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LEAK RESISTANT DRY CELL

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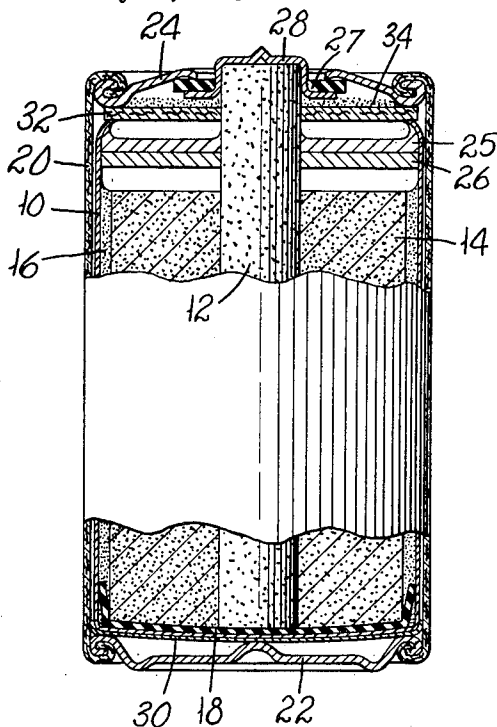


Fig. 1.

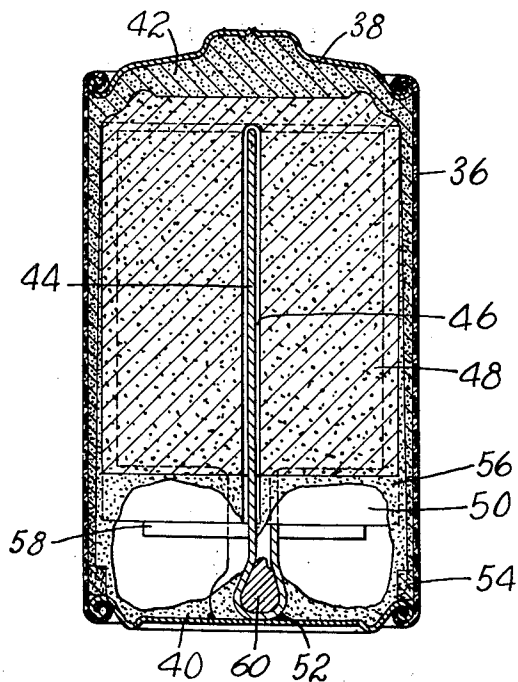


Fig. 2.

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1

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LEAK RESISTANT DRY CELL

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This invention relates to dry cells, and more particularly, to means of rendering such cells substantially leak-resistant.

In its simplest embodiment, a Le Clanche dry cell comprises a cupped container of zinc which acts as an anode, a cathodic mix of manganese dioxide and a carbon collector rod embedded in the cathodic mix; the collector rod and cathodic mix being suitably embodied in the form of a bobbin and disposed within the container and separated therefrom by an electrolyte paste comprising ammonium chloride, zinc chloride and a thickening agent. Suitably, the cell may be encased in a paper or cardboard jacket which is closed both at its top and bottom with a metal closure, the bottom closure consisting of a metal plate in contact with the bottom of the cupped zinc container.

As a Le Clanche cell is drained, the zinc container is attacked by an electro-chemical reaction, which may ultimately cause the zinc container to become perforated. The by-product of this reaction and the electrolyte, a viscous liquid which shall hereafter be referred to as the "exuded material" is acid, which may, after the zinc container is perforated escape from the container and attack and corrode the top and/or bottom metal closures of the cell. Essentially this corrosion is the result of a chemical reaction, but ultimately the reaction becomes in part electro-chemical and is accelerated. As a result, when the top and/or bottom metal closures are attacked by the exuded material, they will also be perforated, thereby allowing the exuded material to leak from the cell and attack and corrode the container in which the cell is disposed, such as a flashlight casing.

There have been many attempts by the prior art to furnish cell constructions which solve the above problem, but none of these have been wholly successful for one reason or another.

The principal object of the invention is to provide an improved leak-resistant dry cell.

A concurrent object of the invention is to provide a leak-resistant dry cell without affecting the electrical characteristics of the cell.

Broadly stated, the objects of the invention are accomplished by physically positioning within a dry cell structure, between the cell components and the cell's exterior jacket and/or terminals, a material which will react or combine chemically with the exuded material to form an inert, immobile, liquid-proof barrier in the path of exudate migration, thereby obstructing further exudate migration and successfully prohibiting leakage from the cell.

Any material which will react or combine chemically with the exuded material to form an inert liquid-proof barrier is suitable in the practice of the invention. Specifically, magnesium, magnesium oxide, or a sodium salt of abietic acid may be used. When magnesium or magnesium oxide is employed in the practice of the invention as the reactant material, the magnesium reacts with the exuded material to form a magnesium ammonium chloride complex. When a sodium salt of abietic acid is employed, a complex comprising a zinc salt of abietic acid is formed. These complexes form hydrates which will confine any available water in the exuded material. Thus, a liquid-proof barrier is built up which prohibits further migration of the exuded material. Depending upon convenience and the design of the particular cell

2

or battery of cells, the reactant material may be incorporated in the form of a disc, cup, rod or as a powder.

Obviously, a great many variations in construction embodying the above-outlined principles are possible. The following drawings present only those designs which most effectively illustrate these principles although it will be understood that the invention is useful for other types of construction of both cells and batteries.

FIG. 1 is a vertical elevation, partially in section, of a leak-resistant dry cell embodying the invention; and FIG. 2 is a vertical elevation of another leak-resistant dry cell embodying the invention.

Referring now to FIG. 1, a round cell employing the Le Clanche type system is shown embodying the principles of the invention. As illustrated, the cell comprises a cupped consumable zinc anodic container 10, a cathode 12 of carbon embedded in a depolarizer mix 14 of manganese dioxide, both disposed within the anodic container 10 and separated therefrom by a conventional gelled electrolyte 16. A bottom washer 18 is provided within the anodic container 10 and has resting on it the carbon electrode 12 and the depolarizer mix 14. The cupped anodic container 10 is provided with a non-metallic jacket 20, such as cardboard, one end of which has locked or otherwise secured thereto a metallic bottom plate 22, which underlies and is in contact with the bottom of the anodic container 10, and the other end of which is locked or otherwise secured to an annular top closure member 24. Optionally, a metallic jacket may be employed if an insulating liner is placed between the metallic jacket and the anodic container 10. The closure of the cell is of the conventional type. An asphalt seal 25 is supported on a washer 26 beneath the top closure member 24, the inner edge of which rests on an insulating washer 27 which is carried by a flanged metal terminal cap 28 mounted on the carbon cathode 12.

According to the principles of the invention, a magnesium cup 30 is provided between the anodic container 10 and the metallic bottom closure 22. When assembling the cell, care should be taken that the magnesium cup 30 is clean of any oxide film or the like in order to assure good electrical contact between the bottom of the anodic container 10 and the metallic bottom closure 22. After the cell has been in use for a period of time, the anodic container 10 may become perforated thereby allowing exudate to escape and migrate toward the metallic bottom closure 22. Prior to reaching the bottom closure 22, however, the exuded material will contact the magnesium cup 30 and react to form a liquid-proof barrier comprising a magnesium ammonium chloride complex which will prohibit further migration of exuded material and prevent it from contacting and corroding the metallic bottom closure 22. Similarly, the top closure 24 may be protected from migration of exuded material. To accomplish this, a cardboard disc 32 which electrically insulates the anodic container 10 from the metallic top closure 24 is dusted with magnesium oxide powder 34. Any exuded material which migrates to the top of the cell will react with the magnesium oxide and be immobilized prior to contacting the metallic top closure 24. If desired, the magnesium or any other suitable reactant, could be impregnated within the cardboard disc 32, and also within the jacket 20. Likewise, the inner sides of the bottom closure 22 and the top closure 24 could suitably be clad with magnesium.

FIG. 2 illustrates a so-called "inside-out" version of a Le Clanche round cell. A cell of this type is disclosed and claimed in U.S. Patent 2,605,299 and comprises a non corrodible tube 36 which is closed at one end by a metallic top member 38 and at the other end by a metallic bottom closure 40, both of which are tightly secured to the tube 36 by having the edges of the

tube 36 and the edges of the top member 38 and bottom closure 40 crimped and rolled together. Adjacent the inner surfaces of the tube 36 and the top member 38 and in juxtaposition therewith is the carbon cathode 42 of the cell which is molded into the tube 36, thereby sealing the top of the cell. A zinc anode 44 is positioned centrally within the cell, and is provided with a conventional separator 46 of bibulous material. The intervening space in the cell between the cathode 42 and anode 44 is substantially filled with an electrolyte wet depolarizer mix 48 leaving an air space 50, however, through which the stem of the anode 44 extends to the metallic bottom closure 40 to which it is electrically connected at 52, as by soldering. A fibrous support ring 54 is provided at the bottom of the tube 36 and the cell is sealed internally at the bottom by a conventional seal 56 of wax.

One of the outstanding advantages of this type cell is that the carbon cathode 42 is both chemically and electrochemically inactive with respect to the ammonium chloride electrolyte which is employed and will not corrode, perforate, nor permit any electrolyte to leak from the cell. Unfortunately, difficulty exists in maintaining the contact between the stem of the anode 44 and the metallic bottom closure 40 after a prolonged period of service. The stem of the zinc anode 44 is subjected to attack and corrosion by the electrolyte and may lose its contact with the bottom closure 40, thereby open-circuiting the cell. Once this occurs the metallic bottom closure 40 will be attacked, and may perforate thereby allowing electrolyte to escape from the cell.

This hazard is avoided, according to the principles of the invention, by mounting a magnesium disc 58 across the bottom of the cell, above the bottom closure 40, such as by soldering it to the stem of the anode 44, to prevent access of electrolyte to the bottom closure 40 and the contact of the anode 44 therewith. Preferably, a magnesium rod or button 60 is also placed on the back side of the stem of the anode 44 to protect it from attack. Likewise, if desired, both the stem of the anode 44 and the bottom closure 40 may be clad with magnesium metal.

To prove the efficacy of the invention, a number of Le Clanche cells were provided with a magnesium cup between the bottom of the anodic container and the metallic bottom closure as illustrated in FIG. 1, and these cells were tested against identical cells which were not provided with magnesium cups and which serve as the control. The cells, some of which were 1 year old and the remainder 2 months old, were placed on a continuous $2\frac{1}{4}$ ohm drain for 24 hours a day, and at the end of each day, the cells which showed any indication of leakage were removed. The table below indicates the percentage of cells which were removed at five day intervals.

Table

Days to Initial Leakage	Percentage of Cells Which Leaked			
	Two Month Old Cell		One Year Old Cell	
	Control	Cell of Invention	Control	Cell of Invention
5.....	0	0	0	0
10.....	20	0	20	20
15.....	20	0	40	30
20.....	70	10	60	40
25.....	70	20	80	50
30.....	80	40	80	50
35.....			100	60

A study of the results tabulated above clearly shows the success of the invention. At the end of 10 days, none of the two month old cells embodying the principles of the invention showed evidence of leakage, while 20 percent of the controlled cells had leaked. On the twentieth day of the test, 70 percent of the control cells had leaked but only 10 percent of the cells of the invention. Even,

after a continuous $2\frac{1}{4}$ ohm drain for a period as long as thirty days, only half as many cells of the invention had leaked when compared to the control cells.

The success of the invention is also illustrated by the one year old cells which are naturally more susceptible to leakage. At the end of twenty days one and a half times as many control cells had leaked as cells embodying the principles of the invention. By the thirty-fifth day of the test, all the control cells had leaked but only 60 percent of the cells of the invention.

I claim:

1. A leak resistant dry cell of the Le Clanche type which is characterized by the inclusion therein of at least one material selected from the group consisting of magnesium, magnesium oxide, and a sodium salt of abietic acid, said material being located between the active elements of said cell and the enclosing members of said cell, whereby said material, which chemically reacts with any exuded material to form an inert, immobile liquid-proof barrier in the path of exudate migration, will obstruct further migration of said exudate and prohibit leakage from said cell.

2. A leak resistant dry cell of the Le Clanche type which comprises a cupped consumable zinc anode container, a carbon cathode embedded in a depolarizer mix of manganese dioxide disposed therein and separated therefrom by a gelled electrolyte comprising ammonium chloride, zinc chloride, and a thickening agent, said cupped container provided with a jacket which at one end has locked thereto a metallic bottom closure plate which underlies and is in electrical contact with the bottom of said cupped container and at the other end a metallic top closure which is electrically insulated from said anodic container by a cardboard disc, said cell being further characterized by the inclusion therein of at least one material selected from the group consisting of magnesium, magnesium oxide, and a sodium salt of abietic acid, said material being located between the active elements of said cell and the enclosing members of said cell, whereby said material, which chemically reacts with any exuded material to form an inert, immobile liquid-proof barrier in the path of exudate migration, will obstruct further migration of said exudate and prohibit leakage from said cell.

3. The leak-resistant dry cell of claim 2 wherein said reactant material comprises a cup of magnesium metal inserted between the bottom of said cupped container and said metallic bottom closure.

4. The leak-resistant dry cell of claim 2 wherein said reactant material comprises a cup of magnesium metal inserted between the bottom of said cupped container and said metallic bottom closure and magnesium oxide powder disposed on said cardboard insulating disc beneath said top closure.

5. The leak-resistant dry cell of claim 2 wherein the inner sides of said top and bottom closures are clad with magnesium.

6. The leak-resistant dry cell of claim 4 wherein said magnesium oxide powder is impregnated in said cardboard disc.

7. The leak-resistant dry cell of claim 4 wherein magnesium is impregnated in said non-metallic jacket.

8. A leak-resistant dry cell of the Le Clanche type which comprises a non-metallic tube, a metal closure for the top of said tube, a carbon cathode lining said tube and making electrical connection with said top closure, an electrolyte-wet depolarizer mix of manganese dioxide substantially filling said tube except for a free space at the bottom of said tube in contact with said cathode, said electrolyte comprising ammonium chloride and zinc chloride, a consumable zinc anode embedded in said mix, and a metal closure for the bottom of said tube, said consumable zinc anode having a stem extending through said free space which is electrically connected to said bottom closure, said cell being further characterized by the inclusion therein of at least one material selected from the group

5

consisting of magnesium, magnesium oxide, and a sodium salt of abietic acid, said material being located across the bottom of said cell above said metallic bottom closure, whereby the access of said electrolyte to said bottom closure and to said electrical contact of said anode stem therewith is prevented by the chemical reaction of said electrolyte and said selected material to form an inert, immobile liquid proof barrier in the path of said electrolyte.

9. The leak-resistant dry cell of claim 8 wherein said selected material is a magnesium disc.

10. The leak-resistant dry cell of claim 9 wherein a magnesium button is attached to the back of said anode stem.

11. The leak-resistant dry cell of claim 8 wherein said

6

anode stem and said metallic bottom closure are clad with magnesium.

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