Oct. 4, 1955 W. E. GILDERSLEEVE 2,719,537

FLOW REGULATING DEVICE

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FIG. 1

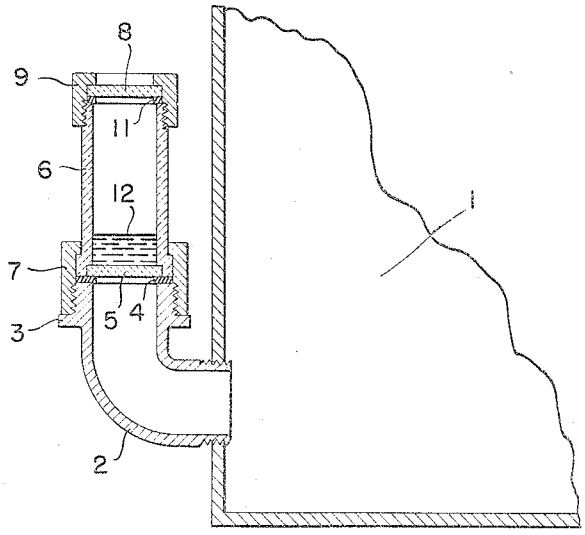
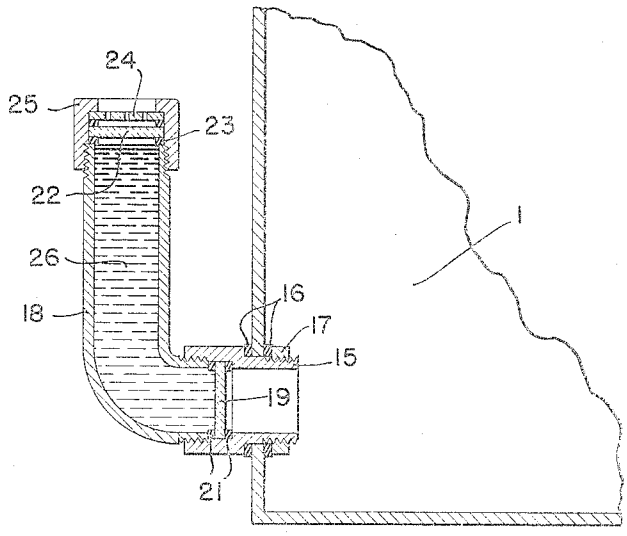


FIG. 2



INVENTOR.
WILLIAM E. GILDERSLEEVE

BY R. W. Mason

ATTORNEY.

United States Patent Office

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FLOW REGULATING DEVICE

William E. Gildersleeve, Philadelphia, Pa., assignor to Selas Corporation of America, Philadelphia, Pa., a corporation of Pennsylvania

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7 Claims. (Cl. 137—251)

The present invention relates to apparatus which will act as a pressure seal for a closed container, and more particularly to an automatic check valve for a container that is to be continuously purged by a flow of some gas.

It is frequently necessary to purge continuously an enclosure in which mechanism such as electric motors or switches, for example, are located, especially when such enclosure is surrounded by an explosive atmosphere. Various devices have been placed in the exhaust line of the purging gas to prevent an inflow of the explosive atmosphere into the enclosure being purged if the purging gas supply should fail. Most devices for this purpose have some drawback, however, such as requiring a purging pressure that is too high, or failing to have a positive seal against reverse flow through the device.

It is an object of the present invention to provide a device which may be used in the exhaust line for purging gas for an enclosure which may be used to maintain a back pressure of various values in the enclosure. It is a further object of the invention to provide such a device in which a substantially greater pressure is needed for a reverse flow of atmosphere into the enclosure that is being purged than is required for the normal flow of purging gas from the enclosure. It is a still further object of the invention to provide such a device which is easily assembled of readily obtainable materials.

The device of the present invention includes a vertically extending standpipe in the form of a container, the upper and lower ends of which are closed by discs of porous ceramic or other material. The discs are treated to pass a gas but to be impervious to a liquid under normal pressures. Between the discs in the container is placed a liquid of a depth varying with the amount of pressure it is desired to maintain in the enclosure.

The various features of novelty which characterize my invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, however, its advantages and specific objects attained with its use, reference should be had to the acompanying drawings and descriptive matter in which I have illustrated and described a preferred embodiment of the invetntion.

In the drawings:

Figure 1 is a view in section of one embodiment of the invention; and

Figure 2 is a view in section of a different embodiment of the invention.

Referring to Figure 1 of the drawings, there is shown at 1 a portion of an enclosure which is adapted to be sealed and to contain some apparatus which has a fire hazard in an explosive atmosphere such as, for example, an electric motor or an electric switch. The enclosure is to be supplied continuously with some suitable purging gas under a suitable pressure in any conventional manner. This enclosure is provided with an exhaust opening across which the pressure relief or check valve to which this invention is directed may be placed. This device includes an elbow or fixture 2, the horizontal portion of which is shown as being threaded tightly into the exhaust opening provided in the enclosure 1. The vertical portion of the elbow 2 has a flange 3 extending therefrom below an upper threaded portion thereof. Resting upon the upper end of the elbow is a gasket 4 of some resilient material such as rubber and a membrane in the form of a disc 5. Actually, the disc is received in and cemented to the lower flared end of a cylinder 6. The cylinder with its disc is attached to the upper end of the elbow 2 by means of a collar 7 that is provided with a radially extending flange which bears against the flared lower end of cylinder 6. As the collar is threaded to the upper end of the elbow, the washer 4 wili be compressed so that a pressure tight joint is made between the elbow and the cyinlder.

The upper end of the cylinder is closed by a second membrane taking the form of a second porous disc 8 which is held in place against the upper end of the cylinder by means of a radially extending flange formed on a collar 9. In assembling these parts, a resilient washer 11 is placed between the upper end of the cylinder and the disc 8 prior to the time that the collar is threaded on to the upper end of the cylinder tightly enough to make a pressure tight joint between the two. Each of the discs 5 and 8 is made of some porous material such as a porous ceramic, and each of them is treated to be hydrophobic. Discs of this type may be obtained commercially and are used as filter elements in various processes. They have the characteristic of being impervious to gas and impervious to liquids such as water and mercury within the pressure range encountered in this service.

In the operation of the device, a liquid such as mercury is placed within the container formed by cylinder 6 and above disc 5 to a depth equal to the head of pressure which is to be maintained in the enclosure 1. Thereafter, as a purge gas is supplied to the enclosure, it will pass through the elbow 2 and pass through the porous disc 5. The purge gas will then bubble through the liquid 12 to the upper portion of the cylinder 6 and will pass through the disc 8. The resistance of the discs 5 and 8 to the flow of gas is negligible, so that the actual back pressure in the enclosure 1 is determined by the depth of the liquid 12 through which the purge gas must bubble in order to escape to the atmosphere.

In an actual device of the type described, the discs 5 and 8 are made of a micro porous porcelain, the pores of which have a maximum radius of 50 microns. The discs are one-eighth of an inch thick and have an effective diameter of five-eighths of an inch. When one-quarter inch of mercury has been placed on the disc 5, there is required a minimum of five inches water column pressure of the purge gas in order to flow through the disc and bubble up through the mercury. This pressure is, therefore, maintained within the enclosure 1 and serves the purpose of preventing inflow of an explosive atmosphere into the enclosure, as well as providing exhaust for a continually flowing purging gas of some desired characteristics for the application. As noted above, gas will just begin to bubble through the mercury at five inches water column in the enclosure 1. If the flow of purging gas through the device is increased to 1 cubic foot per hour, for example, the back pressure in the enclosure will be raised to seventeen inches water column.

In actual operation, electrical equipment for example, will generate heat so that the air inside the enclosure will be at a slightly higher temperature than the surrounding atmosphere. Therefore, the device of the invention must act as a check valve to prevent outside air from entering the enclosure due to a cooling and consequent contraction of the inside air, if for some reason the supply of purging gas should fail. It has been found that a differen-

tial pressure between the atmosphere and the interior of the enclosure slightly above seven inches of mercury is required in order to get a back flow through the disc **5**. This is due to the fact that upon a reverse flow through the device, the mercury or other liquid is forced through the pores of the disc **5** and is actually filtered thereby. Since the disc has been treated to be hydrophobic, considerable pressure is required to overcome the surface tension of the liquid and force it through the disc in a reverse direction. The pressure required to produce a reverse flow into the enclosure is well above anything that will be required in service. Therefore, the device acts as a positive check valve.

The device will operate without the upper disc **8**, but is improved thereby since the disc **8** serves to prevent the accumulation of dirt and moisture on the surface of the mercury. Since this disc is also treated to be hydrophobic, it will prevent the flow of any moisture into the chamber formed by the cylinder **6** where it might condense and change the level of liquid through which the purging gas has to bubble. Thus, an accurate pressure can be maintained within the enclosure **1** over an extended period of time. It is noted that the cylinder **6** in this case is shown as being made of glass or other transparent material which is capable of withstanding the required pressures. By having the cylinder transparent, it is easy to determine when the purge gas is bubbling through the liquid and thus set the flow of this gas to obtain the desired rate of bubbling and, therefore, the desired back pressure in the enclosure.

The construction of Figure 2 is different from that of Figure 1 and is intended to be used with a liquid that is lighter than mercury, such as water for example. In this case, there is provided a fixture **15** which extends through the opening in the enclosure **1**. This fixture is held in pressure tight relation with respect to the opening by means of a pair of washers **16** and a nut **17** that is threaded over the inner end of the fixture. The outer end of the fixture is flared to receive the lower end of a cylindrical member **18**. In this case, the member is shown as being made of a solid material such as a pipe, and is provided with a horizontal portion extending into the fixture and a vertical portion which forms a container to hold the liquid that determines the back pressure within the enclosure. Between the end of the horizontal portion of member **18** and the fixture **15** is placed a porous disc **19**. This disc is held in position between a pair of resilient washers **21**. Therefore, as the member **18** is rotated into its proper position, the washers are compressed to make a pressure tight joint between the various parts.

The upper end of member **18** is closed by a ceramic disc **22** on each side of which is a resilient washer **23**. Above the disc **22**, there is placed a thin, perforated metal disc **24** which serves to protect the porous disc in case something is dropped against the top of the device. The discs **24** and **22** are held in position against the upper end of member **18** by means of a collar **25**, this collar having an inwardly extending flange which bears against the outer edge of the disc **24**.

In the operation of this form of the invention, the member **18** is filled with a liquid such as water to the desired height to give a predetermined back pressure in the enclosure **1**. Since the discs **19** and **23** have been treated to be hydrophobic, no water will flow through the disc **19** into the enclosure. Purging gas, however, can flow through the disc **19** and bubble up through the water column in the member **18** to be discharged through the disc **22**. The height of the water column can be whatever is necessary in order to give the back pressure required in the enclosure **18**.

Since water is relatively light liquid, the head of water extending in the horizontal portion of the member **18** will not be sufficient to cause any great differential pressure between the top and bottom of the disc **19**. If, however, a heavy liquid such as mercury was used in a construction of this type, the weight of the mercury would be such that a materially different pressure would be required for the purging air to flow through the upper portion of the disc **19** than would be required to flow through the lower portion of this disc. It is noted, however, that water could be used in place of mercury, for example, in the construction shown in Figure 1. A longer column **6**, however, would be required for water than is required for mercury.

The member **6** in Figure 1 has been shown as being transparent, whereas the member **18** in Figure 2 has been shown as being solid. It will be obvious, however, that either of the members **6** or **18** can be made of material that is transparent or not, as desired. It will be obvious, also, that a protecting disc such as is shown at **24** could be used with the construction of Figure 1 if it is so desired. From the above, it will be seen that I have provided what is in effect a pressure regulating check valve to be used on the exhaust opening for purging gas flowing from a sealed enclosure. This valve is simple to construct and has no moving parts that can be disturbed or get out of order during the operation of the same. Any dirt or other contaminating material in the purging gas is prevented by the porous disc from moving into the sealing liquid. In a like fashion, the second or upper porous disc in each case acts to protect the sealing liquid. The same back pressure may be maintained in the enclosure over a long period of operation. In addition to the above, the device has the advantage of having an extremely high resistance to a reverse flow of gas toward the interior of the enclosure. If it is desired to have the device inside of the enclosure, instead of outside as shown, it is only necessary to invert the standpipe **6** or **18** so that the purge gas can flow through a porous disc before it bubbles through the liquid.

While in accordance with the provisions of the statutes, I have illustrated and described the best form of embodiment of my invention now known to me it will be apparent to those skilled in the art that changes may be made in the form of the apparatus disclosed without departing from the spirit and scope of the invention as set forth in the appended claims, and that in some cases certain features of my invention may be used to advantage without a corresponding use of other features.

What is claimed is:

1. A one-way flow device for gas comprising means forming a vertically extending hollow member, a porous membrane having the characteristic of being pervious to gas and impervious to liquid under pressure differentials at least equal to those with which the device is used, means to attach said membrane across the lower end of said member, means substantially to close the upper end of said member, and a body of liquid in said member covering said membrane, means including an enclosed space under pressure and connected to said member below said membrane to direct a gas through said membrane to bubble up through said liquid, said liquid acting to prevent a reverse flow of gas through said membrane.

2. In a device of the class described, a hollow fixture adapted to extend through the side of an enclosed space under pressure, a porous ceramic disc having the characteristic of being impervious to liquid under pressure differentials at least equal to those with which the device is used, a hollow cylindrical member, means to attach the lower end of said member to the end of said fixture with said disc between the two and acting as a barrier between them, said member extending in a vertical direction, means substantially to close the upper end of said member, and a body of liquid in said member above said disc, whereby a gas moving from said space must pass through said disc and bubble up through said liquid, said liquid acting to prevent a reverse flow of gas through said membrane.

3. The combination of claim 2 in which said ceramic

disc is located in a horizontal plane, and in which said liquid is mercury.

4. The combination of claim 2 in which said ceramic disc is located in a vertical plane, and said liquid is water.

5. In combination a closed, vertically extending container, means forming each end of said container comprising a membrane of rigid porous material having the characteristic of being pervious to gas and impervious to liquid under pressure differentials at least equal to those with which the device is used, a body of liquid in said container, and means to mount said container across an opening in an enclosed space with interior of said container in comunication with said space through one of said porous members.

6. A device of the class described comprising a standpipe, a membrane pervious to gas and impervious to liquid under pressure differentials at least equal to those with which the device is used attached across each end of said standpipe, the space in said standpipe between said membranes adapted to contain a liquid, and means to attach said standpipe to an enclosure with the interior of the standpipe communicating with the interior of the enclosure through one of said membranes.

7. In a device of the class described, the combination

of a vertically extending tubular member, means to attach said member to the wall of a chamber under pressure with the interior of said member in communication with the interior of said chamber, a first porous member pervious to gases but impervious to liquids under pressure differentials at least equal to those with which the device is used, means to mount said porous member across the interior of said tubular member adjacent to said chamber, said tubular member having a predetermined quantity of liquid therein supported by said porous member, gas from the interior of said chamber being adapted to flow through said porous member and bubble through the liquid in said tubular member, a back pressure being created that is dependent upon the unit weight and quantity of the liquid, said liquid acting to prevent a reverse flow of gas through said porous member.

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