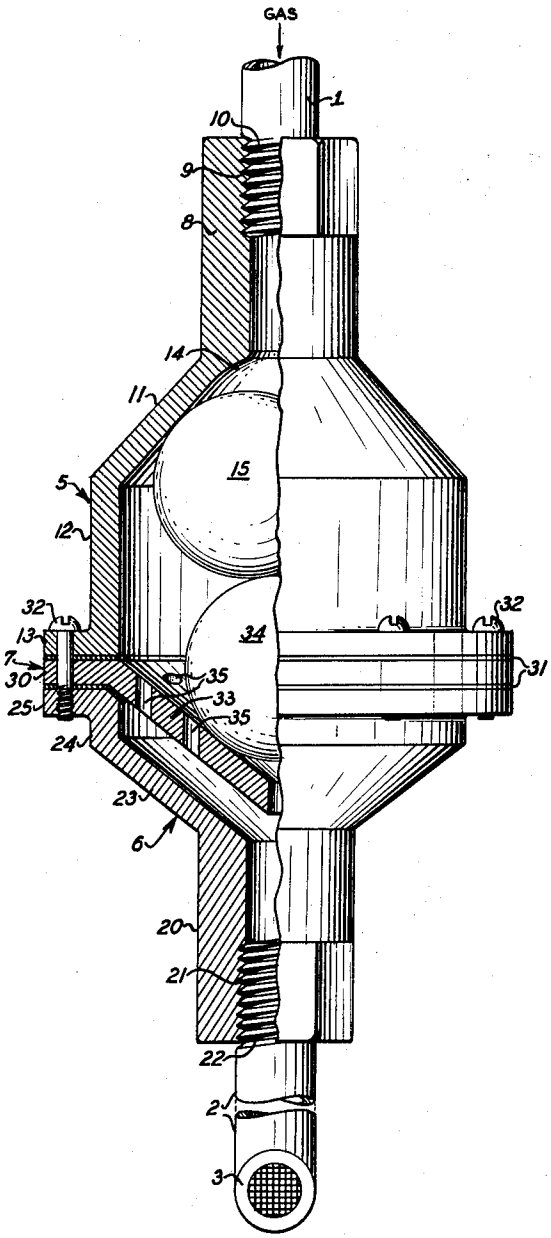
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VENT VALVE

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VENT VALVE

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This invention relates to vent valves and more particularly to a vent valve for use in venting one fluid in proximity to another fluid having a greater specific gravity than the fluid being vented and which would otherwise enter the opening from which the vented fluid is discharged if such opening were submerged therein. The vent valve of the invention is particularly applicable to the venting of gases evolved by batteries in electrically lighted buoys although it may be used to equal advantage in many other venting situations.

One object of the invention is to provide a simple and reliable vent valve of the indicated type which will effectively close the vent when the latter is submerged in the heavier fluid either in an upright or, an inverted position or while inclined from the vertical at any angle.

Another object of the invention is to provide a vent valve of the indicated type which will permit the reduction of excess pressure built up in the chamber to be vented during periods of submersion without permitting the entry of the submerging fluid into the vent.

Other objects and advantages of the invention will become apparent from a perusal of the following description when read in connection with the accompanying drawing, wherein a preferred embodiment of the invention is shown partly in elevation and partly in section.

In the drawing, the vent valve of the invention has been illustrated in connection with vent pipes 1 and 2 which may be employed when the valve is embodied in a buoy provided with an electrically lighted lamp to which current is supplied from dry cell or other types of batteries located in a chamber in the body of the buoy. Vent pipe 1 extends upwardly from the battery chamber and then is bent so that the discharge end shown in the drawing, which is substantially shorter than the other leg of the pipe, extends substantially vertically downward when the buoy is in its normally upright position. The vent valve is threadedly engaged with and dependently supported by the discharge end of pipe 1. The vent pipe 2 is threadedly connected at its upper end to the lower end of the vent valve and preferably is constituted of a short length of pipe having at its lower end a discharge outlet 3 disposed at an angle to the vertical. In venting the battery chamber of a buoy, it is preferred that there be provided two such units, each composed of the vent valve and pipes 1 and 2, and with the pipe 1 of one unit communicating with the upper part of such chamber and with the pipe 1 of the other unit leading out of the bottom end of such chamber so as to provide better circulation of gases within the chamber. With such an arrangement the discharge outlet 3 of the pipe 2 of that unit which is in communication with the upper part of the battery chamber is preferably inclined at an angle best suited for the entry of air under pressure, as when the wind is blowing, while the discharge outlet 3 of the other pipe 2 is preferably inclined in the opposite direction and at an angle which will tend to provide a suction effect at such outlet. As a practical matter, it has been found that satisfactory results are obtained with the discharge

outlets 3 of both pipes 2 disposed at an angle of 45° to the vertical. The outlets 3 preferably should be covered with screens to prevent fish, seaweed and other foreign bodies in the water from entering the pipes 2 and passing on into the valve chambers.

The valve body is composed of an upper shell 5, a lower shell 6 and an intermediate partition member 7 which is clamped between the two shells 5 and 6. The shell 5 includes at its upper end a tubular nipple 8 provided with an internal thread 9 for engagement with an external thread 10 on the discharge end of vent pipe 1. From the lower end of the nipple 8, the shell 5 projects downwardly and outwardly to form a frusto-conically-shaped wall portion 11. Integral with the lower or wider end of wall portion 11 is a cylindrically-shaped wall portion 12 which is provided at its lower end with an outwardly turned annular flange 13. At the juncture of the nipple 8 and the tapered wall portion 11, the shell 5 is provided with a tapered valve seat 14 formed to snugly receive a valve ball 15.

The shell 6 is provided at its lower end with a tubular nipple 20 having an internal thread 21 for engagement with the external thread 22 formed on the upper end of vent pipe 2. The shell 6 extends upwardly and outwardly from the upper end of nipple 20 to form a frusto-conically-shaped wall portion 23. An annular section 24 provided with an external flange 25 is connected with the upper end of the tapered wall portion 23. An annular flange 30 formed on the periphery of the member 7 is clamped between the flanges 13 and 25 of the upper and lower valve shells. The three flanges are associated with gaskets or sealing rings 31, and secured together in fluid tight relation by bolts 32 which are in threaded engagement with screw threads provided in the flange 25 of shell 6.

The shells 5 and 6 and the member 7 are formed out of any suitable material or materials capable of withstanding corrosive action of the fluids to which the valve may be subjected in use. The member 7 within the annular flange 30 thereof is shaped in the form of an inverted cone 33 and supports a ball 34 which cooperates with the valve ball 15 in a manner hereinafter described. As shown the cone portion 33 is provided with holes 35 of sufficient size to permit ready passes therethrough of the fluids involved. Instead of being in the form of a perforated conically-shaped metal plate or casting as shown in the drawing, the cone portion may be in the form of a mesh structure of sufficient rigidity to accomplish the purposes of the invention. In the form shown, it is contemplated that the holes 35 shall be arranged so as to assure rapid drainage through the member 7 regardless of the position of ball 34. Thus the holes 35 may be arranged along one or more spiral lines in said member or may be arranged in any other predetermined pattern capable of accomplishing the results desired. Whether the cone portion is made in the form of a mesh or a perforated plate, it is preferred that the holes therein be made fairly small so as not to offer any interference to the rolling motions of ball 34 in the use of the valve.

The balls 15 and 34 are made of any suitable material which is inert or resistant to the fluids to which the valve shall be subjected in usage and which provides the balls with a smooth surface. Thus either or both of the balls may be made of glass, or of a synthetic rubber compound such as "neoprene," or of other suitable known plastic materials. Ball 15 is constructed to have a specific gravity less than that of the heavier fluid in which the valve may be submerged so that as such fluid rises within the valve shell 5, as for example, when the valve is submerged in an upright position in such fluid, the ball will float and be guided or directed by the tapered wall portion 11 thereof into a fluid sealing fit on the seat 14. Thus

the ball 15 will seal the opening defined by seat 14 under a buoyant force equal to the weight of the bulk of the fluid displaced by the ball to prevent any of such heavier fluid from passing into the vent pipe 1 through valve nipple 8. The effectiveness of the seal will be enhanced by the fluid film which is usually formed on the surface of the ball. The ball 15 should be sufficiently heavy to enable it to overcome surface adhesion that may be created by fluid film thereon and to drop from the seat 14 when the fluid drains from the valve.

Ball 34 as previously indicated, rolls on the upper surface of cone portion 33 of member 7 and further is of sufficient weight to bear on ball 15 and to move the latter to a sealing fit on seat 14 when the vent valve is disposed either in an inverted position or in an inclined position at any angle greater than a predetermined angle from the vertical. In order that it may accomplish such result under all conditions, ball 34 is constructed to have a weight sufficient to overcome the combined buoyant force of both balls 15 and 34 in whatever fluid they may be used.

As an example of the relation in weight that may be utilized in the balls 15 and 34 when the valve is used for the particular purpose described, let it be assumed that ball 15 has a specific gravity of 0.1. With such a specific gravity ball 15 will readily float in any sea water that might enter into shell 5 of the valve and at the same time will be heavy enough to break its seal with the seat 14 and move away from such seat when the sea water has been drained from the valve and ball 34 has assumed a position permitting such movement of ball 15. Ball 34 in such use should have a specific gravity greater than the specific gravity of the sea water, plus the difference between the specific gravity of the sea water and the specific gravity of ball 15. Thus, if we assume further that the specific gravity of the sea water is 1.0, then the specific gravity of ball 34 should be greater than $1.0+(1.0-0.1)=1.9$, when the specific gravity of ball 15 is 0.1. Given this specific gravity, the ball 34, in the event the valve becomes submerged and filled with water in an inverted position, will have sufficient weight to hold ball 15 in sealing relation on seat 14 against the action of the combined buoyant force of balls 15 and 34.

The force exerted by ball 34 on ball 15 is also dependent upon the angles of the tapered wall portion 11 of shell 5 and the cone portion 33 of wall 7 which may be chosen as desired, but preferably should be such that

(1) When the valve in an upright position is rocked through a predetermined angle from the vertical, as for example, approximately 45° from the vertical, the ball 15 shall always be enabled to remain unseated, provided no water is in the valve chamber,

(2) When the valve either is rocked from an upright position through an angle greater than the said predetermined angle, or is inverted, the ball 34 is enabled to exert a force on ball 15 capable of causing the latter to seat properly on the valve seat 14, and

(3) The angle between the conical wall portions 11 and 33 should not be likely to cause a wedging action of the balls such as to render them inoperative to properly perform their intended functions in the valve.

By way of example, in a valve designed for the use indicated and employing balls, one having a specific gravity of approximately 0.2, and the other having a specific gravity of approximately 2.5, a satisfactorily operating valve for a buoy is obtained when the angle which the tapered wall portion 11 of shell 5 makes with the internal portion of a diametric plane located at the enlarged end thereof is approximately 50° and when the angle which the cone portion 33 of member 7 makes with the internal portion of a diametric plane located at the enlarged end thereof is approximately 40°. The cone portion 33 is illustrated as concentric to and in parallelism with the tapered wall portion 23 of shell 6, but if found desirable it may be formed and/or arranged at an angle to such wall portion. Whatever the angular disposition of wall portion 11 and cone portion 33 relative to wall portion 12, such parts should be so constructed that the valve cavity defined thereby will have a confined area of such dimensions and configuration that the balls 15 and 34 cannot reverse their positions in the operations of the valve.

It is believed to be understood from the foregoing description, that when the vent valve of this invention is in upright, vertical position as shown in the drawing, the ball 15 will be unseated and resting on ball 34. As the buoy on which the valve may be mounted is caused to rock gently by the ocean swells, the ball 34 does not substantially change its position on the cone portion 33, but the ball 15 will move within the shell 5 without seating itself on the valve seat 14. Should the ocean roughen to the extent that the vertical axis of the valve moves through an angle greater than the said predetermined angle from the vertical (45°) in its rocking movements, ball 34 shall be caused to roll up on the upper surface of the cone portion 33 an amount sufficient to move ball 15 to a seated condition on seat 14; the wall portion 11 guiding ball 15 to such seated condition under the force exerted by ball 34. When the valve passes through such predetermined angle on its return movement to the vertical, the ball 15 shall become unseated again. It will thus be seen that as the valve is caused to oscillate through an angle greater than twice the said predetermined angle, cone portion 33, ball 34 and wall portion 11 will cause ball 15 to close the outlet end of pipe 1 during those portions of such oscillations of the valve which are beyond an angle twice that of the said predetermined angle, and will permit the ball 15 to become unseated between such angle portions provided there is no water affecting the action of ball 15. Should water enter into the valve during the movements of the buoy, the ball 15 will be subjected to the buoyant force of the water which whenever the valve is submerged in the water either vertically in an upright position, or while inclined from the vertical at an angle less than the said predetermined angle, shall coact with the guiding wall portion 11 to cause the ball to become securely seated on the valve seat 14. When such submersion takes place while the valve is disposed at greater angles than said predetermined angle, the weight of the ball 34 begins to assist the buoyant force acting on ball 15. When the angle at which the valve is submerged becomes sufficiently great, or when the valve is submerged in an inverted position, the weight of the ball 34 alone shall cause the ball 15 to move into sealing position on seat 14.

It will be noted also that as the valve returns each time to an upright position during the movements of the buoy, any water that may have entered the valve shall be quickly drained out through the openings 35 of the cone portion 33, the nipple portion 20 of the valve and vent pipe 2. The pipe 2 has the further advantage that it lessens the effects of spray or freezing on the balls 15 and 34. With regard to the latter effect, should the inclined opening 3 of the pipe 2 be closed by ice, the latter will prevent the entry of water into the valve at below freezing temperatures thus enabling the balls 15 and 34 to continue operating in their proper manner so that when the ice coating is finally thawed, the balls shall be in proper position to prevent the entry of water into vent pipe 1 should the condition of the sea at that time require this. It will further be noted that the construction of the valve is such that any excess pressure built up in the battery chamber at any time and during any sea conditions, shall be released. This will be accomplished by a fluttering action of valve 15 and without permitting the entry of any sea water into the vent pipe 1. The release pressure required to unseat valve 15 to this end shall be dependent upon the angle of inclination of the valve, the depth of its submersion, the specific gravities of the balls

15 and 34, and the specific gravity of the fluid in which the valve is submerged.

While I have hereinabove described and illustrated in the accompanying drawing, a preferred embodiment of my invention, it is to be understood that other forms thereof may be adopted without departing from the spirit of the invention, or the scope of the appended claims.

I claim:

1. A vent valve including, in combination, an upper shell and a lower shell defining a cavity, a valve seat formed in said upper shell and located at the upper end of said cavity, a ball valve for said seat positioned in said cavity, said upper shell having a frusto-conically-shaped wall portion providing a surface for guiding said ball valve to said seat, a perforated diaphragm clamped between said upper and lower shells and including a conical portion extending downwardly from the clamped portion thereof in spaced relation to said lower shell and providing a guide surface in opposed relation to said wall portion, and a ball member supported by said diaphragm and located between said diaphragm and said ball valve, said ball valve having a specific gravity substantially less than the specific gravity of the fluid it is to prevent passing through the valve, and said ball member having a specific gravity sufficiently greater than that of such fluid to enable it to move said ball valve to seated position against the combined buoyant forces on said ball member and said ball valve in such fluid.

2. A vent valve including, in combination, a body having a cavity therein and provided with an inlet passageway through which is admitted into such cavity the fluid to be vented and with a passageway for discharging the vented fluid in such cavity, a valve seat located in said cavity at the terminus of said inlet passageway, a ball valve for said seat positioned in said cavity, a wall portion of said body providing a surface for guiding said ball valve to said seat, means providing a guide surface spaced from said valve seat in opposed relation to said wall portion, and a ball member located between said guide surface and said ball valve, said ball valve having a specific gravity substantially less than that of a second fluid which may enter such cavity through said discharge passageway and is to be prevented from passing from such cavity through said inlet passageway, and said ball member having a weight greater than the weight of said ball valve and sufficient to overcome the combined buoyant force of both balls in the second fluid, whereby said ball valve and ball member are operable to close said valve seat to passage therethrough of such second fluid as may be present in said cavity regardless of the position of the vent valve.

3. A vent valve including, in combination, a body having a cavity therein and provided with an inlet passageway through which is admitted into such cavity the fluid to be vented and with a passageway for discharging the vented fluid in such cavity, a valve seat located in said cavity at the terminus of said inlet passageway, a ball valve for said seat positioned in said cavity, means providing a conical surface spaced from said valve seat in opposed relation thereto, and a ball member located between said conical surface and said ball valve, the combined radii of said ball valve and said ball member being less than the distance between the centers of said ball valve and ball member when said ball valve is in seated position and said ball member is positioned at the bottom of said conical surface, but great enough so that while said ball valve may move away from said valve seat to open the inlet passageway to the cavity, said ball valve and ball member cannot reverse their positions in the cavity, said ball valve having a specific gravity substantially less than that of a second fluid which may enter such cavity through said discharge passageway and is to be prevented from passing from such cavity through said inlet passageway, and said ball member having a weight greater than the weight of said ball valve and sufficient to overcome the combined buoyant force of both balls in the second fluid, whereby said ball valve and ball member are operable to close said valve seat to passage therethrough of such second fluid as may be present in said cavity regardless of the position of the vent valve.

4. A vent valve including, in combination, a body having a cavity therein and provided with an inlet passageway through which is admitted into such cavity the fluid to be vented and with a passageway for discharging the vented fluid in such cavity, a valve seat located in said cavity at the terminus of said inlet passageway, a ball valve for said seat positioned in said cavity, a wall portion of said body providing a conical surface for guiding said ball valve to said seat, means providing a second conical surface spaced from said first conical surface and in opposed relation thereto, and a ball member located between said second conical surface and said ball valve, the combined radii of said ball valve and said ball member being less than the distance between the centers of said ball valve and said ball member when said ball valve is in seated position and said ball member is positioned at the bottom of said second conical surface, but great enough so that while said ball valve may move away from said valve seat to open the inlet passageway to the cavity, said ball valve and ball member cannot reverse their positions in the cavity, said ball valve having a specific gravity substantially less than that of a second fluid which may enter such cavity through said discharge passageway and is to be prevented from passing from such cavity through said inlet passageway, and said ball member having a weight greater than the weight of said ball valve and sufficient to overcome the combined buoyant force of both balls in the second fluid, whereby said ball valve and ball member are operable to close said valve seat to passage therethrough of such second fluid as may be present in said cavity regardless of the position of the vent valve, and drainage means for discharging through said discharge passageway in the substantially normal position of the vent valve any of such second fluid as may have collected in said cavity.

5. A vent valve such as defined in claim 4, in which the smaller ends of said conical surfaces are nearest the valve seat and discharge passageway, said second conical surface having an angle of taper with relation to the central axis of said valve seat greater than the angle of taper of said first conical surface with relation to such central axis, and in which said drainage means includes a plurality of fluid passages provided in said second conical surface and arranged in a predetermined manner to enable the ready drainage of said second fluid from such surface.

6. A vent valve such as defined in claim 4, in which the smaller ends of said conical surfaces are nearest the valve seat and discharge passageway, the angle of taper of said first conical surface with relation to the central axis of said valve seat being different from the angle of taper of said second conical surface, and such angles of taper being such that said ball valve will remain unseated while said central axis is tilted from normal vertical position through a predetermined angle, and will be moved by said ball member to seated position through the coaction of said conical surfaces when said central axis is tilted from normal position through an angle greater than said predetermined angle.

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