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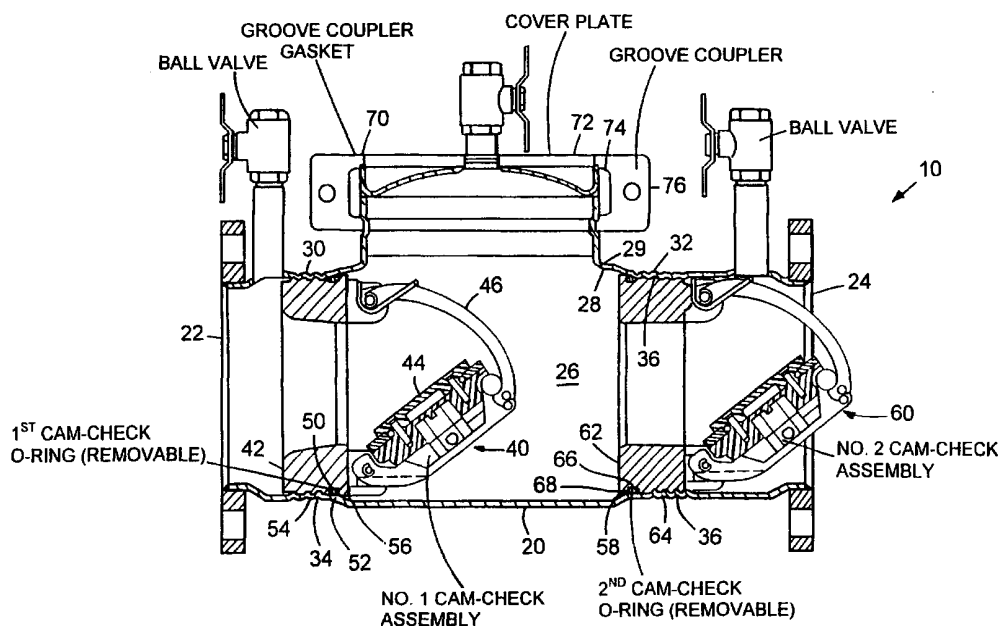
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(54) Title: BACKFLOW PREVENTION ASSEMBLY



(57) Abstract: A backflow prevention assembly has a unitary housing with a passage therethrough, two threaded regions formed in an inner surface of the unitary housing, and two valve assemblies positioned in the passage to prevent fluid flow in a direction. Each valve assembly has an annular mount having a threaded outer surface that engages one of the threaded regions on the inner surface of the housing. The threads can be formed by placing a die having a thread on an outer surface thereof in contact with an inner surface of the unitary housing, and pressing on the outer surface of the housing.

WO 01/40586 A1

Backflow Prevention Assembly

Background

5 This invention relates to a backflow preventer.

Backflow preventers are principally used to prevent contamination of a public water distribution system by reducing or eliminating backflow or back-siphonage of contaminated water into the system. Usually, the backflow prevention assembly is installed in a pipeline between a main supply line and a service line that feeds an
10 installation, e.g., a hotel, factory or other institution, or even a multiple or single family residence. A backflow prevention assembly typically includes two check valves that are configured to permit fluid flow only in the direction from the main supply line to the service line.

Figure 1 illustrates a conventional connection between a valve module 40'
15 and a housing 20' of a prior art backflow preventer. As shown, an annular mount 90 having an threaded inner surface 92 and a smooth outer surface 94 is secured to a cylindrical inner surface 96 of housing 20', e.g., by solder 98 or welding 99. The valve module 40' is then screwed into mount 90 to secure it to the housing.

Summary

20 In one aspect, the invention is directed to a backflow prevention assembly. The backflow prevention assembly has a unitary housing with a passage therethrough, two threaded regions formed in an inner surface of the unitary housing, and two valve assemblies positioned in the passage to prevent fluid flow in a direction. Each valve
25 assembly has an annular mount having a threaded outer surface that engages one of the threaded regions on the inner surface of the housing.

Implementations of the invention may include the following features. The two valve assemblies may be cam-check valves. The threaded regions may be formed by a thread rolling process, e.g., by placing a threaded die against the inner surface of the

housing and pressing on an outer surface of the housing. Threaded regions may also be formed in the outer surface of the unitary housing.

In another aspect, the invention is directed to a method of forming threads in a tubular housing. In the method, a die having a thread on an outer surface thereof is
5 placed in contact with an inner surface of a unitary housing having a passage therethrough. The outside of the housing is pressed to drive the inner surface against the threads on the outer surface of the die to form threads on the inner surface of the housing.

Implementations of the invention may include the following features. The thread on the outer surface of the first die may be generally the inverted shape of the threads to
10 be formed on the inner surface of the housing. A second die having a thread formed on an outer surface thereon may be used to press on the outside of the housing. Two valve assemblies may be positioned in the passage to prevent fluid flow in a direction, each valve assembly having an annular mount having a threaded outer surface that engages one of the threaded regions on the inner surface of the housing. A port may be formed in a
15 wall of the housing.

Advantages of the invention may include the following. The backflow prevention assembly is easier to assemble, e.g., in the field, and is less expensive to manufacture than currently available backflow prevention assemblies for similar applications.

Other features and advantages of the invention will become apparent from the
20 following detailed description, including the drawings and the claims.

Brief Description of the Drawings

Figure 1 illustrates a conventional connection between a check valve and a housing in a prior art backflow preventer;

25 Figure 2 is a cross-sectional view of a backflow prevention assembly according to an embodiment of the present invention;

Figure 3 is a cross-sectional view of a check valve from the backflow preventer of Figure 2;

Figure 4 is a cross-sectional side view illustrating the formation of the threads in
30 the housing of the backflow preventer;

Figure 5 is a view along line 5-5 of Figure 4;

Figure 6 is an expanded view of the connection of the check valve to the housing in the backflow preventer of Figure 2; and

Figure 7 is cross-sectional view of a backflow prevention assembly according to an alternative embodiment of the present invention.

5

Detailed Description

Referring to Figure 2, a backflow prevention assembly 10 includes a unitary tubular housing 20 having a first end 22 and a second end 24. A through bore 26 extends between the ends 22, 24 of housing 20 for the flow of water therethrough. A pair of valve modules 40, 60 are located inside through bore 26 to permit fluid flow from the first end 22 of housing 20 to the second end 24 of housing 20, while preventing fluid flow in the opposite direction. An inner surface 28 of tubular housing 20 includes two threaded annular regions 30, 32 with internal threads 34, 36.

Valve module 40 may be a cam-check valve, e.g., Check Assembly Kit No. RK-775CK1 available from Watts Industries, North Andover, Massachusetts, although the invention is applicable to other valves, such as a ball valve. As shown in Figure 3, cam-check valve 40 includes an annular seat 42, a clapper 44 pivotally connected to annular seat 42, and a cam arm 46 to prevent over-extension of clapper 44. An outer surface 48 of seat 42 includes external threads 54 and an annular recess 50 to secure an O-ring 52 near an end 56 of the seat adjacent clapper 44. When valve module 40 is inserted into through bore 26, external threads 54 on seat 42 cooperate with threads 34 in threaded annular region 30 to secure valve module 40 in housing 20. In addition, O-ring 52 is secured between outer surface 48 of seat 42 and housing 20 to prevent fluid leakage therebetween. A similar cam-check valve, lacking external threads and an annular recess for an O-ring on the outer surface of the seat, is described in U.S. Patent No. 5,855,224, the entirety of which is incorporated herein by reference.

Returning to Figure 2, valve module 60 can also be a cam-check valve, and can be constructed in a fashion similar to valve module 40 with an annular seat 62, a clapper pivotally connected to annular seat 62, and a cam arm to prevent over-extension of clapper. An outer surface of the seat includes external threads 64 and an annular recess 66 to hold an O-ring 68. External threads 64 cooperate with internal threads 36 to secure valve module 60 in housing 20. Like valve module 60, O-ring 68 is secured between the

outer surface of seat 62 and housing 20 to prevent fluid leakage therebetween. However, in valve module 60, annular recess 66 can be located near an end 58 of seat 62 opposite clapper 60.

Housing 20 includes a port 70 which provides access to bore 26 and valve
5 modules 40 and 60. Port 70 is closed by securing a cover plate 72 to a rim 74 with a groove coupler 76 and a groove coupler gasket 78.

Referring to Figures 4 and 5, threads 34, 36 are formed in housing 20 by a thread rolling process that uses a threaded internal die 80. Internal die 80 has threads 82 that are the inverse shape of the threads to be formed on housing 20. Unlike conventional thread
10 rolling processes, in which a die with non-inverted threads is held against the outside surface of a housing, in this method, internal die 80 is held against inside surface 28 of housing 20. Specifically, housing 20 begins with an inner diameter D1 that is slightly larger than the major diameter D2 of threads 82 on internal die 80. The threaded internal die 80 is inserted into through bore 26, and external die 84 are positioned around an outer
15 surface 29 of tubular housing 20. The external die force a portion 30 of tubular housing 20 inwardly to mold inner surface 28 of housing 20 to internal die 80, thereby forming threads 34. Alternatively, tubular housing 20 can be held steady and internal die 80 can be moved in an orbit as it is pressed against the inner surface of the housing. In either case, the threads penetrate the blank inner surface to form the thread roots and displace
20 material radially outward to form the die crests. Then the internal die is unscrewed from threaded portion 30 to remove the internal die from the housing. This thread rolling process is then repeated to form threads 36 in threaded portion 32 of housing 20. Alternatively, two die could be inserted into the through bore, and threaded portions 30 and 32 could be formed simultaneously. In addition, the external die 84 can have a thread
25 86 formed on its outer surface to force the material of the housing into the gaps between threads 82 on internal die 80, thereby also forming threads on outer surface 29. The port 70 could be formed in housing 20 before or after threaded portions 30 and 32.

Since the inner surface of the housing directly contacts the die, the threads more closely match the shape intended by the die than if a die with non-inverted threads was
30 pressed against the outside surface of the housing. In contrast to other thread forming processes, such as grinding, thread rolling does not remove metal. In addition, the cold forming process can strengthen the threads by work hardening and form reinforcement.

As previously discussed, in the conventional backflow preventer shown in Figure 1, the threads are formed in a mount that is soldered to the housing. In contrast, as shown in Figure 6, threaded portions 30 and 32 are formed directly on inner surface 28 of unitary housing 20, and valve module 40 is secured directly to housing 20, without an intervening
5 mount or soldering, thereby decreasing the time and expense in constructing the backflow prevention assembly 10.

Referring to Figure 7, in an alternative embodiment, an n-shaped backflow prevention assembly 100 includes a unitary tubular housing 110 having a first end 112 and a second end 114. Attached to end 112 of housing 110 is a first member 116, and
10 attached to end 114 of housing 110 is a second member 118. Members 116, 118 have open ends 120, 122, respectively. Member 116, unitary tubular housing 110, and member 118 define an n-shaped throughbore 123 for the flow of water therethrough. Tubular housing 110 has an inner surface 124, including threaded annular regions 126, 128 in the vicinity of ends 112, 114, respectively, formed as described above.

Member 116 is formed as follows. Pipe 130 has an end 132 which is flared to fit
15 over housing end 112. Pipe 130 is cut at 134 at 90 degrees to form two lengths of pipe 136, 138. The second length of pipe 138 is welded to first length 136 to form a 90-degree bend. Second length of pipe 138 has an end 140 to which an extension 142 is welded. Extension 142 has an end 144 to which a flange 146 is welded. Member 118 is formed in
20 the same manner, with a flange 148 being welded to an end 122 of a second extension 150. Members 116, 118 are welded to 110 at ends 112, 114.

As described above, two valves (not shown) are attached to tubular housing 110 at threaded annular regions 126, 128 by passing valves through a port 152.

Other embodiments are within the scope of the claims.

25 What is claimed is:

1. A backflow prevention assembly, comprising:
a unitary housing having a wall defining a passage therethrough;
two threaded regions formed in an inner surface of the unitary housing by
reshaping the wall of the unitary housing; and
5 two valve assemblies positioned in the passage to prevent fluid flow in a
direction, each valve assembly having an annular mount having a threaded outer surface
that engages one of the threaded regions on the inner surface of the housing.
2. The backflow prevention assembly of claim 1, wherein the two valve
10 assemblies are cam-check valves.
3. The backflow prevention assembly of claim 1, wherein the threaded
regions are formed by a thread rolling process.
- 15 4. The backflow prevention assembly of claim 1, wherein the threaded
regions are formed by placing a threaded die against the inner surface of the housing and
pressing an outer surface of the housing.
5. The backflow prevention assembly of claim 1, further comprising threaded
20 regions formed in the outer surface of the unitary housing.
6. The backflow prevention assembly of claim 1, wherein the wall defines the
passage in a straight configuration.
- 25 7. The backflow prevention assembly of claim 1, further comprising two
members attached to the housing, wherein the housing and the members define a curved
configuration.

8. The backflow prevention assembly of claim 7, wherein the curved configuration is n-shaped.

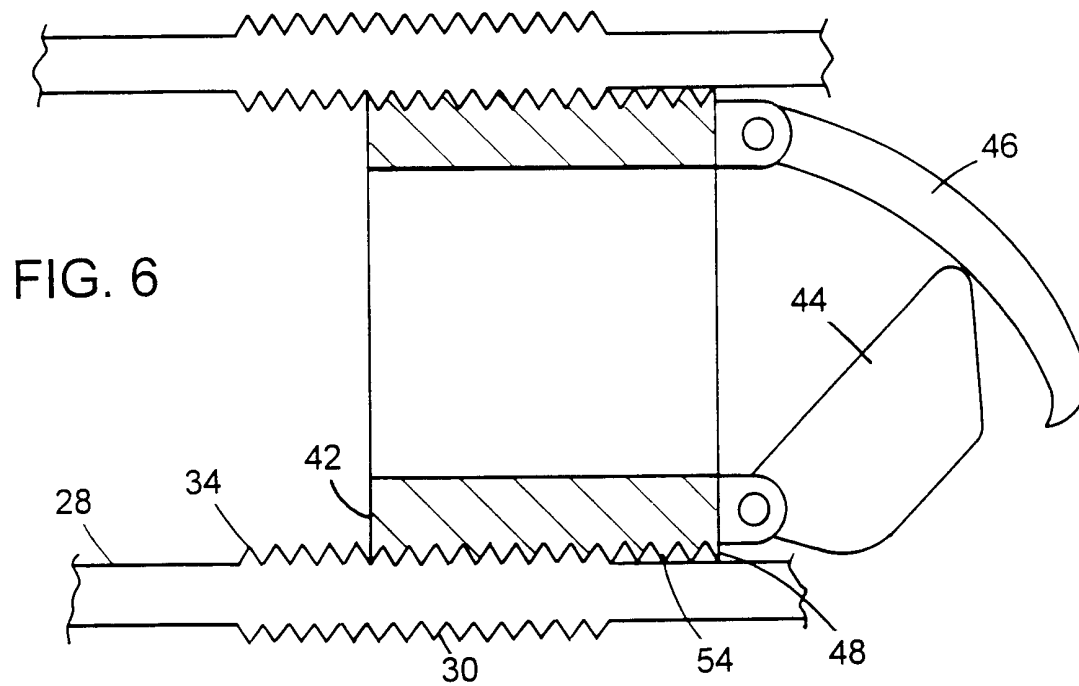
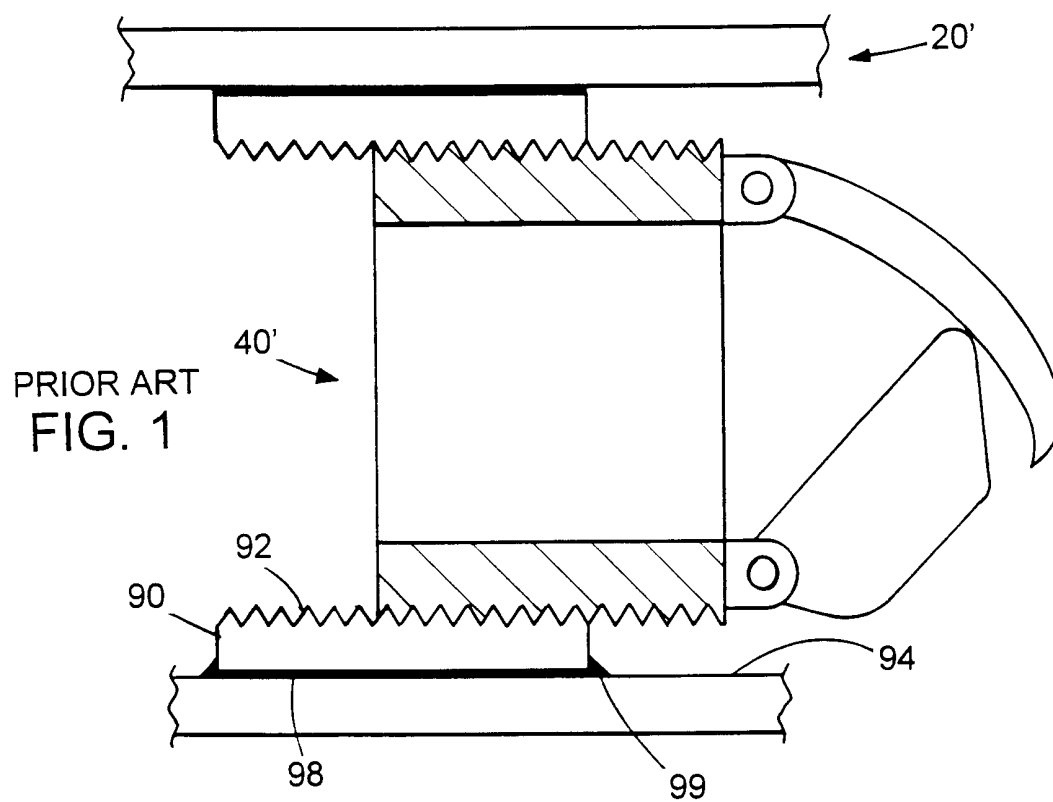
9. A backflow prevention assembly, comprising:
5 a unitary housing having a passage therethrough;
two threaded regions formed directly in an inner surface of the housing by placing a die having a thread on an outer surface thereof in contact with the inner surface of the housing and pressing on the outside of the housing to drive the inner surface against the threads on the outer surface of the die; and
10 two valve assemblies positioned in the passage to prevent fluid flow in a direction, each valve assembly having an annular mount having a threaded outer surface that engages one of the threaded regions on the inner surface of the housing.

10. A backflow prevention assembly, comprising:
15 a unitary housing having a passage therethrough;
two threaded regions formed in an inner surface of the unitary housing;
and
two valve assemblies positioned in the passage to prevent fluid flow in a direction, each valve assembly having an annular mount having a threaded outer surface
20 that engages one of the threaded regions on the inner surface of the housing.

11. A backflow prevention assembly, comprising:
a housing having a passage therethrough;
two threaded regions formed in an inner surface of the unitary housing by
25 reshaping the wall of the unitary housing; and
two valve assemblies positioned in the passage to prevent fluid flow in a direction, each valve assembly having an annular mount having a threaded outer surface that engages one of the threaded regions on the inner surface of the housing.

12. A method of forming threads in a tubular housing, comprising:
placing a first die having a thread on an outer surface thereof in contact
with an inner surface of a unitary housing having a passage therethrough; and
pressing on the outside of the housing to drive the inner surface against the
5 threads on the outer surface of the first die to form threads on the inner surface of the
housing.
13. The method of claim 12, wherein the thread on the outer surface of the
first die is generally the inverted shape of the threads to be formed on the inner surface of
10 the housing.
14. The method of claim 12, wherein a second die having a thread formed on
an outer surface thereon is used to press on the outside of the housing.
15. The method of claim 12, further comprising positioning two valve
assemblies positioned in the passage to prevent fluid flow in a direction, each valve
assembly having an annular mount having a threaded outer surface that engages one of
the threaded regions on the inner surface of the housing.
16. The method of claim 12, further comprising forming a port in a wall of the
20 housing.

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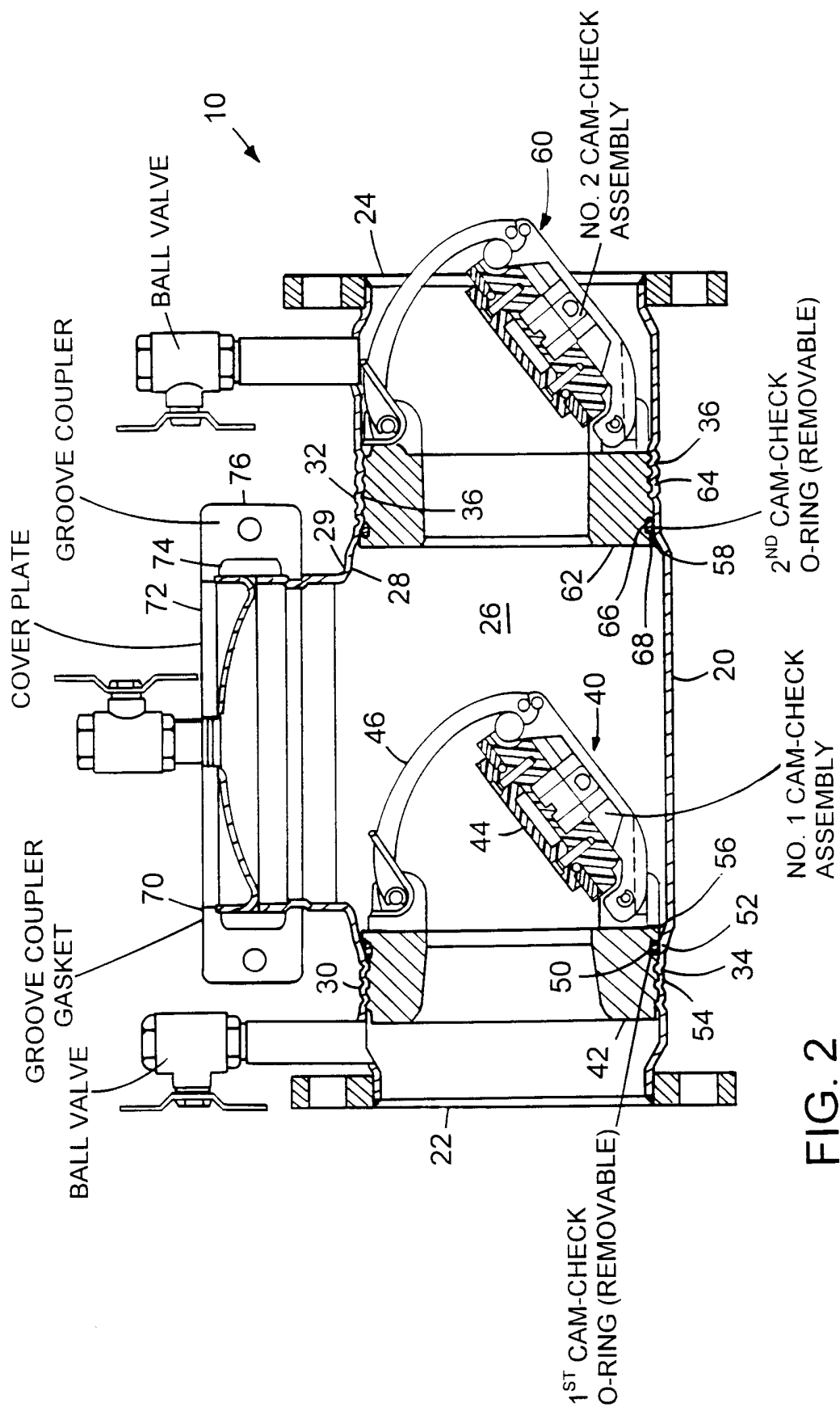


FIG. 2

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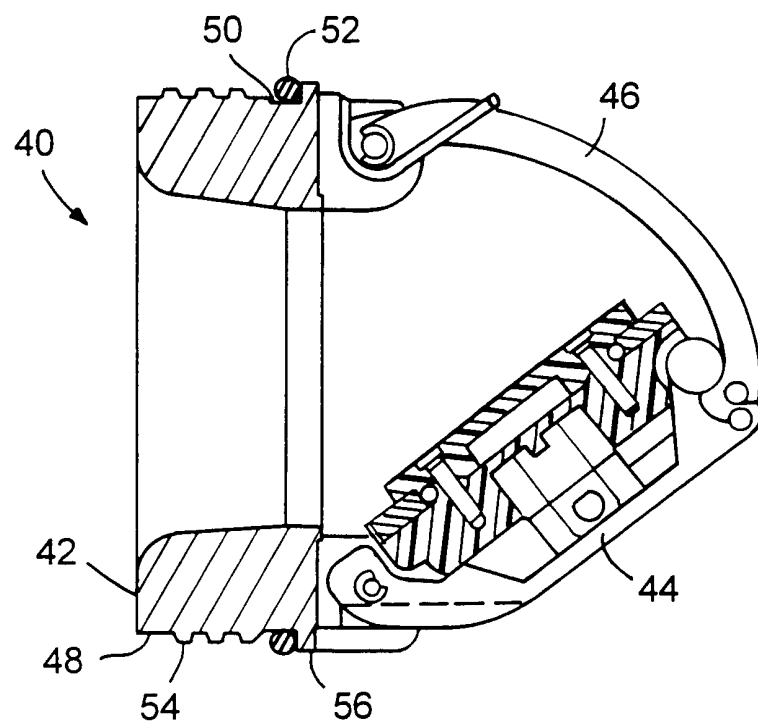
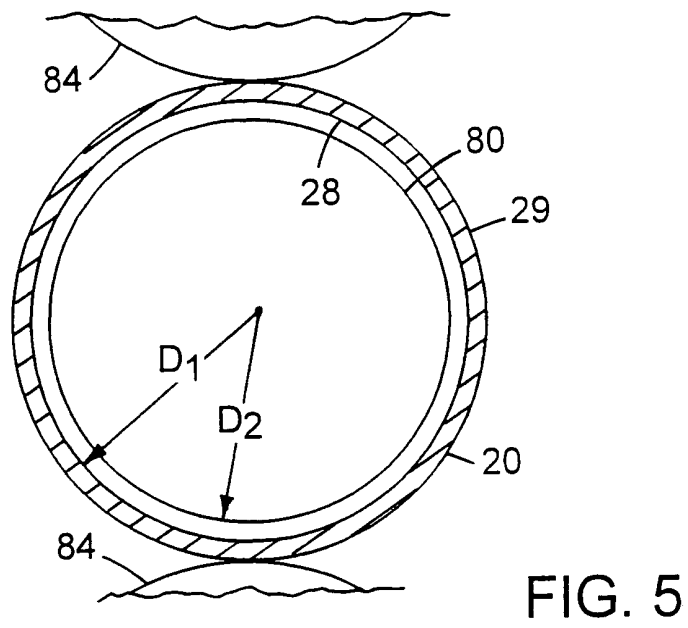
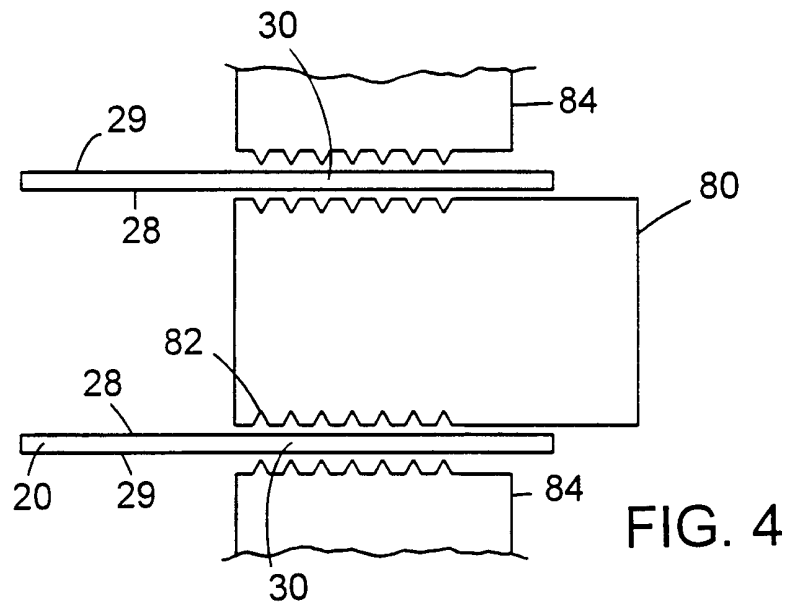


FIG. 3

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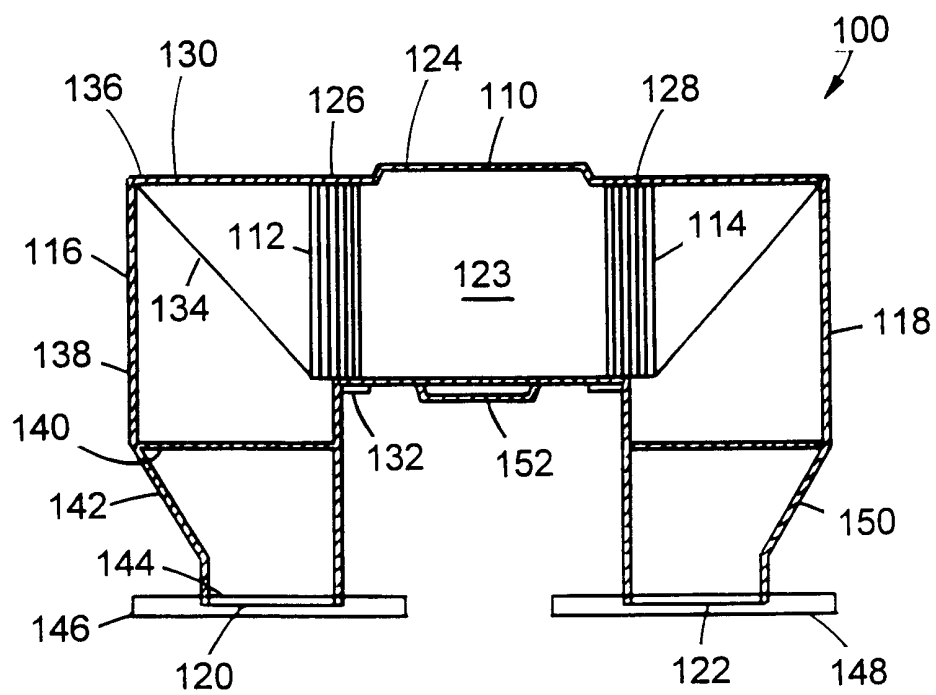


FIG. 7

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 00/32718

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 E03C1/10 F16K15/03

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 7 E03C F16K E03B

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 practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Y	page 3, line 25 - line 31; figure 1 ---	2,7,8
X	US 3 630 058 A (KIPLINGER VILMER H ET AL) 28 December 1971 (1971-12-28)	12-14
	column 2, line 21 - line 41; figure ---	
X	US 4 336 702 A (AMADO JR JUAN J) 29 June 1982 (1982-06-29)	12,13
	column 2, line 3 - line 5 column 2, line 23 - line 52; figure 2 ---	
Y	EP 0 461 647 A (AMES CO) 18 December 1991 (1991-12-18)	2
A	column 4, line 49 -column 5, line 45; figures 3-5 ---	1,6,10, 11
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☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 00/32718

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5 107 888 A (DUNMIRE CHARLES W) 28 April 1992 (1992-04-28) abstract; figures 9,10 -----	7,8

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 00/32718

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