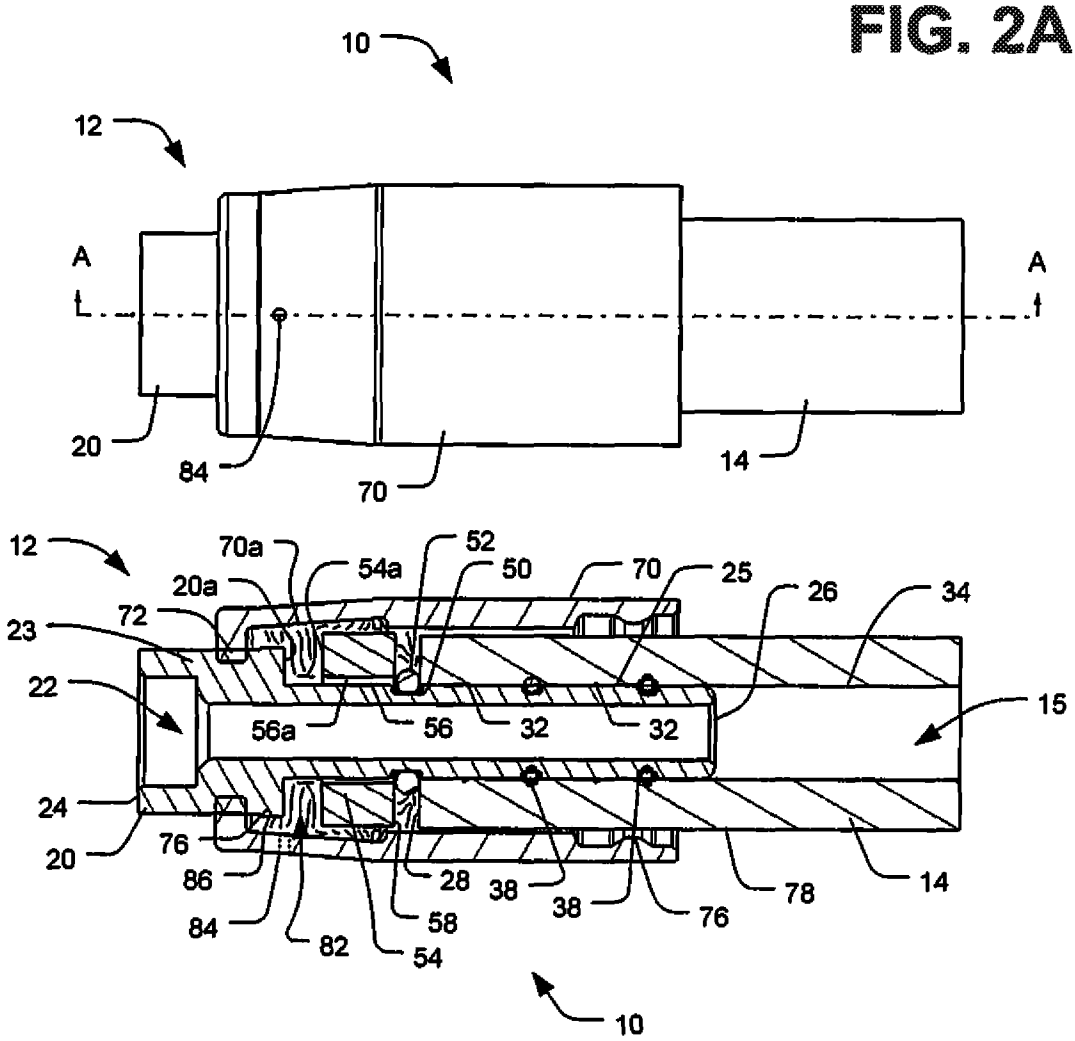
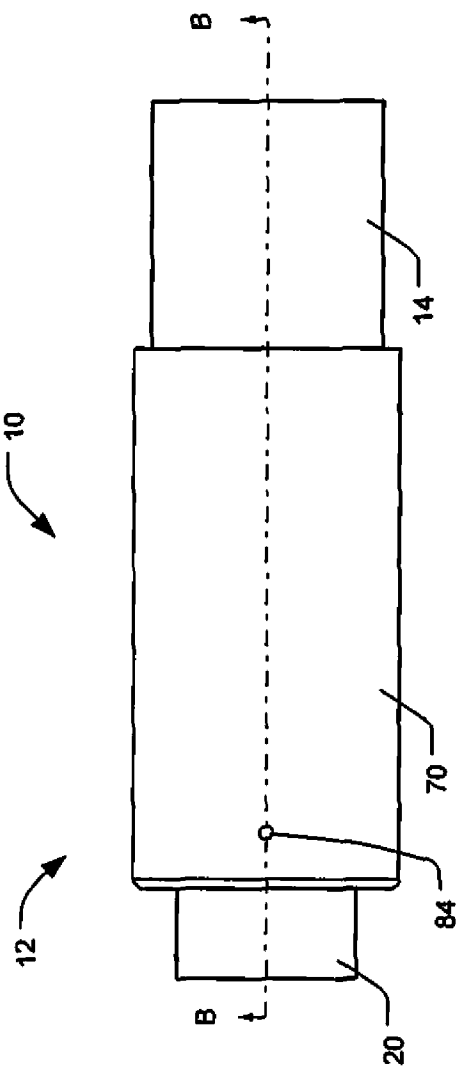


FIG. 2B


B
B
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84
20

FIG. 3A

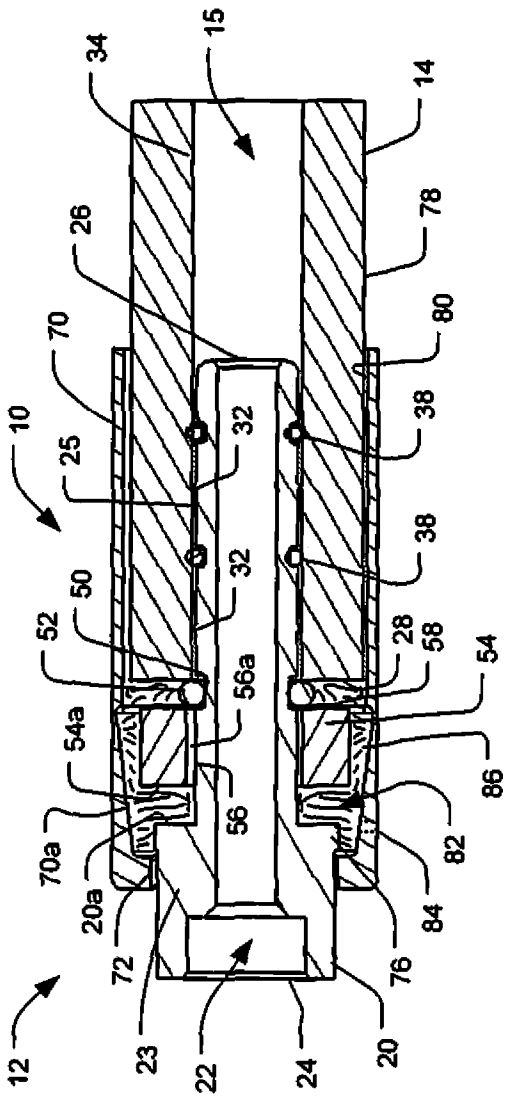
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FIG. 3B

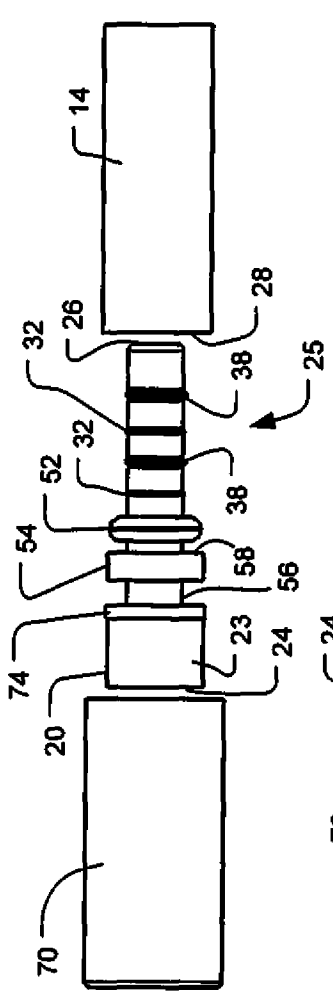

FIG. 4A

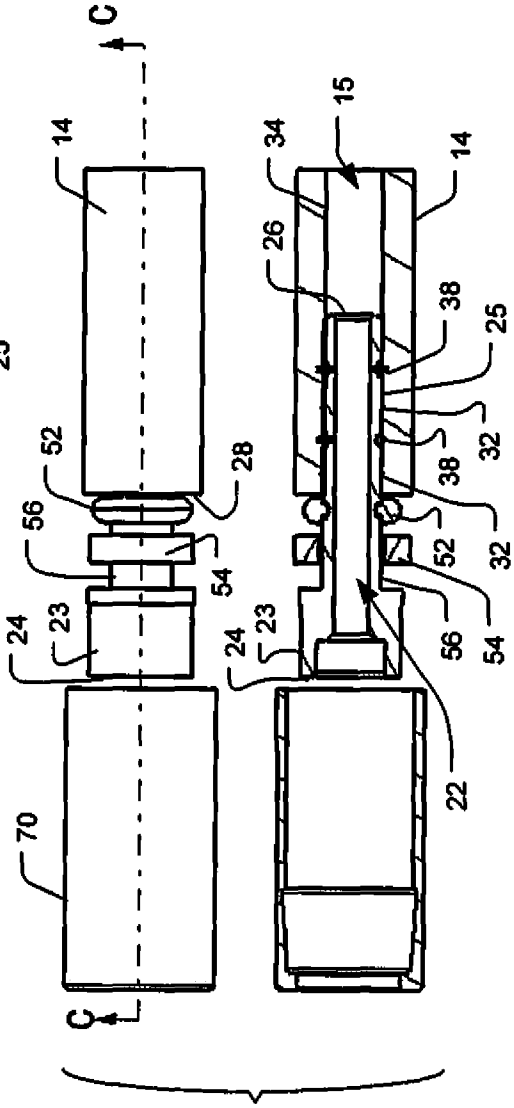

FIG. 4B

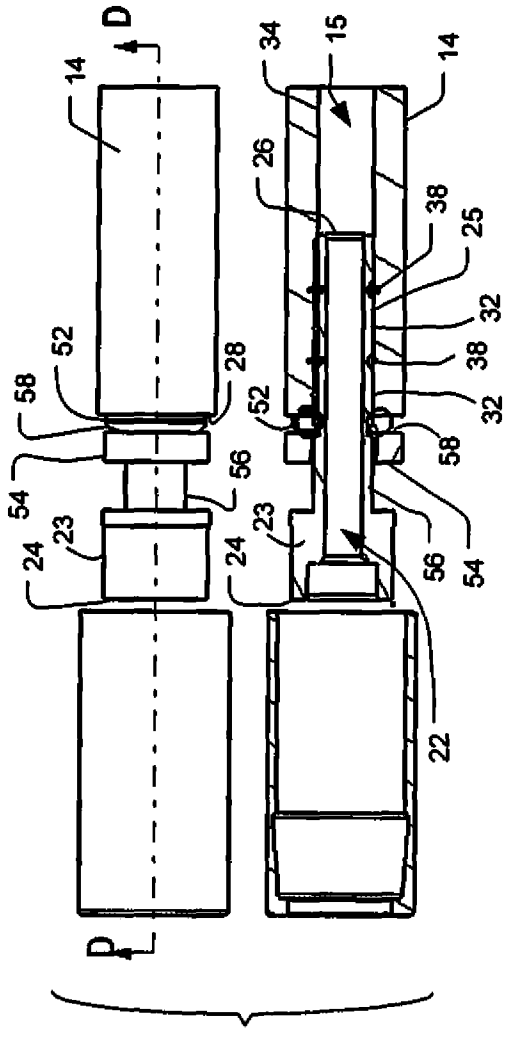

FIG. 4C