

PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Improvements in and relating to Sealing Electric 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 ROBERT CARMICHAEL and JOHN LESLIE SANDERSON DALEY), 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 sealed galvanic cell, such as alkaline manganese dioxide-zinc primary or secondary cell.

For many years there have been so-called "leak-proof" type cells available, but none of these cells have actually retained liquid electrolyte successfully for long periods of time. Escape of electrolyte to the outside of a cell container is a problem particularly in the case of a cell containing a caustic electrolyte, which is about the most difficult to seal, for not only is the supply of electrolyte diminished, but a hazard is created if the cell is to be handled.

Past attempts to provide leak-proof alkaline cells have shown that one of the major difficulties that must be overcome is what is termed "negative leakage," that is, creepage of the electrolyte through the seal assembly of the cell at its negative terminal side.

The problem of negative leakage is not wholly a mechanical one, but one which also involves an electrocapillary action that occurs with alkaline cells. Electrocapillary action is the result of a conductive path forming between the oppositely charged parts of a cell container, i.e., the negative container cover and the positive container, or vice-versa. This conductive path, across which an electric current will flow, may be set up inside the cell container as the result of electrolyte wetting the inside of the seal gasket used to separate the oppositely charged parts of the cell, or on the outside of the cell due to wetting of the outside of the seal gasket with

moisture, such as might occur as a result of high relative humidity.

The current which flows across either conductive path is termed "electrocapillary drive." It encourages creepage of the electrolyte and actually may drive electrolyte from the cell, no matter how good the mechanical seal is.

The principal object of the invention is to provide a cell closure which will prevent creepage of electrolyte from an alkaline galvanic cell and substantially prohibit external electrocapillary action from taking place.

Broadly stated, the objects of the invention are accomplished by mechanically tight cell closure which eliminates all short, wettable paths between the polarized members of a cell and thus reduces any electrocapillary action to a minimum.

Accordingly, the present invention provides a sealed galvanic cell comprising a cupped polarized metallic container having disposed therein an anode and a cathode with a separator therebetween and an alkaline electrolyte, such ~~cell~~ being closed at the open end of the cupped container by a closure which comprises an annular "U" shaped gasket of a hard di-electric synthetic plastic material which is resistant to cold flow, as herein after defined, such gasket having a central aperture, therein, an annular unpolarized metallic cover recessed in the gasket and a polarized metallic terminal which passes through the apertures in the gasket and the cover, the gasket being radially compressed between the cover and the terminal.

The present invention also provides a method for production of a sealed galvanic cell, such cell comprising a cupped polarized metallic container, having disposed therein an anode and a cathode with a separator therebetween, an alkaline electrolyte, an annular unpolarized metallic cover and a polarized terminal, which comprises providing an annular "U" shaped gasket of a hard di-electric plastic material which is resistant to cold flow as herein after defined, placing the unpolarized metallic cover in the annular

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"U" shaped gasket, inserting the terminal through the aperture in the gasket and the cover, thereby radially compressing the gasket between such cover and such terminal, placing the thus assembled gasket, cover and terminal in the open end of the cupped container and drawing such container through a reducing die to radially compress the gasket between the container wall and the cover.

The term "resistant to cold flow" as used herein as applied to a material, means a material having the following properties measured at 73°F. and in lbs. per sq. inch.

Tensile strength	from 5,000 to 10,500
Modulus of Elasticity	from 38,000 to 40,000
Compression strength	
at 1% deformation	from 800 to 4,900
Rockwell Hardness	from 45 to 118
Stiffness	from 19,000 to 20,000

More specifically, the cell closure of the invention comprises a non-polarized cover, a polarized terminal centrally located in the cover, and a seal gasket of a hard di-electric plastic material (preferably nylon) which is resistant to cold flow. The gasket is common to both the positive seal, i.e., between the container and cell cover, and to the negative seal, i.e., between the negative terminal and the cover.

According to the closure of the present invention, electrocapillary action is eliminated by the characteristic of a negatively polarized terminal passing through the cell cover. The terminal is insulated from such cover by a U-shaped non-conductive gasket and is radially sealed there to prevent electrolyte creepage. The cell cover is non-polarized and the gasket is radially compressed between such unpolarized cover and the conductive container whereby all short wettable paths between the polarized members of the cell closure are effectively eliminated and electrocapillary action prohibited. In addition, both the positive and negative seals are rendered extremely tight mechanically by radial compression of the seal gasket between the cover and container and cover and terminal.

The invention will be further illustrated by reference to the accompanying drawings, wherein

Fig. 1 is a front elevation, partially in section, showing an alkaline manganese dioxide-zinc cell, employing the preferred cell closure of the invention;

Fig. 2 is a sectional view of the cell closure members of Fig. 1 prior to assembly;

Fig. 3 shows the cell closure members of Fig. 2 after the assembling and radial sealing of the negative terminal seal; and

Fig. 4 is a front elevation, partially in section, showing an alkaline manganese dioxide-zinc cell employing another embodi-

ment of the cell closure of the invention.

Referring now to the drawings, and particularly Fig. 1, an alkaline manganese dioxide-zinc cell which comprises a cupped container 10, provided with an insulating jacket 11, and having an anode 12 and cathode 14, separated by a separator 16 and electrolyte 18, disposed therein, may be sealed with the cell closure of the invention as set forth below.

As shown more clearly in Fig. 2, the cell closure of the invention comprises a non-polarized metallic cover 20, a polarized metallic flanged terminal 22 provided initially with a tapered section 24, and an annular "U" shaped seal gasket 26, of hard synthetic plastic material, preferably nylon.

As shown in Fig. 3, the initial step in sealing a cell with the closure of the invention, comprises radially sealing the polarized terminal 22 in place. This may be accomplished by driving the tapered polarized terminal 22 through a central aperture 28 provided in the seal gasket 26 with the non-polarized cover already in place. The terminal 22 is deliberately of a slightly larger diameter than the aperture 28 in the seal gasket 26, so that when the tapered terminal 22 is driven through the aperture 28 in the seal gasket 26, the seal gasket 26 is radially compressed between the cover 20 and the terminal 22, thereby furnishing an extremely tight mechanical seal at this point. Subsequent to this sealing the tapered section 24 of the terminal post 22 may be flattened out to firmly secure it in place.

The thus sealed members of the cell closure are then positioned in the open-topped container 10 and an extremely tight mechanical seal between the polarized container 10 and the non-polarized cover 20 is accomplished by drawing the container 10 through a reducing die to compress the outer periphery 27 of the seal gasket 26 between the container 10 and cover 20, under a radial force substantially equivalent to but not greater than the yield strength of the metal of which the container is formed.

Another method of accomplishing the radial seal at the polarized terminal is illustrated in the cell shown in Fig. 4. In this embodiment an open-mouthed flanged rivet 30 which constitutes the polarized terminal is passed through the aperture 28 in the gasket 26 with the cover 20 in place, and subsequently expanded so that it radially compresses the seal gasket 26 between the rivet 30 and the cover 20. As explained before, the thus assembled cell closure members are then positioned in the cupped container 10 and the container 10 is drawn through a reducing die to radially compress the outer periphery 27 of the gasket 26 between the container 10 and the cover 20.

If desired, in either of the embodiments shown in Figs. 1 and 4 after the cell con-

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5 tainer 10 has been sealed with the cell closure of the invention, an insulating washer 32 may be positioned across the cell closure and an external metallic cover 34, which is in contact with the polarized terminal 22 or 30, is provided across the open end of the cell jacket 11. In any event, the polarized terminal 22 or 30 is in contact with the anode 12 by means of an anode collector 31.

10 Preferably, in the practice of the invention, as illustrated in Figs. 1 and 4, the seal gasket 26 which is employed is provided with an annular depending flange 36 which minimizes any internal electrocapillary action.

15 The preferred combination of a depending flange with an unpolarized cover which eliminates all short paths between oppositely charged parts of the cell which could be either internally or externally wetted and with the extremely tight mechanical radial sealing of the seal gasket at both the positive and negative terminal of the cell, results in a truly leak resistant cell.

The Table set forth below shows the out-

standing results obtained with the sealed galvanic cell of the present invention. In these comparative tests, the quality of the cell closure of the invention was determined in a short period of time by storage under extreme conditions. The cells tested were stored for thirty days at 95°F. and 90 per cent relative humidity. The control cells were cells which were sealed by radially compressing a synthetic plastic non-conductive gasket between a positively polarized container, and an unpolarized cover. The cover was polarized after the closure was made ~~at~~ attaching a connector from the negatively charged center terminal post to a fastener inserted in the metal cover.

After thirty days storage, under the indicated conditions, the cells were observed and classified into three categories based on the caustic crust formation around the seal portion of the cell. The three categories were identified as none, light, and heavy. Cells having a heavy crust formation are deemed unacceptable for use.

TABLE

Per Cent of Cells Showing Caustic Creepage
After 30 Days Storage at 95° F. and 90 Per Cent
Relative Humidity

Type of Seal	Caustic Crust Formation		
	None	Light	Heavy
Control	0	70	30
Tapered Terminal (Fig. 1)	100	0	0
Bulged Rivet Terminal (Fig. 4)	27	66	7

50 A study of these results shows that when the preferred tapered terminal post of the invention is employed there is no creepage whatsoever of electrolyte to the outside of the cell container. When the bulged rivet terminal is employed, 27 per cent of the cells evidenced no creepage and only 7 per cent were unacceptable. In contrast, the seal of the control permitted some leakage in all of the cells and in 30 per cent of the cases this creepage was of such magnitude that the cells were unacceptable.

WHAT WE CLAIM IS:—

1. A sealed galvanic cell comprising a cupped polarized metallic container having disposed therein an anode and a cathode with a separator therebetween and an alkaline electrolyte, such cell being closed at the open end of the cupped container by a closure which comprises an annular "U" shaped gasket of a hard di-electric synthetic plastic material which is resistant to cold flow as here-

inbefore defined, such gasket having a central aperture therein, an annular unpolarized metallic cover recessed in the gasket and a polarized metallic terminal which passes through the apertures in the gasket and the cover, the gasket being radially compressed between the cover and the terminal.

2. A cell as claimed in claim 1, in which the annular "U" shaped gasket is provided with an internal annular depending flange.

3. A cell as claimed in claim 1 or 2, in which the hard di-electric synthetic plastic material of the gasket is nylon.

4. A cell as claimed in any of claims 1 to 3, in which the metallic terminal is tapered and is of a diameter slightly larger than the diameter of the aperture in the gasket.

5. A cell as claimed in any of claims 1 to 3, in which the metallic terminal is an open-mouthed flanged rivet.

6. A method for producing a sealed galvanic cell, such cell comprising a cupped polarized



tainer 10 has been sealed with the cell closure of the invention, an insulating washer 32 may be positioned across the cell closure and an external metallic cover 34, which is in contact with the polarized terminal 22 or 30, is provided across the open end of the cell jacket 11. In any event, the polarized terminal 22 or 30 is in contact with the anode 12 by means of an anode collector 31.

Preferably, in the practice of the invention, as illustrated in Figs. 1 and 4, the seal gasket 26 which is employed is provided with an annular depending flange 36 which minimizes any internal electrocapillary action.

The preferred combination of a depending flange with an unpolarized cover which eliminates all short paths between oppositely charged parts of the cell which could be either internally or externally wetted and with the extremely tight mechanical radial sealing of the seal gasket at both the positive and negative terminal of the cell, results in a truly leak resistant cell.

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After thirty days storage, under the indicated conditions, the cells were observed and classified into three categories based on the caustic crust formation around the seal portion of the cell. The three categories were identified as none, light, and heavy. Cells having a heavy crust formation are deemed unacceptable for use.

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WHAT WE CLAIM IS:—

1. A sealed galvanic cell comprising a cupped polarized metallic container having disposed therein an anode and a cathode with a separator therebetween and an alkaline electrolyte, such cell being closed at the open end of the cupped container by a closure which comprises an annular "U" shaped gasket of a hard di-electric synthetic plastic material which is resistant to cold flow as here-

inbefore defined, such gasket having a central aperture therein, an annular unpolarized metallic cover recessed in the gasket and a polarized metallic terminal which passes through the apertures in the gasket and the cover, the gasket being radially compressed between the cover and the terminal.

2. A cell as claimed in claim 1, in which the annular "U" shaped gasket is provided with an internal annular depending flange.

3. A cell as claimed in claim 1 or 2, in which the hard di-electric synthetic plastic material of the gasket is nylon.

4. A cell as claimed in any of claims 1 to 3, in which the metallic terminal is tapered and is of a diameter slightly larger than the diameter of the aperture in the gasket.

5. A cell as claimed in any of claims 1 to 3, in which the metallic terminal is an open-mouthed flanged rivet.

6. A method for producing a sealed galvanic cell, such cell comprising a cupped polarized

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metallic container having disposed therein an anode and a cathode with a separator therebetween, an alkaline electrolyte, an annular unpolarized apertured metallic cover and a
5 polarized terminal, which comprises providing an annular "U" shaped gasket of a hard di-electric plastic material which is resistant to cold flow as hereinbefore defined, placing
10 the unpolarized metallic cover in the annular "U" shaped gasket, inserting the terminal through the aperture in the gasket and the cover, thereby radially compressing the gasket between such cover and such terminal, plac-
15 ing the thus assembled gasket, cover and terminal in the open end of the cupped container and drawing such container through a reducing die to radially compress the gasket between the container wall and the cover.

20 7. A method as claimed in claim 6, in which compression of the gasket between the container wall and the cover is effected under a radial force substantially equivalent to, but not greater than the yield strength of the metal of which the container is formed.

8. A method as claimed in claim 6 or 7, in which compression of the gasket between the terminal and the cover is effected by driving through the aperture in the gasket a tapered terminal of a diameter slightly larger than the diameter of such aperture in such gasket. 25 30

9. A method as claimed in claim 6 or 7, in which compression of the gasket between the terminal and the cover is effected by passing an open-mouthed rivet terminal through the aperture in the gasket and there-
35 after expanding such open-mouthed rivet.

10. A sealed galvanic cell substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

11. A method for producing a sealed gal-
40 vanic cell, substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

W. P. THOMPSON & CO.,
12, Church Street, Liverpool, 1,
Chartered Patent Agents.

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