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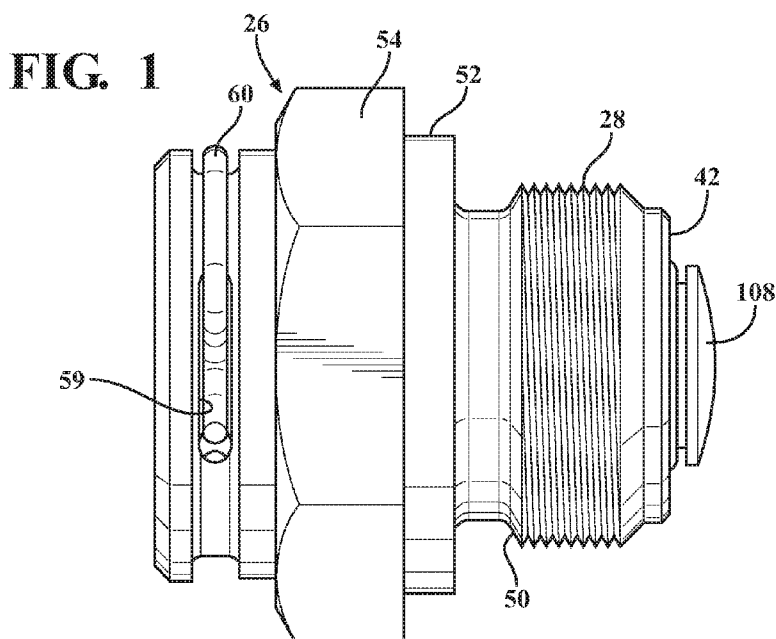
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- with international search report (Art. 21(3))
- with amended claims (Art. 19(1))

(54) Title: QUICK CONNECTOR FLUID COUPLING WITH INTEGRATED CHECK VALVE



(57) Abstract: A fluid coupling has an outlet for receiving the lead end of a tubular fluid conduit having an external locking shoulder. The coupling also holds within it adjacent an outlet a valve body that is normally closed, but is contacted and displaced against the closing force of a bias spring to open the outlet when the conduit is fully inserted and locked into the coupling by way of said locking shoulder.

QUICK CONNECT FLUID COUPLING WITH INTEGRATED CHECK VALVE

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application is a non-provisional application of U.S. Provisional Application No. 62/117,635, filed February 18, 2015, and claims the benefit thereof.

FIELD OF THE INVENTION

[0002] This invention is in the field of fluid couplings and includes a coupling body adapted to lockingly receive therein a tubular conduit that, when fully inserted, opens a check valve to permit through flow.

BACKGROUND

[0003] Fluid couplings are commonly used in automotive applications where, for example, coolant or lubricant is pumped from a supply point to a use point and the assembly sequence is such as to require a quick connection somewhere in the flow path.

[0004] In application serial number 14/725,639, a coupling with an “assurance cap” is described. The cap provides an indication that the supply tube has been fully inserted into the coupling so as to achieve a secure connection.

BRIEF SUMMARY OF THE INVENTION

[0005] The present invention provides a fluid coupling adapted to lockingly and sealingly receive a tubular fluid conduit. The coupling includes a normally closed check valve within the flow path and near an outlet point. The valve length and the location of a lock shoulder on the tubular conduit are such that the lead end of the conduit urges the valve toward an open condition only

when the conduit is fully, lockingly inserted into the coupling body. The valve has a fluted body that permits fluid to flow around the valve body and through the coupling outlet. Withdrawal of the conduit, either intentionally or otherwise, causes the valve to close.

BRIEF DESCRIPTION OF THE DRAWINGS

- [0006] Fig. 1 is a side view of a coupling useful in an embodiment of the invention;
- [0007] Fig. 2 is a cross-sectional view of the coupling of Fig. 1;
- [0008] Fig. 3 is an end view of the coupling with a check valve installed;
- [0009] Fig. 4 is an opposite end view of the coupling;
- [0010] Fig. 5 is a sectional view of the coupling with the check valve in a normally closed position;
- [0011] Fig. 6 is a perspective view, partly in section, of the coupling with check valve closed;
- [0012] Fig. 7 is a perspective view of the check valve body;
- [0013] Fig. 8 is an end view of the check valve body;
- [0014] Fig. 9 is a side view of the coupling with a tubular conduit partially inserted;
- [0015] Fig. 10 is a side view in section of the coupling with the conduit partially inserted and the valve closed;
- [0016] Fig. 11 is a side view of the coupling with the conduit fully inserted and the valve open;
- [0017] Fig. 12 is a side view in section of the coupling with conduit fully seated and valve open;

- [0018] Fig. 13 is a perspective view of an alternative design for the check valve body;
- [0019] Fig. 14 is an end view of the alternative valve body;
- [0020] Fig. 15 is a side view of the alternative valve body; and
- [0021] Fig. 16 is another perspective view of the check valve showing the recessed end cap.

DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

[0022] Referring now to Figs. 1-12, there is depicted a quick connect fluid coupling 20, including a one-piece metal body 26 with a through bore/flow path adapted to receive one end 22 of a tubular fluid conduit 24 in a locked fluid-sealed state. The coupling body 26 is itself removably mountable in a port of a utilization component (not shown).

[0023] The tubular conduit 24 is typically made of metal, but rigid plastic material may also be employed. The tubular conduit 24 has a generally constant diameter extending from the lead end 22. A section 30 extends upstream from the lead end 22 at a first diameter to an outward extending endform 32 having a tapered conical surface 34 which terminates in a large diameter end and a radially extending, back-facing shoulder 36. A fluid path 23 extends through the tubular member 24 for fluid flow.

[0024] The coupling body 26 can be, but need not necessarily be, integrally made of a single piece of metallic or plastic material. The coupling body 26 has a through bore 40 extending from a first end 42 to a second end 44. The bore 40 need not have a constant diameter between the first and second ends 42 and 44.

[0025] An annular internal groove 46 is formed in the coupling body 26 intermediate the first and second ends 42 and 44. The groove 46 receives a seal member 48, such as an O-ring, for sealing the tubular member 24 to the coupling body 26 to prevent fluid leakage there between.

[0026] As described above, the coupling body 26 has an externally threaded end portion 28. The threaded end portion 28 is spaced from the first end 42. A recessed radially inward extending groove 50 can be formed in certain applications adjacent between one end of the threaded end portion 28 and a larger diameter annular collar 52 to receive an external seal member or washer, not shown. A hexagonally shaped portion 54 forming a plurality of hex flats 55 is formed adjacent the annular collar 52. A reduced diameter end portion 56 having a generally constant diameter extends from one end of the hexagonal portion 54 to the second end 44 of the coupling body 26. A recessed, outward opening, annular groove 58 is formed in the receiving portion 56. The groove 58 has a constant closed inner end facing the bore 40 in the coupling body 26 which is interrupted by one or more circumferentially spaced slots 59.

[0027] A resilient clip or retainer 60 is mounted in the groove 58. The clip 60 can be, but need not necessarily be, formed of a single piece of spring wire. The clip 60 can be formed with a plurality of inward extending protrusions 62 which project through the slots 59 in the groove 58, when the clip 60 is in a relaxed state behind the shoulder 36 on the tubular member 24 to lock the tubular member 24 to the coupling body 26.

[0028] When the first end 22 of the tubular member 24 is inserted into the receiving portion or socket 56 of the coupling body 26, the head portion 32 of the first end 22 of the tubular member 24 slides through the receiving portion 56 toward the first end of the coupling body 26. The inwardly extending protrusions 62 on the clip 60 seated in the groove 58 slide along the radially outward tapered endform 34 on the tubular member 24 causing the resilient clip 60 to expand radially outward moving the protrusions 62 on the clip 60 out of the bore 40 until the shoulder 36 on the endform 32 can slide past the clip 60. At this point, the protrusions 62 on the clip 60 snap

radially inward into the bore 40 behind the shoulder 36 locking the tubular member 24 in the coupling body 26.

[0029] As shown in Figs. 10 and 12, the threads 28 on the coupling body 26 threadingly engage internal threads 29 in a bore 27 formed in an external component. This enables fluid to flow between the external component 25 and the tubular member 24, but only when the valve 100 is open as hereinafter described.

[0030] Referring briefly to Fig. 2, the bore 40 has a radially inward extending, reduced diameter lip 70 formed at the first end 42. The lip 70 is spaced from a tapered end surface 72 adjacent first end 42 and forms an inward extending shoulder 74 which opens to a first end bore portion 76. The tapered end surface 72 forms a seal seat for a seal member and described hereafter.

[0031] A check valve 100 is axially slidably carried in the coupling body 26 in the first end bore portion 76 and is movable between a first closed position blocking or preventing fluid flow through the coupling body 26 and thus fluid flow between the bore 27 in the external component 25 and the bore 23 in the tubular member 24. The valve 100 has a second position shown in Fig. 12 allowing fluid flow between the bore 27 in the external fluid component 25 and the bore 23 in the tubular member 24.

[0032] The check valve 100 can be a one-piece body 102 formed of metal or plastic. The body 102 has a first end 104 and an opposed second end 106. A domed head 108 is formed at the first end 26 and has a larger diameter peripheral edge 109 than an adjacent recess 110. The recess 110 receives a seal member, such as an O-ring 112. An adjacent larger diameter wall 114 forms the other end of the recess 110. A fluted plunger 116 is disposed on the body 102 and extends from the wall 114 to the second end 106. The plunger 116 includes four circumferentially spaced, radially

extending flutes 120 projecting radially outward from a central stem 122. The flutes 120 may be provided in any number, such as two flutes, three flutes, four flutes, etc.

[0033] Interior smoothly curved or angled surfaces 124 are formed at one end of the flutes 120 between the flutes 120 and the wall 114. The surfaces 124 provide a smooth flow directing action on the plunger 116 for fluid flow across the plunger 116, as described hereafter.

[0034] Each of the flutes 120 has an enlarged diameter end flange 130 extending radially outward to a larger diameter outer end surface spaced from a radially outer surface 132 on each flute 120. The end flanges 130 form a seat for a biasing member, such as a coil spring 134, hereafter “spring 134”, which extends around the outer surface 132 of the flutes 120 between the end flange 130 on the plunger 116 and the shoulder 74 formed by the lip 70 at the first end 42 of the coupling body 26.

[0035] Referring to Figs. 13-16, there is shown an alternative check valve 200 that can replace the plunger 116 of Figs. 7 and 8. The valve 200 is also one piece of metal or plastic and has a closed, solid, recessed end cap 208 and a base flange 206. The flange 206 performs the function of the shoulder 130 of plunger 116. Adjacent the end cap 208 is a seal groove 210 that receives the O-ring 112 from the embodiment of Fig. 10. Four large flow-through openings 212 are defined by ribs 214 within the valve body 200. Fluid flows through check valve 200 in the same way it flows through the valve 100 shown in Figs. 7, 8, 12 and 13.

ASSEMBLY

[0036] In assembling the check valve 100 or 200 in the coupling body 26, the check valve body absent the O-ring 112, is inserted through the second end 44 of the coupling body 26 until the

head 108 or 208 and the edge 109 on the first end 104 of the check valve body projects through the tapered surface 72 and the first end 42 of the coupling body 26, as shown in Fig. 5.

[0037] Force is applied to move the check valve body 102 or 200 through the bore portion 76 in the coupling body 26 until the entire recess 110 or 210 on the check valve body 102 or 200 extends outward beyond the first end 42 of the coupling body 26. The O-ring 112 is then installed in the recess 110 or 210 and the force removed to allow the spring 134 to urge the check valve body 102 or 200 toward the second end 44 and retracting the head 102, 204 at the first end 104 of the check valve body 102 toward the first end 42 of the coupling body 26 until the check valve O-ring 112 sealing engages the tapered surface 72 at the first end 42 of the coupling body 26. The O-ring 112, in this position, not only seals the check valve body 102 in the bore 40 to the coupling body 26, but also retains the check valve 100 or 200 in the coupling body 26.

[0038] It will also be understood that in place of the spring 134, a one-time detent mounting arrangement may be provided to mount check valve 100 in the coupling body 26. In this aspect, a radially outward extending may be formed on one end of one or more of the flutes 120 adjacent the wall 114 to engage a detent in the form of an inward extending circumferential recess in the lip 70 adjacent the first end of the coupling body 26. Engagement of the lip in the detent retains the check valve 100 in the closed flow position until the check valve 100 is moved to the open flow position, as described hereafter, when the tubular member 26 is inserted into the bore 40 in the coupling body 26, as shown in Fig. 12.

OPERATION

[0039] In operation, prior to insertion of the tubular member 26 into the bore 40 in the coupling body 26, the spring 134 will urge the check valve 100 or 200 to the first closed position shown in Fig. 5 where the O-ring 112 closes the bore 40 at the first end 42 of the coupling body 26

to fluid flow. When insertion of the tubular member 24 into the coupling body 26 begins, as shown in Figs. 9 and 10, the first end 22 of the tubular member 24 will engage the end 106 of the flutes 120 on the check valve body 102, as shown in Fig. 10 or the end 206 shown in Fig. 15. In this position, the check valve 100 or 200 remains in the first fluid flow closed position as the O-ring 112 is firmly engage with the tapered surface 72 with the first end 42 of the coupling body 26. Further insertion of the tubular member 24 into the bore 40 in coupling body 26 compresses the spring 134 and urges the check valve body 102 or 200 toward the second open position or toward the right in the orientation shown in Figs. 9-12. The tubular member 24 continues to be slidably inserted into the coupling body 26 compressing the spring 134 as shown in Fig. 12. The check valve 100 or 200 is now in the second open position for fluid flow between the bore 27 in the external component 25 and the bore 23 in the tubular member 24.

[0040] If the tubular member 24 is disengaged from the retainer clip 60 on the coupling body 26, for any reason, whether intentionally or accidentally, the spring 134 will urge the check valve 100 toward the first fluid flow closed position, or to the left in the orientation shown in Figs. 9-12, until the O-ring 112 again sealingly engages the tapered surface 76 at the first end 42 of the coupling body 26 closing off and blocking further fluid flow between the bore 23 in the tubular member 24 and the bore 27 in the external component 25.

[0041] The quick connect fluid connector with integrated check valve 100, 200 provides a number of advantages. The O-ring 112 retains the check valve body within the connector coupling body 26 without the need for additional retention elements. The check valve 100 or 200 is activated and moved between the first and second position only by insertion of the tubular member 24.

[0042] If the coupling body 26 is mounted in the external component 25 or the bore 27 of the external component 25 which functions as an outlet port carrying pressurized fluid, removal or

accidental separation of the tubular member 24 from the quick coupling body 26 causes a fluid shutoff, when the tubular member 24 is disconnected from the coupling body 26. This shutoff feature also allows a customer to ship the external component 25 in a fluid-filled position as the check valve 100 in the quick coupling body 26 will be in the fluid flow closed position prior to insertion of the tubular member 24 into the coupling body 26.

[0043] The quick connector 26 with integrated check valve 100 or 200 can also be used by a customer who manufactures or installs the external component 25 to eliminate the need for insertion of the test plug into the bore 27 in the port of the external component 25, as well as to eliminate the need for a separate shipping plug when the external component 25 is shipped to an assembly location. This eliminates the need to remove a separate shipping plug prior to tubular member installation and also provides higher sealing capability for a higher pressure leak test.

[0044] The quick connector 26 with integrated check valve 100 or 200 is ideal for certain automotive applications, such as turbo engine applications, where the fluid fitting can be used as a shut-off valve when the tubular member 24 is accidentally disconnected on the assembly. This will minimize the potential for thermal events should fluid spray from the disconnected tubular member flow onto adjacent hot turbo application components.

[0045] While the invention has been described in connection with certain embodiments, it is to be understood that the invention is not to be limited to the disclosed embodiments but, on the contrary, is intended to cover various modifications and equivalent arrangements included within the scope of the appended claims, which scope is to be accorded the broadest interpretation so as to encompass all such modifications and equivalent structures as is permitted under the law.

What is claimed is:

1. A combination fluid coupling and check valve comprising:
a connector body having a throughbore, a fluid conduit inlet, and a fluid outlet;
the connector body having means for sealingly receiving a tubular fluid conduit through said conduit inlet;
said connector body having means to lock in place a fully inserted tubular conduit;
said conduit having an external radial formation co-acting with said means when fully operatively inserted;
a check valve axially displaceably mounted in said throughbore adjacent said outlet end, a bias spring operatively disposed between the body and said check valve to urge the check valve toward a first closed position seated against said fluid outlet for preventing fluid flow through said outlet end, said check valve further having an interior end adapted to be contacted by said tubular conduit to work against said bias spring to displace said check valve, the axial lengths of said check valve and said conduit being such that the conduit displaces the valve, when full inserted, to a second unseated position to allow fluid flow from said conduit around said check valve and through said outlet end;
whereby removal of the tubular conduit from the connector body allows the bias spring to return the check valve to the first closed position, preventing fluid flow through said connector.
2. The fluid connector of claim 1 wherein the check valve comprises:
a body having a first end;
a seal member carried on the body adjacent the first end for sealing engagement with the connector body when the check valve is in the first position; and

a plurality of flow paths extending axially through the check valve body between the first end and a second end of the check valve body.

3. The fluid connector of claim 1 wherein:

the bias spring is carried on the body to bias the connector body toward the closed position.

4. The fluid connector of claim 3 wherein:

the seal member on the check valve body sealingly engages the first end of the connector body to retain the check valve body in the connector body.

5. The fluid connector of claim 4 further comprising:

the biasing member compressed by engagement with a tubular member inserted into the connector body with the check valve to allow movement of the quick connector body to the second position.

6. A fluid coupling for receiving a tubular member having an endform spaced from a first insertion end comprising:

a coupling body having a bore received adapted for receiving the tubular member;

a retainer mounted on the body and positioned to engage a shoulder on the tubular member on the endform to lock the tubular member in the fitting body when the insertion end of the tubular member reaches a fully inserted position into the bore in the quick connector body;
and

a check valve movably mounted in the quick connector body for movement between a first position closing the bore in the connector body to fluid flow and a second position opening the bore to fluid flow through the connector body;

the location of the valve being such as to be contacted by said tubular member during insertion thereof and moved to said second position only when said tubular member is fully inserted.

7. A fluid coupling adapted to make a fluid connection between a tubular conduit and a utilization device comprising:

a connection body having an inlet, an outlet and a flow path therebetween;

said inlet being adapted to lockingly and sealingly receive a tubular fluid conduit fully inserted therein;

said outlet having an inwardly-facing shoulder;

a check valve body axially displaceably mounted in said outlet and having a forward-facing shoulder and an end cap;

a bias spring disposed around said valve body and trapped between said inwardly-facing and forward-facing shoulder for bringing said valve body to a position closing flow through said outlet;

said valve body being of such length as to be contacted and displaced by a fully inserted tubular conduit against said spring to a position opening said outlet to fluid flow.

8. The coupling defined in claim 7 wherein the end cap is domed.

9. The coupling defined in claim 7 wherein the end cap is recessed.

AMENDED CLAIMS

received by the International Bureau on 22 June 2016 (22.06.2016)

What is claimed is:

1. A combination fluid coupling and check valve comprising:

a connector body having a throughbore, a fluid conduit inlet, and a fluid outlet;

the connector body having means for sealingly receiving a tubular fluid conduit through said conduit inlet;

said connector body having retainer means to lock in place a fully inserted tubular conduit;

said conduit having an external radial formation co-acting with said retainer means when fully operatively inserted;

a check valve axially displaceably mounted in said throughbore adjacent said outlet end, a bias spring operatively disposed between the connector body and said check valve to urge the check valve toward a first closed position seated against said fluid outlet for preventing fluid flow through said outlet end, said check valve further having an interior end adapted to be contacted by said tubular conduit to work against said bias spring to displace said check valve, the axial lengths of said check valve and said conduit being such that the conduit displaces the valve, when full inserted, to a second unseated position to allow fluid flow from said conduit around said check valve and through said outlet end;

whereby only removal of the tubular conduit from the connector body allows the bias spring to return the check valve to the first closed position, preventing fluid flow through said connector;

a seal member carried on the connector body adjacent to first end for sealing engagement with the connector body when the check valve is in the first position; the combination further comprising a bias spring carried on the connector body to bias the check

valve toward the closed position; said seal member on the check valve sealingly engaging the first end of the connector body to retain the check valve in the connector body;

said biasing member being compressed by engagement with said tubular conduit when inserted into the connector body to allow movement of the connector body to the second position.

2. The fluid connector of claim 1 wherein the check valve has a body defining multiple parallel flow paths therethrough.

FIG. 1

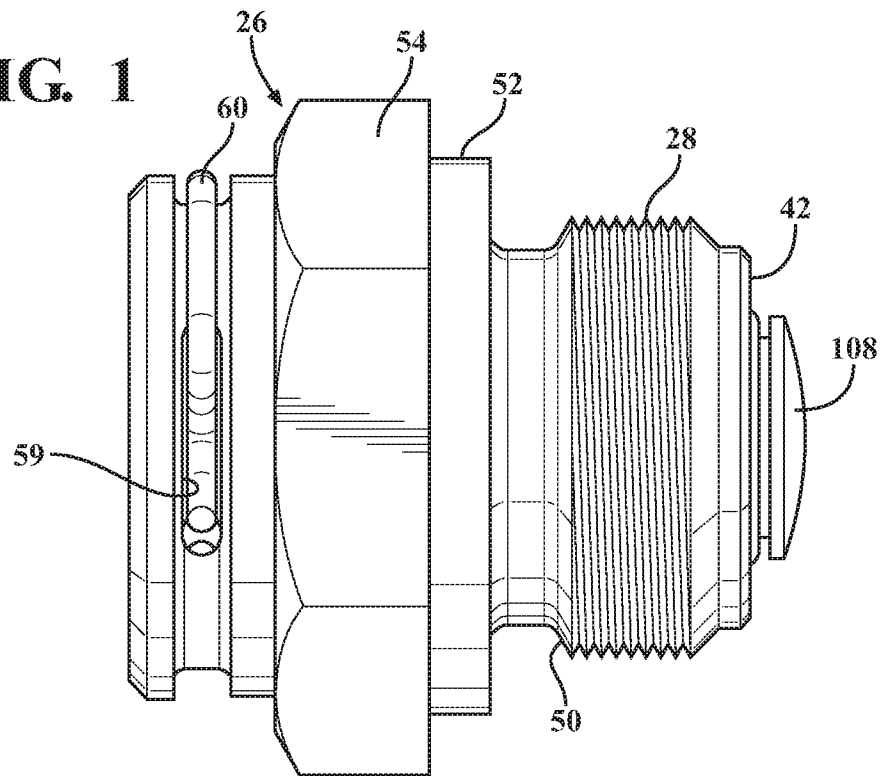


FIG. 2

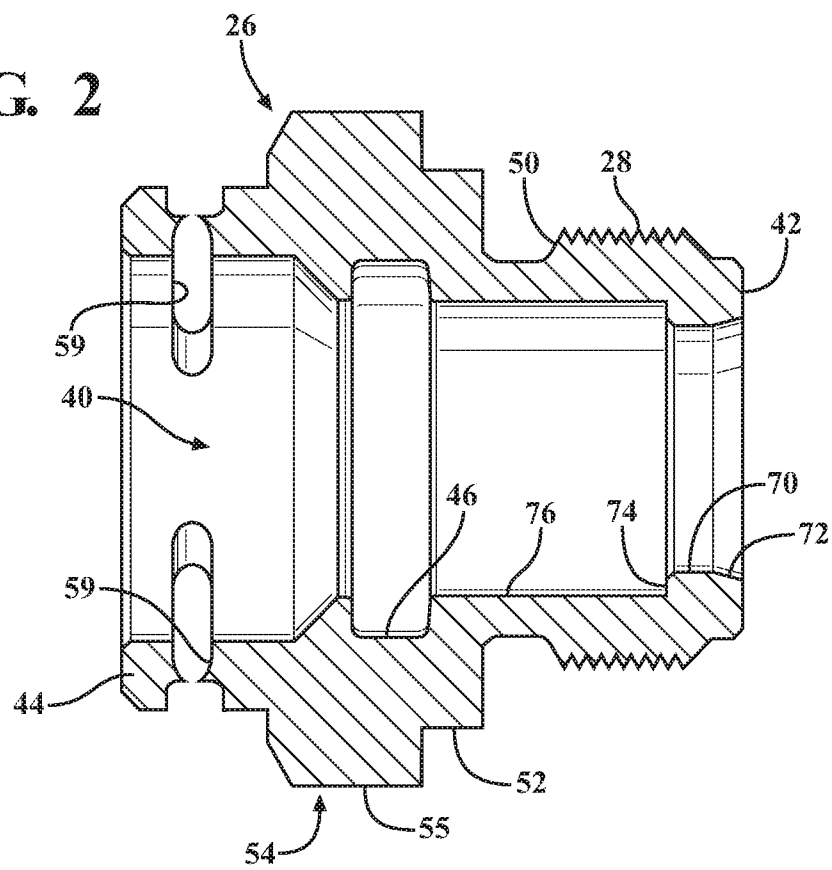


FIG. 3

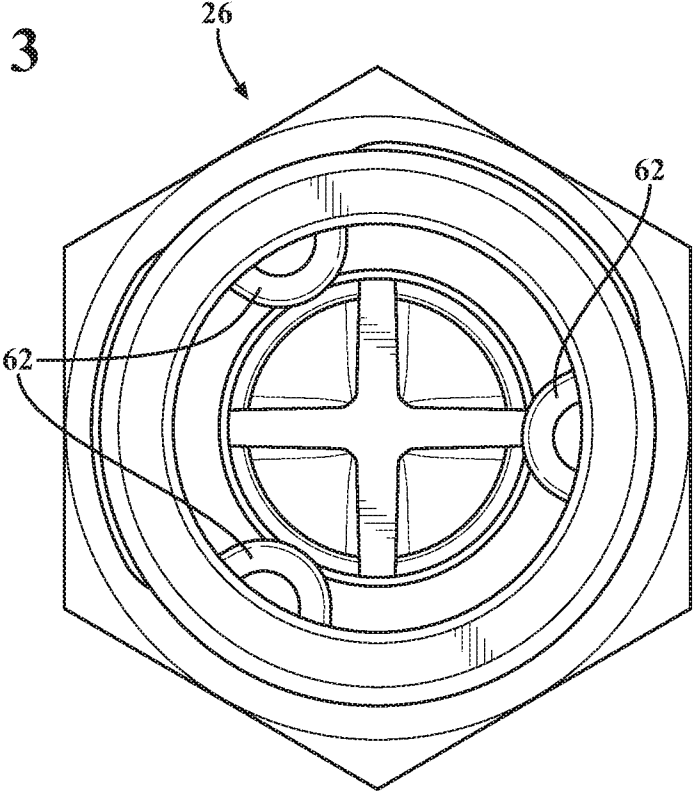


FIG. 4

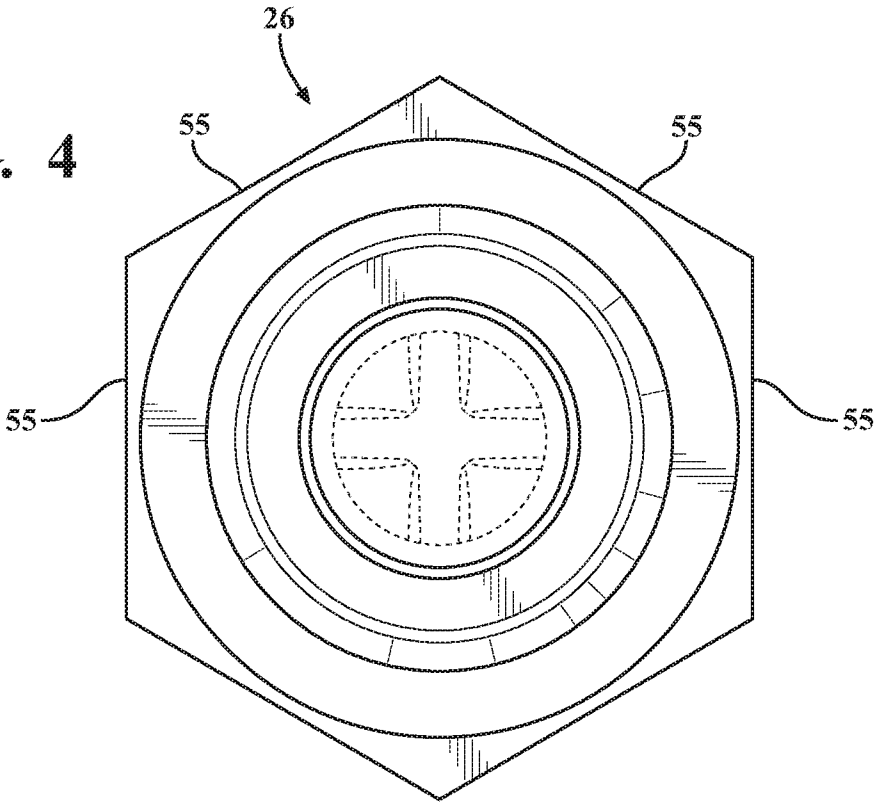


FIG. 5

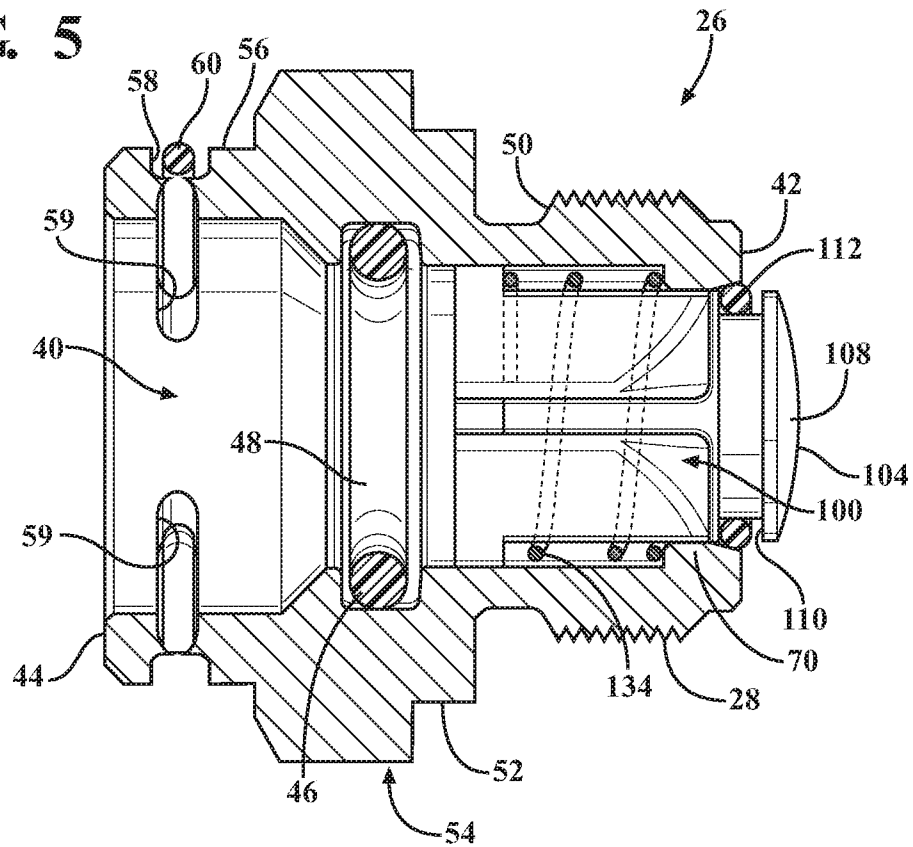


FIG. 6

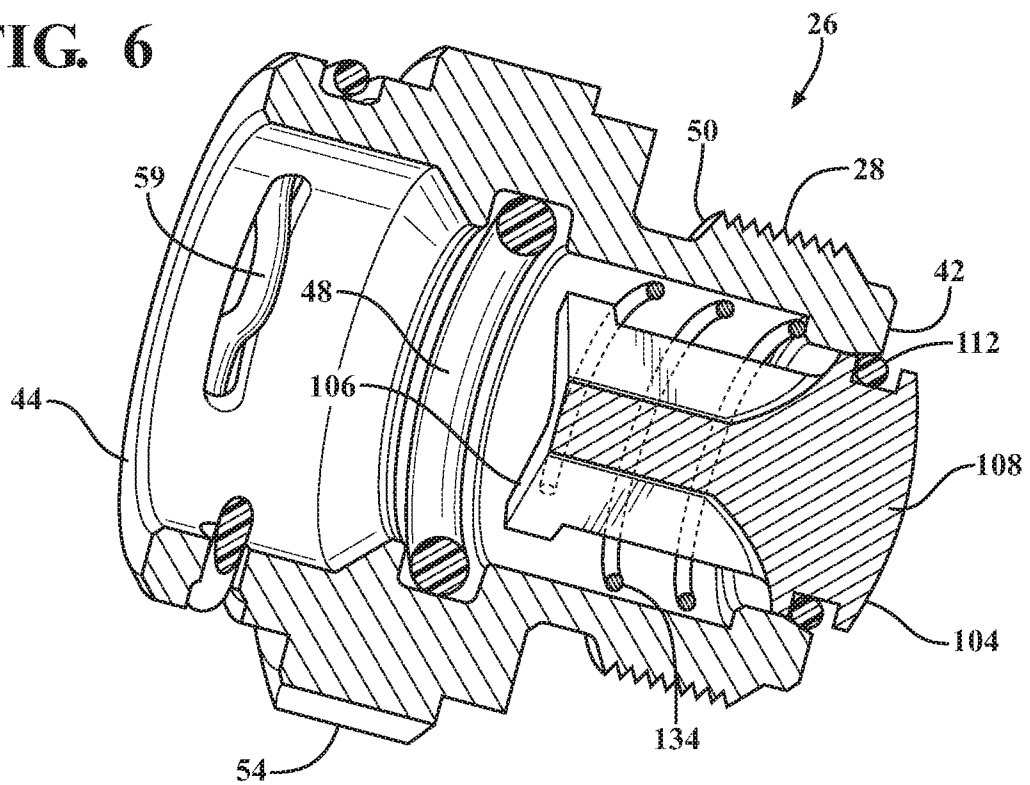


FIG. 7

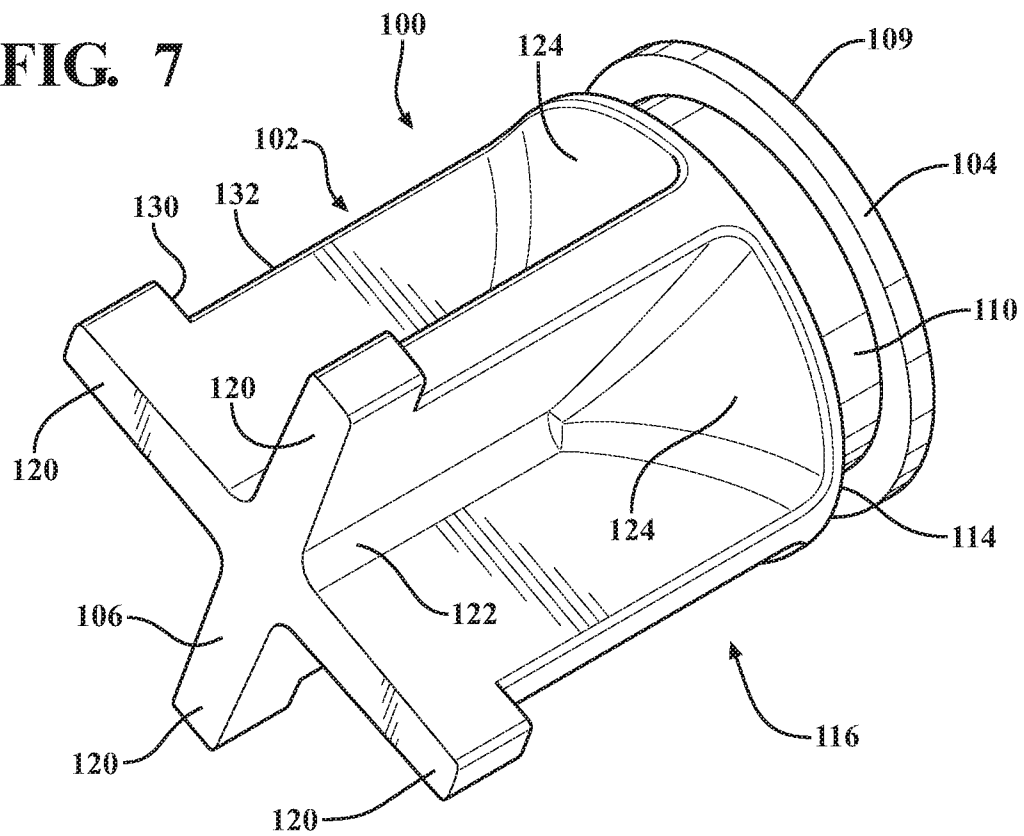
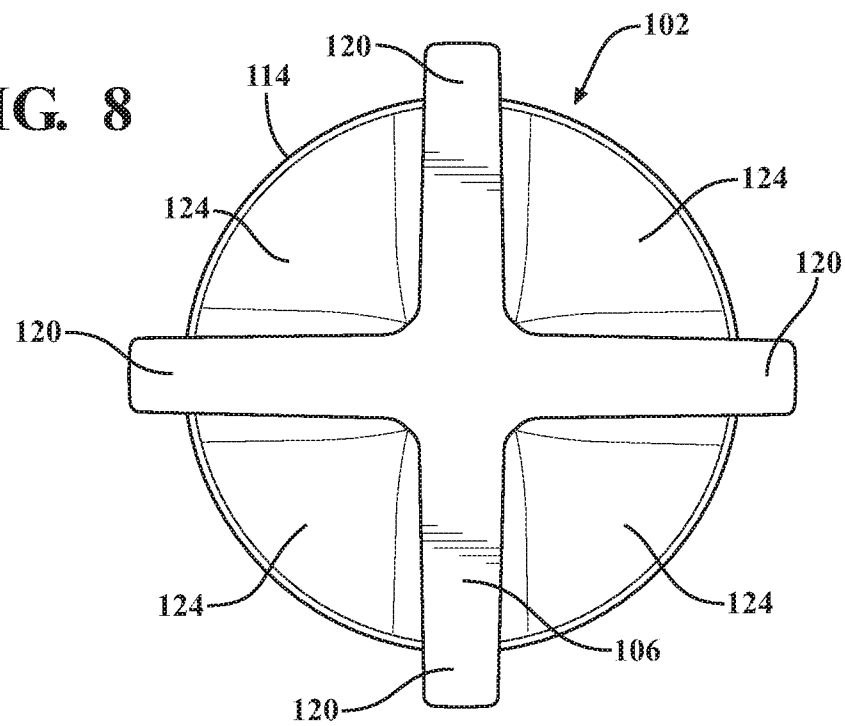
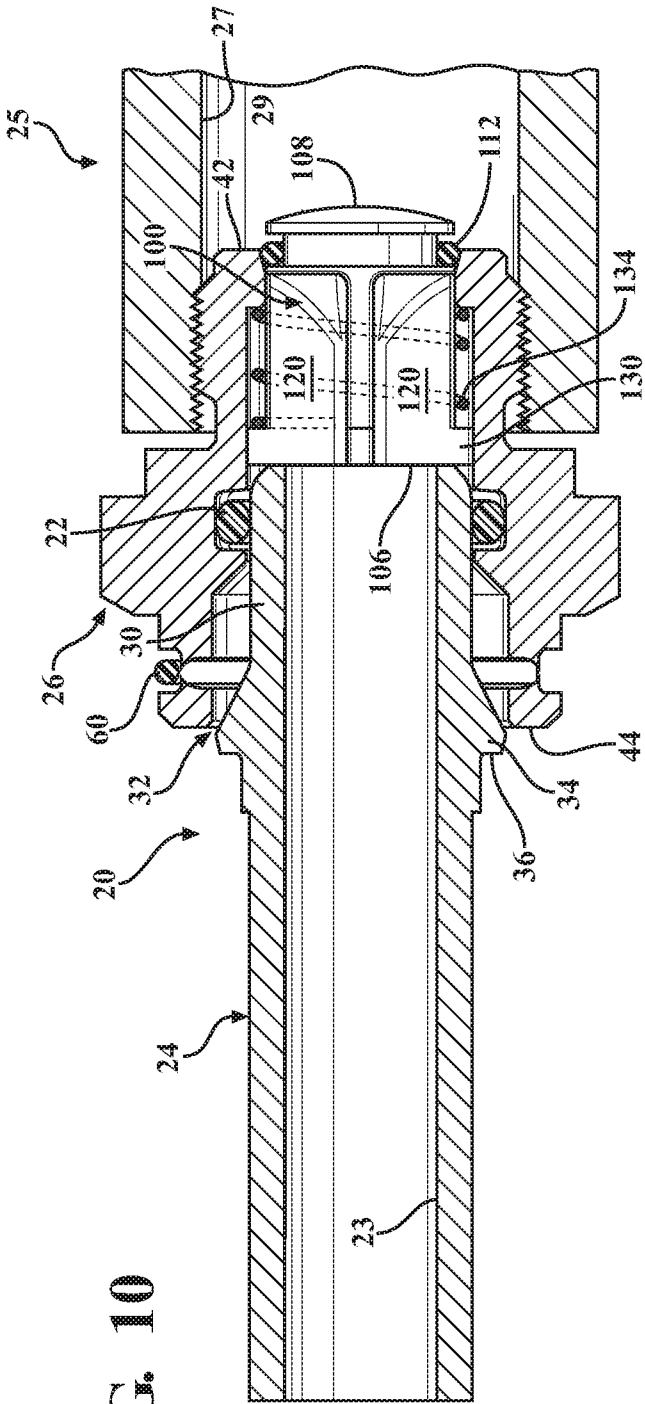
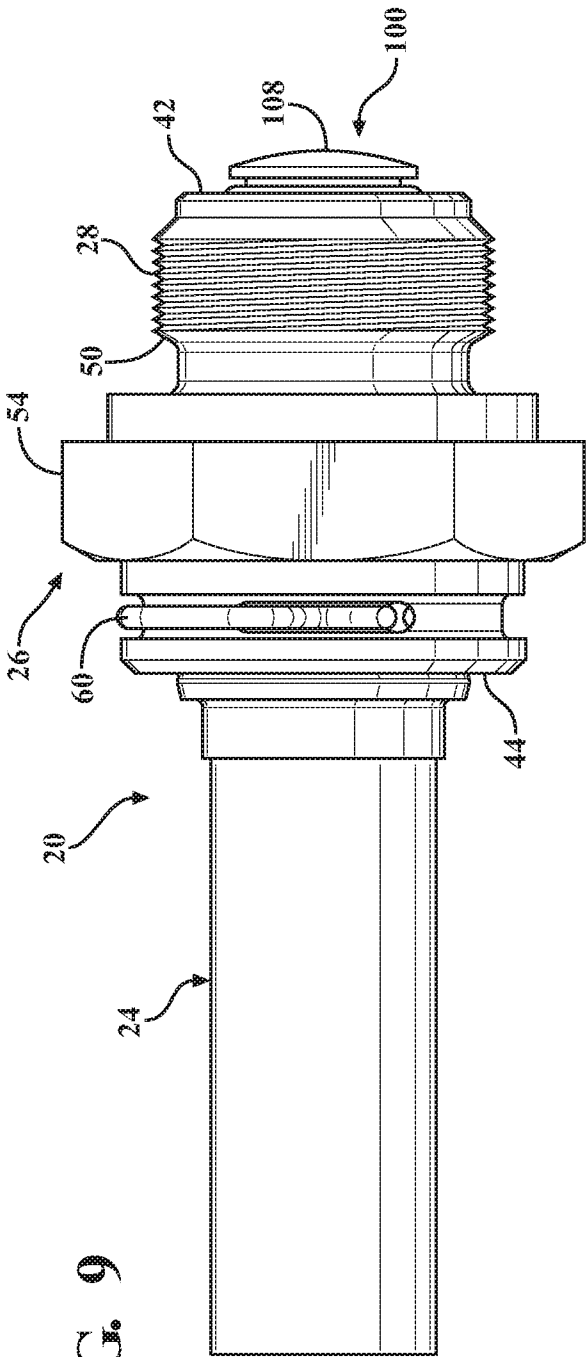


FIG. 8





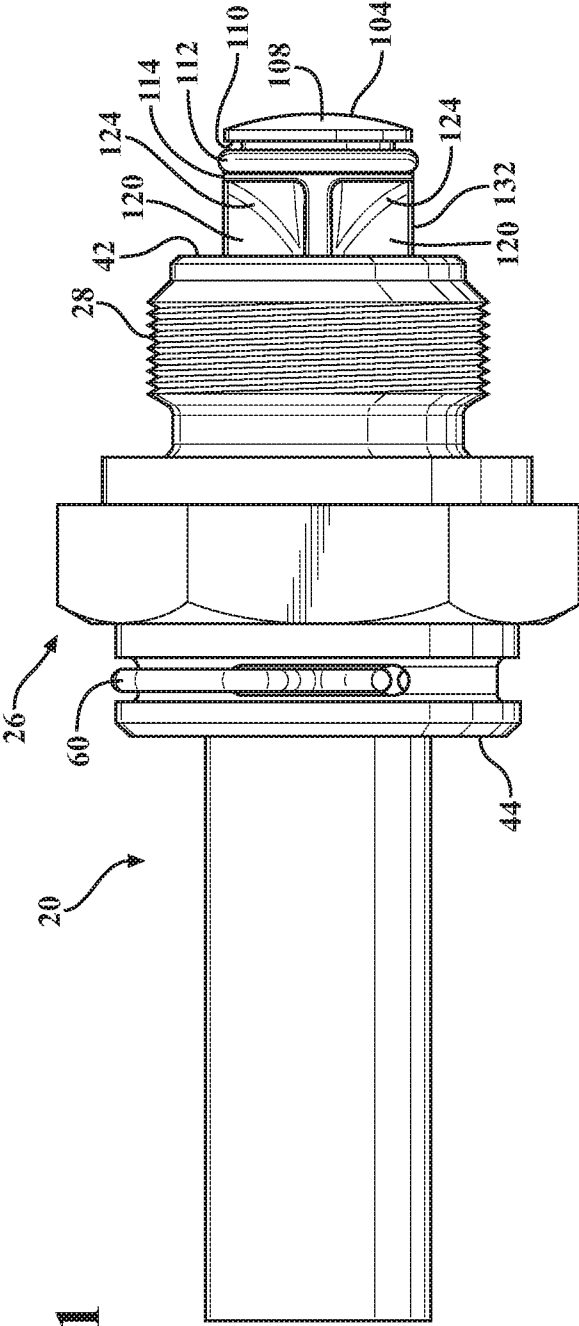


FIG. 11

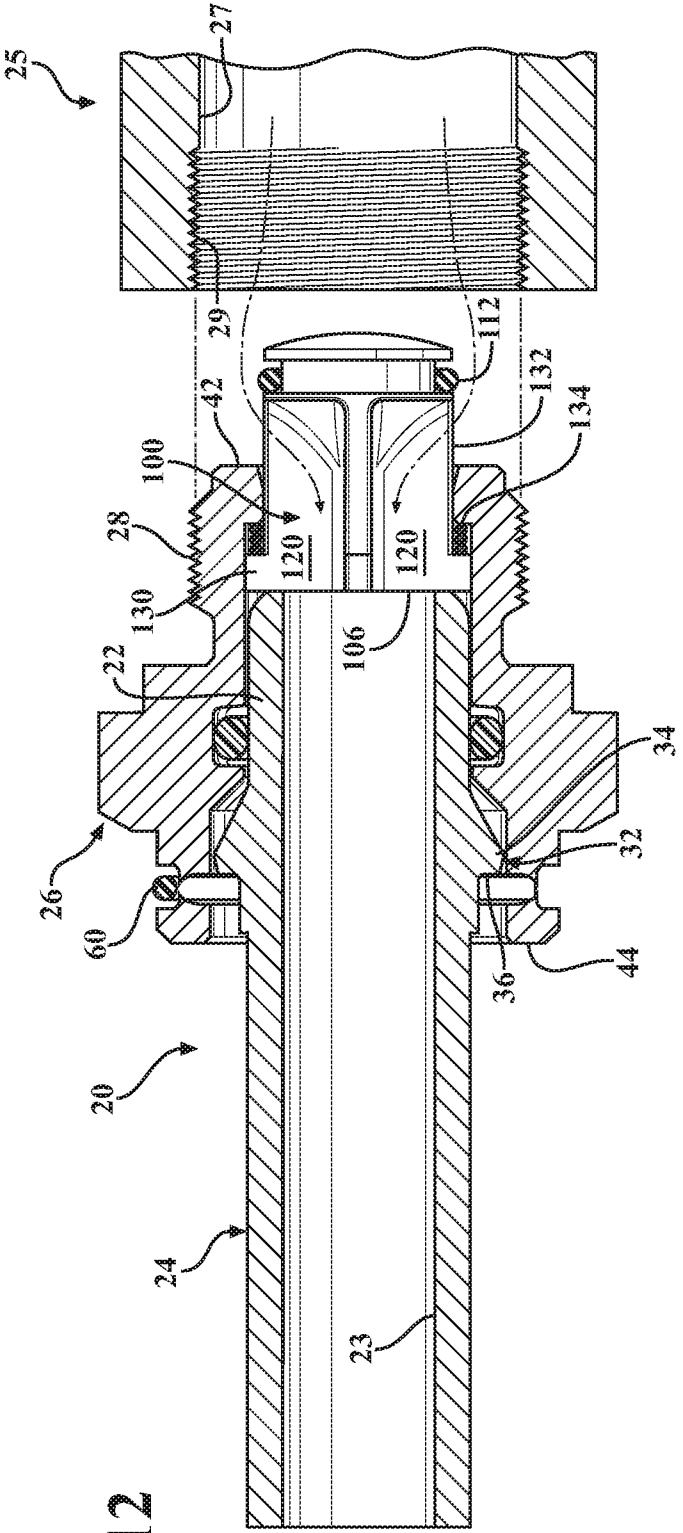


FIG. 12

FIG. 13

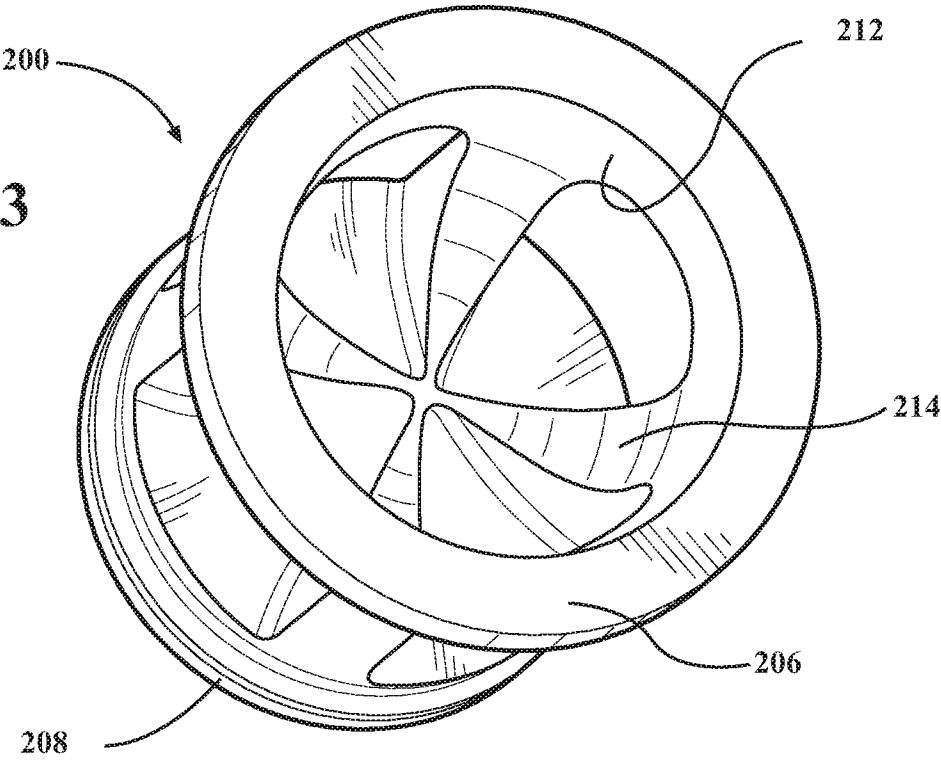


FIG. 14

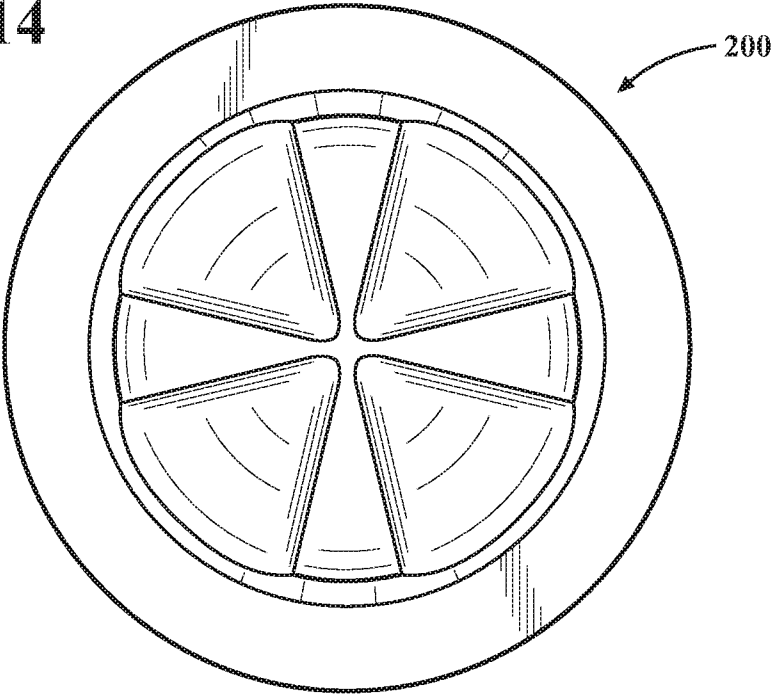


FIG. 15

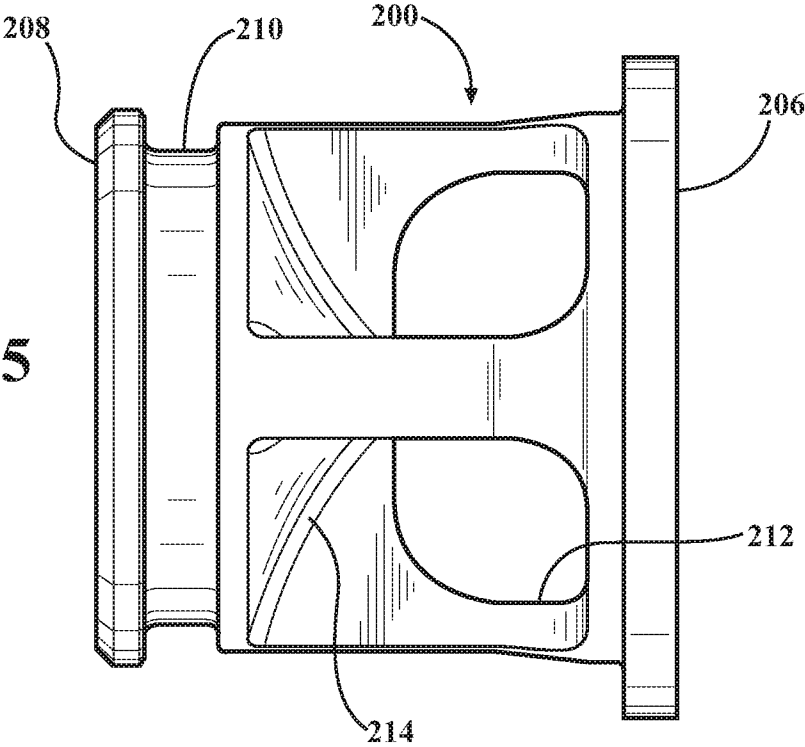
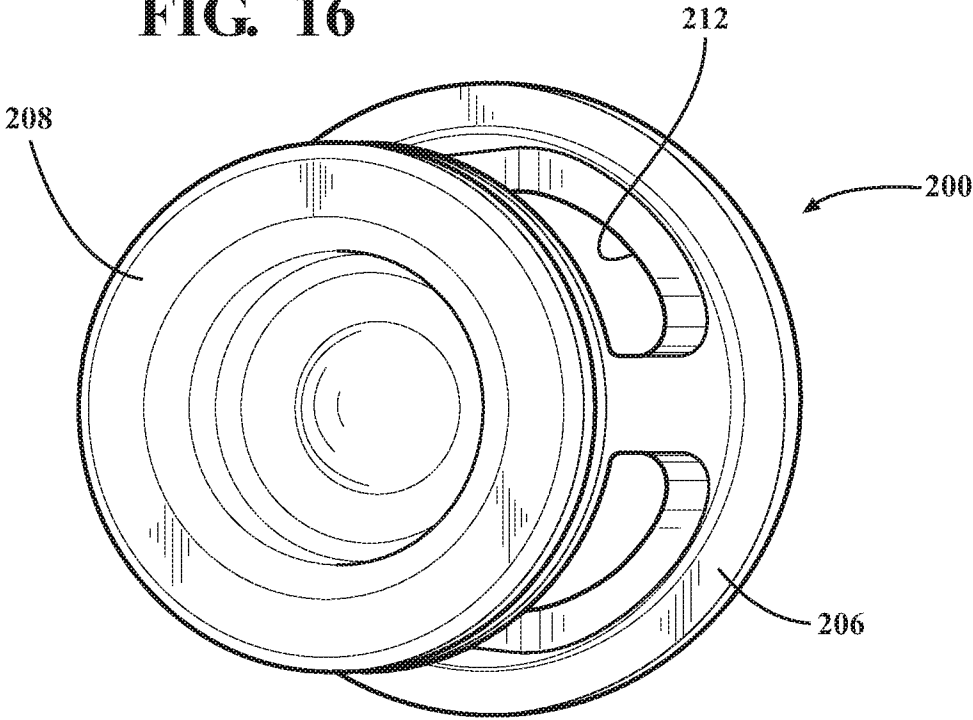


FIG. 16



INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 16/17130

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:
This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I: Claims 1-5, directed to a combination fluid coupling and check valve comprising: a conduit having an external radial formation.

Group II: Claim 6, directed to a fluid coupling comprising an endform.

Group III: Claims 7-9, directed to a fluid coupling comprising a plurality of shoulders.

-*- See Supplemental Sheet -*-

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
1-5

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 16/17130

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - F16K 17/40 (2016.01)

CPC - F16K 17/40

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): F16K 17/40 (2016.01)

CPC: F16K 17/40

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
 IPC (8): F16K24/00, F16K17/40, F16L37/138, F16L37/084, F16L21/08, E21B35/00, F16L37/00 (2016.01). CPC: F16K24/00, F16K17/40, F16L37/138, F16L37/084, F16L21/08, E21B35/00, F16L37/00. USPC: 137/74, 137/75, 251/149*.

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
 PatBase. Google (Web, Patent, Scholar). Search Terms: AN, Army, Automatic, Automotive, Barb, Channel, Check, Circlip, Clip, Collar, Coupling, Disconnect, Fin, Fitting, Fitting, Flow, Fluid, Garter, Gas, Groove, Hose, Hose end, Inline, Insert, Insert, Liquid, Male, Navy, Nipple, Passage, Pipe, Plunger, Push, Quick, Retainer, Relief, Shouldered, Sh

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X ----- Y ----- A	US 3,245,423 A (HANSEN et al.) 12 April 1966 (12.04.1966) Fig. 1; col 2 ln 16-18, 22-29, 34-42, 45-58, 51-56.	1, 3 ----- 2 ----- 4-5
Y ----- A	US 2,377,812 A (SCHEIWER) 05 January 1945 (05.01.1945) Figs. 1, 5; pg 1 col 2 ln 53-56, pg 2 col 1 ln 18-24, 53-56, 73 - pg 2 col 2 ln 2.	2 ----- 4-5
A	US 5,758,682 A (CAIN) 02 June 1998 (02.06.1998) Figs. 2-3; col 3 ln 31-45, col 4 ln 6-14.	1-5
A	US 3,532,101 A (SNYDER) 06 October 1970 (06.10.1970) Figs. 1-3; col 2 ln 67-71, col 3 ln 11-18.	1-5
A	US 7,458,392 B2 (CORNWELL) 02 December 2008 (02.12.2008) Figs. 1-4; col 4 ln 29-43, 52-65.	1-5

☐ Further documents are listed in the continuation of Box C.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

18 May 2016 (18.05.2016)

Date of mailing of the international search report

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 16/17130

Continuation of Box III: Observations where unity of invention is lacking:

The inventions listed as Groups I-III do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical feature(s) for the following reasons:

Group I requires the special technical feature of an external radial formation, not required by Groups II-III.

Group II requires the special technical features of an endform and a retainer, not required Groups I and III.

Group III requires the special technical feature of a plurality of shoulders, not required by Groups I-II.

The only shared technical feature(s) that would otherwise unify Groups I-III are a fluid coupling comprising a body having a bore and a means for receiving a tubular member, a check valve displaceably mounted in said bore, and a first closed position and second open position. However, these technical features do not represent a contribution to the prior art, because they are anticipated by US 857,897 A (PATTERSON).

Patterson discloses a fluid coupling (coupling member 1 including coupling member 2, Fig. 1; pg 1 ln 29-33) comprising a body (coupling member 2, Fig. 1; pg 1 ln 29-33) having a bore (unnumbered; bore central to 2 as illustrated in Fig. 1; pg 1 ln 29-33) and a means for receiving ("threaded at their outer ends" pg 1 ln 33-36) a tubular member (pipe section 4, Fig. 1; pg 1 ln 33-36), a check valve (swinging check valve 7, Fig. 1; pg 1 ln 36-43) displaceably mounted in said bore (as illustrated in Fig. 1; "pivoted or hinged" pg 1 ln 36-43), and a first closed position (instance of 7 illustrated in solid lines in Fig. 1; pg 1 ln 36-43, "closed" pg 1 ln 56-67) and a second open position (unnumbered; position of 7 illustrated in phantom lines in Fig. 1; pg 1 ln 36-43; "open" pg 1 ln 67-74).

The only shared technical feature(s) that would otherwise unify Groups I and III is a bias spring. However, this technical feature does not represent a contribution to the prior art, because it is anticipated by US 8,869,828 B2 (SMITH).

Smith discloses a bias spring (valve spring 141, Fig. 2; col 6 ln 29-38).

As the common technical feature(s) of Groups I-III were known in the art at the time of the invention, they cannot be considered to be common technical feature(s) that would otherwise unify Groups I-IV.

Therefore, Groups I-III lack unity under PCT Rule 13.