

AUTOMATIC GAS PURGE VALVE

FIELD OF THE DISCLOSED SUBJECT MATTER

The present disclosed subject matter relates to a gas purge valve and more specifically to an automatic gas purge valve configured for discharging gas at substantially high flow rates.

5 BACKGROUND OF THE DISCLOSED SUBJECT MATTER

A wide variety of gas purge valves are known in the art, deigned for fitting on different fluid systems and configured for different purposes e.g. pressure control, discharge of residual gas within a liquid in the system, etc.

For example, US 4,770,201 discloses a fluid flow valve such as a faucet or air-
10 purge valve comprising a housing having defined therein a fluid through-flow aperture with a valve seating formed in the housing and bounding said aperture. A flexible closure membrane is secured at one end to the housing and is adapted to be biased, under fluid pressure in the housing, against the valve seating so as to seal the aperture. Membrane displacing means are secured to an opposite end of the membrane so that
15 displacement of the displacing means in a first sense progressively detaches successive transverse portions of the membrane from the seating so as to open the aperture while displacement of the displacing means in an opposite sense allows for the membrane to become sealingly biased against the seating.

A gas purge valve is disclosed in US 7,617,838 directed to a gas purge valve
20 comprising a housing formed with an inlet and an outlet formed with a valve seating, and a sealing assembly comprising a sealing member displaceable between an open position and a closed position. The sealing assembly is supported by an external support

lever mechanism extending outside the housing, to thereby displace the sealing assembly into sealing engagement with the valve seating at the closed position.

US6,105,608 is directed to a gas purge valve comprising a valve housing that has a valve inlet and major and minor valve outlets, a valve partition mounted in the
5 housing divides the housing into a first chamber communicating with the valve inlet and a second chamber that communicates with the minor valve outlet. A restrictive flow passage is defined in the housing that effects communication between the first and second chambers and has a through flow rate less than that of the minor valve outlet. A minor valve closure device is provided for closing the minor valve outlet to liquid
10 outflow. A differential pressure responsive device mounted in the partition member and displaceable in response to a pressure differential between the chambers and a major valve outlet obturating device responsive to displacement of the differential pressure responsive device into the opening of the major valve outlet when the pressure differential exceeds a predetermined magnitude.

15 SUMMARY OF THE DISCLOSED SUBJECT MATTER

According to the present disclosed subject matter there is disclosed an automatic gas purge valve system comprising a normally closed gas discharge faucet configured for discharging gas at substantially high flow rates, and an automatic valve unit configured for selectively generating a flow pulse to displace the gas discharge faucet
20 into its open position.

The automatic gas purge valve comprises a housing configured with a an automatic valve unit having an inlet port in flow communication with the housing and an outlet port being in flow communication with a control chamber of a normally closed gas discharge faucet, said gas discharge faucet configured with a fluid inlet port being in
25 flow communication with the housing and a fluid discharge port; and wherein the automatic valve is manipulable between a closed position and an open position responsive to liquid level within the housing.

According to one particular configuration the automatic gas purge valve comprises a housing configured with a float member extending into the housing and articulated to an automatic valve unit having an inlet port in flow communication with
30 the housing and an outlet port being in flow communication with a control chamber of a normally closed gas discharge faucet, said gas discharge faucet configured with a fluid

inlet port being in flow communication with the housing and a fluid discharge port; and wherein the automatic valve is manipulable between a closed position and an open position responsive to liquid level within the housing. This configuration, when configured with a float member extending into the housing is typically suited for use
5 with dirty liquid, e.g. sewage liquids, industrial waste, etc.

According to another configuration of the disclosed subject matter, the automatic valve unit is connected to the housing of the gas purge valve at a lower portion thereof, wherein manipulation between the closed position and the open position is responsive to liquid level within the housing by communicating vessels rule. This
10 configuration, when devoid of float member extending into the housing is typically suited for use with liquids substantially free of dirt and matter.

The arrangement is such that liquid rise within the housing displaces the automatic valve into a closed position and liquid decrease results in opening the automatic valve and consequently generating a pressure signal at the control chamber so
15 as to displace the automatic gas purge valve into its open position to purge the valve.

Liquid decrease within the housing corresponds with gas accumulation within the housing.

Any one or more of the following features and designs can be associated with the valve subject of the present disclosed subject matter, in combination or independent
20 from one another:

The housing is configured as a substantially vertically extension in flow communication with the main fluid line;

The length (height) of the housing is at least 4 times the diameter thereof;

A mounting flange accommodates the gas discharge faucet and the automatic
25 valve, said mounting flange is in the form of a top flange of the housing or integral with the housing;

The float is articulated to the automatic valve via a rigid link;

The automatic valve is a peel-away type valve;

The control chamber is configured for airing after displacement of the gas
30 discharge faucet into its open position. Airing can be facilitated via a bleed aperture or a bleed valve. According to one particular example, a bleed aperture is configured at a location between an outlet port of the automatic valve unit and a control chamber of the gas discharge faucet; The housing of the gas purge valve can be

configured with a so-called vacuum breaker, configured for facilitating automatic ingress of gas (e.g. ambient air) into the housing at the event of pressure decrease therein. Typically said vacuum breaker is configured as a one-way type valve fitted at an upper portion of the housing;

5 The housing is configured as a cylindrical chamber for mounting on the main fluid supply line. Alternatively, the housing extends from the supply line and is integrated therewith.

 The term *supply line* is used herein the specification and claims in its broad sense and denotes fluid supply lines (including liquid, gas and mixed media fluid lines),
10 of any size and purpose.

BRIEF DESCRIPTION OF THE DRAWINGS

In order to understand the invention and to see how it may be carried out in practice, an embodiment will now be described, by way of a non-limiting example only, with reference to the accompanying drawings, in which:

15 **Fig. 1A** illustrates a gas purge valve system according to the disclosed subject matter, at the closed position;

Fig. 1B is an enlargement of the portion marked 'A' in Fig. 1A;

Fig. 2A illustrates the system of Fig. 1A at the open position;

Fig. 2B is an enlargement of the portion marked 'B' in Fig. 2A;

20 **Fig. 3** is a view similar to Fig. 2A, illustrating a modification wherein a control chamber airing arrangement is configured;

Fig. 4A illustrates a gas purge valve system according to a modification of the disclosed subject matter, at the closed position; and

Fig. 4B illustrates the system of Fig. 4A at the open position.

25 DETAILED DESCRIPTION OF EMBODIMENTS

Attention is first directed to Figs. 1A and 1B of the drawings illustrating a gas purge system generally designated **10**. The gas purge system is mounted over a main liquid supply line **12**.

 The gas purge system **10** comprises a cylindrical pear-shaped housing **20**
30 configured with a lower portion **22** widened at its bottom, and a top tubular portion **24**. The gas purge system is secured to the liquid supply line **12** via a coupling flange **14**

such that the interior of the housing is in fluid flow with the interior of the fluid line **12**. The housing is mounted such that its longitudinal axis extends substantially vertically. The lower portion **22** is fitted near a bottom end thereof with a ball-type faucet **28**.

It is appreciated that the height of the housing **20** is a height **h** significantly
5 longer than its diameter **d**, the ration being at least about, such that the housing serves as a chamber of considerable volume.

A mounting flange **30** is fixedly secured by a plurality of bolts **32** over a top flange **34** of the housing **20**, however in a sealed fashion.

Attached over the mounting flange **30**, at a top outside surface **42** there is an
10 automatic valve unit generally designated **46**, having articulated thereto a float member **48** supported within the housing **20** and articulate to the automatic valve unit **46** via a rigid rod **50** extending through an opening **52** (Figs. 1B and 2B) at the mounting flange **30**, wherein said rigid rod **50** and the articulated float member **48** are restricted for substantially axial displacement coaxially with, or parallel to, the longitudinal axis of
15 the housing **20**. It is seen that the rod **50** is long and extends substantially low, thus enabling the float member **48** to displace, at its lowermost position, in close proximity towards the bottom of the housing **22**, with a significant volume of gas trapped within the housing at the closed position, as will be discussed herein below.

As can best be seen in the enlarged figures of Figs. 1A and 1B, the automatic
20 valve unit **46** is configured with a housing **60** screw coupled at **62** to the mounting flange **30**. The housing **60** defines a space **61** and is configured with an inlet port **66** being in flow communication with the housing **20**, and with an outlet port **68** extending from a fluid through-flow aperture **70**, with a valve seating **72** formed in the housing and bounding said aperture **70**.

25 A flexible closure membrane **76** is secured at one end **80** to the housing **60** and at an opposite end **82** to a membrane displacing member **84** which in turn is articulated to the rigid rod **50**. The membrane displacing member **84** is configured with an inclined membrane biasing wall surface **90**, equally inclined as wall portion **92** configured with the opening **70**.

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The membrane displacing member **84** is adapted to be displaced only in the axial direction by the rigid rod **50** (responsive to liquid level within the housing **20**) between two distinct positions, namely:

a sealed position (Figs. 1A and 1B), wherein membrane displacing member **84** is axially upwards displaced whereby the inclined surface **90** bears against membrane **76** and biases it against the valve seating **72** so as to seal the aperture **70** and the outlet port **68**;

5 and an open position (Figs. 2A and 2B), wherein the membrane **76** is detached (peeled away) from the valve seating **72** so as to expose the aperture **70** and open the fluid flow path between the outlet port **68** and the space **66** of the housing **60**, so that a flow path now extends between the housing **20**, the space **66** and the outlet port **68**.

The arrangement is such that the displacement of the membrane displacing
10 member **84** in a downwards sense progressively detaches successive transverse portions of the membrane **76** from the seating **72** so as to open the aperture **70**, while displacement of the membrane displacing member **84** in an opposite sense (upwards) allows for the membrane **76** to become sealingly biased against the seating **72**.

The mounting flange **30** further seats a normally closed gas discharge faucet
15 generally designated **100**, being in flow with an inside space of the housing **20** through a discharge conduit **102** having one end **104** open into the housing **20** and an opposite end **108** extending into an inlet port **112** of housing **113** of the gas discharge faucet **100**. The inlet port **112** is configured with a valve seating **114** engageable by a sealing seat **120** of sealing plunger **126** extending through a plunger bore **122**, said plunger being
20 normally biased into sealing engagement with the sealing seating **114** by a coiled spring **128** extending within a control chamber **132** and bearing at one end against a shoulder portion of plunger head **134** of the sealing plunger **126** and at an opposite end against a housing wall portion **136**. Extending from the plunger bore **122** there is a fluid discharge ports **140** (two, oppositely extending in the illustrated example), and being in
25 fluid flow communication with the inlet port **112**.

As can be seen in Figs. 1B and 2B the plunger head **134** is configured with an annular seal (O-ring) **144**, whereby the sealing plunger **126** is sealingly displaceable in the axial direction within the housing **113**, said sealing displacement of the seal **144** against the inner wall surface **146** renders the control chamber **132** being a sealed
30 chamber, i.e. not being in fluid flow with the inlet port **112** or the fluid discharge ports **140**.

Further noted, the plunger head **134** has a surface area greater than the sealing head portion **154**, whereby the fluid pressure applied within the control chamber **132** is

sufficient for displacing the sealing plunger **126** from its normally sealed position (Figs. 1A and 1B) into the temporarily open position (Figs. 2A and 2B) and where upon ceasing the pressure within the control chamber **132** the biasing spring will entail spontaneous displacement of the sealing plunger **126** back into its normally sealed position.

A fluid command port **148** is in fluid communication with the control chamber **132** and is in fluid flow communication with the outlet port **68** of the automatic valve unit **46** via a conduit **150**.

As can be seen in Figs 1A and 2A, the float member **48** is a substantially large float, to thereby provide an efficient closing force (buoyant force) in an upwards direction to close/seal the automatic valve unit **46**, upon liquid level rise within the housing, and on the other hand to ensure a sufficiently strong opening force, (gravity force) in a downwards direction, upon liquid level drop within the housing, so as to open the automatic valve unit **46**.

The arrangement is such that at the normal course of operation of the system, the system will be at the so called closed position (Figs. 1A and 1B), wherein liquid level **L** within the housing **20** is at a normal level, sufficiently raised so as to generate buoyant forces on the float member **48**, to thereby displace it into its uppermost position, entailing corresponding upwards displacement of the membrane displacing member **84** into the closed position, whereby the inclined surface **90** bears against membrane **76** and biases it against the valve seating **72** so as to seal the aperture **70** and the outlet port **68**. At this position the gas discharge faucet **100** remains at its normally sealed position, such that fluid flow through the fluid discharge ports **140** is prohibited.

However, upon liquid level decrease within the housing **20**, to a level **L'** (Figs. 2A and 2B), the float member **48** follows the liquid level **L'** and descends under gravity, entailing corresponding axial displacement of the rigid rod and the articulated membrane displacing member **84** in a downwards sense, thereby progressively detaching successive transverse portions of the membrane **76** from the seating **72** so as to fully open the aperture **70**.

Opening the aperture **70** facilitates a pressure command signal to flow via conduit **146** into the control chamber **132** of the gas discharge faucet **100**, resulting in pressure built up within the control chamber **132** and further in displacement of the sealing plunger **126** from its normally sealed position (Figs. 1A and 1B) into the open

position (Figs. 2A and 2B), whereby a substantially high flow rate path is now temporarily opened to facilitate discharge of high volume of gas through open end **104** of discharge conduit **102**, then through valve seating **114** and out to the atmosphere (or a collecting duct; not shown) through the fluid discharge port/s **140**.

5 Upon ceasing the pressure within the control chamber **132** the biasing spring will entail spontaneous displacement of the sealing plunger **126** back into its normally sealed position.

 The arrangement disclosed hereinabove provides a compact discharge valve system, yet competent for efficiently discharging large volumes of gas from a liquid
10 system and at a high flow rate, whilst providing that the system remains normally closed unless at a discharge position.

 In Fig. 3 of the drawings there is illustrated a modification of the arrangement disclosed in the previous figures, wherein like elements are designated with same reference numbers. In the example of Fig. 3 the control chamber **132** is configured for
15 airing after displacement of the gas discharge faucet **100** into its open position. Airing is facilitated via a bleed aperture **153** configured at the housing of the gas discharge faucet **100**, wherein if desired a one way valve can be positioned, e.g. a mushroom type valve and the like.

 It is however appreciated that the airing port can be configured at any location
20 between the outlet port **68** of the automatic valve unit **46** and a control chamber **132** of the gas discharge faucet **100**.

 Turning now to Figures 4A and 4B, there is illustrated a modified configuration of a gas purge valve system according to the presently disclosed subject matter. For sake of clarity, like elements are designated with like reference numbers as in the
25 example of figures 1 and 2, however shifted by 200.

 The gas purge valve system generally designated **210** comprises a cylindrical pear-shaped housing **220** configured with a lower portion **222** widened at its bottom and configured for coupling to a top tubular portion **224**. The gas purge system is configured for securing to a liquid supply line (not shown) via a coupling flange **214** such that the
30 interior of the housing is in fluid flow with the interior of the fluid line.

 A mounting flange **230** is fixedly secured over a top flange **234** of the housing **220**, however in a sealed fashion.

Attached at the lower portion **222** of the housing **220**, and being in flow communication with an inside space **223** thereof, there is mounted an automatic valve unit generally designated **246**.

The automatic valve unit **246** is configured with a housing **260** screw coupled at
5 **262** to a mounting extension **263** extending from the housing **222**. The housing **260** defines a space **261** and is configured with an inlet port **266** being in flow communication with the inside space **223** within housing **220**, and with an outlet port **268** extending from a fluid through-flow aperture **270**, with a valve seating **272** formed in the housing and bounding said aperture **270**, as best seen in the enlargements of Figs.
10 1B and 2B. A flexible closure membrane **276** is secured at one end **280** to the housing **260** and at an opposite end **282** to a membrane displacing member **284**, namely a float member, axially displaceable within the housing **260**, responsive to liquid level therewithin, which in turn is responsive to liquid rise within the housing **220**. The membrane displacing member **284** is configured with an inclined membrane biasing
15 wall surface **290**, equally inclined as wall portion **292** configured with the opening **270**.

It is seen that the automatic valve unit **246** is connected to the housing **222** of the gas purge valve at a lower portion thereof, wherein manipulation between the closed position and the open position is responsive to liquid level within the housing **222** by communicating vessels rule. This configuration, when devoid of float member
20 extending into the housing is typically suited for use with liquids substantially free of dirt and matter.

The membrane displacing member **284** is adapted to be displaced only in the axial direction (responsive to liquid level within the housing **20**) between two distinct positions, namely:

25 a sealed position (Fig. 4A), wherein membrane displacing member **284** is axially upwards displaced whereby the inclined surface **290** bears against membrane **276** and biases it against the valve seating **272** so as to seal the aperture **270** and the outlet port **268**;

and an open position (Fig. 4B), wherein the membrane **276** is detached (peeled
30 away) from the valve seating **272** so as to expose the aperture **270** and open the fluid flow path between the outlet port **268** and the space **266** of the housing **260**, so that a flow path now extends between the housing **220**, the space **266** and the outlet port **268**.

The arrangement is such that the displacement of the membrane displacing member **284** in a downwards sense progressively detaches successive transverse portions of the membrane **276** from the seating **272** so as to open the aperture **270**, while displacement of the membrane displacing member **284** in an opposite sense
5 (upwards) allows for the membrane **276** to become sealingly biased against the seating **272**.

The mounting flange **330** further seats a normally closed gas discharge faucet generally designated **300** of similar design to discharge faucet generally designated **100** in the previous example, and reference is made thereto for further details. The discharge
10 faucet **300** is in flow with the inner space **223** of housing **220** through a discharge conduit **302** having one end **304** open into the housing **220** and an opposite end **308** extending into an inlet port **312** of housing **313** of the gas discharge faucet **300**. A valve seating **314** is engageable by a sealing seat **320** of a sealing plunger **326** extending through a plunger bore **322**, said plunger being normally biased into sealing engagement
15 with the sealing seating **314** by a coiled spring **328** extending within a control chamber **332**, and bearing at one end against a shoulder portion of plunger head **334** of the sealing plunger **326** and at an opposite end against a housing wall portion **336**. Extending from the plunger bore **322** there is a fluid discharge ports **340** (one only, as opposed to two in the previous example), and being in fluid flow communication with
20 the inlet port **312**.

The plunger head **334** is configured with an annular seal (O-ring) **344**, whereby the sealing plunger **326** is sealingly displaceable in the axial direction within the housing **313**, said sealing displacement of the seal **344** against the inner wall surface **346** renders the control chamber **332** being a sealed chamber, i.e. not being in fluid flow
25 with the inlet port **312** or the fluid discharge port **340**.

Further noted, the plunger head **334** has a surface area greater than the sealing head portion **354**, whereby the fluid pressure applied within the control chamber **332** is sufficient for displacing the sealing plunger **326** from its normally closed/sealed position (Fig. 4A) into the temporarily open position (Fig. 4B) and where upon ceasing
30 the pressure within the control chamber **332** the biasing spring will entail spontaneous displacement of the sealing plunger **326** back into its normally sealed position.

A fluid command port **348** is in fluid communication with the control chamber **332** and is in fluid flow communication with the outlet port **268** of the automatic valve

unit **246** via a conduit **350**, which in the present example is configured as a double shield wall, for reinforcing same.

The arrangement is such that at the normal course of operation of the system, the system will be at the so called closed position (Fig. 4A), wherein liquid level **L** within
5 the housing **220** is above that of the float member **284** of the automatic valve unit **246** sufficiently so as to generate buoyant forces on the float member **248** owing to the communicating vessels rule, to thereby displace the float member **248** into its uppermost, closed position, entailing corresponding upwards displacement of the membrane displacing member **284** into the closed/sealed position, whereby the inclined
10 surface **290** bears against membrane **276** and biases it against the valve seating **272** so as to seal the aperture **270** and the outlet port **268**. At this position the gas discharge faucet **300** remains at its normally sealed position, such that fluid flow through the fluid discharge ports **340** is prohibited.

However, upon liquid level decrease within the housing **220**, to a level **L'** (Fig.
15 4B), the membrane displacing member **284** follows the liquid level **L'** and descends under gravity, entailing progressively detaching successive transverse portions of the membrane **276** from the seating **272** so as to fully open the aperture **270**.

Opening the aperture **270** facilitates a pressure command signal to flow via conduit **346** into the control chamber **332** of the gas discharge faucet **300**, resulting in
20 pressure built up within the control chamber **332** and further in displacement of the sealing plunger **326** from its normally sealed position (Fig. 4A) into the open position (Fig. 4B), whereby a substantially high flow rate path is now temporarily opened to facilitate discharge of high volume of gas through open end **304** of discharge conduit **302**, then through valve seating **314** and out to the atmosphere (or a collecting duct; not
25 shown) through the fluid discharge port **340**, as represented by the arrows.

Upon ceasing the pressure within the control chamber **332** the biasing spring will entail spontaneous displacement of the sealing plunger **326** back into its normally sealed position.

It is appreciated that the configuration disclosed in connection with Figs. 4A and
30 **4B**, namely exposure of the automatic valve unit **246** to liquid within the housing **222** renders it not being suitable for liquids containing material, e.g. sewage, industrial waste and the like, but is rather suitable for clean liquids.

As can further be noted in Fig. 4A and 4B, the housing **222** is configured at an upper portion thereof with a so-called vacuum breaker generally designated **380**, configured for facilitating automatic ingress of gas (e.g. ambient air) into the housing at the event of pressure decrease therein.

5 Typically said vacuum breaker **380** is configured as a one-way type valve fitted at an upper portion of the housing. The arrangement is such that a seal member **382** is normally biased into sealing engagement of an inlet seat **384** by means of a compression spring **386**. However, upon pressure drop within the housing **222** the spring **386** compress, allowing the seal member **382** to displace from the seat **384**, thereby
10 facilitating air ingress into the housing **222**.

Furthermore, the control chamber is configured for airing after displacement of the gas discharge faucet into displace into its open position. Airing can be facilitated via a bleed aperture **394** or a bleed valve (not shown). The bleed aperture **394** can configured at any location between an outlet port of the automatic valve unit and a
15 control chamber of the gas discharge faucet.

While there has been shown an example of the disclosed subject matter, it is to be understood that many changes may be made therein without departing from the spirit of the invention, *mutandis mutatis*.

Claims:

1. An automatic gas purge valve comprising a housing configured with an automatic gas purge valve system comprising

a normally closed gas discharge faucet having a control chamber, the gas discharge faucet being configured with a fluid inlet port being in flow communication with the housing and a fluid discharge port configured for discharging gas at substantially high flow rates; and

an automatic valve unit having an inlet port in flow communication with the housing and an outlet port being in flow communication with the control chamber, and configured for selectively generating a flow pulse at the control chamber to displace the gas discharge faucet into its open position;

wherein the automatic valve unit is manipulable between a closed position and an open position solely responsive to liquid level within the housing;

wherein the automatic valve unit is configured with a flexible closure membrane secured at one end to the housing and at an opposite end to a membrane displacing member; and

wherein displacement of the membrane displacing member in a downwards sense progressively detaches successive transverse portions of the flexible closure membrane so as to open the outlet port towards the open position of the automatic valve.

2. The automatic gas purge valve according to claim 1, further comprising a float member extending into the housing and articulated to the automatic valve unit.

3. The automatic gas purge valve according to claim 1, wherein the automatic valve unit is connected to the housing at a lower portion thereof, wherein manipulation between the closed position and the open position is responsive to liquid level within the housing by communicating vessels rule.

4. The automatic gas purge valve according to claim 1, wherein liquid rise within the housing displaces the automatic valve unit into the closed position and liquid decrease results in opening the automatic valve unit and consequently generating a pressure signal at the control chamber so as to displace the automatic valve unit into its open position to purge the automatic gas purge valve.
5. The automatic gas purge valve according to claim 1, wherein the housing is configured for mounting at a substantially vertical position on a fluid flow line.
6. The automatic gas purge valve according to claim 1, wherein the housing has a height extending at least 4 times a diameter thereof.
7. The automatic gas purge valve according to claim 2, wherein the housing is configured at an upper end thereof with a mounting flange accommodating the gas discharge faucet and the automatic valve unit.
8. The automatic gas purge valve according to claim 2, wherein the float member is articulated to the automatic valve unit via a rigid link extending downwards from the automatic valve unit into an inside space of the housing downwards from the automatic valve unit.
9. The automatic gas purge valve according to claim 2, wherein the automatic valve unit is a peel-away type valve.
10. The automatic gas purge valve according to claim 1, wherein the control chamber is configured for airing after displacement of the gas discharge faucet into displace into its open position.
11. The automatic gas purge valve according to claim 1, wherein the housing is configured as a cylindrical chamber for mounting on a main fluid supply line.

12. The automatic gas purge valve according to claim 1, wherein the housing of the gas purge valve is configured with a vacuum breaker, for facilitating automatic ingress of gas into the housing at the event of pressure decrease therein.