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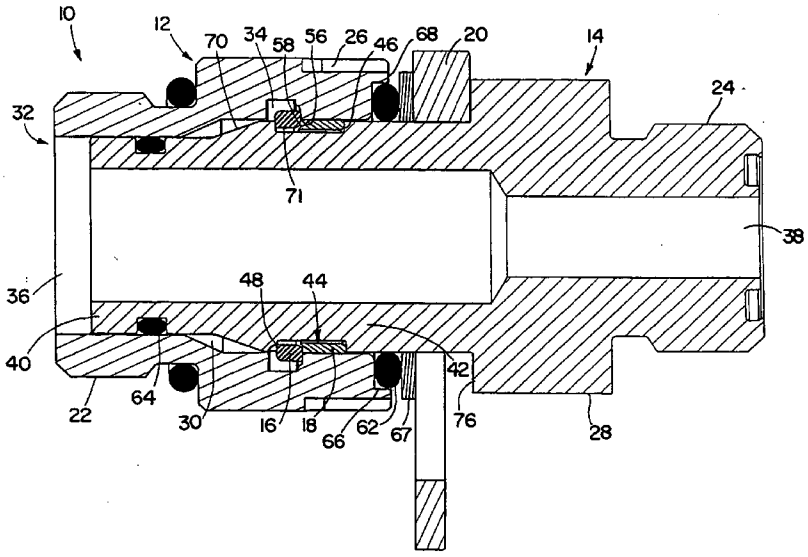
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(54) **Title:** PUSH-TO-CONNECT COUPLING FOR PRESSURE APPLICATIONS



(57) **Abstract:** A push-to-connect coupling comprising a female part and a male part telescopically insertable into the female part, and an expandible and contractible lock ring retained in one of the female and male parts for engaging a latching groove on the other of the female and male parts for holding the male part in the female part at a latching position, and wherein the male part is movable into the female part beyond the latching position to cause a release ring to act on the lock ring to unlatch the lock ring to allow the male part to be withdrawn from the female part. The coupling can be pushed together to connect, and the coupling can be disconnected without requiring the use of a tool.

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PUSH-TO-CONNECT COUPLING FOR PRESSURE APPLICATIONS

Related Applications

This application claims the benefit of U.S. Provisional Application No. 60/789,747 filed April 6, 2006, which is hereby incorporated herein by reference in its entirety.

Field of the Invention

The invention herein described relates generally to push-to-connect couplings for pressure applications.

Background of the Invention

Push-to-connect couplings heretofore have been provided to allow for quick connection and sealing of a coupler socket (female half) and a nipple (male half). Such couplings have particular application for connecting tubes to one another or a tube to another component such as a manifold block.

In a typical push-to-connect coupling, the male and female parts are connected together solely by axial displacement of the parts. This has the advantage of permitting the parts to be very quickly and easily coupled.

Push-to connect couplings also have been provided with a release mechanism to disconnect the male and female parts. Prior art release mechanisms have required the use of a special tool which presents some drawbacks. Perhaps the most common drawback, especially when the coupling is infrequently disconnected, is misplacement of the special tool such that it cannot be found when needed. If the special tool cannot be found, service personnel may be inclined to use some other tool that is handy, and this could cause damage to the coupling such that the male and female parts might not mate and/or seal properly when re-connected. Another drawback is the need to use two hands to effect the release, one to hold the coupling part that is being disconnected and the other to hold the special tool, or any tool for that matter. This can be a difficult and tedious task if the coupling is located in a hard to reach location.

U.S. Patent No. 3,731,955 discloses a push-pull connector including telescopically slidable male and female connector members each provided with an annular peripheral recess. The members are interlocked by a resilient U-shaped packing secured in one of the recesses and extending into an engaged position in the other recess. A disconnect ring mounted in this other recess is slidably movable axially of the connector members to forcefully cam the packing out of its interlocking engagement to permit the connector members to be separated. While separation can be accomplished without the need for a tool, the connector can generally be used in only low pressure applications because the force holding the connectors together under load is limited by the shear or deformation strength of the resilient packing.

Summary of the Invention

The present invention provides a push-to-connect coupling comprising a female part and a male part telescopically insertable into the female part. An expandible and contractible lock ring is retained in one of the female and male parts for engaging a latching groove on the other of the female and male parts for holding the male part in the female part at a latching position, and the male part is movable into the female part beyond the latching position to cause a release ring to act on the lock ring to unlatch the lock ring to allow the male part to be withdrawn from the female part. As is preferred, the coupling can be pushed together to connect, and the coupling can be disconnected without requiring the use of a tool.

More particularly, a push-to-connect coupling according to the invention comprises a female part, a male part, a radially expandible and contractible lock ring, and a release ring. The female part includes a socket that opens to an axial end of the female part, and the socket has a nipple receiving portion and a lock ring groove circumscribing the socket at a location axially outwardly of the nipple receiving portion. The male part is telescopically insertable into the socket in the female part for enabling fluid communication between respective fluid flow passages in the female and male parts. The male part has a leading nipple portion and a trailing latching portion having an annular radially outwardly opening latch groove that is axially bounded by axially inner pusher shoulder and an axially outer

latching shoulder. The radially expandable and contractible lock ring is retained in the annular lock groove in the female part. The lock ring in a relaxed condition has a radially inner diameter less than the diameter of the latching portion at the latching shoulder of the latch groove, and the lock ring is expandable into the lock ring groove to allow the male part to be inserted therethrough to a latching position aligning the latch groove with the lock ring, whereupon the lock ring can contract into the latch groove and create an axial interference with the latching shoulder to prevent the male part from being axially withdrawn from the female part. The release ring is retained in the latch groove and has an axial length less than the latch groove . The release ring is movable by the pusher surface into the lock ring when the male part is pushed axially inwardly beyond its latching position, and the release ring has a cam surface for acting upon a follower surface of the lock ring to cause the lock ring to expand radially outwardly sufficiently to allow the lock ring to pass over the latching shoulder and thereby permit axial withdrawal of the male part from the female part.

The female part may extend beyond and surround the release ring when the male part is in its latching position.

A seal may be provided for sealing the female part to the male part at a location in the female part spaced axially outwardly of the lock ring groove, and a seal may be provided for sealing between the female part and the male part at a location in the female part located axially inwardly of the lock ring groove.

In a preferred embodiment, the cam surface and/or follower surface, most preferably the cam surface, may be tapered.

The male part may have a ramp surface between the nipple portion and the trailing latching portion for progressively expanding the lock ring, in particular a split lock ring, as the male part is being inserted into the female part.

In a preferred embodiment, the female part extends beyond and surrounds the release ring when the male part is in its latching position.

The male part may have a shoulder axially spaced from an end face of the female part when the male part is in its latching position, and a lock-out device is insertable into the space between the shoulder and end face to prevent the male

part from being pushed further into the female part. The lock-out device may surround the male part and be captured in a recess in the male part that prevents withdrawal or separation of the lock-out device from the male part. The lock-out device may be movable between a locking position preventing the male part from being pushed further into the female part and a release position permitting the male part to be inserted beyond its latching position.

The foregoing and other features of the invention are hereinafter described in detail in conjunction with the accompanying drawings which set forth exemplary embodiments illustrating a few of the various ways in which the principles of the invention may be employed.

Brief Description of the Drawings

In the annexed drawings:

Fig. 1 is a cross-sectional view of an exemplary push-to-connect coupling according to the invention.

Figs. 2-5 are sequential cross-sectional views of the push to connect coupling of Fig. 1 at various positions during installation (connect).

Fig. 6 is cross-sectional view of the push to connect coupling of Fig. 1 in an installed (connected) position.

Figs. 7-9 are sequential cross-sectional views of the push to connect coupling of Fig. 1 at various positions during removal (disconnect).

Detailed Description

Referring now in detail to the drawings and initially to Fig. 1, an exemplary push-to-connect coupling according to the invention is indicated generally by reference numeral 10. The coupling 10 generally comprises a female part 12, a male part 14, a radially expandible and contractible lock ring 16, a release ring 18, and a lockout ring 20. In the illustrated embodiment, the female part 12 and male part 14 have respective threaded end portions 22 and 24 for threaded connection to other components. For example, the female part 12 may be fastened to a manifold, and the male part 14 may be fastened to the end of a tube, such as a hose or tubing. In addition, the female part 12 may be provided with wrench

engaging grooves 26 and the male part 14 may be provided with a hex collar 28 for facilitating fastening of the parts to other components. It should be understood, however, that the female and male parts may be otherwise configured for attachment to other components of a fluid transfer system, as will be readily recognized by those skilled in the art. The coupling 10 may be used in any of a variety of applications to provide a quick push-to-connect connection, while also providing a push-to-release feature as hereinafter discussed.

The female part 12, which may be made of any suitable material, typically metal, includes a socket 30 that opens to an axial end of the female part. The socket 30 has a nipple receiving portion 32 and a lock ring groove 34 circumscribing the socket at a location axially outwardly of the nipple receiving portion.

The male part 14, which may be made of any suitable material, typically metal, is telescopically insertable into the socket 30 in the female part for enabling fluid communication between respective fluid flow passages 36 and 38 in the female 12 and male 14 parts. The male part 14 has a leading nipple portion 40 and a trailing latching portion 42 having an annular radially outwardly opening latch groove 44 that is axially bounded by a pusher shoulder or surface 46 and a latching shoulder or surface 48. As shown, the pusher and latching surfaces are formed by the side walls of the groove 44, although other arrangements are also contemplated.

The radially expandable and contractible lock ring 16 is retained in the annular lock groove 34 in the female part 12. The lock ring 16 preferably is a split ring made of metal, although other suitable non-elastomeric materials may also be used. The illustrated lock ring 16 is generally rectangular shape in cross-section, however, other cross-sectional shapes can also be used. The lock ring 16 can be resiliently expanded and contracted between a relatively relaxed condition and an expanded condition as herein described. In the relaxed condition shown in Fig. 1, the radially inner diameter of the lock ring 16 is less than the diameter of the latching portion 42 at the latching shoulder 48 of the latch groove 44. The lock ring 16 is expandable into the lock ring groove 34 to allow the male part 14 to be inserted therethrough to a latching position (Fig. 1) aligning the latch groove 44 with

the lock ring 16, whereupon the lock ring 16 can contract into the latch groove 44 and create an axial interference with the latching shoulder to prevent the male part 14 from being axially withdrawn from the female part. When pressurized fluid is supplied to the flow passages 36 and 38 in the female 12 and male 14 parts, fluid pressure will try to force the male portion out of the female portion. The latching shoulder 48 will bear against the lock ring 16 which in turn will bear against the axially outer wall of the lock ring groove 34, thereby preventing the male part 14 from separating from the female part. The axially outer portion of the lock ring 16 may have a reduced diameter portion that prevents the lock ring 16 from expanding by any significant amount that could lead to its release from the latching groove, as is conventionally known.

The release ring 18 is retained in the latch groove 44 and has an axial length less than the latch groove 44. The release ring 18 preferably is a split ring made of any suitable material and typically a metal. The release ring 18 is movable by the pusher surface 46 into the central aperture of the lock ring 16 when the male part 14 is pushed axially inwardly beyond its latching position. The release ring 18 has a cam surface 56 for acting upon a follower surface 58 of the lock ring 16 to cause the lock ring 16 to expand radially outwardly sufficiently to allow the lock ring 16 to pass over the latching shoulder 48 and thereby permit axial withdrawal of the male part 14 from the female part. Thus, the female 12 and male 14 parts can be easily released without the need for a tool. Preferably at least one of the cam surface and follower surface 58 is tapered to facilitate the camming action.

The female part 12 preferably extends beyond and surrounds the release ring 18 when the male part 14 is in its latching position of Fig. 1. That is, the release ring 18 is fully contained within the confines of the female part, thereby preventing any inadvertent actuation of the release ring 18.

A seal 62 may be provided for sealing the female part 12 to the male part 14 at a location in the female part spaced axially outwardly of the lock ring groove 34, and a seal 64 may be provided for sealing between the female part and the male part 14 at a location within the female part located axially inwardly of the lock ring groove 34. In the illustrated embodiment, the seal 62 is an annular seal retained in

a counterbore 66 in the axial end face 68 of the female part 12. The seal 62, in particular an O-ring, is held in the groove by a washer 67 that in turn is held against the lockout ring 20. The seal 64 is an annular seal, particularly an O-ring, that is retained in a groove on the OD of the nipple portion 40 of the male part 14. The seal seals against the ID of the nipple receiving portion of the female part 12 that closely surrounds the OD of the nipple 40 with a sliding fit.

For similar reasons, the male part 14 has a ramp surface 70 between the nipple portion 40 and the trailing latching portion 42 for progressively expanding the lock ring 16 as the male part 14 is being pushed through the lock ring 16. It will be appreciated that a radially inner surface 71 of the lock ring 16 has an axially dimension that permits the lock ring 16, when in the expanded state, to extend from the radially outer surface of the release ring 18 to the latch shoulder 48 to thereby permit withdrawal of the male part 14 from the female part 12 during disconnect.

The lockout device 20 is located between the end face 68 and a backstop 76 on the male part 14. The illustrated lockout device 20 has an opening through which the male part 14 extends. In the illustrated embodiment, the opening is a closed-ended slot that is captured on the male part 14 such that it cannot be removed when the male part 14 is coupled to the female part 12. The lockout device 20 is transversely movable between a release position and a lock position, the latter being shown in Fig. 1. When the lockout device 20 is in the lock position, a relatively thick portion of the lockout device 20 is positioned between the backstop 76 and the washer 67 to prevent the male part 14 from being pushed further into the female part 12. When shifted to its release position, a thinner portion of the lockout device 20 is aligned with the backstop 76 and washer 67 thereby allowing the male part 14 to be pushed into the female part 12 beyond the latching position, thereby to actuate the release ring 18 for decoupling the male part 14 from the female part 12.

Turning now to Figs. 2-5, the operation of the coupling 10 during installation (connection) will be described. In Fig. 2, the female part 12 and male part 14 are illustrated in a pre-installation position wherein the female part 12 and male part 14 are separate from each other.

In Fig. 3, the nipple portion 40 of the male part 14 is received within the nipple receiving portion 32 of the socket 30 of the female part 12. Ramp surface 70 of the male part 14 is contacting lock ring 16 such that further inward movement of the male part 14 will result in the lock ring 16 being pushed radially outward by the ramp surface 70.

In Fig. 4, the male part 14 is further received within the female part 12 such that the lock ring 16 has been pushed radially outwardly into the lock ring groove 34. In this position, the lock ring 16 is fully expanded and a radially inner surface 71 of the lock ring 16 is engaged with latch shoulder 48. Further inward movement of the male part 14 will result in the latch shoulder 48 clearing the lock ring 16 and the lock ring 16 contracting radially inwardly into latch groove 44.

In Fig. 5, the male part 14 is still further received within female part 12 such that latch shoulder 48 has cleared the lock ring 16 and the lock ring 16 has contracted radially inwardly into latch groove 44. The lock ring 16 is now axially engaged with latch shoulder 48.

Turning to Fig. 6, the coupling 10 is illustrated in the installed (connected) position. In this position, the male part 14 has been slightly withdrawn from the female part 12 in relation to the position illustrated in Fig. 5. Latch shoulder 48 is engaged with lock ring 16 which in turn is engaged with a surface of the lock ring groove 34 thereby preventing removal of the male part 14 from the female part 12. Lockout device 20 is in the lock position and a relatively thick portion of the lockout device 20 is positioned between the backstop 76 and the washer 67 to prevent the male part 14 from being pushed further into the female part 12.

Now turning to Figs. 7-9, operation of the coupling 10 during release (disconnect) will be described. Beginning from the position illustrated in Fig. 6, the lockout device 20 is moved to the unlock position, and the male part 14 is pushed into the female part 14, as shown in Fig. 7. As the male part 14 is pushed into the female part 12, the ramp surface 70 of the release ring 18 forces the lock ring 16 radially outwardly.

Once the lock ring 16 has been expanded by the release ring 18 such that the radially inner diameter of the lock ring 16 is greater than the latching portion 42

of the male part 14 at latch shoulder 48, the male part 14 can be withdrawn from the female part 12.

In Fig. 8, the release ring 18 is now axially engaged with latch shoulder 48, having shifted axially inwardly from its position in Fig. 7 as the male part 14 is withdrawn. The radially inner surface 71 of the lock ring 16 is engaged with the radially outer surface of the release ring 18 and the radially outer surface of the latch shoulder 48. The radially inner surface 71 of the lock ring may have an axial dimension that is greater than the axial extent of the ramp surface 70 to prevent the lock ring 16 from contracting into the latch groove 44 before coming into radial contact with the latch shoulder 44 during withdrawal of the male part 14.

In Fig. 9, the male part 14 has been further withdrawn from the female part 12. The latch shoulder 48 has cleared the lock ring 16 such that complete removal of the male part 14 from the female part is possible.

Although the invention has been shown and described with respect to a certain preferred embodiment or embodiments, it is obvious that equivalent alterations and modifications will occur to others skilled in the art upon the reading and understanding of this specification and the annexed drawings. In particular regard to the various functions performed by the above described elements (components, assemblies, devices, compositions, etc.), the terms (including a reference to a "means") used to describe such elements are intended to correspond, unless otherwise indicated, to any element which performs the specified function of the described element (i.e., that is functionally equivalent), even though not structurally equivalent to the disclosed structure which performs the function in the herein illustrated exemplary embodiment or embodiments of the invention. In addition, while a particular feature of the invention may have been described above with respect to only one or more of several illustrated embodiments, such feature may be combined with one or more other features of the other embodiments, as may be desired and advantageous for any given or particular application.

Claims

1. A push-to-connect coupling comprising:

a female part including a socket that opens to an axial end of the female part, the socket having a nipple receiving portion and a lock ring groove circumscribing the socket at a location axially outwardly of the nipple receiving portion,

a male part that is telescopically insertable into the socket in the female part for enabling fluid communication between respective fluid flow passages in the female and male parts, the male part having a leading nipple portion and a trailing latching portion having an annular radially outwardly opening latch groove that is axially bounded by axially inner pusher shoulder and an axially outer latching shoulder,

a radially expandable and contractible lock ring retained in the annular lock groove in the female part, the lock ring in a relaxed condition having a radially inner diameter less than the diameter of the latching portion at the latching shoulder of the latch groove, and the lock ring being expandable into the lock ring groove to allow the male part to be inserted therethrough to a latching position aligning the latch groove with the lock ring, whereupon the lock ring can contract into the latch groove and create an axial interference with the latching shoulder to prevent the male part from being axially withdrawn from the female part, and

a release ring retained in the latch groove and having an axial length less than the latch groove, the release ring being movable by the pusher surface into the lock ring when the male part is pushed axially inwardly beyond its latching position, and the release ring having a cam surface for acting upon a follower surface of the lock ring to cause the lock ring to expand radially outwardly sufficiently to allow the lock ring to pass over the latching shoulder and thereby permit axial withdrawal of the male part from the female part.

2. A push-to-connect coupling according to claim 1, wherein the female part extends beyond and surrounds the release ring when the male part is in its latching position.

3. A push-to-connect coupling as set forth in claim 2, comprising a seal for sealing the female part to the male part at a location in the female part spaced axially outwardly of the lock ring groove.

4. A push-to-connect coupling as set forth in any preceding claim, further comprising a seal for sealing between the female part and the male part at a location in the female part located axially inwardly of the lock ring groove.

5. A push-to-connect coupling as set forth in any preceding claim, wherein at least one of the cam surface and follower surface is tapered.

6. A push-to-connect coupling as set forth in any preceding claim, wherein the male part has a ramp surface between the nipple portion and the trailing latching portion for progressively expanding the lock ring as the male part is being inserted into the female part.

7. A push-to-connect coupling comprising a female part and a male part telescopically insertable into the female part, an expandible and contractible lock ring retained in one of the female and male parts for engaging a latching groove on the other of the female and male parts for holding the male part in the female part at a latching position, and the male part being movable into the female part beyond the latching position to cause a release ring to act on the lock ring to unlatch the lock ring to allow the male part to be withdrawn from the female part.

8. A push-to-connect coupling as set forth in claim 7, wherein the lock ring is a split lock ring.

9. A push-to-connect coupling as set forth in claim 7 or claim 8, wherein the female part extends beyond and surrounds the release ring when the male part is in its latching position.

10. A push-to-connect coupling as set forth in any one of claims 7-9, comprising a seal for sealing the female part to the male part at a location in the female part spaced axially outwardly of the lock ring.

11. A push-to-connect coupling as set forth in any one of claims 7-10, further comprising a seal for sealing between the female part and the male part at a location in the female part located axially inwardly of the lock ring.

12. A push-to-connect coupling as set forth in any one of claims 7-11, wherein a ramp surface is provided to expand or contract the lock ring as the male part is being inserted into the female part.

13. A push-to-connect coupling as set forth in any preceding claim, wherein the male part has a shoulder axially spaced from an end face of the female part when the male part is in its latching position, and further comprising a lock-out device insertable into the space between the shoulder and end face to prevent the male part from being pushed further into the female part.

14. A push-to-connect coupling as set forth in claim 13, wherein the lock-out device has a hole through which the male part extends.

15. A push-to-connect coupling as set forth in claim 13, wherein the lock-out device surrounds the male part and is captured in a recess in the male part that prevents withdrawal of the lock-out device from the male part.

16. A push-to-connect coupling as set forth in any one of claim 13-16, wherein the lock-out device is movable between a locking position preventing the male part from being pushed further into the female part and a release position permitting the male part to be inserted beyond its latching position.

17. A push-to-connect coupling as set forth in claim 1, wherein the lock ring has a radially inner surface having an axial length greater than an axial extent of the cam surface.

18. A push-to-connect coupling as set forth in claim 1, wherein the lock ring has a rectangular shape cross-section.

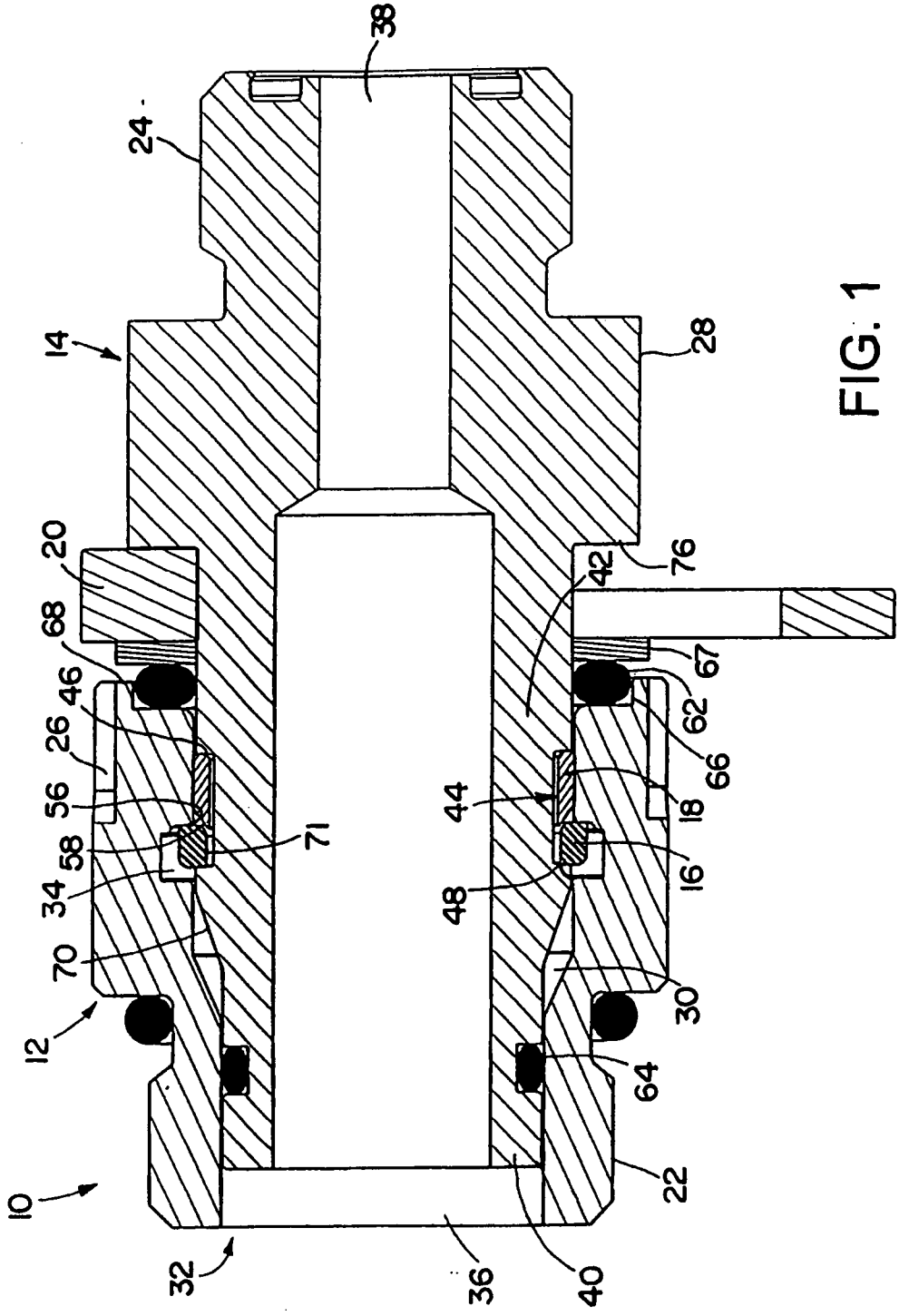

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FIG. 1

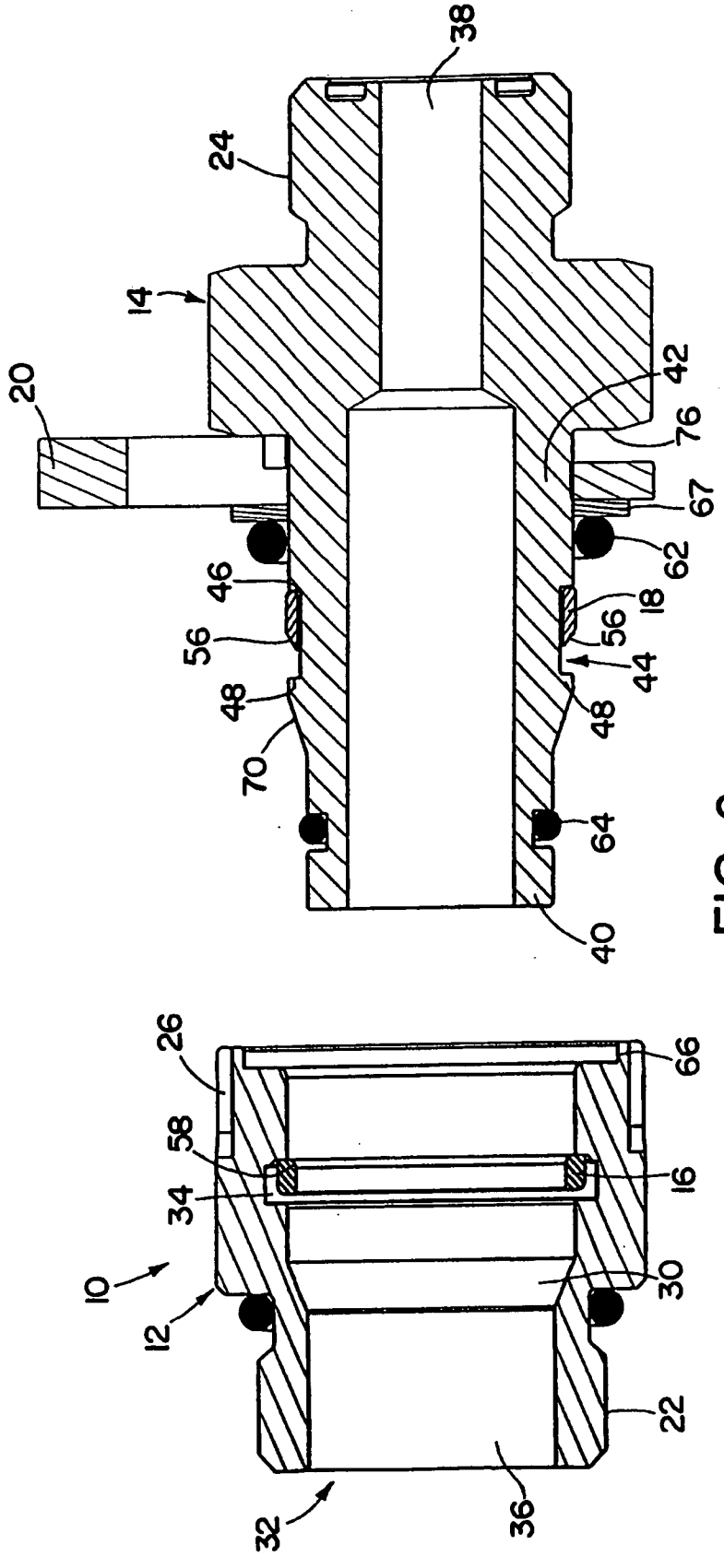

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FIG. 2

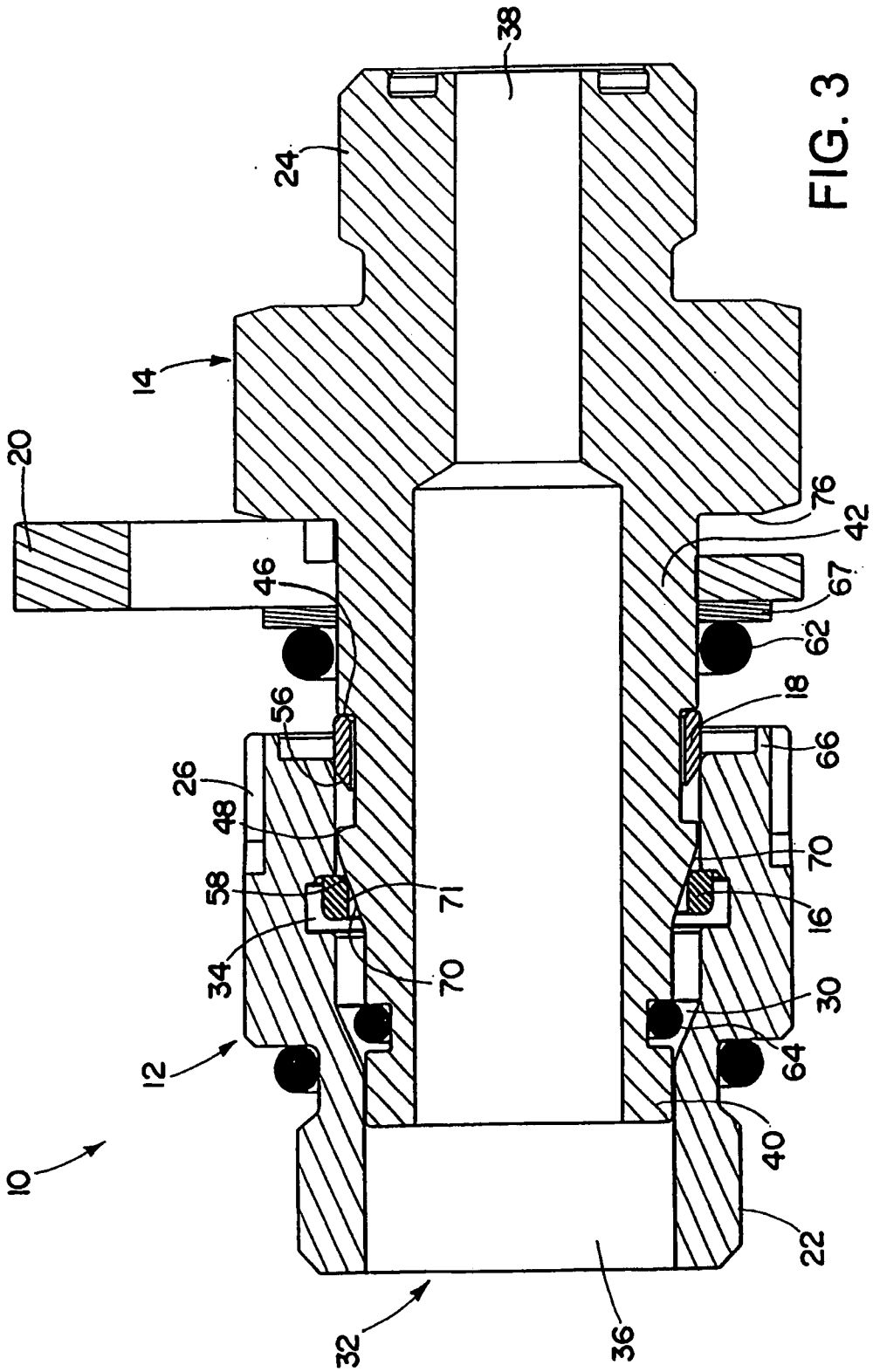

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FIG. 3

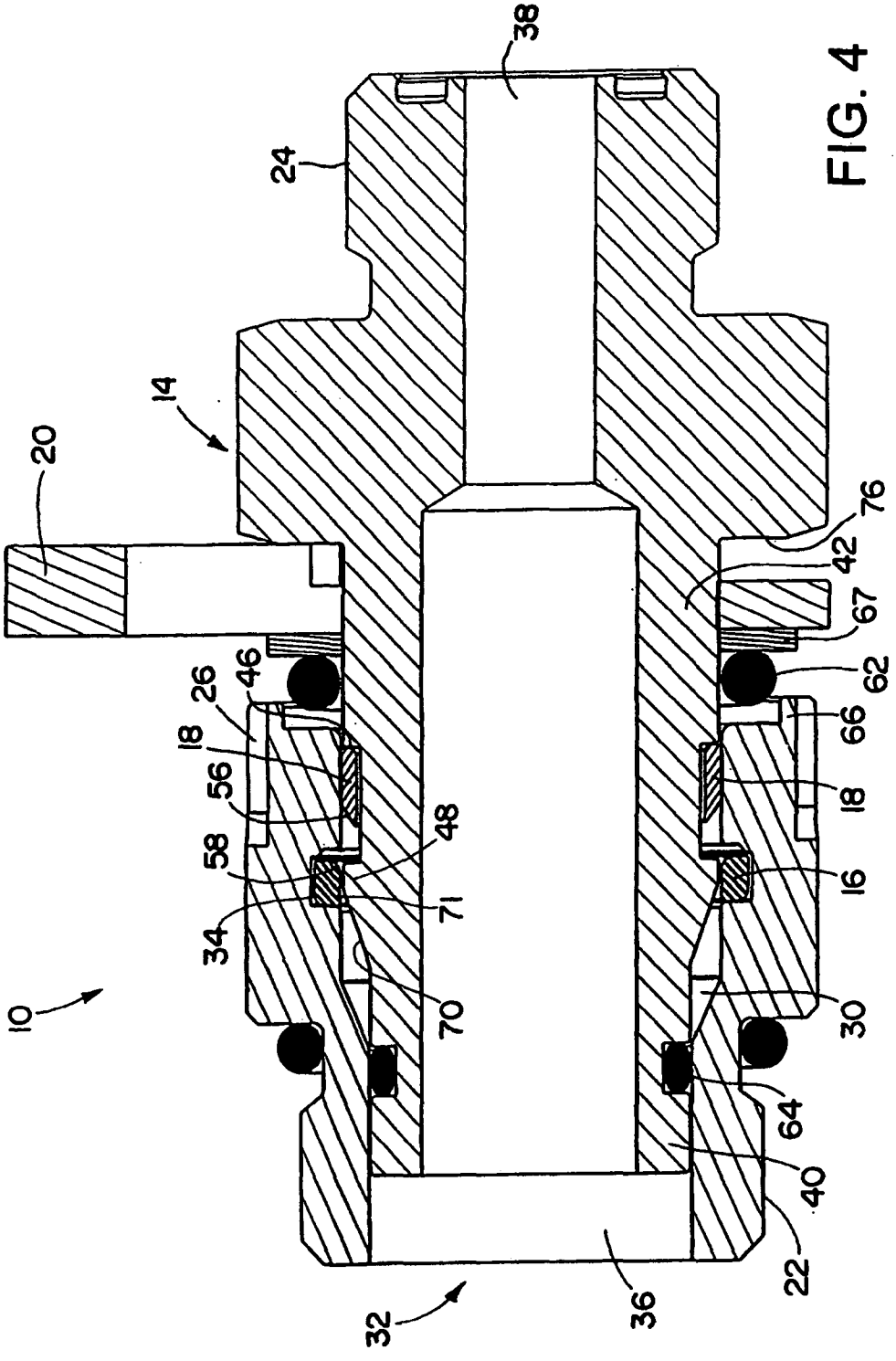

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FIG. 4

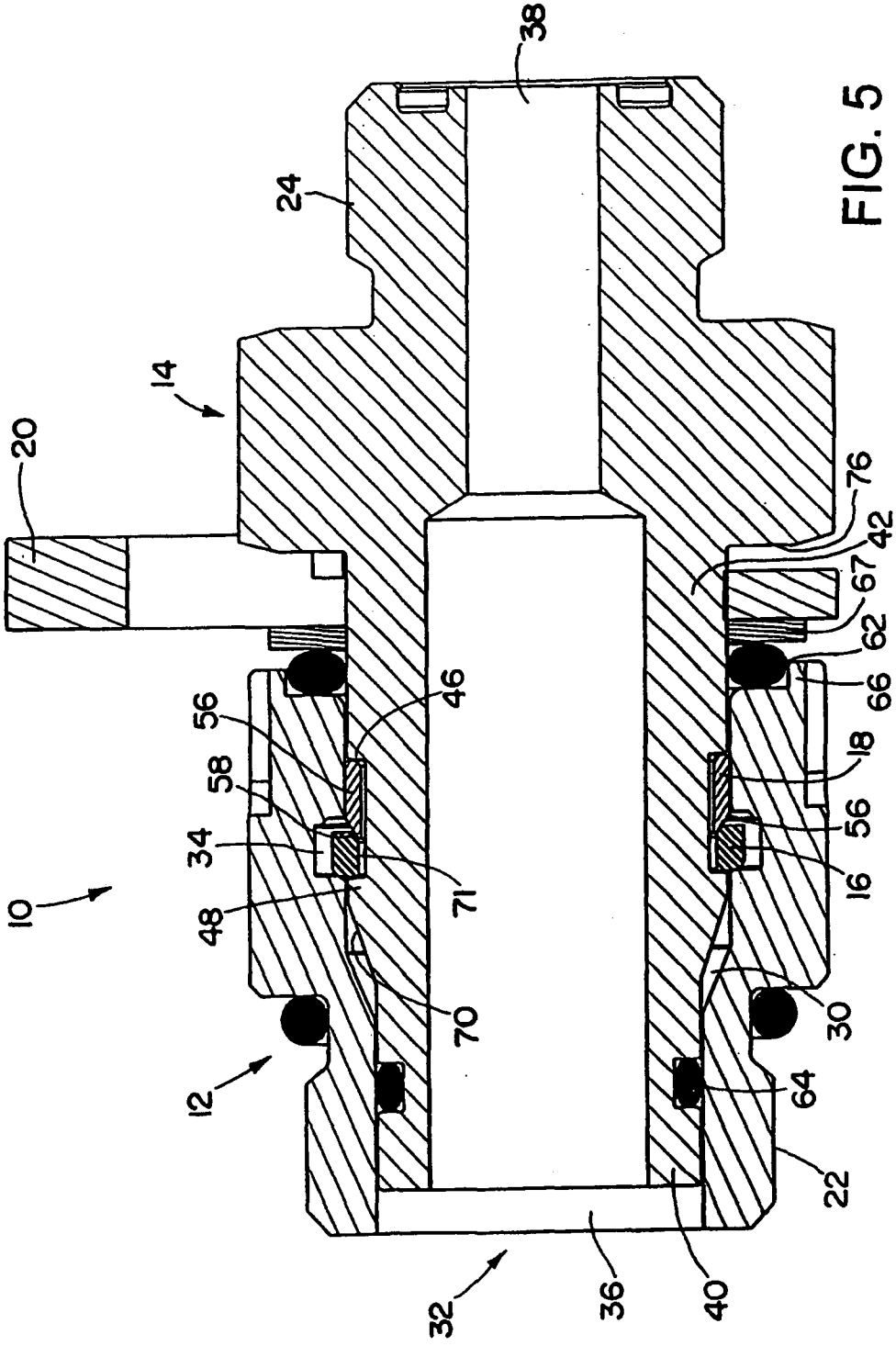

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FIG. 5

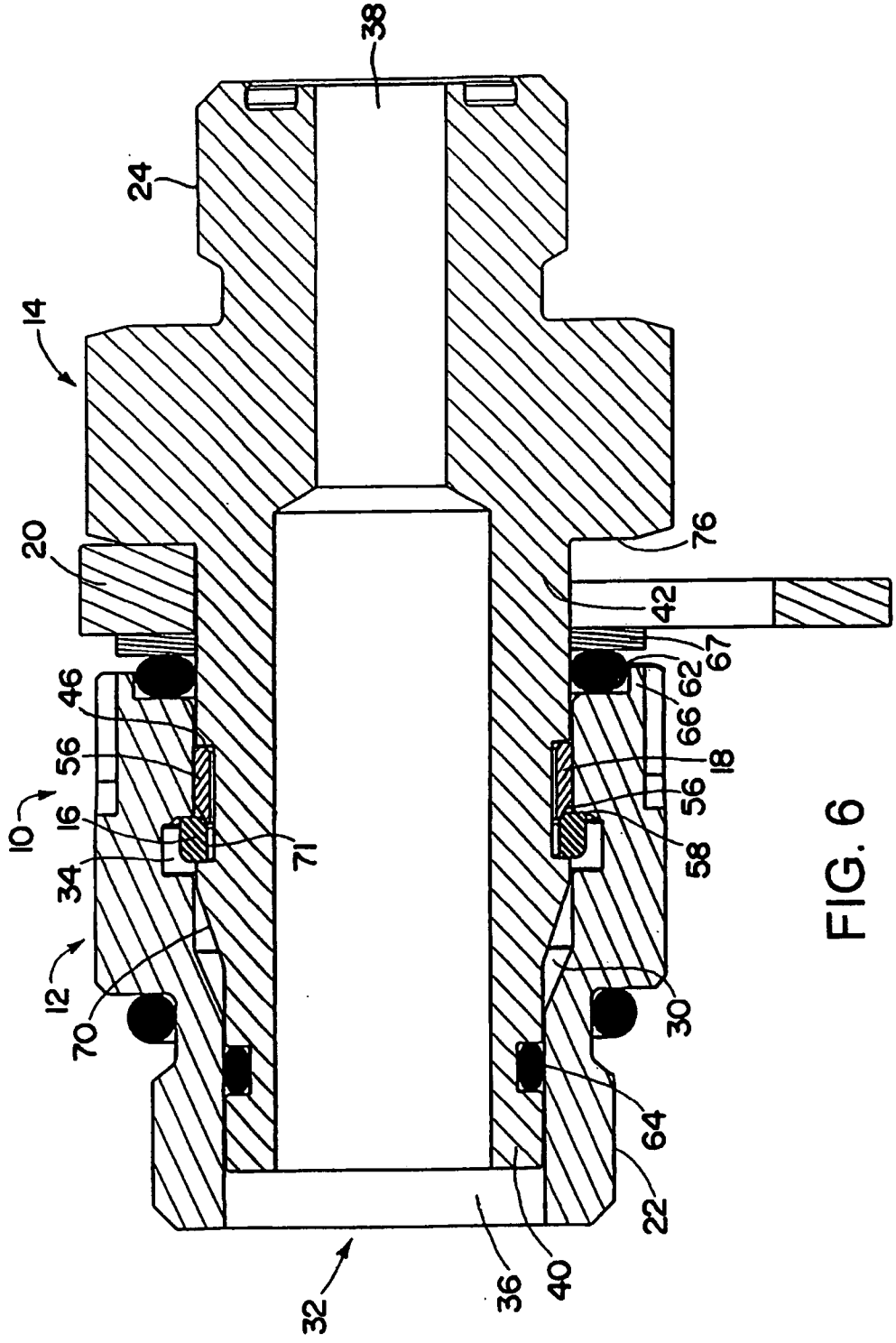

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FIG. 6

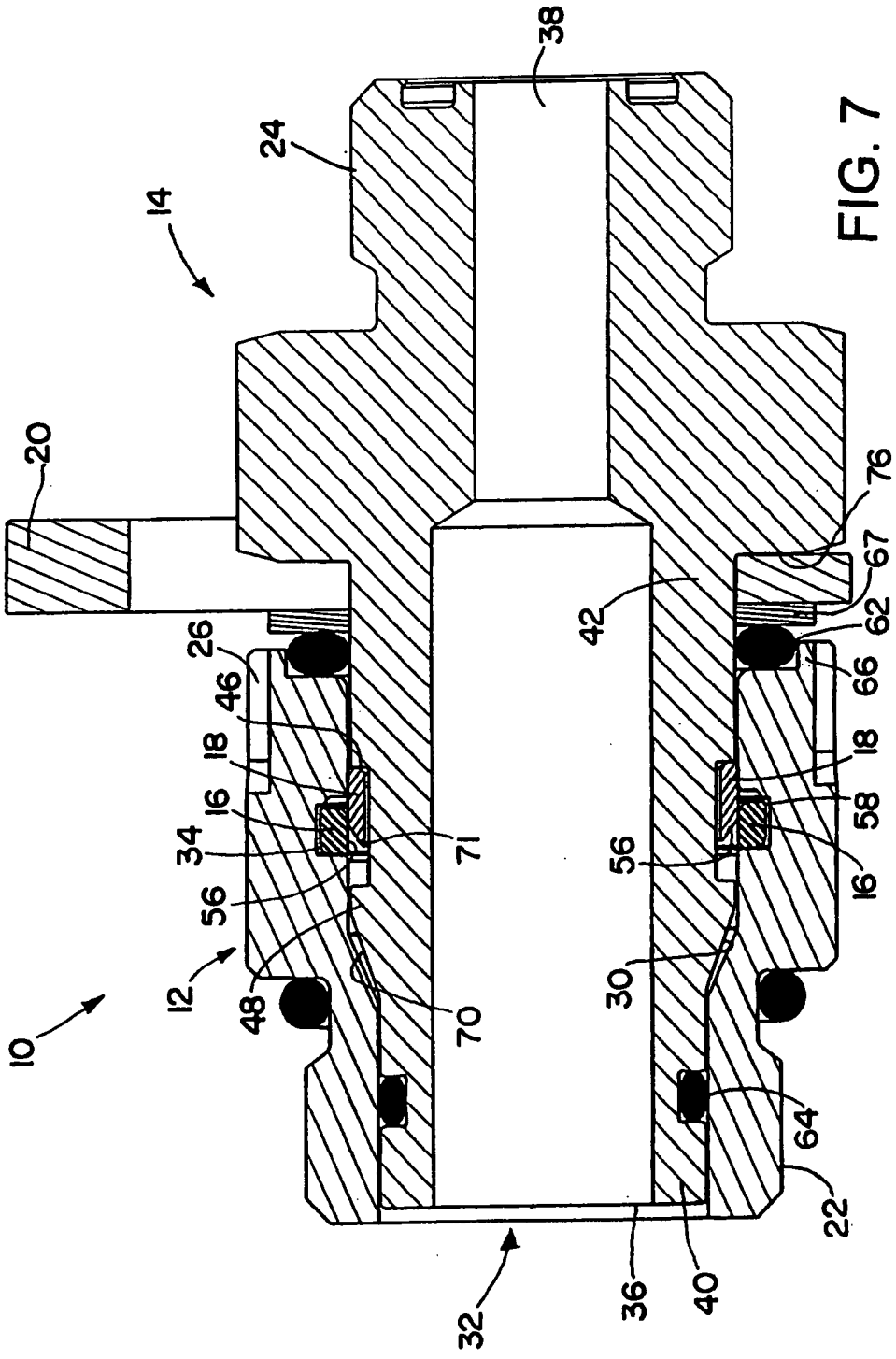

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FIG. 7

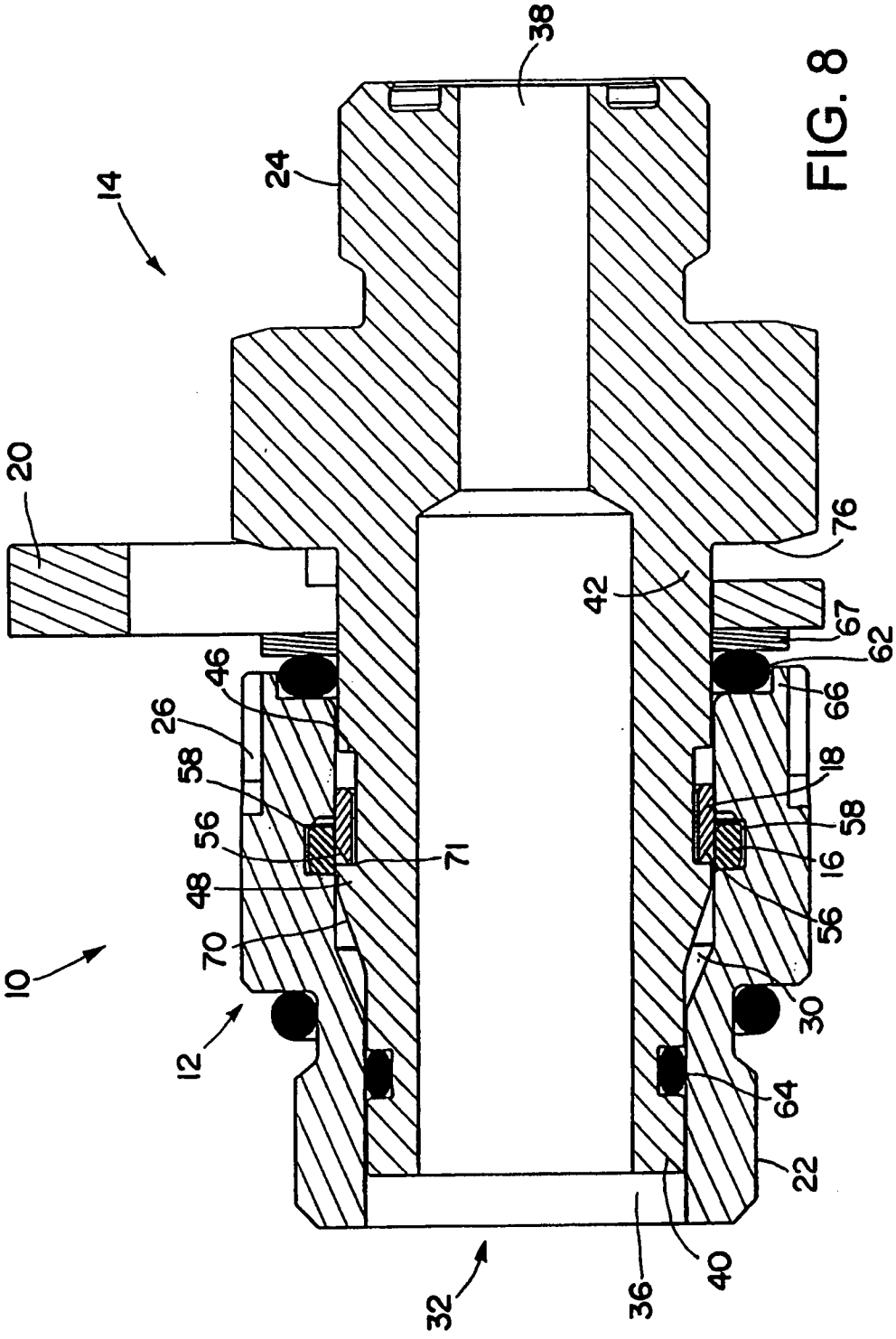

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FIG. 8

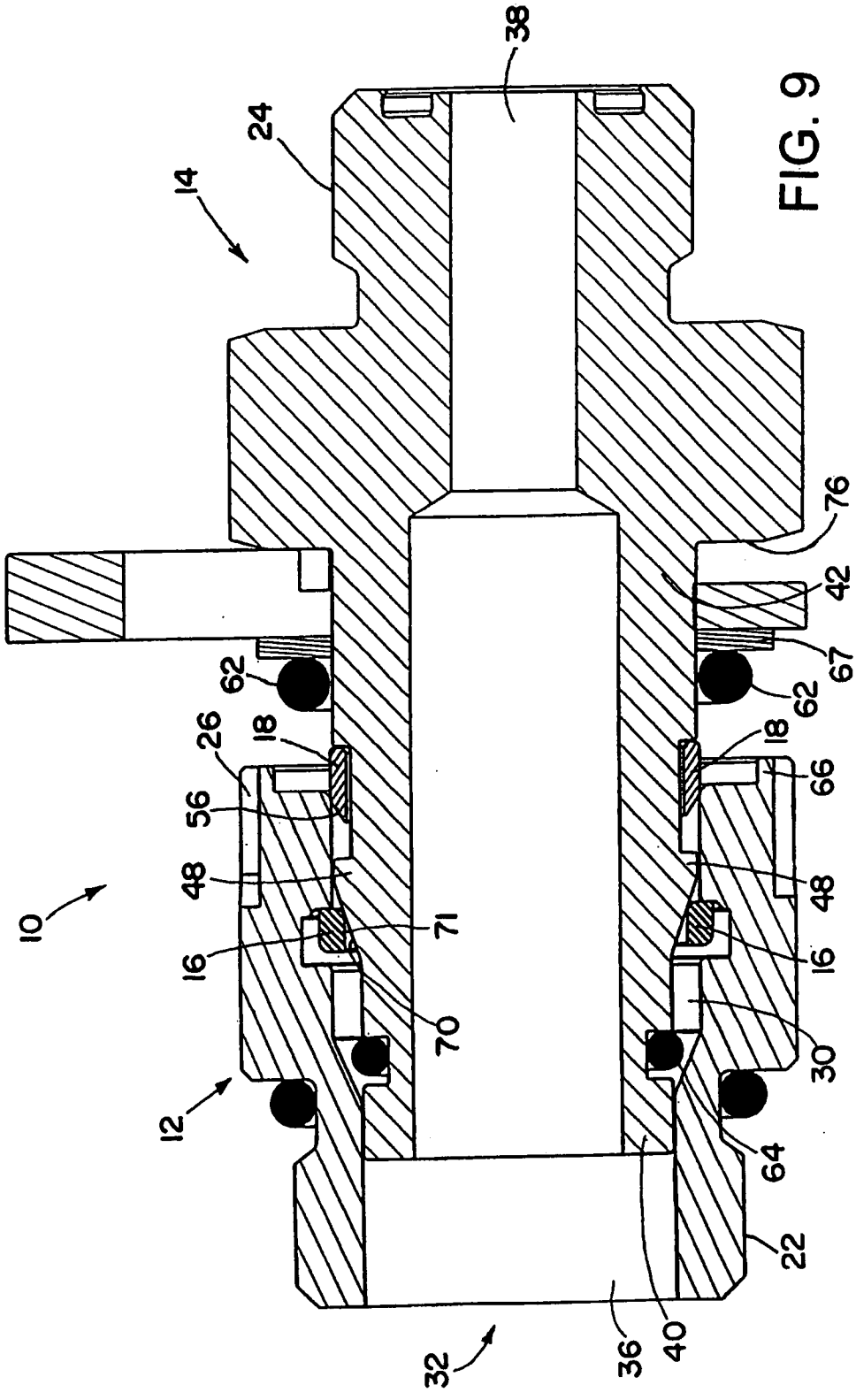

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FIG. 9