



(51) International Patent Classification:
B01D 53/26 (2006.01)

(21) International Application Number:
PCT/US2010/056815

(22) International Filing Date:
16 November 2010 (16.11.2010)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
61/261,566 16 November 2009 (16.11.2009) US

(71) Applicant (for all designated States except US): **CUMMINS FILTRATION IP INC.** [US/US]; 1400 - 73rd Avenue NE, Minneapolis, MN 55432 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **SCHECKEL, Benjamin, L.** [US/US]; 840 West Jefferson St., Stoughton, WI 53589 (US). **SMITH, Bradley, A.** [US/US]; 702 Bear Claw Way #204, Madison, WI 53717 (US). **PARIKH, Chirag, D.** [IN/US]; 3045 Maple Valley Dr. #204, Madison, WI 53719 (US).

(74) Agents: **MCBRIDE, M., Scott et al.**; Andrus, Sceales, Starke & Sawall, LLP, 100 East Wisconsin Avenue, Suite 1100, Milwaukee, WI 53202 (US).

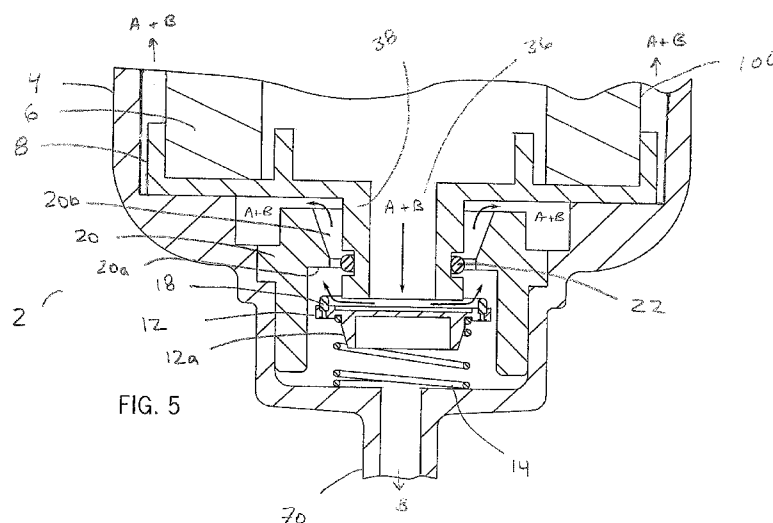
(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— with international search report (Art. 21(3))

(54) Title: COMBINATION RELIEF VALVE AND DRAINAGE MECHANISM REQUIRING INSERTED ELEMENT TO PERMIT DRAINAGE IN A COALESCER SYSTEM



(57) Abstract: Disclosed are coalescer systems for coalescing a liquid phase dispersed in a gas phase. The disclosed systems include a filter element which, when installed in the system, contacts and moves a valve to an open drainage position to permit flow of liquid through the system. In the disclosed systems, the filter element and valve also are configured such that under excess pressure conditions the valve permits the gas phase to bypass filter media of the filter element. In particular, the disclosed coalescer systems may be utilized in a CV system in order to remove oil mist from gas in the CV system.

COMBINATION RELIEF VALVE AND DRAINAGE MECHANISM REQUIRING INSERTED ELEMENT TO PERMIT DRAINAGE IN A COALESCER SYSTEM

BACKGROUND

[0001] The field of the invention relates to coalescer systems for coalescing a mixture of two phases, namely a continuous phase and a dispersed phase. In particular, the field relates to coalescer systems for coalescing drops of a dispersed phase liquid phase in a continuous gas phase in order to collect and remove the dispersed phase from the continuous gas phase.

[0002] Coalescer systems are used widely to remove immiscible droplets from a gaseous or liquid continuous phase, such as in crankcase ventilation (CV) filtration, fuel water separation (FWS), and oil-water separation. For CV applications, near 100% removal efficiency of oil mist is required to protect the turbocharger in closed CV applications and to protect the environment in open CV applications. Increasingly high efficiency, low pressure drop and longer life are sought. To accomplish this, coalescer systems should be protected from plugging, submicron droplets need to be removed, and the oil needs to drain efficiently from the system.

SUMMARY

[0003] Disclosed are coalescer systems for coalescing a dispersed phase from a continuous phase. The disclosed systems may be utilized in order to collect and remove a liquid dispersed phase from a continuous gas phase. The disclosed systems include a filter element which coalesces the liquid dispersed phase and when installed in the system, contacts and moves a drainage valve to an open position or “set position” to permit drainage of the coalesced liquid phase. When the filter element is removed from the system, the drainage valve moves to a closed position preventing the coalesced liquid phase from draining from the system and into the environment. In the disclosed systems, the filter element and drainage valve also are configured such that under excess pressure conditions, for example, when the filter media of the filter element is plugged and excess pressure develops in the system, the continuous gas phase and dispersed liquid phase may bypass the filter media of the filter

element via the excess pressure in the system moving the drainage valve to a bypass position. In particular, the disclosed coalescer systems may be utilized in a CV system in order to remove oil mist from gas in the CV system.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] FIG. 1 illustrates a cross-sectional view of a coalescer system of the prior art having an intake end (top) and a drainage end (bottom).

[0005] FIG. 2 illustrates an enlarged cross-sectional view of the drainage end of the coalescer system of the prior art as illustrated in FIG. 1.

[0006] FIG. 3 illustrates a cross-sectional view of one embodiment of a coalescer system as contemplated herein having an intake end and an opposite end that functions as a drainage end.

[0007] FIG. 4 illustrates an enlarged cross-section view of the drainage end of the coalescer system as illustrated in FIG. 3 under bypass conditions (A) and under open drainage, non-bypass conditions (B).

[0008] FIG. 5 provides a two-dimensional cross-section view of one embodiment of a drainage end of a coalescer system as contemplated herein.

[0009] FIG. 6 provides another view of the drainage end of the coalescer system as shown in FIG. 5.

[0010] FIG. 7 provides a two-dimensional cross-sectional view of another embodiment of a drainage end of a coalescer system as contemplated herein.

[0011] FIG. 8 provides a cross-sectional view of another embodiment of an intake end of a coalescer system as contemplated herein.

[0012] FIG. 9 illustrates a two-dimensional view of one embodiment of a filter element as contemplated herein having horizontal symmetry.

[0013] FIG. 10 illustrates a two-dimensional cross-sectional view of one embodiment of a coalescer system as contemplated herein.

[0014] FIG. 11 illustrates an enlarged two-dimensional cross-section view of the intake end of the coalescer system of FIG. 10.

[0015] FIG. 12 illustrates an enlarged two-dimensional cross-section view of the drainage end of the coalescer system of FIG. 10.

[0016] FIG. 13 illustrates airflow under bypass conditions through the drainage outlet of the filter element of the coalescer system of FIG. 10.

[0017] FIG. 14 illustrates drainage through the coalescer system of FIG. 10.

DETAILED DESCRIPTION

[0018] Disclosed are coalescer systems for coalescing a dispersed phase from a continuous phase. In particular, the disclosed systems may be utilized in order to collect and remove a liquid dispersed phase from a continuous gas phase. The disclosed systems include a filter element which may coalesce a liquid dispersed phase and when installed in the system, contacts and moves a drainage valve to an open position or set position to permit drainage of the coalesced liquid phase. As such, the term “open” is utilized herein to refer to a configuration of the system whereby the filter element is inserted and has moved the drainage valve to an open position to permit drainage of the coalesced liquid phase. When the filter element is removed from the system, the drainage valve moves to a closed position preventing the coalesced liquid phase from draining from the system and permitting servicing of the system without leaking coalesced liquid phase (*e.g.*, oil) into the environment. In the disclosed systems, the filter element and drainage valve also are configured such that under excess pressure conditions, for example, when the filter media of the filter element is plugged, the continuous gas phase and dispersed liquid phase may bypass the filter media of the filter element via the excess pressure moving the drainage valve to a bypass position. The continuous gas phase and dispersed liquid phase then may exit the filter element through a

drainage outlet, pass around the outside of the filter element and through a gas outlet. As such, the term “bypass” is utilized herein to refer to flow of the continuous phase through an drainage outlet of the filter element and not through the filter media.

[0019] Referring now to the figures, FIG. 1 illustrates a cross-sectional view of a coalescer system 2 of the prior art having an intake end and a drainage end (enlarged in FIG. 2). The system includes an intake inlet 50, a gas outlet 60, and a drainage outlet 70. The system 2 further includes a chamber 4 and a filter or coalescing element 100 (see also FIGS. 9 and 10) that includes media 6 and an intake end plate 10 and a drainage end plate 8. The system 2 also includes a valve having a disc or ball 12 biased into a closed position by a mechanism such as a spring 14. When the filter element 100 is inserted in the system 2, a protrusion 8a on the drainage end plate 8 contacts the disc or ball 12 and moves the disc or ball 12 into an open drainage position. In the system 2, a gaseous phase A (e.g., air and/or other gas) comprising a dispersed liquid phase B (e.g., hydrocarbon liquid (such as oil mist) and/or water) enters the intake inlet 50. The gaseous phase A passes through the filter media 6 and exits the system laterally through the gas outlet 60. The dispersed liquid phase B coalesces in the filter media 6 and drains vertically through the system. Arrows illustrate the flow of gas A through the system where the gas includes dispersed liquid B such as oil (FIG. 1). The dispersed liquid B coalesces in the media and drains from the system, also as illustrated by arrows. When the filter element 100 is inserted in the system 2 and the disc or ball 12 is in an open position, the coalesced liquid B drains from the drainage outlet 70.

[0020] FIG. 3 illustrates a cross-sectional view of a coalescer system 2 as contemplated herein having an intake end and a drainage end (enlarged in FIG. 4). The system includes an intake inlet 50, a gas outlet 60, and a drainage outlet 70. The system 2 further includes a chamber 4 and a filter or coalescing element 100 (see also FIGS. 9 and 10) that includes media 6 and an intake end plate 10 and a drainage end plate 8. The system 2 also includes a valve having a disc or ball 12 biased into a closed position by a mechanism such as a spring 14. When the filter element 100 is inserted in the system 2, a drainage spout 38 on the drainage end plate 8 contacts the disc or ball 12 and moves the disc or ball 12 into an open

drainage position. In the system **2**, a gaseous phase **A** (e.g., air and/or other gas) comprising a dispersed liquid phase **B** (e.g., hydrocarbon liquid (such as oil mist) and/or water) enters the intake inlet **50**. The gaseous phase **A** passes through the filter media **6** and exits the system laterally through the gas outlet **60**. The dispersed liquid phase **B** coalesces in the filter media **6** and drains vertically through the system as illustrated by arrows. Arrows also illustrate the flow of gas **A** through the system where the gas includes dispersed liquid **B** such as oil (FIG. 3). When the filter element **100** is inserted in the system **2** and the disc or ball **12** is in an open position, the coalesced liquid **B** drains from the drainage outlet **70** (FIGS. 3A and 4A). Under bypass conditions (FIGS. 3B and 4B), for example, as the filter media **6** becomes plugged, gas **A** and dispersed liquid **B** flow through an opening **36** in the drainage spout **38**. Air pressure forces the disc or ball **12** downward against the bias spring **14** creating an exit gap for gas **A** and dispersed liquid **B** to flow out of the filter element **100**. Gas **A** and dispersed liquid **B** flow along the outside of the filter media **6** and through the gas outlet **60**. As such, the valve element functions as a relief valve for flow of gas **A** and dispersed liquid **B** under excess pressure conditions. Coalesced liquid **B** also may flow around the disc or ball **12** and through the drainage outlet **70**.

[0021] FIG. 5 provides a two-dimensional cross-sectional view of one embodiment of a drainage end of a coalescer system **2** as contemplated herein. The arrows in FIG. 5 illustrate bypass flow through the system. The drainage end has a valve element that includes a disc **12** biased into a closed position via a spring **14**. The disc **12** retains the spring **14** via a retaining ring **12a**. As shown, the spring **14** fits around the outside of the retaining ring **12a**. However, in other embodiments, the spring **14** may fit around the inside of the retaining ring **12a** (FIGS. 10-14). The disc may be molded and includes a sealing element **18** on its top surface, such as an over-molded silicone or plastic ring. Optionally, the disc includes a patch of media on a top surface (e.g., a 1-2 mm patch of media (not shown)). The valve element also includes a sealing/retaining ring **20** that seals against the disc **12** and retains the disc **12** and spring **14** in position in the valve element. The drainage end plate **8** has a drainage spout **38** with an opening **36** through which through which gas **A** and dispersed liquid **B** may flow under excess pressure conditions (*i.e.*, bypass conditions) such as when the filter media **6** is plugged

and does not permit sufficient gas flow therethrough.

[0022] Further shown in FIG. 5, when the filter element **100** is inserted in the chamber **4** of the system **2**, the drainage spout **38** contacts the disc **12** and moves the disc **12** to an open drainage position. The system typically includes only a single drain (*i.e.*, a central drainage outlet **70** that is dependent upon insertion of the filter element **100** for drainage), but optionally the system may include a central drainage outlet **70** and a side drain (*e.g.*, a side drain that does not depend on an inserted filter element **100** for drainage). When the filter element **100** is not inserted in the chamber **4** of the system **2**, the disc **12** moves into a closed position and the sealing element **18** contacts an underside **20a** of the sealing/retaining ring **20** and prevents liquid flow through the drainage spout **38**. Optionally, the filter element **100** may have an identical drainage end plate **8** and intake end plate **10** and may be inserted in either orientation (*i.e.*, with either end at the drainage end or intake end of the system (FIG. 9)). The drainage spout **38** of the drainage end plate **8** (and/or inlet spout **38** of the intake end plate **10**) may have an O-ring **22** around an exterior surface (*e.g.*, a neck of the spout) for sealing against an opening in the chamber **4**.

[0023] As shown in FIG. 5, under excess pressure conditions (*i.e.*, bypass conditions) such as when the filter media **6** becomes plugged, gas **A** and dispersed liquid **B** flow through an opening **36** in the drainage spout **38**. Air pressure forces the disc or ball **12** downward against the bias spring **14** creating an exit gap for gas **A** and dispersed liquid **B** to flow out of the filter element **100**. Gas **A** and dispersed liquid **B** flow along the outside of the filter media **6** and through the gas outlet **60**. As such, the valve element functions as a relief valve for flow of gas **A** and dispersed liquid **B** under excess pressure conditions. Coalesced liquid **B** also may flow around the disc or ball **12** and through the drainage outlet **70**. The system **2** is configured such that the filter element **100** contacts the valve element and moves the valve element to a predetermined position to create the desired valve opening or cracking pressure for the system. For example, in FIG. 5, the system **2** is configured such that the filter element **100** moves the disc **12** of the valve element to a predetermined position to create the desired valve opening or cracking pressure for the system based on compression of the spring **14**.

[0024] FIG. 6 provides another view of the drainage end of the coalescer system of FIG. 5. The arrows illustrate liquid **B** draining through the system when the filter element **100** is installed (*i.e.*, normal drainage without bypass flow). Liquid **B** flows over a top surface **20b** of the retaining ring **20** for the valve element, around an edge of the disc **12**, and through the drainage outlet **70**. When the filter element **100** is removed, the disc **12** moves into a closed position and the sealing element **18** contacts an underside **20a** of the retaining ring **20** and prevents liquid **B** from flowing through the system. Optionally, the filter element **100** may include weep holes at the end of the outlet end plate (*e.g.*, at the end of a drainage spout present at the end of the outlet end plate) permitting flow of coalesced liquid phase therethrough. (See FIG. 13).

[0025] FIG. 7 provides a two-dimensional cross-sectional view of another embodiment of a drainage end of a coalescer system **2** as contemplated herein. The system **2** includes a central chamber section **4a** and a drainage chamber section **4b** sealed against the central chamber section **4a** via an O-ring **28**. The drainage chamber section **4b** includes a valve element that includes a disc **12** biased into a closed position via a spring **14**. The disc **12** and spring **14** are retained via a retaining ring **20** present on the drainage chamber section **4b**. A sealing ring **220** is positioned on the top surface of the retaining ring **20**. The drainage end plate **8** has a drainage spout **38** with an opening **36** through which gas **A** and dispersed liquid media **6** may flow when the filter media **6** is plugged and does not permit sufficient gas flow therethrough.

[0026] As shown in FIG. 7, when the filter element **100** is inserted in the central chamber section **4a** of the system **2**, the drainage spout **38** contacts the disc **12** and moves the disc **12** to an open drainage position. When the filter element **100** is not inserted in the central chamber section **4a** of the system **2**, the disc **12** moves into a closed position and the sealing element **18** contacts an underside **220a** of the sealing ring **220** and prevents liquid flow through the system. Optionally, the filter element **100** may have an identical drainage end plate **8** and intake end plate **10** (not shown) and may be inserted in either orientation (*i.e.*, with either end at the drainage end or intake end of the system. (See FIG. 9)). The drainage spout **38** of the drainage end plate **8** (and/or inlet spout **38** of the intake end plate **10**) may

have a sealing gasket **26** about the rim of its end **42** for sealing axially against the disc **12** and/or for sealing radially against a sealing ring **120** in the inlet chamber section **4c** (FIG. 8).

[0027] FIG. 8 provides a cross-sectional view of another embodiment of an intake end of a coalescer system as contemplated herein. The system **2** includes a central chamber section **4a** and an inlet chamber section **4c** sealed against the central chamber section **4a** via an O-ring **30**. The intake end plate **10** of FIG. 8 is identical to the drainage end plate **8** of FIG. 7. Gas **A** comprising dispersed liquid **B** flows into the system through the intake inlet **50** in the inlet chamber section **4c** and through the opening **36** in the intake end plate **10**. In this position, the sealing gasket **26** seals radially **34** against an interior wall of a sealing ring **120** of the intake inlet **50**. The sealing gasket **26** is overmolded and functions to seal the inlet spout of the filter element **100** to the inlet chamber section **4c** and to seal the outlet spout of the filter element **100** to the drainage chamber section **4b**. (See FIG. 7).

[0028] FIG. 9 illustrates a two-dimensional view of one embodiment of a filter element **100** as contemplated herein having horizontal symmetry. The drainage end plate **8** is identical to the intake end plate **10** such that the filter element **100** may be inserted in either orientation in the coalescer systems contemplated herein. Shown is an inlet/drainage spout **38** having an opening **36**. An O-ring **22** is positioned around the neck of the inlet/drainage spout **38** for contacting a sealing surface in a chamber for receiving the filter element. Preferably, the sealing surface is chamfered (FIGS. 11-14).

[0029] FIG. 10 illustrates a two-dimensional cross-sectional view of one embodiment of a coalescer system **2** as contemplated herein. Shown is a filter element **100** inserted in a filter chamber having a central chamber section **4a**, a drainage chamber section **4b**, and an inlet chamber section **4c**. FIG. 11 illustrates an enlarged two-dimensional cross-section view of the intake end of the coalescer system of FIG. 10. The inlet chamber section **4c** has a retaining ring **120** with a chamfered face **120a** for contacting an O-ring **22** positioned on the neck of an inlet spout **38** of an intake end plate **10** of a filter element **100**. The chamfered face **120a** of the retaining ring **120** fixes the filter element axially to prevent vibratory damage

during use. The chamfered face **120a** also ensures that the O-ring **22** is always in compression. Air and oil enter the system through opening **36** in the inlet spout **38**.

[0030] FIG. 12 illustrates an enlarged two-dimensional cross-section view of the drainage end of the coalescer system of FIG. 10. The drainage end has a valve element positioned in the drainage chamber section **4b**. The valve element includes a disc **12** biased into a closed position via a spring **14**. The disc **12** includes a retaining ring **12a** for the spring **14** where the spring **14** fits around the inside of the retaining ring **12a**. The system **2** also includes a filter element **100** having media **6**, a drainage end plate **8**, and an intake end plate **10** (not shown). The drainage end plate **8** has a drainage spout **38** with an opening **36** through which through which gas **A** and dispersed liquid **B** may flow under excess pressure conditions (*i.e.*, bypass conditions) such as when the filter media **6** is plugged and does not permit sufficient gas flow therethrough.

[0031] Further shown in FIG. 12, the system **2** also includes a retaining ring **20** positioned in the drainage chamber section **4b** for the disc **12** and spring **14**. A sealing ring **220** is positioned on the top surface of the retaining ring **20**. The sealing ring **220** has a chamfered face **220a** for contacting an O-ring **22** positioned on the exterior radial surface of the drainage spout **38** (*i.e.*, around the neck of the drainage spout **38**) of the drainage end plate **8** of the filter element **100**. Contact point **110** of chamfered face **220a** and O-ring **22** provides a seal. The chamfered face **220a** of the sealing ring **220** fixes the filter element **100** axially to prevent vibratory damage during use. The chamfered face **220a** also ensures that the O-ring **22** is always in compression. When the filter element **100** is inserted in the chamber **4** of the system **2**, the drainage spout **38** contacts the disc **12** and moves the disc **12** to an open drainage position. When the filter element **100** is not inserted in the chamber **4** of the system **2**, the disc **12** moves into a closed position and a top surface of the disc contacts an underside **220b** of the sealing ring **220** and prevents liquid flow through the drainage spout **38**.

[0032] FIG. 13 illustrates airflow under bypass conditions through the drainage outlet of the filter element **100** of the coalescer system of FIG. 10. As shown in FIG. 13, under excess

pressure conditions (*i.e.*, bypass conditions) such as when the filter media **6** is plugged and does not permit sufficient gas flow therethrough, gas **A** and dispersed liquid **B** flow through the drainage spout **38**, push the disc **12** to a further open position, and flow under the bottom of the drainage spout **38**. The gas **A** and dispersed liquid **B** then flow through an opening **220c** in the sealing ring **220**, around a gap **80** between the drainage end plate **8** and the interior surface of the central chamber section **4a**, and towards the gas outlet **60** (see FIG. 10), as shown by the arrows. As such, the valve element functions as a relief valve for flow of gas **A** and dispersed liquid **B** under excess pressure conditions. Additionally, coalesced liquid **B** also may flow around the disc **12** and through the drainage outlet **70**. The system **2** is configured such that the filter element **100** contacts the valve element (*e.g.*, via the spout **38** of the filter element **100** contacting the disc **12** of the valve element) and moves the valve element to a predetermined position to create the desired valve opening or cracking pressure for the system. For example, in FIG. 13, the system **2** is configured such that the filter element **100** moves the disc **12** of the valve element to a predetermined position to create the desired valve opening or cracking pressure for the system (*e.g.*, based on compression of the spring **14** of the valve element).

[0033] FIG. 14 illustrates drainage through the drainage end of the coalescer system of FIG. 10. When the filter element **100** is inserted in the system **2** and the disc or ball **12** is in an open position, coalesced liquid **B** drains from the drainage outlet **70**. Arrows illustrate the flow of dispersed liquid **B** such as oil through the system. As shown in FIG. 14, a dispersed liquid phase **B** (*e.g.*, hydrocarbon liquid (such as oil mist) and/or water) coalesces in the filter media **6** and drains vertically through the system (*e.g.*, along the outside of the filter media **6** through a gap **80** between the filter media **6** and the interior surface of the central chamber section **4a**). The coalesced liquid flows along the top surface of the sealing ring **220** and through a hole **220c** in the sealing ring **220**. The coalesced liquid then flows onto the surface of the disc or ball **12** and through a gap **90** between the disc or ball **12** and the retaining ring **20**. A weeping hole **38a** is provided along the bottom surface of the drainage spout **38** to prevent coalesced liquid **B** from collecting on the top surface of the disc or ball **12** (*i.e.* providing egress for coalesced liquid flowing along the inside surface of the filter media **6** and

through outlet 36).

[0034] The coalescer systems disclosed herein may be adapted for use in coalescer systems and methods disclosed in the art. (See, e.g., U.S. Patent Nos. 7,416,657; 7,326,266; 7,297,279; 7,235,177; 7,198,718; 6,907,997; 6,811,693; 6,740,358; 6,730,236; 6,605,224; 6,517,615; 6,422,396; 6,419,721; 6,332,987; 6,302,932; 6,149,408; 6,083,380; 6,056,128; 5,874,008; 5,861,087; 5,800,597; 5,762,810; 5,750,024; 5,656,173; 5,643,431; 5,616,244; 5,575,896; 5,565,078; 5,500,132; 5,480,547; 5,480,547; 5,468,385; 5,454,945; 5,454,937; 5,439,588; 5,417,848; 5,401,404; 5,242,604; 5,174,907; 5,156,745; 5,112,498; 5,080,802; 5,068,035; 5,037,454; 5,006,260; 4,888,117; 4,790,947; 4,759,782; 4,667,647; 4,643,834; 4,640,781; 4,304,671; 4,251,369; 4,213,863; 4,199,447; 4,083,778; 4,078,965; 4,052,316; 4,039,441; 3,960,719; 3,951,814; and U.S. published Application Nos. 2007-0289915; 2007-0107399; 2007-0062887; 2007-0062886; and 2007-0039865; the contents of which are incorporated herein by reference in their entireties.)

[0035] In the foregoing description, certain terms have been used for brevity, clarity, and understanding. No unnecessary limitations are to be implied therefrom beyond the requirement of the prior art because such terms are used for descriptive purposes and are intended to be broadly construed. The different configurations, systems and method steps described herein may be used alone or in combination with other configurations, systems and method steps. It is to be expected that various equivalents, alternatives and modifications are possible.

CLAIMS

What is claimed is:

1. A coalescer system for coalescing a liquid phase dispersed in a gas phase, the system comprising:

- (a) a chamber having an inlet, a gas outlet, and a drainage outlet, wherein a gaseous phase comprising a dispersed liquid phase enters the chamber through the inlet and exits the chamber through the gas outlet;
- (b) a filter element for insertion in the chamber, the filter element comprising:
 - (i) filter media for coalescing the dispersed liquid phase as the gaseous phase passes through the filter media, and
 - (ii) endplates, namely an inlet end plate and a drainage end plate, wherein the end plates each have spouts with openings permitting flow of the gas phase and dispersed liquid phase therethrough, namely an inlet spout and a drainage spout; and
- (c) a valve element biased in a closed position;

wherein:

when the filter element is inserted in the chamber, the drainage spout opens the valve element and permits flow of the coalesced liquid phase through the drainage spout and through the drainage outlet of the chamber; and

when the filter media becomes plugged, the filter element permits flow of the gaseous phase through the drainage spout and through the gas outlet, thereby bypassing the filter media.

2. The system of claim 1, wherein the inlet end plate and drainage end plate are identical.

3. The system of claim 1, wherein the valve element comprises a closing element biased against the spout of the end plate via a spring mechanism when the filter element is inserted in the system.

4. The system of claim 3, wherein the closing element is a disc or ball.
5. The system of claim 3, wherein the valve element comprises a retaining ring containing the closing element and the spring mechanism.
6. The system of claim 5, wherein the closing element is a disc.
7. The system of claim 6, wherein the disc has a patch of media on a top surface for contacting the drainage spout.
8. The system of claim 6, wherein the disc comprises a sealing element on a top surface that seals against a bottom surface of the retaining ring to prevent flow of the coalesced liquid phase through the drainage outlet of the chamber when a filter element is not inserted in the system.
9. The system of claim 1, wherein the chamber further comprises an auxiliary drainage outlet permitting flow of the coalesced liquid phase therethrough, and flow of the coalesced liquid phase through the auxiliary drainage is not dependent upon a filter element being inserted in the system.
10. The system of claim 1, wherein the drainage spout moves the valve element to an open drainage position via the drainage spout contacting a disc in the valve element that is biased in a closed position and moving the disc to an open position.
11. The system of claim 10, wherein the drainage spout comprises an O-ring around an exterior surface.
12. The system of claim 10, wherein the drainage spout comprises a sealing gasket about an end rim that axially contacts a top surface of the disc and that radially contacts an interior surface of an intake inlet of the chamber.
13. The system of claim 1, wherein the drainage spout comprises one or more notches in a surface that contact the valve element, thereby permitting flow of coalesced

liquid phase therethrough.

14. A coalescer system for coalescing a liquid phase dispersed in a gas phase, the system comprising:

- (a) a chamber having an inlet, a gas outlet, and a drainage outlet, wherein a gaseous phase comprising a dispersed liquid phase enters the chamber through the inlet and exits the chamber through the gas outlet;
- (b) a filter element for insertion in the chamber, the filter element comprising:
 - (i) filter media for coalescing the dispersed liquid phase as the gaseous phase passes through the filter media, and
 - (ii) endplates, namely an inlet end plate and a drainage end plate, wherein the end plates each have spouts with openings permitting flow of the gas phase and dispersed liquid phase therethrough, namely an inlet spout and a drainage spout; and
- (c) a valve element biased in a closed position via a spring mechanism;

wherein:

when the filter element is inserted in the chamber, the drainage spout opens the valve element to an open position via compressing the spring mechanism, thereby permitting flow of the coalesced liquid phase through the drainage spout and through the drainage outlet of the chamber, the open position corresponding to cracking pressure for the system wherein when pressure in the system exceeds cracking pressure, the valve element is moved to a bypass position via further compression of the spring, thereby permitting bypass flow of the gaseous phase through the drainage spout and through the gas outlet.

15. The system of claim 14, wherein the inlet end plate and drainage end plate are identical.

16. The system of claim 14, wherein the valve element comprises a disc having a patch of media on a top surface.

17. The system of claim 14, wherein the valve element comprises a ring that contains the spring mechanism.

18. The system of claim 14, wherein the end plate moves the disc or ball to a height that creates compression in the spring that corresponds to cracking pressure for the system.

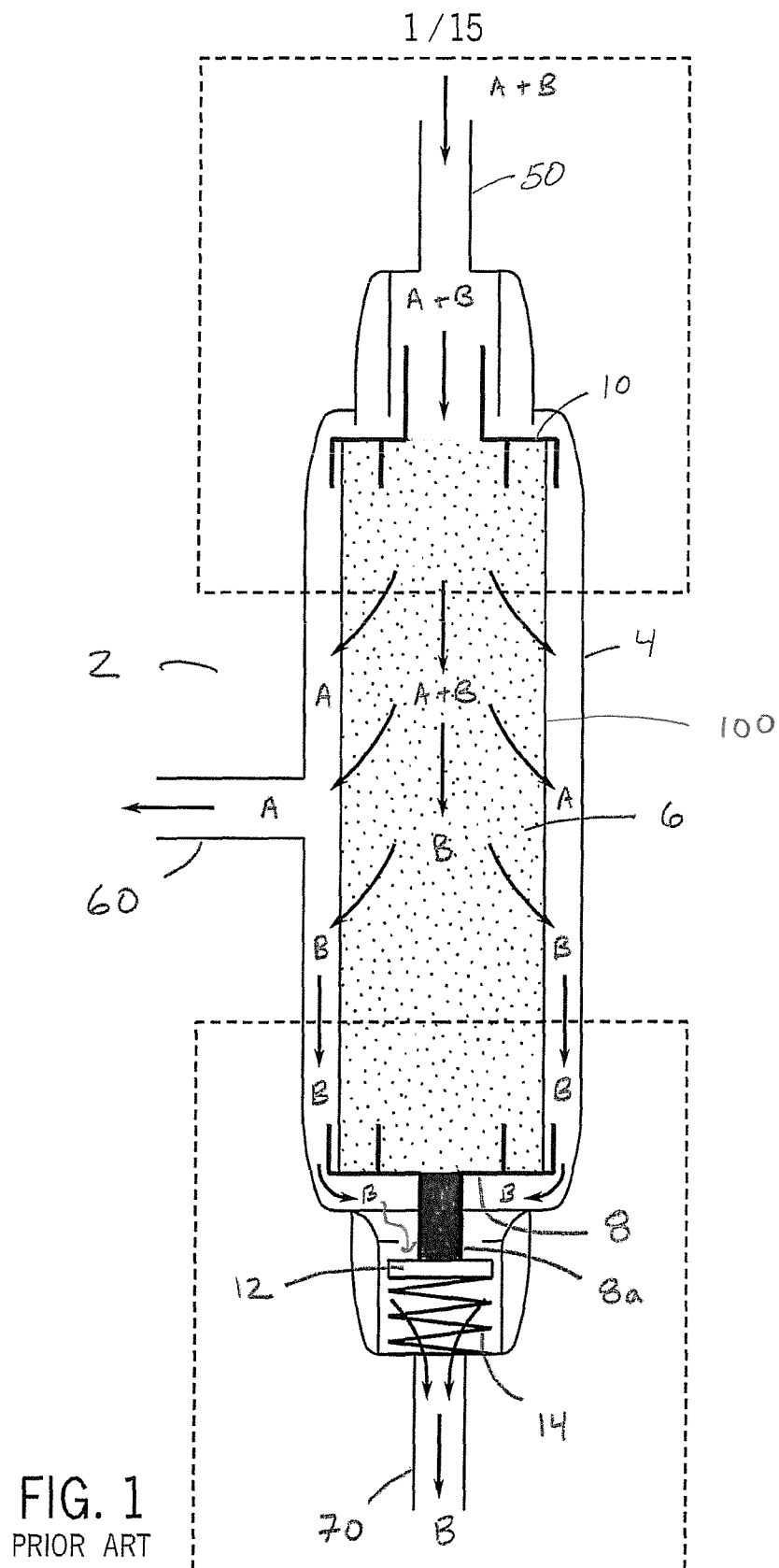
19. A coalescer system for coalescing a liquid phase dispersed in a gas phase, the system comprising:

- (a) a chamber having an inlet, a gas outlet, and a drainage outlet, wherein a gaseous phase comprising a dispersed liquid phase enters the chamber through the inlet and exits the chamber through the gas outlet;
- (b) a filter element for insertion in the chamber, the filter element comprising:
 - (i) filter media for coalescing the dispersed liquid phase as the gaseous phase passes through the filter media, and
 - (ii) endplates, namely an inlet end plate and a drainage end plate, wherein the end plates each have spouts with openings permitting flow of the gas phase and dispersed liquid phase therethrough, namely an inlet spout and a drainage spout; and
- (c) a valve element comprising a closing element biased in a closed position via a spring mechanism;

wherein:

when the filter element is inserted in the chamber, the drainage spout moves the closing element to an open position via compressing the spring mechanism, thereby permitting flow of the coalesced liquid phase through the drainage spout and through the drainage outlet of the chamber, the open position corresponding to cracking pressure for the system wherein when pressure in the system exceeds cracking pressure, the closing element is moved to a bypass position via further compression of the spring, thereby permitting bypass flow of the gaseous phase through the drainage spout and through the gas outlet.

20. The system of claim 19, wherein the inlet end plate and drainage end plate are identical.



2 / 15

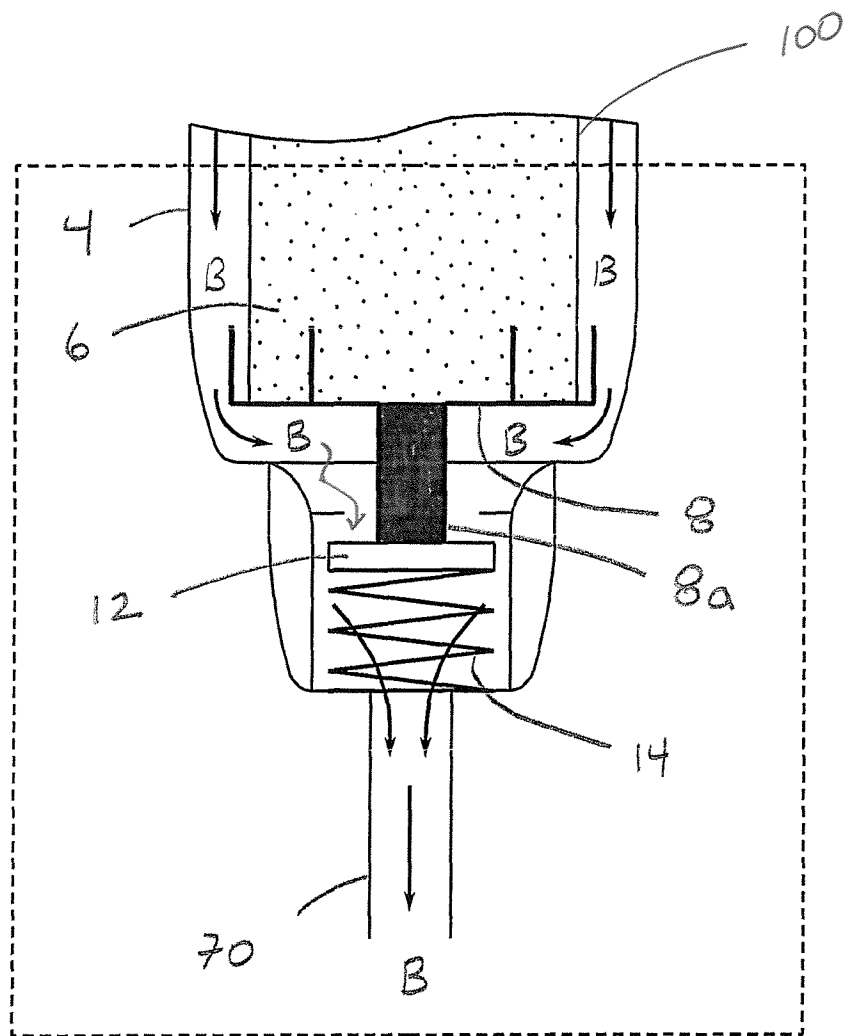


FIG. 2

3 / 15

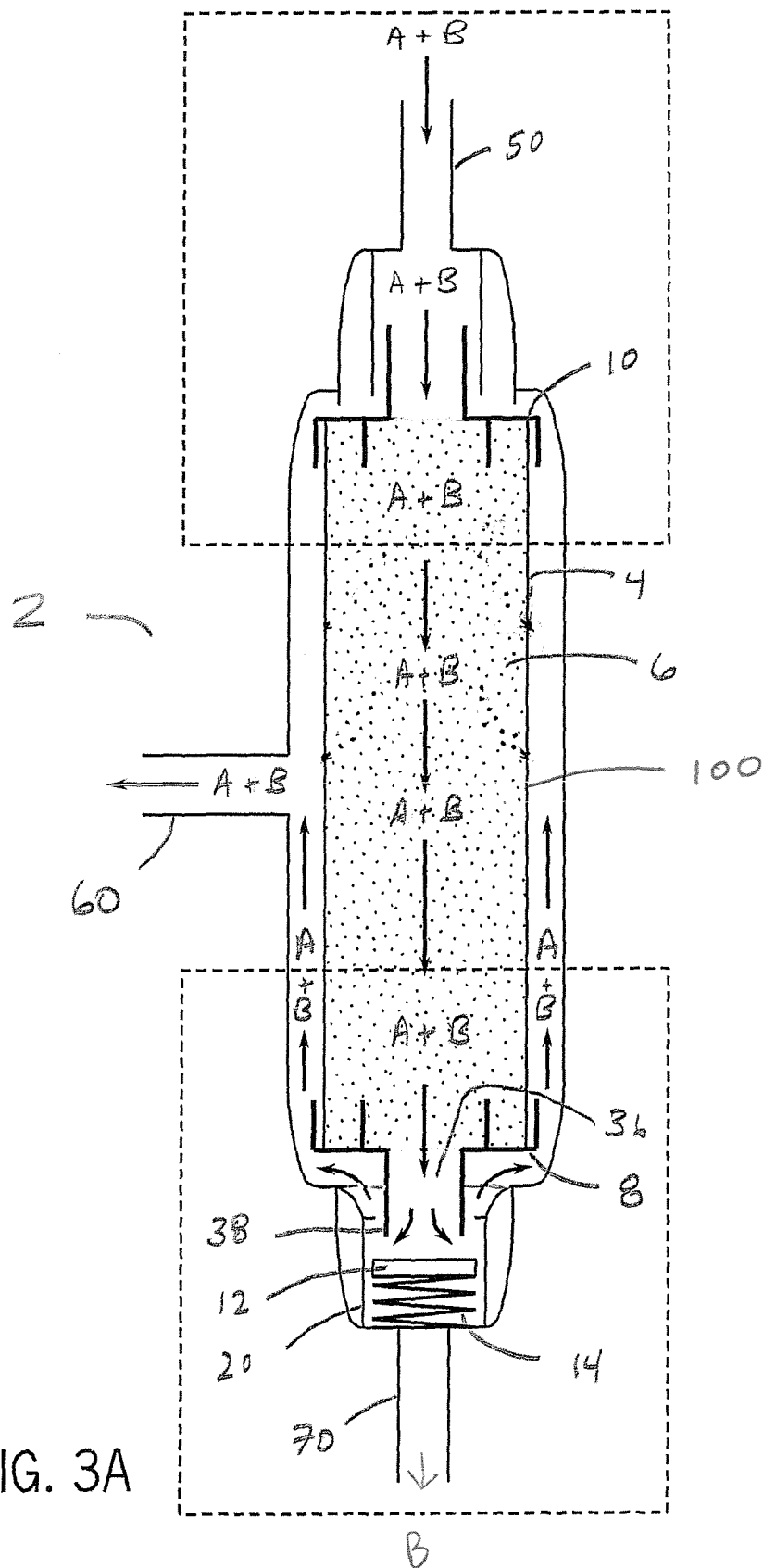
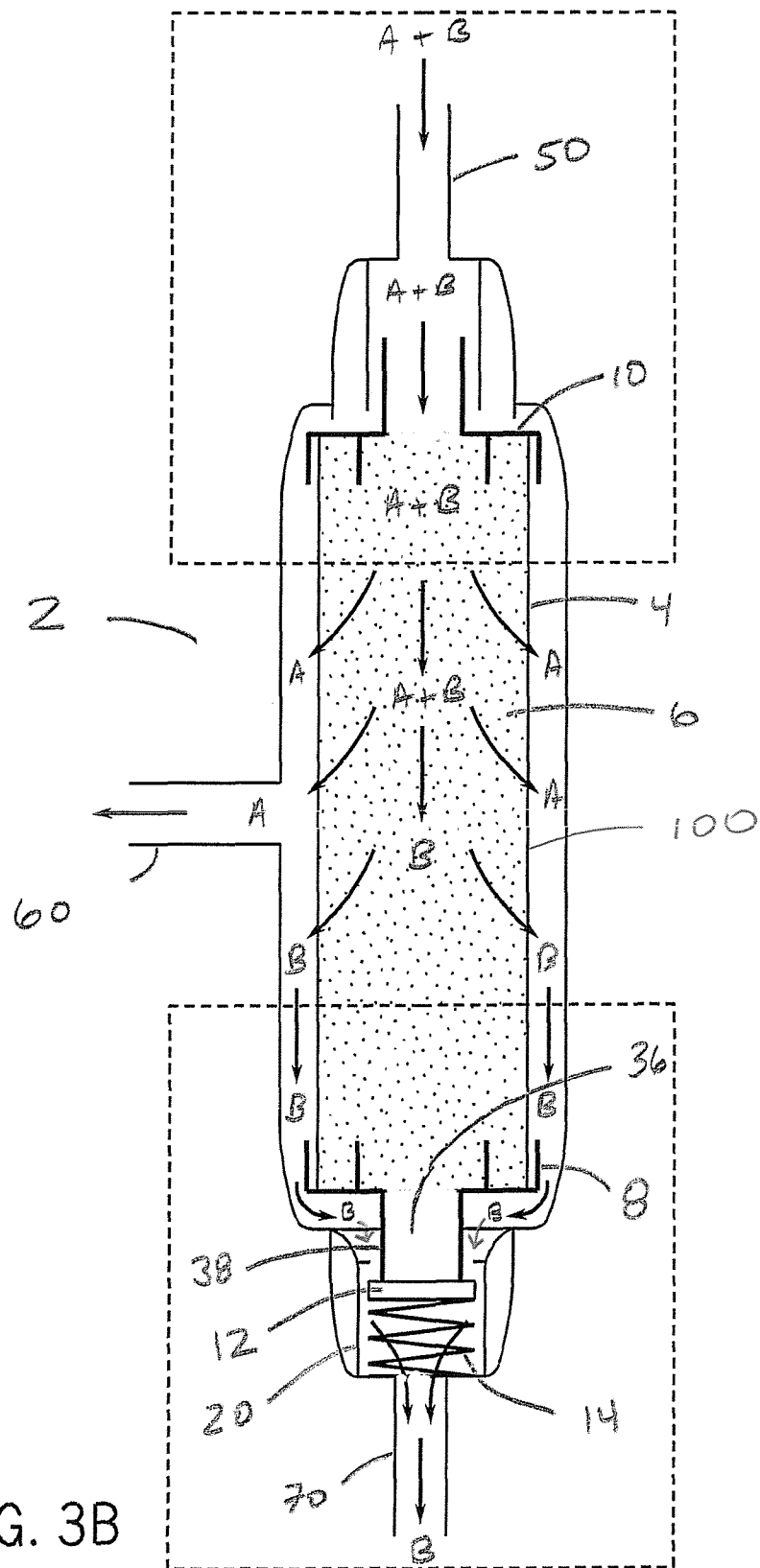
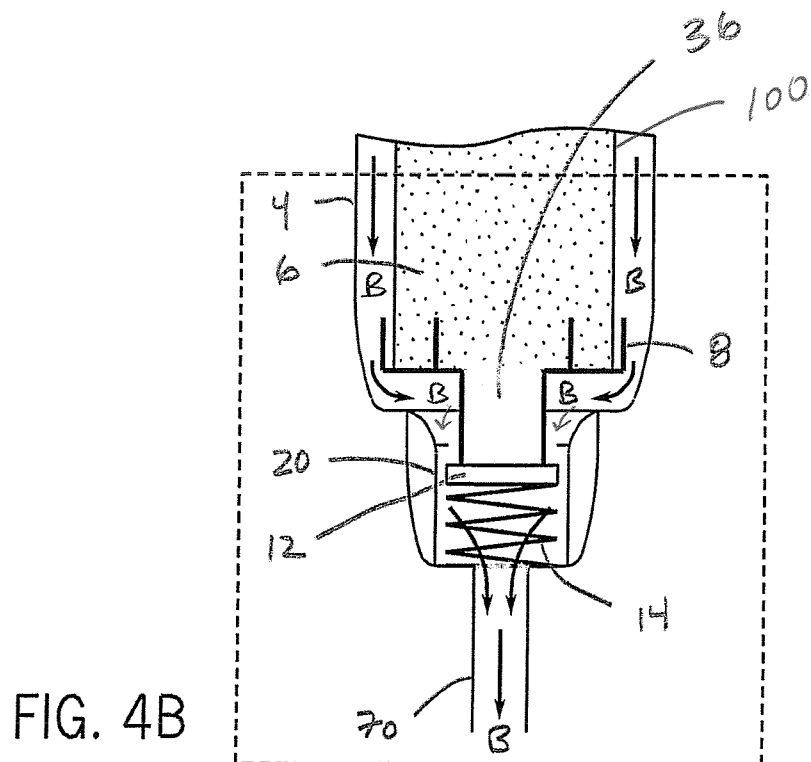
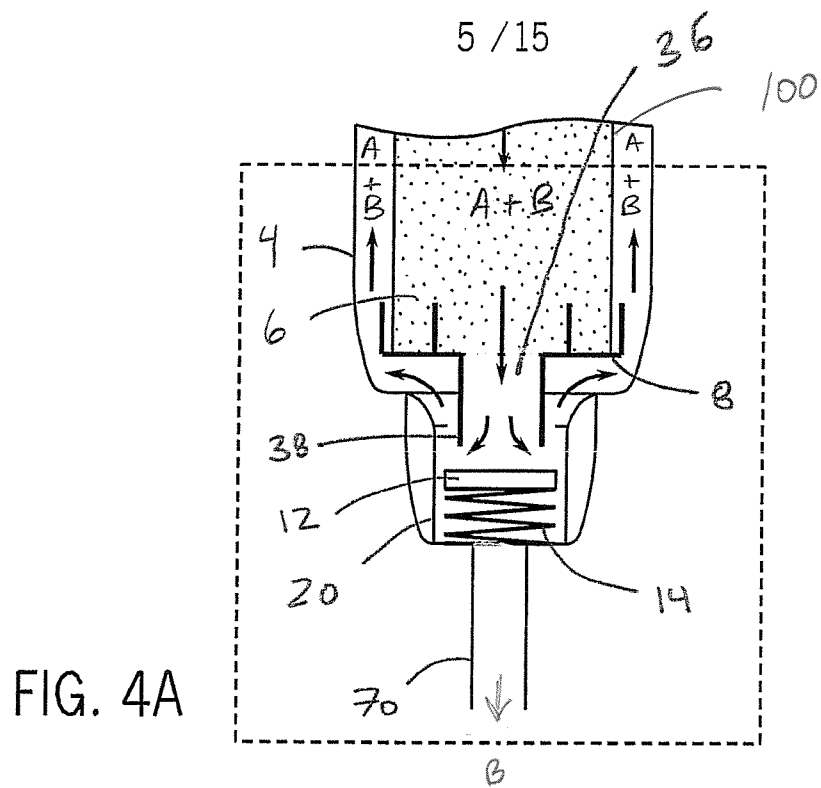


FIG. 3A

4 / 15





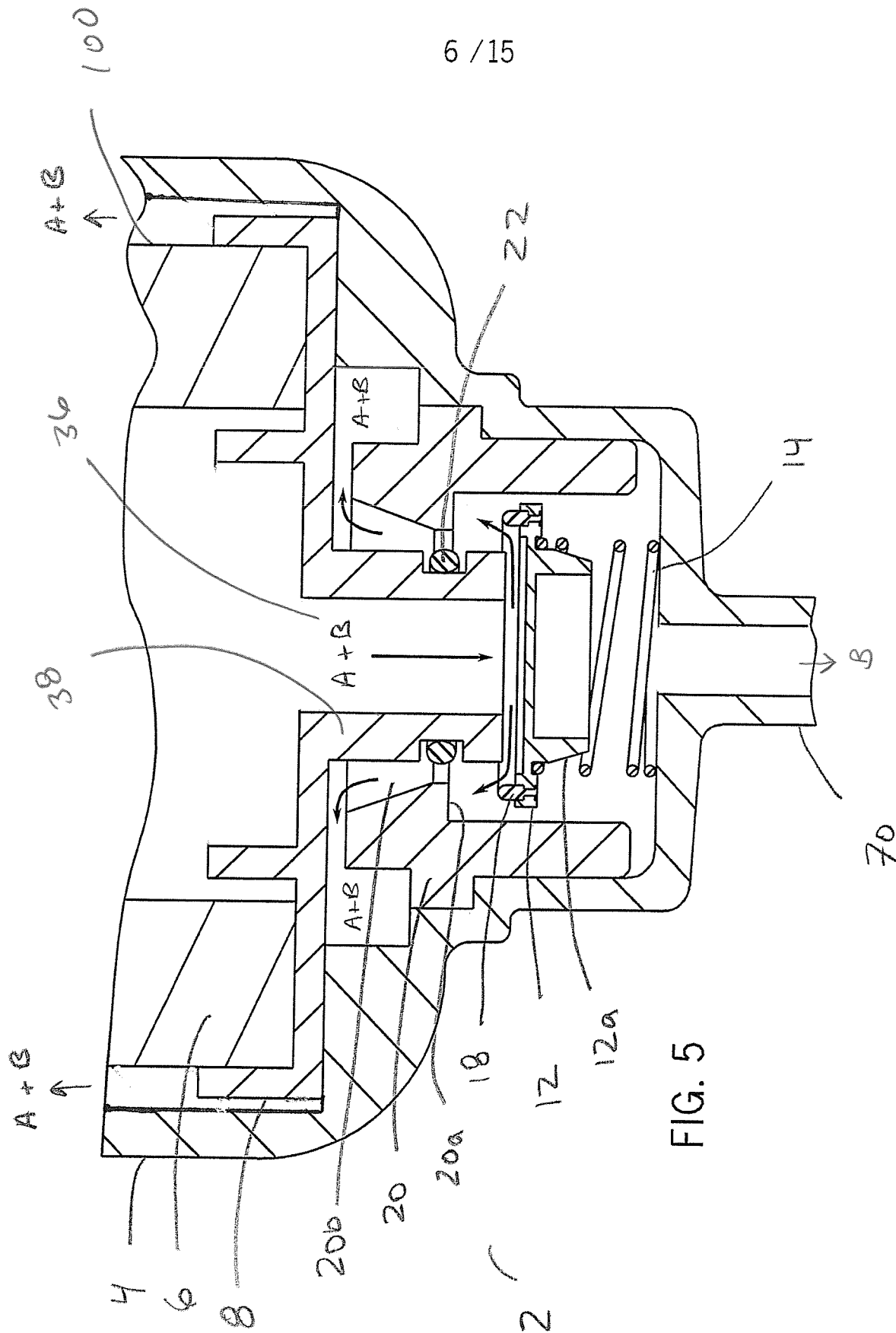


FIG. 5

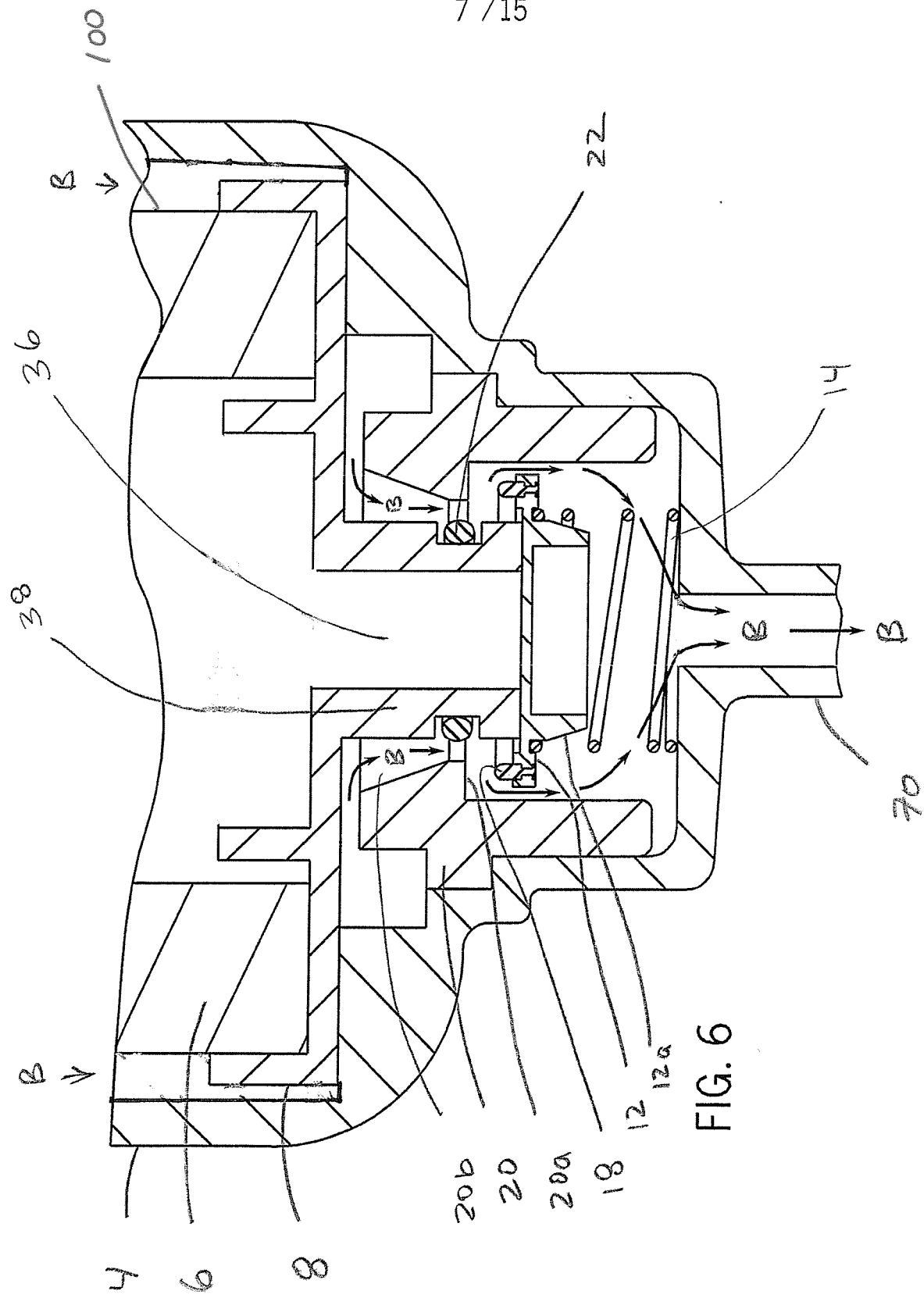
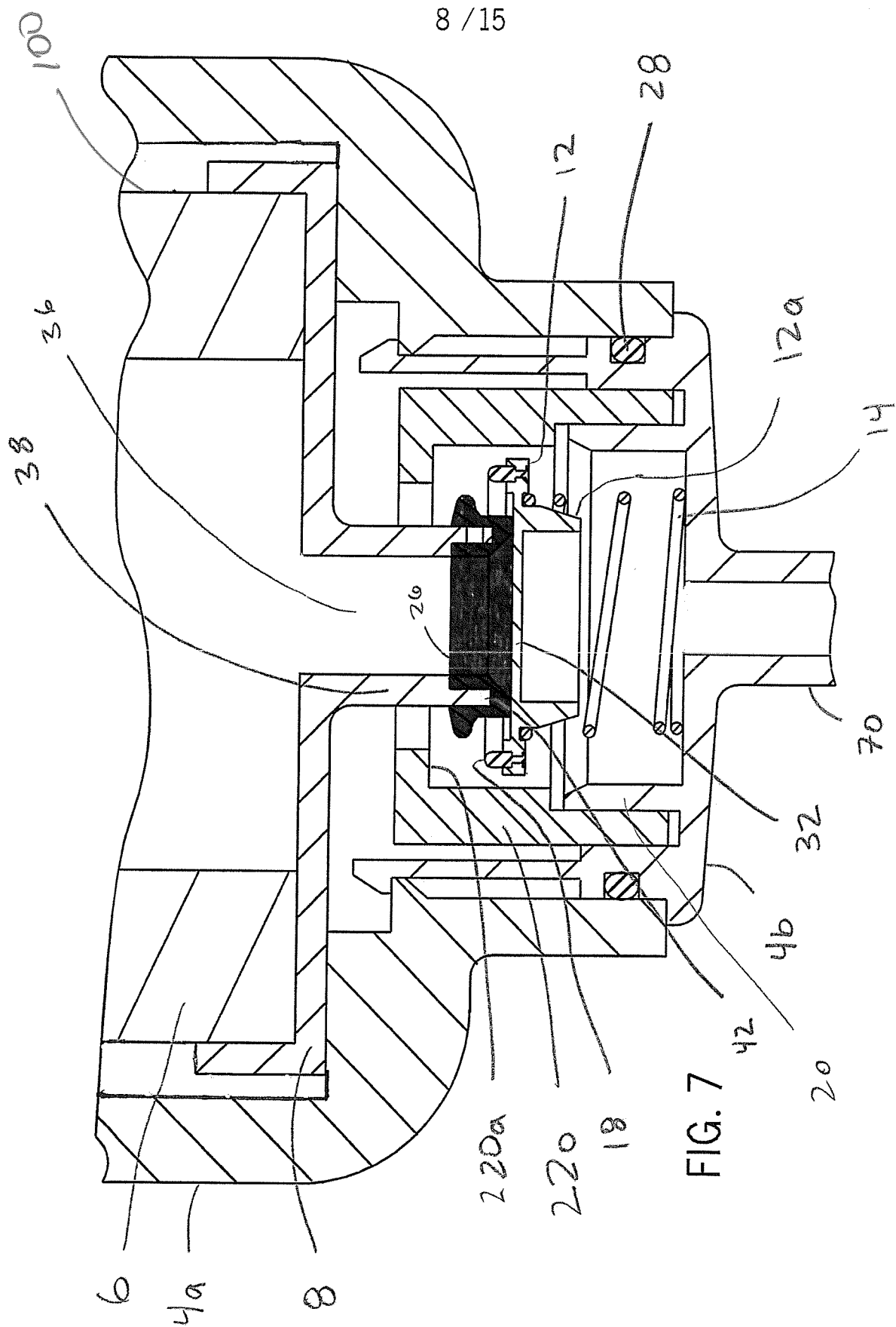
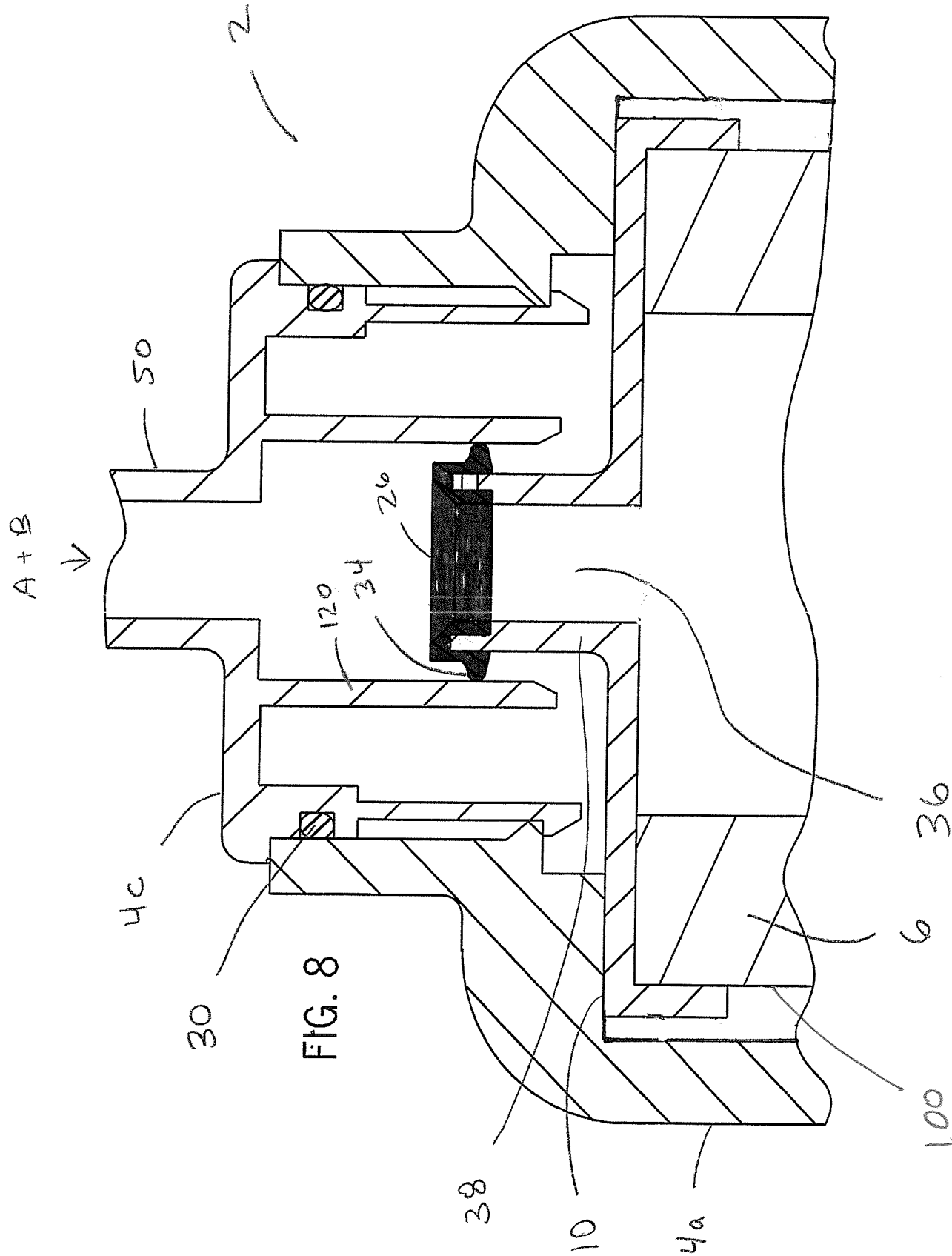
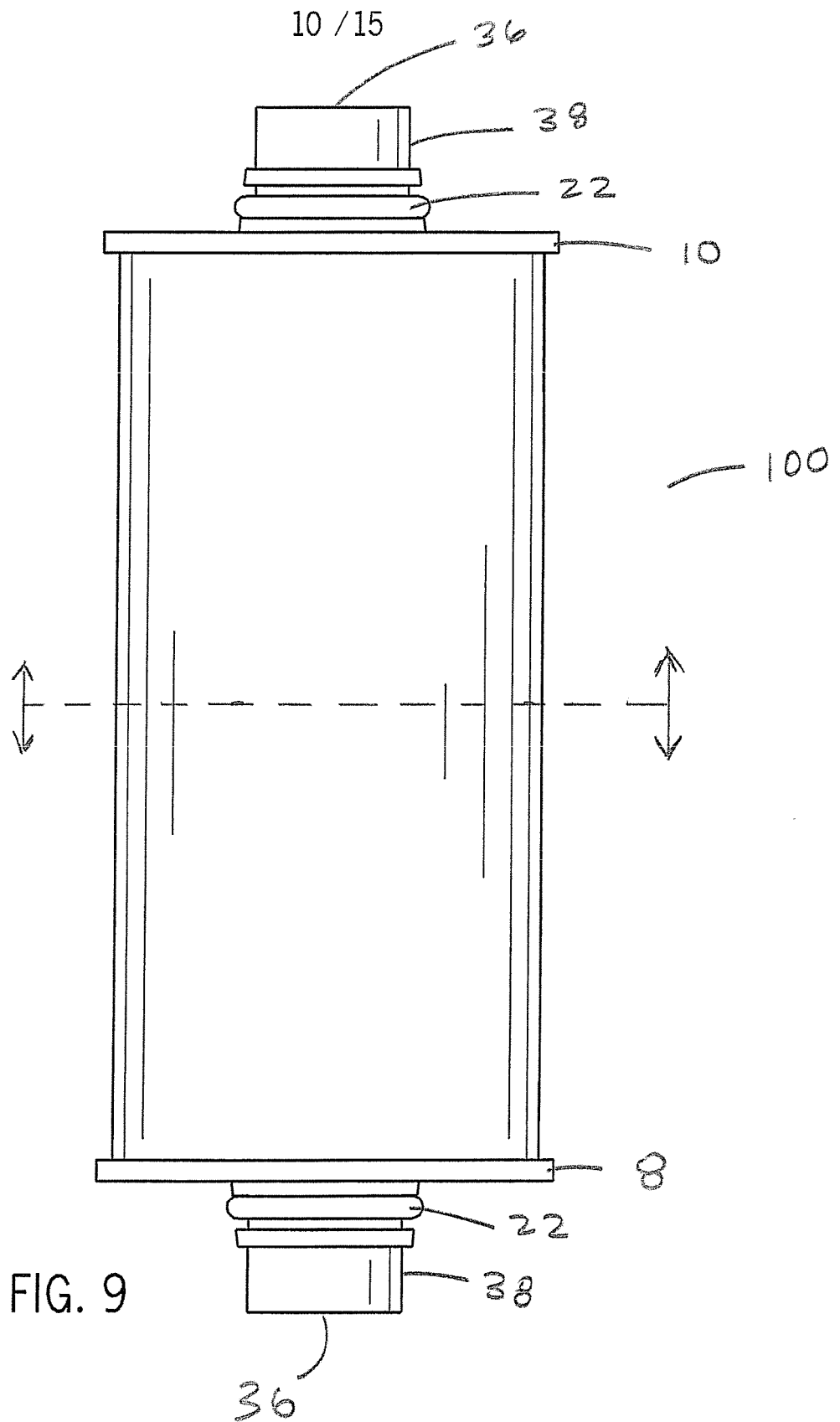


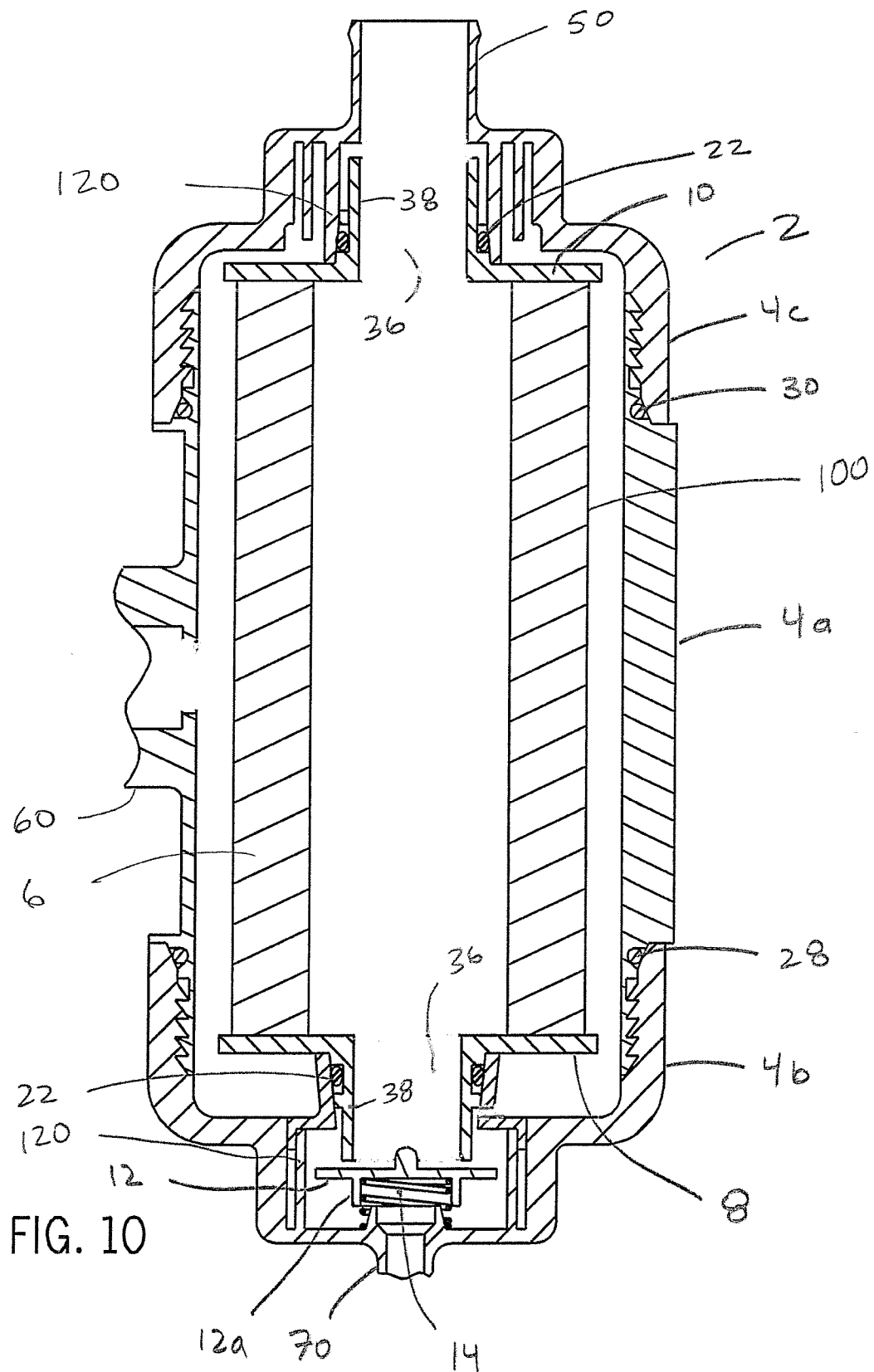
FIG. 6

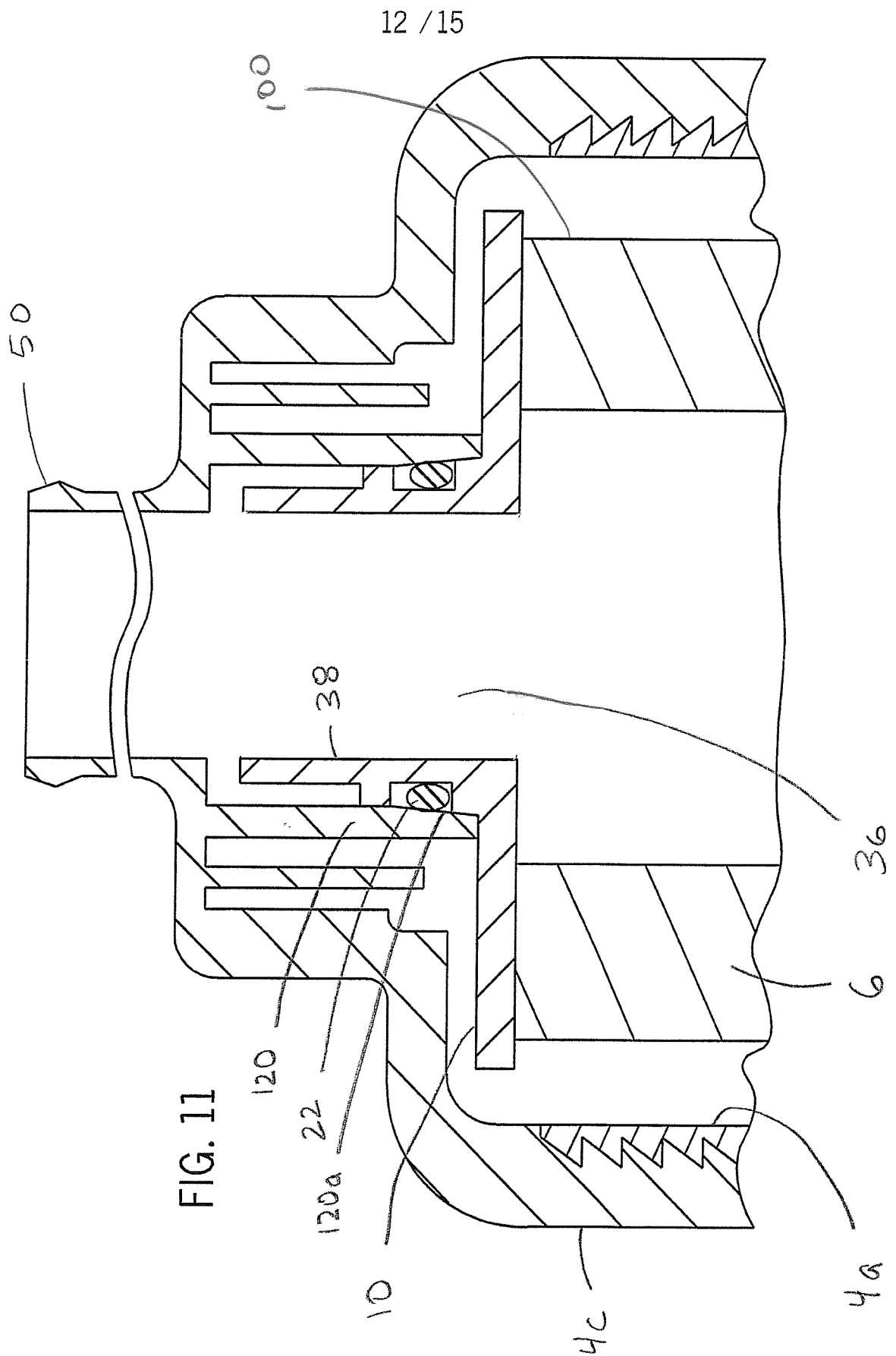


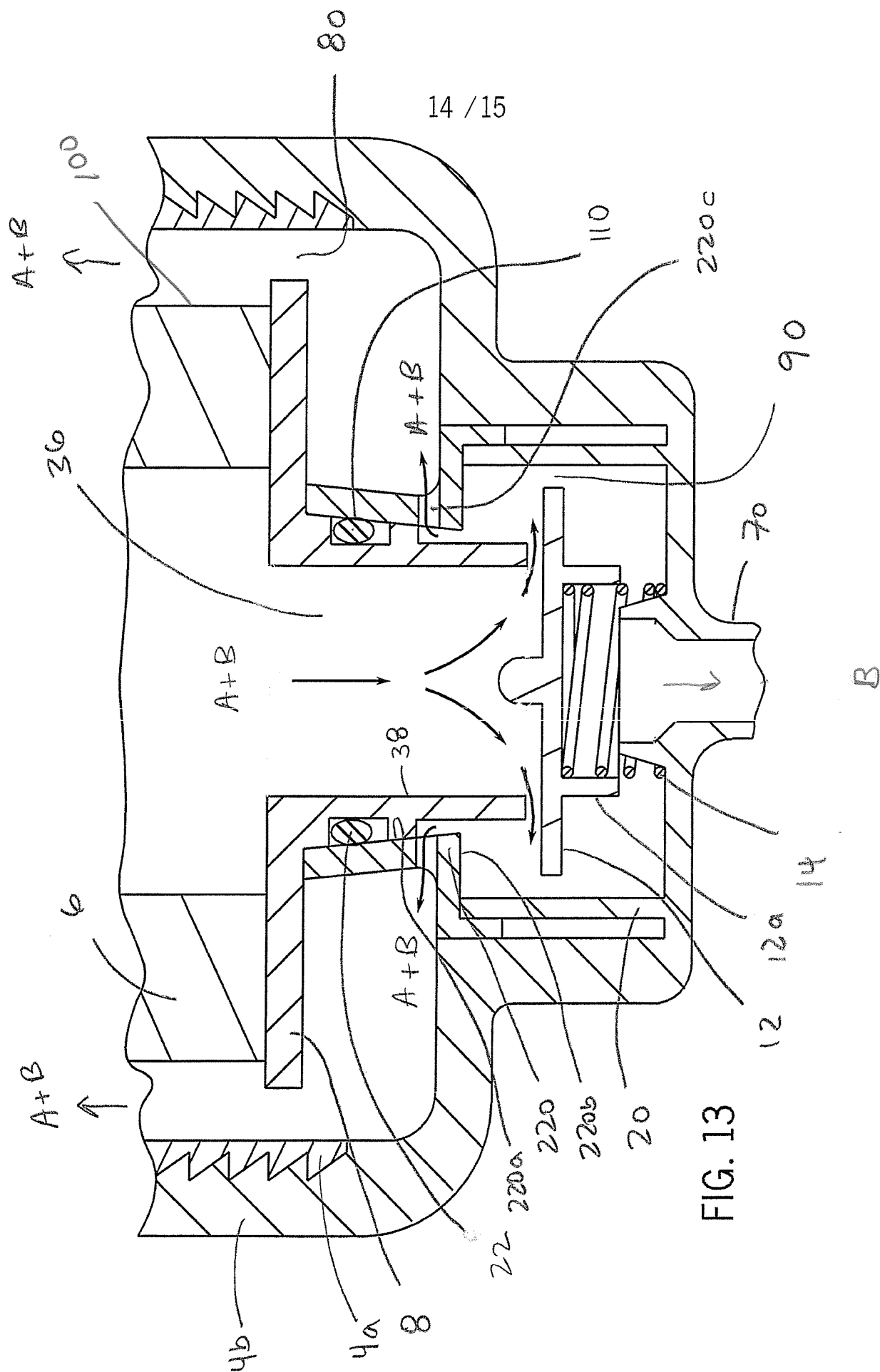


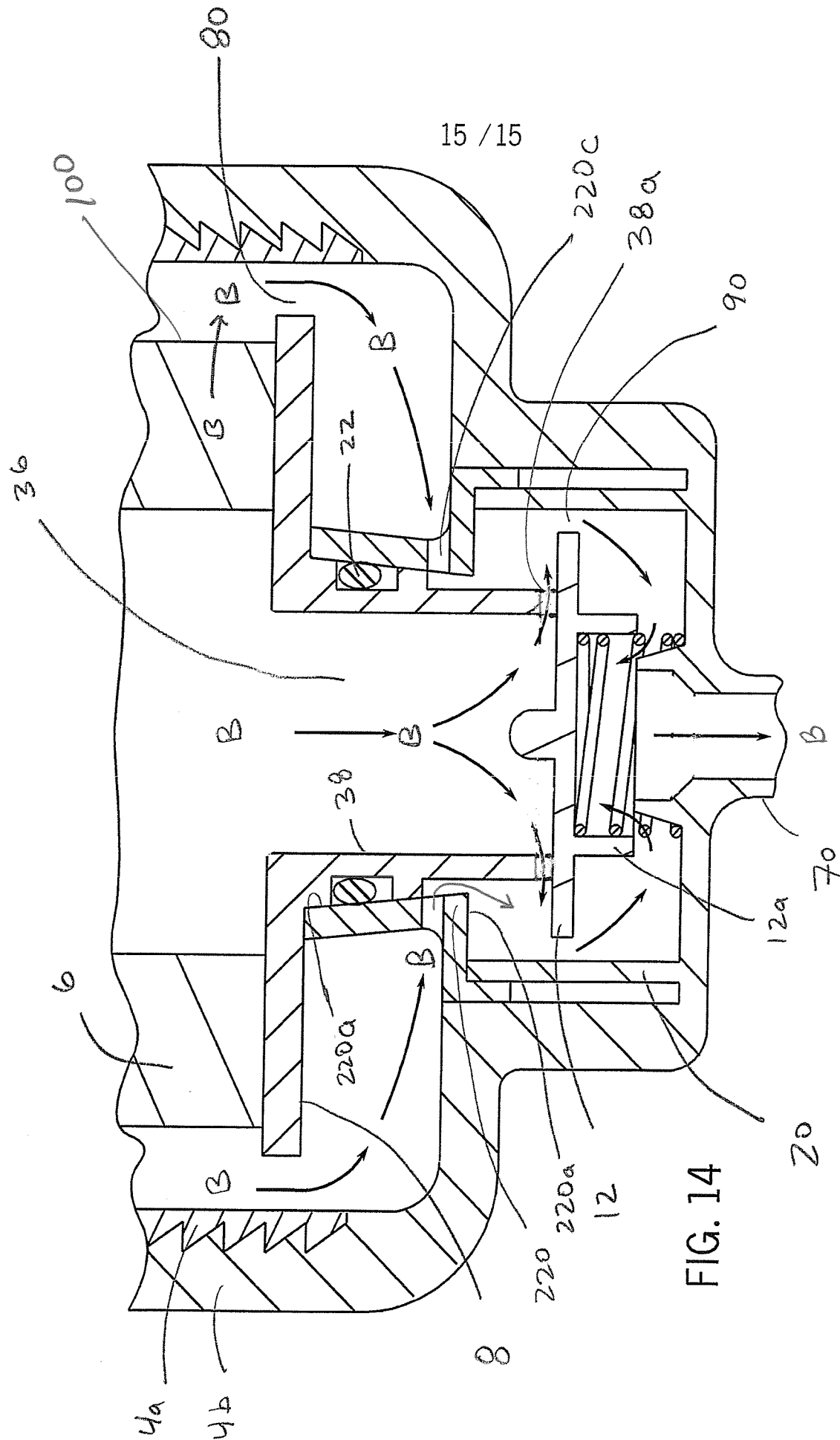


11 / 15









INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 10/56815

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - B01D 53/26 (2010.01)

USPC - 95/19

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)

USPC: 95/19

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

USPC: 55/312; 95/273

(keyword limited; terms below)

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

PubWEST (PGPB, USPT, EPAB, JPAB); Google

Search terms used: filter, valve, drain, vent, exhaust, bypass, clog, block, plug, obstruct, gas, fluid, liquid, et al.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2009/0050121 A1 (Holzman et al.) 26 February 2009 (26.02.2009), para [0015]-[0020], Fig 1-6, 11	1-20
Y	US 2008/0190832 A1 (Schachtrup et al.) 14 August 2008 (14.08.2008), para [0033]-[0043], Fig 1-5	1-20
A	US 2002/0092280 A1 (Gieseke et al.) 18 July 2002 (18.07.2002), entire document	1-20
A	US 2004/0237484 A1 (Altwater et al.) 02 December 2004 (02.12.2004), entire document	1-20
A	US 2004/0211181 A1 (Fornof) 28 October 2004 (28.10.2004), entire document	1-20

☐

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

31 December 2010 (31.12.2010)

Date of mailing of the international search report

18 JAN 2011

Name and mailing address of the ISA/US

Mail Stop PCT, Attn: ISA/US, Commissioner for Patents
P.O. Box 1450, Alexandria, Virginia 22313-1450

Facsimile No. 571-273-3201

Authorized officer:

Lee W. Young

PCT Helpdesk: 571-272-4300
PCT OSP: 571-272-7774