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T. A. REILLY ET AL
LEAK-RESISTANT DRY CELL

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Fig. 1.

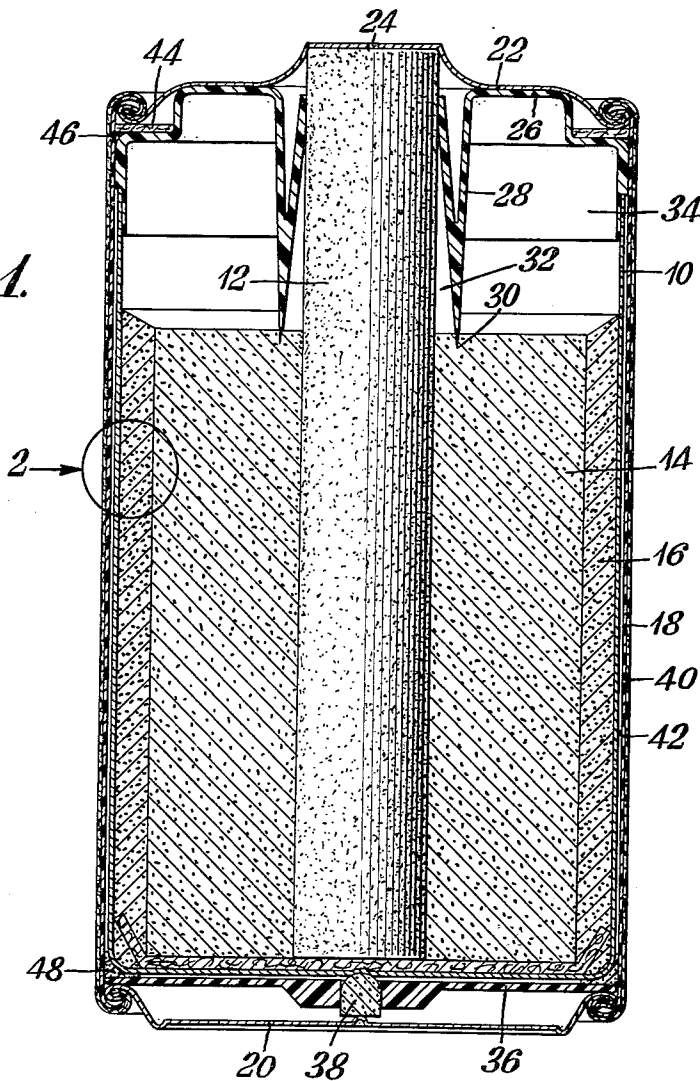
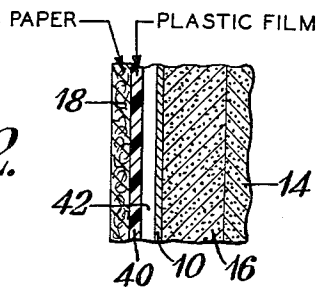


Fig. 2.



INVENTORS
THOMAS A. REILLY
JOHNSON R. BECKMAN
HARRY K. BISHOP

BY *John F. Hohmann*
ATTORNEY

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LEAK-RESISTANT DRY CELL

Thomas A. Reilly, Johnson R. Beckman, and Harry K. Bishop, Cleveland, Ohio, assignors to Union Carbide Corporation, a corporation of New York
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This invention relates to leak-resistant dry cells of the type having a closed container surrounding the cell proper.

The so-called LeClanche dry cells used for flashlights, portable radios, photoflash and other devices has gone through an evolution of improvements during the past decade or more in an attempt by manufacturers to prevent leakage from the cell during and after its use. Despite the many proposals, however, that have been advanced, there still remains a need for a better leak-resistant dry cell.

One proposal that has been adopted commercially is to encase a conventional dry cell within a closed container. This dry cell construction, however, has been plagued by certain difficulties. For example, one type of container that has been used is composed of a metal. Although this type of container is strong and rugged, it nevertheless suffers from the disadvantage that the metal is subject to corrosion by liquid exudate from the cell. To avoid this disadvantage, non-corrodible containers have also been utilized. The principal difficulty, however, with non-corrodible containers is that they do not possess the strength of metal containers and suffer from the disadvantage that they may often be damaged, and even destroyed, by the pressure which builds up from the formation of gas within the cell. Several suggestions have been advanced for overcoming this disadvantage of non-corrodible containers in which the attempt has been made to continuously vent the gas from the cell. Thus, in prior constructions, the gas has been vented, for example, through the carbon electrode, and then out through venting means provided in the top closure of the container. The difficulty with these suggestions is that the venting paths, for instance through the carbon electrode, have been prone to obstruction by cell exudate, thereby blocking the passage of gas from the cell.

In addition to obstructing the venting paths provided in the cell, this cell exudate has also given rise to other serious problems. For example, one difficult problem has been the tendency for metal formed in solution by normal consumption of the metal electrode to deposit out from the cell exudate in the form of spongy tree-like deposits. These metal deposits have formed principally on top of the depolarizer mix between the electrodes of the cell and have been particularly troublesome from the standpoint of cell performance, for they very likely can short out the cell by establishing short-circuit paths between the cell electrodes. Thus, the cell in many instances may be drained of its power even though it is not in use.

It is therefore an important object of the invention to provide an improved gas venting path in a leak-resistant dry cell of the type having a non-corrodible container, which gas venting path is not prone to obstruction during use of the cell.

More specifically, it is another object to provide such a gas venting path in a leak-resistant dry cell while at the same time preventing the establishment of short-circuit paths between the electrodes of the cell.

Still another object is to provide such a gas venting path in a leak-resistant dry cell particularly of the type of construction utilizing a non-metallic jacket having locked thereto a metallic bottom closure, in which the

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jacket is protected against liquid penetration and in which the bottom closure is protected against corrosion.

Briefly, these and other objects are achieved by the invention which comprises an annular, substantially cupped shaped seal cap positioned below the top closure over the top open end of the cup electrode of a leak-resistant dry cell. The cap has a tubular opening surrounding but spaced from the carbon electrode, the lower end of which is embedded within the depolarizer mix of the cell. This tubular opening defines a barrier which protects the carbon electrode from contact by liquid cell exudate and also provides a path for venting gas from the cell. The top closure for the cell is locked in engagement with a non-metallic jacket provided with a liquid-proof liner. Also locked to the jacket is a metallic bottom plate protected against corrosion by a shield positioned within the lower edges of the jacket. An electrical contact element is positioned within the shield and makes electrical contact between the bottom of the cup electrode and the bottom plate.

In the accompanying drawing:

FIG. 1 is a vertical section of a leak-resistant dry cell embodying the invention; and

FIG. 2 is a greatly enlarged view of the encircled portion indicated at 2 in FIG. 1.

Referring to the drawing, a leak-resistant dry cell of a construction otherwise conventional but embodying the invention is shown in FIG. 1. The cell comprising a cup electrode 10 of a consumable metal, for instance, zinc, containing therein a central electrode 12 of porous carbon embedded within a depolarizer mix 14 and immobilized electrolyte 16 suitably in the form of a conventional "paste," is provided with a jacket 18 having locked thereto a metallic bottom plate 20 and a top cover plate 22 having therein a vent 24. Below the top cover plate 22 and rigidly secured between it and the top open end of the cup electrode 10 is an annular, substantially cupped shaped seal cap 26 fitted within the upper edges of the cup electrode 10. The cap 26 has a tubular opening 28 tightly fitted at its upper end around the carbon electrode 12 and at its lower end embedded within the depolarizer mix 14 at the junction 30. The tubular opening 28 is of a substantially V shape and surrounds but is spaced from the carbon electrode 12 defining an inner free space 32 between the tubular opening 28 and the carbon electrode 12, and an outer exudate chamber 34 between the tubular opening 28 and the upper edges of the cup electrode 10. The cap 26 preferably is integrally molded with the tubular opening 28 from a plastic material, for example, polyethylene. The construction for the dry cell described also utilizes a shield for the bottom plate 20 comprising a plastic disc 36, for example, of polyethylene fitted tightly within the lower edges of the jacket 18. This type of construction protects the bottom plate 20 against corrosion and also utilizes an electrically conductive button 38 positioned within the disc for making electrical contact between the bottom of the cup electrode 10 and the bottom plate 20. The button 38 preferably is composed of a non-corrodible and non-consumable type of material, for example, carbon or graphite as substantially disclosed and claimed in our copending application, Serial No. 106,763, filed concurrently herewith.

The jacket 18 is of a non-corrodible type preferably composed of a bibulous paper, for instance, kraft paper and has provided to its inner surfaces a liquid-proof liner 40, preferably composed of a plastic film, for example, polyethylene terephthalate, as best shown in enlarged detail in FIG. 2. This construction conveniently lends itself to incorporating the liquid-proof liner 40 by spiral winding techniques during manufacture of the jacket 18. The liquid-proof liner 40 may also be incorporated

by adhesively bonding it to the interior of the jacket 18 after the latter has been manufactured. The jacket 18 fits the cup electrode 10 rather loosely, thereby providing a supplementary chamber 42 for receiving liquid exudate from the cell, the chamber 42 being sealed off below the outer peripheral edges of the top cover plate 22 by a paper washer 44 sealed to the liquid-proof liner 40 suitably with a latex emulsion as indicated at 46 and also above the shield disc 36 at the bottom of the cell as indicated at 48 in FIG. 1.

Having described the construction of a dry cell embodying the invention, its mode of operation may now be visualized. During use of the cell, especially under severe conditions, gas is released. The gas follows a path through or around the carbon electrode 12 in the depolarizer mix 14, into the free space 32 and through the electrode 12, or directly through the electrode 12 from within the depolarizer mix 14, and then out of the cell through the vent 24 in the top cover plate 22. At the same time, liquid is exuded through the depolarizer mix 14 towards the cup electrode 10 and eventually collects within the exudate chamber 34 but is barred from entering the free space 32 by the tubular opening 28 of the cap 26. The cap 26 protects the metallic top cover plate 22 from corrosion and prevents the escape of liquid exudate from the top open end of the cup electrode 10. The junction 30 provides a barrier which effectively blocks off liquid from creeping into the free space 32 over the top of the depolarizer mix 14. Thus, it will be seen by this construction that liquid exudate is not only barred from blocking the passage of gas through the free space 32 and carbon electrode 12 or from escaping out of the cell by way of the free space 32, but also is barred from contacting the carbon electrode 12 and from establishing short-circuit paths between it and the cup electrode 10 by the deposition of spongy zinc metal over the depolarizer mix 14. This construction also takes advantage of an insoluble salt layer which normally forms over the surfaces of the depolarizer mix 14 during discharge for providing a seal around the junction 30 which liquid exudate cannot penetrate. It will be appreciated that a dry cell of the construction described is easily constructed and readily assembled without difficulty during its manufacture.

A number of dry cells embodying the invention have been made and tested over a wide range of conditions. These tests demonstrated the effectiveness of the invention, for cells otherwise identical in construction but lacking the structural features of the invention showed evidence of leakage from and/or bulging of the cell container, while those cells embodying the invention showed little or no evidence of gas pressure build-up and consistently demonstrated superior leakproofness. The effectiveness of the invention was further demonstrated by the fact that the dry cells of the invention had a longer life and did not short out during the tests.

It will be understood that many changes and modifications of the dry cell construction described herein may be made without departing from the spirit and scope of the invention.

We claim:

1. A leak-resistant dry cell comprising, in combination, a cup electrode of a consumable metal containing depolarizer mix, electrolyte and a central carbon electrode embedded within said depolarizer mix; a non-metallic jacket having a liquid-proof liner embracing said cup

electrode; a metallic top closure and bottom plate locked to said jacket, said top closure having gas venting means therein; an annular substantially cupped shaped cap below said top closure fitted over the top open end of said cup electrode and rigidly secured between said top closure and said cup electrode, said cap having a central tubular opening surrounding said carbon electrode and providing a free space between said tubular opening and said carbon electrode and an exudate chamber surrounding said tubular opening, said tubular opening being embedded within said depolarizer mix and defining a barrier which protects said carbon electrode from contact by liquid exudate from said cell, said tubular opening in conjunction with said gas venting means in said top closure providing a path for venting gas from said cell; a shield for said bottom plate positioned below said cup electrode; and an electrical contact element positioned within said shield and making electrical contact between said cup electrode and said bottom plate.

2. A leak-resistant dry cell as defined by claim 1 in which said jacket loosely fits said cup electrode and provides a supplementary exudate chamber therebetween for said cell, and in which said chamber is sealed below said top closure and above said shield.

3. A leak-resistant dry cell as defined by claim 1 in which said electrical contact element is non-corrodible and non-consumable.

4. A leak-resistant dry cell as defined by claim 1 in which said liquid-proof liner for said jacket is composed of a plastic film.

5. A leak-resistant dry cell as defined by claim 1 in which said cap is composed of a plastic material.

6. A leak-resistant dry cell comprising, in combination, a cup electrode of a consumable metal containing depolarizer mix, electrolyte and a central carbon electrode embedded within said depolarizer mix; a non-metallic jacket having a liquid-proof liner embracing said cup electrode; a metallic top closure and bottom plate locked to said jacket, said top closure having gas venting means therein; and an annular substantially cupped shaped cap below said top closure fitted over the top open end of said cup electrode and rigidly secured between said top closure and said cup electrode, said cap having a central tubular opening surrounding said carbon electrode and providing a free space between said tubular opening and said carbon electrode and an exudate chamber surrounding said tubular opening, said tubular opening being embedded within said depolarizer mix and defining a barrier which protects said carbon electrode from contact by liquid exudate from said cell, said tubular opening in conjunction with said gas venting means in said top closure providing a path for venting gas from said cell.

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