

PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Improvements in or Relating to Seals For Galvanic Cells

We, UNION CARBIDE CORPORATION, of 270, Park Avenue, New York, State of New York, United States of America, a Corporation organised under the laws of the State of New York, United States of America, (Assignee of FRANK GEORGE SPANUR), 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 puncture-type safety seals for galvanic cells or batteries of the sealed type, and has as its principal object to provide an improved radially sealed, puncture-type seal assembly for e.g. alkaline-manganese dioxide cells.

Heretofore in the art most seals were generally either of the blow-out type with or without a backup member or were of the puncture type wherein a thin metal diaphragm is deflected upward against a metal spur which punctures it when the internal pressure exceeds a predetermined value. However, these seals had a number of disadvantages; the former type did not give reproducible action and the latter type did not provide structural support and the latter type also failed to protect the critical seal elements from contact with the corrosive agents of the cell, such as the electrolyte.

According to the present invention a galvanic cell or battery having a centralized terminal and a cover provided with a vent wherein a puncture-type safety seal comprising an annular-shaped seal gasket of plastics material sealing the open end of the cell container is positioned between said centralized terminal and said cover of said cell and between said cover and said cell container, said seal gasket having an inner flange for supporting said centralized terminal, an outer flange portion and a thin vertical wall portion surrounding

said inner flange, a yieldable annular-shaped metallic back-up washer having a surface inclined both inwardly and away from the cover disposed below and in juxtaposition with said seal gasket leaving exposed said thin vertical wall portion of said seal gasket, a bowed annular-shaped metallic washer having a plurality of radially inwardly inclined teeth provided with sharp edges disposed in juxtaposition with said annular-shaped washer, said teeth being projected against and bearing on said inwardly inclined surface of the back-up washer, said gasket being adapted to be deflected outwardly in a longitudinal direction upon the generation of a predetermined gas pressure so as to bear against said back-up washer and to cause it to flex thus causing the teeth of said bowed annular-shaped metallic washer to move over the inwardly inclined surface of said back-up washer and to contact and puncture said exposed thin vertical wall portion of said seal gasket, thus releasing the gas pressure.

The invention will be further described by way of example with reference to the accompanying drawing wherein:

Figure 1 is a vertical sectional view of an alkaline manganese dioxide-zinc cell embodying a puncture-type safety seal of the present invention;

Figure 2 is an enlarged bottom view of the cell, parts being broken away to show the details of the safety seal illustrated in Figure 1; and

Figure 3 is an enlarged fragmentary view in section, showing the safety seal of the invention after the seal has been punctured.

Referring now to the drawing, wherein like reference characters designate like or corresponding parts and particularly to Figures 1 and 3, there is shown an alkaline manganese dioxide-zinc cell 10 which is sealed with a puncture-type safety seal embodying the pre-



sent invention. The cell 10 comprises a cupped metal container 12 (shown upside down) provided with a tubular-shaped insulating jacket 14 and having therein a gelled anode 16, a gelled electrolyte 17, and a cathode 18 separated from the anode 16 by a separator 20. An outer wrapper 22 suitably of metal surrounds the container 12 and insulator 14. At the upper end of the cell 10 is provided a conventional cover 24 which contacts the cupped container 12 and serves as the positive terminal of the cell.

As shown in Figure 1, the cupped metal container 12 is sealed at its bottom open end with the puncture-type seal of the invention. As shown, the seal comprises a generally annular-shaped seal gasket 30, metallic cover 32 which resides in said seal gasket 30 and which has a vent 46 and a centrally located rivet negative terminal element 34 which is in contact with an anode current collector 36. A metallic dished shaped washer 38 is disposed within the seal gasket 30 and is in contact with the inclined bottom portion 40 of the seal gasket 30. A metallic toothed washer 42 having teeth 44 directed radially inward is disposed contiguous to the dished shaped washer 38 such that the teeth 44 can slide relative to the sloping surface of the dished shaped washer 38 as it is displaced by gas pressure generated within the cell 10.

Within the bottom of the cell and just below the seal assembly of the invention is a negative terminal cover 45. It is generally desirable to employ a contact spring 43 between the negative terminal 34 and the negative terminal cover 45. An insulating washer 47 is also positioned between the cover 32 and the external negative terminal cover 45 so as to insulate it from the cupped container 12 and the negative terminal cover 45. This "false" external cover 45 is desirable since it will retain any liquid or spew which may escape in the event the seal vents. The seal gasket 30 is suitably compressed radially between the negative rivet terminal 34 and the cover 32 and between the cover 32 and the container 12 thereby resulting in a leak resistant, gas tight cell.

The seal gasket 30, as best shown in Figure 1, is a one piece suitably molded or machined element having a skirt 50 which encircles and aids in holding the free ends of the cell separator 20 in place, a centralized inner flange 52 which provides sufficient support for the rivet 34, and a thin vertical wall 54 surrounding the flange 52 to facilitate the ready penetration of the teeth of the toothed washer 42. The preferred material for the seal gasket 30 is a hard, insulating plastics-like material or a plastics, such as nylon, a polymer of hexamethylene diammonium adipate. One such nylon plastics found to be extremely satisfactory in the practice of the invention is sold under the trademark "Zytel." This material exhibits high compressive and shear strength and is capable

of withstanding large stresses without a tendency to cold flow. Other suitable plastics materials may also be employed in the practice of the invention provided they are also characterized by a resistance to cold flow and high compressive and shear strength.

Referring now to Figures 2 and 3, as gas is generated within the cell the portion of the seal gasket 30 between the inner and outer flange portions is deflected longitudinally outwardly to a degree wherein it causes the displacement of the dished-shaped washer 38. As the dished-shaped washer deflects elastically in proportion to the "displacement" load, the teeth 44 of the toothed washer 42 bear and slide along the inclined surface of the dished-shaped washer 38 and eventually move radially inward to puncture in at least one place the thin vertical wall 54 of the seal gasket 30, thereby venting the generated gas. This gas pressure relief action is more positive and predictable than with seals conventionally employed in the art.

It should be noticed that the toothed washer 42 and dished-shaped washer 38 are protected from contact with the corrosive reagents within the cell by the seal gasket 30 which is interposed between them and the inside of the cell and sealed between the cover 41 and the container 12 and between the negative rivet terminal 34 and the cover 41. The negative terminal rivet 34 should also be noted to provide structural support and electrical contact for the anode collector strip 36, whereas the "crimped" or curled edge 56 of the cupped metal container 12 holds the dished-shaped washer 38 and toothed washer 44 tightly together in mutual cooperative association with the radial seal at their outer peripheral edges.

In accordance with the above construction, it should be noted that an important virtue or feature of the invention is that it overcomes one of the limitations of prior art galvanic cells embodying a seal of the "safety type" wherein a safety blow-out, gas permeable membrane with no back-up washer is utilized. Such prior art cells have shown repeated susceptibility to leakage at pressures substantially lower than the cell blow-out pressure due to stress cracking of the seal gasket generally in the vicinity of the safety blow out membrane. In this connection, it is noted that the safety seal of the invention is reliable and more predictable in that no leakage has been observed prior to the penetrations of at least one tooth of the toothed washer. Of course, once the seal gasket is punctured the cell not only leaks but because it then functions as an open or unsealed cell, it will "dry up" in about a week and perhaps sooner if current continues to be taken from the cell. Obviously, as in prior art designs there may be some minute diffusion of hydrogen gas past the seal or through the seal gasket of the safety seal of the present invention.

In testing the effectiveness of the invention, a number of "D" size cells were sealed with the puncture-type safety seal of the invention. Another series of cells (identified as the control cells) embodied a conventional safety blow-out, gas permeable membrane (no back-up washer). Both type of cells are designed to vent at approximately the same pressure under normal operating conditions. All of the cells tested were alkaline cells and are essentially identical except for the difference in the seals and the following table illustrates the improved leak resistance of the safety seal of the invention over the control cells.

TABLE I

	Days to Leakage at 40° C.			Days to Leakage at 54° C.		
	First Incidence	20% Leakers	50% Leakers	First Incidence	20% Leakers	50% Leakers
Control	69	90	97	34	36	47
New Seal	Over 170	—	—	71	99	148

Since the cells tested had no "false" end covers or outer jackets, leakage could immediately be detected upon penetrating the seal gasket. In the above table, it is noted that it took about two and one-half times longer at 54° C. to detect any cell leakage from cells embodying the safety seal of the invention versus the control cells. Furthermore, at 40° C the safety seals never approached the 20%—50% leakage level whereas the control cells experienced 20% leakage at 90 days and 50% leakage at 97 days. At the higher temperature, leakage with the safety seal of the invention results from the normal operation of the puncturing device. The spread in days for various % cells leaking is the natural result of different gassing rates for individual cells and the normal variation in release pressure between individual seals. Earlier incidence of leakage and higher % leakers throughout the test on the control cells reflects the gasket cracking problem of the prior art construction.

WHAT WE CLAIM IS:—

1. A galvanic cell or battery having a container, a centralized terminal and a cover provided with a vent wherein a puncture type safety seal, comprising an annular-shaped seal gasket of plastics material sealing the open end of the cell container is positioned between said centralized terminal and said cover of said cell and between said cover and said cell container, said seal gasket having an inner flange for supporting said centralized terminal, an outer flange portion and a thin vertical wall portion surrounding said inner flange, a yieldable annular-shaped metallic back-up

washer having a surface inclined both inwardly and away from the cover disposed below and in juxtaposition with said seal gasket leaving exposed said thin vertical wall portion of said seal gasket, a bowed annular-shaped metallic washer having a plurality of radially inwardly inclined teeth provided with sharp edges disposed in juxtaposition with said annular-shaped washer, said teeth being projected against and bearing on said inwardly inclined surface of the back-up washer, said seal gasket being adapted to be deflected outwardly in a longitudinal direction upon the generation of a predetermined gas pressure so as to bear against said back-up washer and to cause it to flex thus causing the teeth of said bowed annular-shaped metallic washer to move over the inwardly inclined surface of said back-up washer and to contact and puncture said exposed thin vertical wall portion of said seal gasket, thus releasing the gas pressure.

2. A galvanic cell or battery as claimed in claim 1, in which said teeth of said bowed annular-shaped washer are V-shaped.

3. A galvanic cell or battery as claimed in claim 1 or 2, in which said seal gasket is of nylon.

4. A galvanic cell or battery constructed and arranged and adapted to be operated, substantially as hereinbefore, particularly described with reference to and as shown in Figs. 1, 2 and 3 of the accompanying drawing.

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