

PATENT SPECIFICATION

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(54) PRESSURE RELIEF VALVE

(71) We, UNION CARBIDE CORPORATION, a corporation organised and existing under the laws of the State of New York, United States of America, of 270 Park Avenue, New York, State of New York 10017, United States of America, (assignee of HELMUT KASPAR AMTHOR), do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a pressure relief vent valve useful for relieving high internal gas pressures from inside a fluid-tight sealed container. More specifically, the invention relates to improvements in resealable pressure relief vent valves provided in sealed alkaline galvanic cells for preventing the build-up of high internal gas pressures inside the cell container.

Alkaline galvanic cells may generate large quantities of gas under certain conditions during use. Since these cells are required to be fluid-tightly sealed at all times in order to prevent loss of electrolyte by leakage or evaporation, high internal gas pressures may develop. Such pressures may cause leakage, bulging or possible explosion of the cell if not properly vented. Especially in the case of secondary or rechargeable cells, the vent must be resealable in order to avoid drying out of the electrolyte over the normally long life of the cells and to prevent ingress of oxygen and carbon dioxide.

In the past, several different types of resealable pressure relief vent valves have been used for releasing high internal gas pressures from inside a sealed alkaline galvanic cell. One type of valve that has been commonly used consists basically of a valve member such as a flat rubber gasket which is biased into sealing position over a vent orifice by means of a resilient member

such as a helical spring. The resilient member or spring is set to yield at a certain predetermined internal gas pressure momentarily breaking the seal and allowing the gas to escape through the vent orifice.

Another type of resealable pressure relief vent valve that has been tried is that disclosed and claimed in U.S. Patent 3,293,081 issued to J. L. S. Daley on December 20, 1966. This resealable vent valve basically includes an annular seal gasket such as an O-ring which is maintained in sealing position around the periphery of the vent orifice by means of an arc-shaped resilient member or spring. The resilient member or spring is set to yield and permit radial movement of the seal gasket momentarily breaking the seal and allowing the passage of gas through the vent orifice when a predetermined high internal gas pressure is reached inside the cell.

A major problem encountered with resealable pressure relief vent valves of the type just described is that they are bulky and consequently difficult to incorporate into the cell assembly. Furthermore, these pressure relief vent valves are expensive to manufacture and are not at all adaptable for incorporation into miniature size cells.

According to one aspect of the invention there is provided a pressure relief vent valve for a container which comprises a resilient deformable ball of an initial spherical shape and of a size larger than that of said vent orifice, said ball being positioned to overlie a vent orifice in contact with a valve seat provided around the peripheral edge portions of said vent orifice, and a retainer means for maintaining said ball in place over said vent orifice and for compressing said ball into a flattened configuration so as to form a normally fluid-tight seal between said ball and said valve seat, said ball being capable of undergoing further temporary

deformation upon the build-up of a predetermined internal gas pressure inside said container momentarily breaking the seal and allowing gas to escape through said vent orifice.

The invention also provides an alkaline galvanic cell incorporating such a pressure relief valve. The pressure relief vent valve of the invention automatically opens upon the build-up of a predetermined high internal gas pressure inside the cell and then reseals once the pressure has been relieved.

It is an advantage of the invention that the valve is simple and compact and employs a minimum number of parts, is reliable and can be so assembled as to be responsive to a given gas pressure over a wide range of pressures, is inexpensive to manufacture and can be easily adapted to incorporation within nearly all sizes of cells including miniature size cells.

Broadly, the pressure relief vent valve of the invention for relieving high internal gas pressures from inside a fluid-tight sealed container and especially a sealed alkaline galvanic cell, comprises a resilient deformable ball of a suitable elastomeric material which is positioned to overlie a vent orifice provided within the container. A retainer means is positioned over the resilient ball for maintaining the ball in place over the vent orifice and in contact with a valve seat provided around the inner peripheral edge portions of the vent orifice and for compressing and deforming the resilient ball into a flattened configuration forming a normally fluid-tight seal between the flattened ball and the valve seat. The resilient ball is capable of undergoing further temporary deformation upon the build-up of a predetermined high internal gas pressure inside the container momentarily breaking the seal and allowing gas to escape through the vent orifice.

The invention will now be further described, by way of example, with reference to the accompanying drawings, in which:—

Figure 1 is an elevational, partially sectioned view of a typical alkaline galvanic cell incorporating the pressure relief vent valve of the invention;

Figure 2 is an enlarged sectional view of the upper portion of the cell shown in Figure 1;

Figure 3 is an enlarged sectional view of the lower bottom portion of the cell shown in Figure 1 and illustrates a different embodiment of the invention;

Figure 4 is a similar view illustrating another embodiment of the invention;

Figure 5 is a sectional view of the upper portion of a miniature size cell illustrating still another embodiment of the invention;

Figure 6 is a sectional view of the upper

portion of a similar cell illustrating still another embodiment of the invention; and

Figure 7 is a sectional view of the lower portion of a cell similar to that shown in Figure 1 and illustrating a further embodiment of the invention.

Referring now to the drawings in detail, there is shown in Figs. 1 and 2 a typical alkaline galvanic cell incorporating a pressure relief vent valve in accordance with the invention. The cell comprises an inverted metallic cupped container 10 provided with an outer metallic jacket 11 separated from the container 10 by an insulating liner 12 suitably of paper or other fibrous material. Disposed within the container 10 is a tubular anode 14 and a tubular cathode 15 and an alkaline electrolyte 16 suitably an aqueous solution of potassium or sodium hydroxide. The cathode 15 is juxtaposed in contact with the side walls of the container 10 but is separated from the anode 14 by a liquid and gas permeable, electrolyte-containing separator medium 18. The separator medium 18 may be composed of two juxtaposed layers of separator material placed between the anode 14 and cathode 15 and underlying the upper closed end of the container 10.

Suitably, the cell closure for this cell is of the type disclosed and claimed in U.S. Patent No. 3,042,734 issued to J. L. S. Daley on February 15, 1960. Such a cell closure comprises a generally U-shaped annular seal gasket 20 for sealing the open end of the polarized cupped container 10, an unpolarized rigid metallic cover 21 which resides within the U-shaped annular seal gasket 20 and an oppositely polarized, centrally located terminal rivet 22 which is in contact with an anode current collector 23. The seal gasket 20 is preferably made of a relatively hard non-cold-flowable plastic material such as nylon and is radially compressed between the terminal rivet 22 and the metallic cover 21 and between the cover 21 and the lower peripheral edges of the container 10, thereby resulting in an extremely leak resistant fluid-tight sealed cell.

A metallic top cover plate 24 is provided for the cell and is formed with a central protuberance 25 serving as the positive terminal of the cell. The top cover plate 24 is provided with a vent hole 26 and is also formed with a peripheral ring portion 27 which is fitted tightly around the upper peripheral edges of the container 10 and is compressed or squeezed radially inwardly to provide a smooth juncture between the ring portion 27 and the side walls of the container 10. The metallic jacket 12 is locked in place around the upper and lower extremities of the cell by crimping its upper

peripheral edges around the outer edges of the top cover plate 24 and by crimping its lower edges around the outer edges of a metallic bottom plate 28. The bottom plate 28 is maintained in electrical contact with the terminal rivet 22 and serves as the negative terminal of the cell.

The version of the pressure relief vent valve used in the cell of Figs. 1 and 2 includes a resilient ball 30 which is of an initial spherical shape. A vent orifice 32 is positioned to reside just beneath the central protuberance 25 provided on the top cover plate 24 and is formed with upwardly extending cylindrical side walls of a sufficient depth to provide a fairly deep hole. The top cover plate 24 and the central protuberance 25 are so designed that the space or gap between the bottom wall portion of the protuberance 25 and the upper peripheral edges of the vent orifice 32 is less than the diameter of the resilient ball 30 in its initial spherical shape. Thus, it will be seen that the ball 30, when it is in contact with the flat bottom wall portion of the protuberance 25 which acts as a retainer means for the ball 30 is compressed and deformed into a flattened configuration in a position overlying the vent orifice 32 as shown in Figures 1 and 2.

The resilient stress exerted by the flattened ball 30 forces the ball 30 into a normally fluid-tight seal engagement around the peripheral edge portions of the vent orifice 32 forming a valve seat. The vent valve will remain closed sealing off the vent orifice 32 until the internal gas pressure during use or discharge of the cell builds up to some predetermined value which is less than the abnormally high pressure at which the resilient ball 30 is expelled from the vent orifice 32. When this predetermined gas pressure is reached, the ball 30 will undergo further temporary deformation, momentarily breaking the seal around the peripheral edge portions of the vent orifice 32 and allowing gas to escape from inside the cell through the vent orifice 32 around the ball 30 and out through the vent hole 26 provided in the top cover plate 24. The valve will remain open until the forces exerted against the ball 30 by the internal gas pressure are less than the sealing forces exerted by the resilient stress of the ball 30 whereupon the ball will again reseal against the peripheral edge portions of the vent orifice 32 and reseal the valve.

Figure 3 shows a different embodiment of the invention wherein the pressure relief vent valve is incorporated within the cell closure at the bottom of the cell. The rivet head portion of the terminal rivet 22 is formed with an enlarged circular recess 36 for receiving a resilient ball 34. A disc-shaped spring member 38 is positioned in contact against the rivet head and overlies

the circular recess 36 being biased into resilient contact at its outer peripheral edges against a metallic bottom cover plate 40 provided with a vent hole 41. The depth of the circular recess 36 is such that the resilient ball 34 is maintained by the spring member 38 in a flattened configuration overlying the vent orifice 35 and forming a normally fluid-tight seal around the peripheral edge portions of the vent orifice 35. The spring member 38 in this embodiment acts both as a retainer means for the resilient flattened ball 34 and as a means for maintaining electrical contact between the terminal rivet 22 and the metallic bottom cover plate 40 serving as the negative terminal of the cell.

In the embodiment of the invention illustrated in Figure 4, the pressure relief vent valve is incorporated within a modified cell closure which is similar to that used in the cell previously described, except that electrical connection with the metallic bottom cover plate 40 is achieved by means of a polarized metallic cap 42. The metallic cap 42 is provided with a central protuberance 43 which makes contact with a disc-shaped spring member 44, the outer peripheral edges of which are biased into resilient contact with the metallic bottom cover plate 40. The cap 42 underlies the polarized rigid metallic cover 45 which is in contact with the anode current collector 46. The metallic cover 45 together with the cap 42 reside within a generally U-shaped annular seal gasket 47 which is radially compressed between the metallic cover 45 and the lower peripheral edges of the container 10.

The pressure relief vent valve used in this embodiment of the invention includes a resilient ball 48 positioned within the central protuberance 43 on the metallic cap 42 and overlies a shallow vent orifice 49 provided within the metallic cover 45. The protuberance 43 serves as a retainer means for maintaining the resilient ball 48 in place over the vent orifice 49 and for compressing and deforming the ball 48 into a flattened configuration forming a normally fluid-tight seal around the peripheral edge portions of the vent orifice 49. It should be noted that in this embodiment of the invention the pressure relief vent valve is operable to vent gas from inside the cell at relatively low venting pressures and does not incorporate the so-called "two mode" version of the valve as illustrated in Figures 1-3.

Figure 5 illustrates another embodiment of the invention which is useful for incorporating the pressure relief vent valve into a miniature size cell. The cell comprises a metallic container 50 having its upper open end sealed by a generally L-shaped annular seal gasket 51 suitably of a relatively

hard insulating plastic material. A polarized metallic cover 52 resides within the L-shaped annular seal gasket 51 and is formed with a downwardly depending central stem portion 53 which fits through the opening in the seal gasket 51. An electrical conductor member 54 such as a metallic pin is welded or otherwise secured to the central stem portion 53 and makes electrical connection with one of the electrodes of the cell. A metallic terminal cap 55 provided with a vent hole 56 is positioned over the metallic cover 52 and has its lower peripheral edges locked in place by a peripheral bead or flange 57 formed around the outer peripheral edges of the metallic cover 52. The seal gasket 51 is radially compressed between the metallic cover 52 and the container 10 and the upper peripheral edges of the container 10 are crimped over a seal ring 58 suitably of a relatively soft resilient plastic material.

The version of the pressure relief vent valve of this embodiment includes a resilient ball 60 positioned over vent orifice 62. The space or gap between the metallic terminal cap 55 and the peripheral edge portions of the vent orifice 62 is such that the ball 60 is maintained in a flattened configuration as shown.

The embodiment of the invention illustrated in Figure 6 is basically the same as that just described, except that the vent orifice 62 is formed with a conical shaped valve seat around its peripheral edge portions as indicated at 63. Thus, the resilient ball 60 is retained by the metallic terminal cap 55 in a flattened conical configuration against the conical surfaces 63 around the opening of the vent orifice 62 forming the valve seat. It will be seen that in this embodiment of the invention, the resilient ball 60 is compressed to a degree which is somewhat less than when the ball is deformed to a flattened configuration as in the previous embodiments described and that, therefore, the vent valve is capable of venting gas at substantially lower internal gas pressures from inside the cell. It will also be noted in this embodiment that the cell is of the same basic construction as that illustrated in Figure 5 except that the upper peripheral edges of the container 10 are crimped over the upper edges of an L-shaped annular seal gasket 64.

Figure 7 illustrates still another embodiment of the invention incorporating the pressure relief vent valve which can be used in the same type of cell construction as that illustrated in Figures 3 and 4. The cell includes an inverted polarized metallic cup container 65 provided with an outer metallic jacket 66 separated from the container 65 by an insulating liner 67 suitably of paper or other fibrous material. The open end of the

container 65 is sealed by a rigid annular insulating cover 68 suitably of a relatively hard plastic material. The peripheral edge portion of the annular insulating cover 68 abuts against the side walls of the container 65 which are radially compressed inwardly to provide a fluid-tight seal juncture between the cover 68 and the container 65. The lower peripheral edges of the container 65 are crimped over a peripheral bead or flange 69 formed integrally around the outer edges of the insulating cover 68. The metallic jacket 66 and the insulating liner 67 extend beyond the lower extremities of the container 65 and are similarly crimped over the outer edges of a metallic bottom cover plate 70 which serves as the negative terminal of the cell.

The pressure relief vent valve used in this embodiment of the invention includes an inverted metallic cup 71 which resides within a shallow circular recess 72 formed within the annular insulating cover 68. The cup 71 is provided with a central upwardly extending cylindrical stem or sleeve portion 73 which is fluid-tightly fitted through the opening in the insulating cover 68 and provides a fairly deep elongated vent orifice for the valve. Positioned inside the metallic cup 71 is a vent washer 75 having its opening 76 located in alignment with the opening of the central stem or sleeve portion 73.

The resilient ball 74 is maintained in position overlying the opening 76 and is compressed and deformed into a flattened configuration as shown in Figure 7 by means of a metallic cap 77. The cap 77 is held tightly in place by the lower peripheral edges of the inverted metallic cup 71 which are crimped over the outer edges of the cap 77. A conductor member 78 is secured as by welding to the stem or sleeve portion 73 of the metallic cup 71 and makes electrical connection with one electrode of the cell. A resilient spring member 79 which may be punched out from the cap 77 is positioned in contact with the metallic bottom cover plate 70 which serves as the negative terminal of the cell.

An important feature of the pressure relief vent valve of the invention is that the valve is resealable once the internal gas pressure which develops inside the cell has been relieved. This, it will be seen that in all of the embodiments of the vent valve described the resilient flattened ball of elastomeric material possesses an inherent resilient stress which acts as a biasing force to restore the ball back into its sealing position against the peripheral edge portions of the vent orifice when the ball is caused to undergo further temporary deformation upon the build-up of a predetermined internal gas pressure inside the cell. It should be noted, however, that in the case of

miniature size cells such as AAA cells, the primary function of the valve is to act as a positive "fail-safe" pressure relief vent and the valve must not plug up and fail to vent.

5 In order to insure that the vent valve will operate safely in these miniature size cells, it may be desirable to assemble the vent valve in such a way that the resilient ball is under a fairly low final compression and, therefore, will vent at relatively low venting pressures. 10 In such instances, the resilient ball may be prevented from seating properly with the vent orifice to achieve re-sealability due to the presence of particles of active material 15 which may be carried up onto the valve seat from inside the cell. The failure of the valve to seal or reseal properly is not viewed as a fault of the valve but rather as simply a result of the environment.

20 In the broadest aspect of the invention, the resilient ball used in the pressure relief vent valve may be made from most any resilient elastomeric material. Preferably, however, in the case of an alkaline galvanic cell, the resilient ball should be made from 25 resilient elastomeric material which is chemically resistant to the alkaline electrolyte of the cell. A suitable chemically resistant elastomeric material for the resilient ball is an ethylene-propylene 30 copolymer. The hardness of the resilient ball preferably is in the range of from about 60 to 70 Durometer and the ball should be capable of maintaining its resiliency over a long period of time under a substantial 35 amount of deformation.

As already indicated, the peripheral edge portions surrounding the opening of the vent orifice may be used to form the valve 40 seat for the resilient ball in the pressure relief vent valve of the invention. It should be understood, however, that the valve seat for the resilient ball may be formed by a separate member overlying the opening of 45 the vent orifice as in the case of the vent washer used in the embodiment illustrated in Figure 7. Generally speaking, the valve seat in all the embodiments except that illustrated in Figure 6, should be roughly 90 50 degrees in cross-section forming a square shoulder with a sharp edge for minimal contact with the resilient ball to insure a fluid-tight seal.

It should be noted that the resilient ball 55 used in the pressure relief vent valve is of an initial spherical shape and that the valve seat against which the ball bears is circular in the case where the valve is used only as a low pressure vent as illustrated in Figure 4.

60 In some cases, it may be desirable to use a surface additive for lubricating the resilient ball. The lubricant also serves to seal minor imperfections in the valve seat or surfaces of the ball and prevents salt encrustment from 65 any liquid electrolyte which may come into

contact with the vent valve. Suitable surface additives and lubricants include silicone grease, soap and waxes, for example.

As an illustration of the practice of the invention, a number of alkaline zinc-manganese dioxide cells of various sizes, 70 e.g., D, AA, AAA cells, have been made using the pressure relief vent valve of the invention. The resilient deformable ball used in the valves was of spherical shape and 75 was made from an ethylene-propylene copolymer. The diameter of the balls ranged from about 3/32 to 3/16 inch depending on the size of the cell. The venting pressure level of the vent valves used in these cells 80 was set by suitable choice of parameters, i.e., resiliency of the ball, the difference in relative sizes between the ball and the vent orifice, etc., over a wide range of sealing pressures from about 5 to 500 psi. The 85 pressure relief vent valves were found to perform satisfactorily in that gas venting occurred in a predictable and reproducible manner for the various venting pressures used. 90

It will be seen then that the present invention provides a novel and improved pressure relief vent valve for relieving high internal gas pressures from inside a fluid-tight sealed container and especially in 95 alkaline galvanic cell. The pressure relief vent valve of the invention is particularly advantageous in that it is simple and compact and readily adaptable to use in 100 miniature size cells, employs a minimum number of parts with the resilient ball being the only moving part, can be assembled as a unit with little or no handling and employs no parts having critical tolerances in its 105 assembly. The vent valve is furthermore resealable once the internal gas pressure has been relieved from the inside of the container and is responsive over a wide range of gas pressures and is relatively inexpensive to 110 manufacture. In all of the embodiments described, except that illustrated by Fig. 4, the ball was initially in the vent orifice as described in our co-pending Specification 41208/70 (Serial No. 1,336,567). Attention is 115 also directed to this Specification in view of the provisions of Section 9 of the Patent Act.

WHAT WE CLAIM IS:—

1. A pressure relief vent valve for a container which comprises a resilient 120 deformable ball of an initial spherical shape and of a size larger than that of said vent orifice, said ball being positioned to overlie a vent orifice in contact with a valve seat provided around the peripheral edge 125 portions of said vent orifice, and a retainer means for maintaining said ball in place over said vent orifice and for compressing said ball into a flattened configuration so as to form a normally fluid-tight seal between said 130



miniature size cells such as AAA cells, the primary function of the valve is to act as a positive "fail-safe" pressure relief vent and the valve must not plug up and fail to vent. In order to insure that the vent valve will operate safely in these miniature size cells, it may be desirable to assemble the vent valve in such a way that the resilient ball is under a fairly low final compression and, therefore, will vent at relatively low venting pressures. In such instances, the resilient ball may be prevented from seating properly with the vent orifice to achieve re-sealability due to the presence of particles of active material which may be carried up onto the valve seat from inside the cell. The failure of the valve to seal or reseal properly is not viewed as a fault of the valve but rather as simply a result of the environment.

In the broadest aspect of the invention, the resilient ball used in the pressure relief vent valve may be made from most any resilient elastomeric material. Preferably, however, in the case of an alkaline galvanic cell, the resilient ball should be made from resilient elastomeric material which is chemically resistant to the alkaline electrolyte of the cell. A suitable chemically resistant elastomeric material for the resilient ball is an ethylene-propylene copolymer. The hardness of the resilient ball preferably is in the range of from about 60 to 70 Durometer and the ball should be capable of maintaining its resiliency over a long period of time under a substantial amount of deformation.

As already indicated, the peripheral edge portions surrounding the opening of the vent orifice may be used to form the valve seat for the resilient ball in the pressure relief vent valve of the invention. It should be understood, however, that the valve seat for the resilient ball may be formed by a separate member overlying the opening of the vent orifice as in the case of the vent washer used in the embodiment illustrated in Figure 7. Generally speaking, the valve seat in all the embodiments except that illustrated in Figure 6, should be roughly 90 degrees in cross-section forming a square shoulder with a sharp edge for minimal contact with the resilient ball to insure a fluid-tight seal.

It should be noted that the resilient ball used in the pressure relief vent valve is of an initial spherical shape and that the valve seat against which the ball bears is circular in the case where the valve is used only as a low pressure vent as illustrated in Figure 4.

In some cases, it may be desirable to use a surface additive for lubricating the resilient ball. The lubricant also serves to seal minor imperfections in the valve seat or surfaces of the ball and prevents salt encrustment from any liquid electrolyte which may come into

contact with the vent valve. Suitable surface additives and lubricants include silicone grease, soap and waxes, for example.

As an illustration of the practice of the invention, a number of alkaline zinc-manganese dioxide cells of various sizes, e.g., D, AA, AAA cells, have been made using the pressure relief vent valve of the invention. The resilient deformable ball used in the valves was of spherical shape and was made from an ethylene-propylene copolymer. The diameter of the balls ranged from about 3/32 to 3/16 inch depending on the size of the cell. The venting pressure level of the vent valves used in these cells was set by suitable choice of parameters, i.e., resiliency of the ball, the difference in relative sizes between the ball and the vent orifice, etc., over a wide range of sealing pressures from about 5 to 500 psi. The pressure relief vent valves were found to perform satisfactorily in that gas venting occurred in a predictable and reproducible manner for the various venting pressures used.

It will be seen then that the present invention provides a novel and improved pressure relief vent valve for relieving high internal gas pressures from inside a fluid-tight sealed container and especially in alkaline galvanic cell. The pressure relief vent valve of the invention is particularly advantageous in that it is simple and compact and readily adaptable to use in miniature size cells, employs a minimum number of parts with the resilient ball being the only moving part, can be assembled as a unit with little or no handling and employs no parts having critical tolerances in its assembly. The vent valve is furthermore resealable once the internal gas pressure has been relieved from the inside of the container and is responsive over a wide range of gas pressures and is relatively inexpensive to manufacture. In all of the embodiments described, except that illustrated by Fig. 4, the ball was initially in the vent orifice as described in our co-pending Specification 41208/70 (Serial No. 1,336,567). Attention is also directed to this Specification in view of the provisions of Section 9 of the Patent Act.

WHAT WE CLAIM IS:—

1. A pressure relief vent valve for a container which comprises a resilient deformable ball of an initial spherical shape and of a size larger than that of said vent orifice, said ball being positioned to overlie a vent orifice in contact with a valve seat provided around the peripheral edge portions of said vent orifice, and a retainer means for maintaining said ball in place over said vent orifice and for compressing said ball into a flattened configuration so as to form a normally fluid-tight seal between said



5 ball and said valve seat, said ball being capable of undergoing further temporary deformation upon the build-up of a predetermined internal gas pressure inside said container momentarily breaking the seal and allowing gas to escape through said vent orifice.

10 2. A valve as claimed in claim 1 wherein the resilient deformable ball is made of an elastomeric material possessing a hardness of from about 60 to 70 Durometer.

15 3. A valve as claimed in claim 1 or 2 wherein the valve seat is formed with a substantially square shoulder providing a sharp peripheral edge for minimal contact with said resilient ball.

20 4. A valve as claimed in claim 1 or 2 wherein the surfaces of the valve seat are of a substantially conical configuration.

5. A valve as claimed in any of claims 1 to 4 wherein the valve seat is formed by the inner peripheral edge portions of the said vent orifice.

6. An alkaline galvanic cell having a

pressure relief valve as claimed in any preceding claim. 25

7. A cell as claimed in claim 6 wherein one end of said container is sealed by a closure comprising a rigid metallic cover which fits in said end of said container and a seal gasket fluid-tightly sealed between said metallic cover and said container, and wherein the vent orifice is provided within said metallic cover. 30

8. A cell as claimed in either of claims 6 or 7 wherein the retainer means is a metallic cap having a protuberance which fits over said resilient ball in pressure contact therewith and further including a spring member in electrical contact between said protuberance and a metallic bottom cover plate locked in engagement around the extremities of said cell. 35 40

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