Oct. 12, 1937. O. E. RUHOFF ET AL 2,095,421

DRY CELL AND METHOD OF PRODUCING SAME

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Fig. 1.

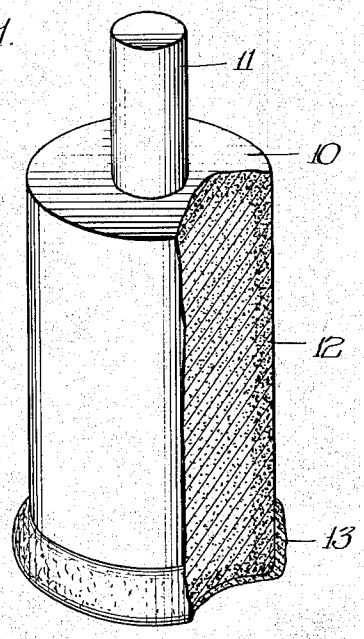
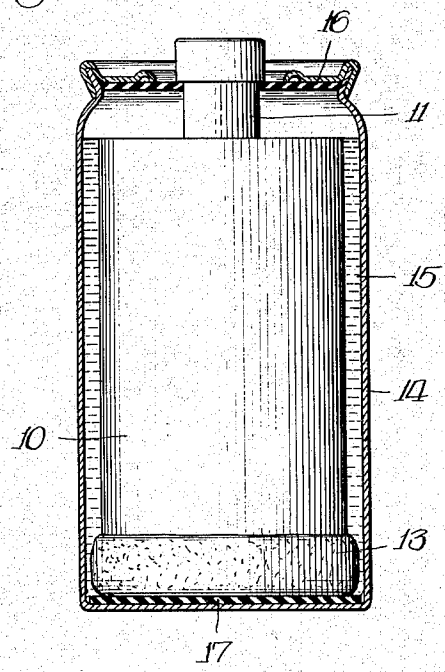


Fig. 2.



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DRY CELL AND METHOD OF PRODUCING SAME

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Application January 23, 1936, Serial No. 60,428

20 Claims. (Cl. 136—124)

This invention relates to improvements in dry cells and their method of manufacture and is applicable to that type of dry cells which have a central core comprising a carbon pencil and a compressed mass of depolarizing material, and in the manufacture of which the core is fabricated as a separate unit and then put into operative association with the zinc can by means of a gelatinous electrolyte surrounding the core and occupying the space between the core and the zinc can.

The depolarizing material of the cores referred to, is usually composed of a mixture of manganese dioxide, carbonaceous material, ammonium chloride, zinc chloride, and water, and such cores are usually formed by preparing the mixture as a damp, fairly cohering mass and then compressing the same around the carbon pencil so that the latter is centrally disposed in the core.

The moldable character of the material enables the formation of good cores by compression but irrespective of how well formed they may be, such cores, nevertheless, are relatively fragile and when inserted into a zinc can, which has a relatively sharp upper edge, portions thereof are likely to fall, or be scraped or broken off. Also there is the further danger of partial disintegration of the core or a washing off of any loosely adhering crumbs or particles when the core is brought into contact with the ungelatinized electrolyte mixture during the period before the electrolyte can be converted to a relatively stiff gelatinous consistency.

The maintenance of the physical form of the core and the prevention of its disintegration after it has been placed in the zinc cup are essential to the production of satisfactory commercial cells, as the scaling off of particles of depolarizing material and the collection thereof adjacent the bottom of the cell between the core and the zinc cup, will cause short circuits in the cell or establish local action therein, either or both of which will entirely destroy the usefulness of the cell as a commercial product, or so materially shorten its life, that it will fall below the standards now demanded for dry cells in use.

In prior commercial practice, it has been customary to maintain the physical form of the core by means of a wrapping of cheese cloth or some similar material. Such cloth or material has been found to be well suited for the purpose as it retains the core particles while at the same time it readily passes the electrolyte mixture so that the latter intimately contacts the core without causing objectionable air films to be formed therebetween. However, cheesecloth and such other materials are relatively expensive and their use adds materially to the cost of the cell particularly as the wrapping operations are both time consuming and costly.

In addition to the above, it has also been customary in commercial practice to provide an insulating washer in the bottom of the zinc can so as to prevent contact between the core, or particles thereof, and the bottom of the can. Such washers are usually formed as disks of waxed paper, or in some cases, specially formed washers designed to have a centering function in the zinc can. Such disks and spacing washers add materially to the cost of dry cells and in addition, require additional assembly steps, for their proper placement in the battery.

In order to reduce the cost of batteries of this type and to simplify the construction and minimize the manufacturing steps, various attempts have been made to eliminate the cheesecloth or other wrappings formerly required for the core and to provide cores with coated or hardened surfaces which are sufficiently hard and durable to withstand the handling to which such cores are subjected during the manufacturing operations. Such cores are known as "unwrapped cores".

One procedure for making batteries having unwrapped cores is described and claimed in the applicants' copending application Serial No. 756,586, filed December 8, 1934. In accordance with said invention, a hardened casing for the core is supplied by the deposition throughout a small region of the surface of the core of an amount of crystallizable substance, such as sal ammoniac which is already present in the core, as a constituent of the depolarizing mixture. Such deposition may be effected in the manner outlined in said copending application with the result that a hardened casing is formed on the core which renders it unnecessary to use cheesecloth or other wrappings for the core.

The present invention is an improvement upon the invention described and claimed in the applicants' copending application above referred to and relates to the provision of means, adapted for use in conjunction with the improvements of said invention, and which enables the elimination of specially constructed centering washers otherwise required between the core and the zinc can to prevent accidental contact therebetween. It is an object of this invention to provide a material which is preferably applied adjacent the bottom portion of the battery core which will provide a spacing and centering means for the core, the

presence of which greatly assist in the ready assembly of the core in the can during the manufacture of the dry cells.

These and other objects not specifically enumerated are contemplated for this invention as will readily appear to one skilled in the art as the following description proceeds. This description can be more readily understood when considered in the light of the accompanying drawing, in which,

Figure 1 is a perspective view of a core made in accordance with the present invention, and which is partially broken away to better disclose the construction thereof, and

Figure 2 is an elevational view in cross section of a completed cell constructed in accordance with the present invention.

By referring to the drawing, it will be noted that the invention is illustrated as embodying a compressed core 10, formed in the customary way in cylindrical form of the usual depolarizing mixture and including an imbedded carbon pencil 11. As disclosed in Figure 1, by the portion broken away, the region 12 adjacent the surface of the core is hardened by means of a recrystallization of a substance contained in the depolarizing mixture, such as sal ammoniac so that the surface region of the core is relatively hard and resistant in the manner described and claimed in applicants' copending application above referred to.

This hard and resistant outer surface region renders the core capable of use without being wrapped and without suffering the likelihood of damage heretofore common in the manufacture of cells of this type. As pointed out in said copending application, the cores may be formed in various ways but by way of example, after being tamped and cleaned, may next be heated by passing the same through a heated oven or other suitable means for drying out the surface region thereof. The drying or baking is satisfactorily accomplished when conducted in a five foot electrically-heated oven through which the cores are passed in an upright position on a conveyor formed of heavily enameled wire screen pieces which may be attached by special links occurring at intervals of approximately one foot.

With this construction the heat may be supplied by hot air from below the screen sections of the conveyor so that the hot air will rise and in so doing, will come in intimate contact with the cores. The speed of the conveyor may be adjusted at a desired rate to cause the cores to remain in the oven for approximately five minutes and the heat of the oven may be adjusted for this heating period to approximately 350 degrees F.

The above practice provides for the outer hardened surface as above described in said copending application and said practice shall be modified as hereinafter indicated in the following invention.

A mixture of a strong solution of sal ammoniac at or near its boiling point and a quantity of wood flour is prepared. This is preferably provided in such form that the wood flour is maintained in suspension in the hot sal ammoniac solution. As a preferred formula the following quantities may be employed:

Water	5 quarts
Sal ammoniac	5 pounds
Wood flour	1 pound

The wood flour may be of any suitable degree of fineness, although good results are obtained when wood flour subdivided to 80 mesh is employed. It is to be understood however, that applicants do not wish to be limited to wood flour of any particular mesh as obviously other degrees of subdivision will also serve well.

In accordance with this invention, after the cores are tamped and cleaned in accordance with the practice of applicants' invention described in their copending application, and before they are dried or heat treated, they are dipped in the above described mixture so as to apply a substantial quantity of said mixture adjacent the bottom portion thereof in a manner illustrated at 13, in the accompanying drawing. This invention is not to be limited however, to the application of this material by dipping as it may be applied by spraying or any other suitable method.

Furthermore, the applicants do not wish to be limited in regard to the extensiveness of the applied material throughout the height of the core as obviously variations in this regard may be practiced according to the results desired.

The cores so treated are next subjected to a drying operation already described in connection with the practice of the applicants' invention of said copending application. In this case however, the cores are preferably inverted so as to prevent the moist coating material from running down and collecting in beads or globules at any point on the core. It has been found when subjected to a drying operation as hereinabove described, namely, for approximately five minutes, at substantially 350 degrees F. that not only is a hardened casing formed on the body of the core, but that the insulating and centering ring on the bottom thereof becomes sufficiently hard and dry to enable the core to be placed directly within the cans without further precaution or care.

It will be noted that it is preferable to have the coating mixture of such a consistency as to enable the production on the core of a rather substantial ring of coating material somewhat in the manner illustrated at 13 in the accompanying drawing. This ring, in addition to its insulating function, thus serves as a centering means by which the cores are maintained in a more or less central position within the can 14 with the avoidance of all liability of the sides of the core touching the inside surface of the can. Accordingly, this feature eliminates the necessity for special centering means of the type usually employed with unwrapped cores. As a result the assembling operation can be quickly and effectively accomplished without the expense of additional centering means and without the delay and expense of bothering with any special devices for centering the core. In operation, it is only necessary to drop an ordinary insulating disk washer 17 in the bottom of the can and then place the core within the can. With the insulating ring at the bottom of the core, proper centering of the core automatically results. The washer 17 can be of slightly less diameter than the can so as to readily assume a flat position on the bottom of the can. In actual practice the mixture which is saturated with sal ammoniac is kept mildly agitated at about its boiling point. Then the cores are preferably dipped to a depth of between one-sixteenth to one-eighth of an inch for the ordinary small size cores.

As above described, the drying or baking treatment is carried out the same as described in applicants' copending application except that the cores are inverted so as to prevent the gathering of the coating material in drops or small lumps at any point on the core. The cores, as with-

drawn from the dipping mixture, immediately show a white ring of the coating material which is due to the fact that the coating mixtures are immediately chilled on exposure to the air which causes a large part of the sal ammoniac to precipitate out of solution. It is found in practice that a portion of the sal ammoniac solution penetrates into the core material whereby the ring and the base thereof adhere very firmly to the core material. As a result, the cores can be handled rapidly and without the need of extreme care in the further steps of manufacturing and assembling the batteries. This feature is extremely important in high speed commercial production required for manufacture at a minimum cost.

It is to be understood that other materials may be used in addition to wood flour, such as any finely divided inactive non-conductive material which does not gelatinize at the temperatures to which the cores are exposed and which also may be easily kept in suspension in the solution.

Furthermore this inventon contemplates the addition to the dipping mixture of approximately one or two per cent of a material such as starch or flour which possess the function of thickening the mixture to some extent, in order that the wood flour may more readily remain in suspension. It is to be understood, however, that it may be desirable to vary the proportions of the several materials over a considerable range, depending upon the consistency of the core material and other factors involved.

Furthermore, the salt ingredient of the solution is not to be restricted entirely to sal ammoniac, as other chemicals may be used in conjunction with sal ammoniac such as other salts commonly used in batteries.

Whereas, in assembling the cores, it is not always essential to use any centering means it may be desirable in certain instances, to use a temporary centering device at the top of the core such as the device shown and illustrated in applicants' copending application above referred to. If such a device is used, however, it may be used with a looser fit with perfect safety than would otherwise be desirable.

As shown in the drawing, the cells of this invention are completed by adding electrolyte **15**, which occupies the space between the core **10** and the can **14**, and thereafter closing the cell by means of any suitable closure **16**.

We claim:

1. The method of producing cores for dry cells which comprises providing a depolarizing mixture having therein a substance which acts electro-chemically as an ingredient of said mixture and which is water-soluble and capable of being deposited from solution to exert a hardening and toughening effect upon the particles of said depolarizing mixture, rendering said mixture moldable by the addition of water, forming said core, applying to the bottom of said core a protective ring of a strong solution of said electro-chemically active substance and wood flour, and thereafter causing evaporation of the water in said core and said protective ring to an extent which causes deposition of said electro-chemically active substance contained in said core and said protective ring in amount sufficient to provide a relatively hard and tough casing for said core and said protective ring consisting of said electro-chemically active substance.

2. The method of producing cores for dry cells which comprises providing a depolarizing mixture having therein a substance which acts electro-chemically as an ingredient of said mixture and which is water-soluble and capable of being deposited from solution to exert a hardening and toughening effect upon the particles of said depolarizing mixture, rendering said mixture moldable by the addition of water, forming said core, applying to the bottom of said core a protective ring of a strong solution of said electro-chemically active substance and wood flour, and thereafter subjecting said core and said protective ring to a drying action whereby a portion of said electro-chemically active substance is deposited in amount sufficient to provide a relatively hard and tough casing for said core and said protective ring consisting of said electro-chemically active substance.

3. The method of producing cores for dry cells which comprises providing a depolarizing mixture having therein a substance which acts electro-chemically as an ingredient of said mixture and which is water-soluble and capable of being deposited from solution to exert a hardening and toughening effect upon the particles of said depolarizing mixture, rendering said mixture moldable by the addition of water, forming said core, applying to the bottom of said core, a protective ring of a strong solution of said electro-chemically active substance and wood flour, and thereafter subjecting said core and protective ring to a heating action for drying said core and said protective ring to deposit a portion of said electro-chemically active substance from solution throughout the outer regions of said core and said protective ring so that said electro-chemically active substance as deposited provides a relatively hard and tough casing for said core and protective ring consisting of said electro-chemically active substance.

4. The method of producing cores for dry cells which comprises a depolarizing mixture having a quantity of sal ammoniac therein, rendering said mixture moldable by the addition of water, forming said core, applying to the bottom of said core a protective ring of a strong solution of sal ammoniac and wood flour and thereafter causing evaporation of the water in said core and protective ring to an extent which causes deposition of said sal ammoniac contained in said core and said protective ring in amount sufficient to provide a relatively hard and tough casing for said core and protective ring consisting of said sal ammoniac.

5. The method of producing cores for dry cells which comprises providing a depolarizing mixture having therein a quantity of sal ammoniac, rendering said mixture moldable by the addition of water, forming said core, applying to the bottom of said core a protective ring of a strong solution of sal ammoniac and wood flour, and thereafter subjecting said core and said protective ring to a drying action whereby a portion of said sal ammoniac contained in said core and said protective ring is deposited in amount sufficient to provide a relatively hard and tough casing for said core and protective ring consisting of sal ammoniac.

6. The method of producing cores for dry cells which comprises providing a depolarizing mixture having a quantity of sal ammoniac therein, rendering said mixture moldable by the addition of water, forming said core, applying to the bottom of said core a protective ring of a strong solution of sal ammoniac and wood flour, and thereafter

subjecting said core and protective ring to a heating action for drying said core and protective ring to deposit a portion of said sal ammoniac from solution throughout the outer regions of said core and said protective ring so that said sal ammoniac as deposited provides a relatively hard and tough casing for said core and said protective ring consisting of said sal ammoniac.

7. The method of producing cores for dry cells which comprises providing a depolarizing mixture having a quantity of sal ammoniac therein, rendering said mixture moldable by the addition of water, forming said core, applying at the bottom of said core a protective ring formed from a mixture of a strong solution of sal ammoniac at or near its boiling point and a quantity of wood flour, thereafter cooling and drying said mixture so as to deposit from solution a portion of said sal ammoniac to form on the surface of said protective ring a hard and tough casing consisting of sal ammoniac.

8. The method of producing cores for dry cells which consists of forming a core of depolarizing mixture, applying to the bottom thereof a protective ring comprising a mixture of wood flour and a strong solution of a substance which acts electro-chemically as an ingredient of the mixture of said core and which is water-soluble and capable of being deposited from solution to exert a hardening and toughening effect, thereafter causing evaporation of the water in said protective ring to an extent which causes deposition of said electro-chemically acted substance in said protective ring in amount sufficient to provide a relatively hard and tough casing for said protective ring consisting of said electro-chemically acted substance.

9. The method of producing cores for dry cells which comprises forming a core of a depolarizing mixture, applying to the bottom of said core a protective ring comprising a mixture of wood flour and a strong solution of sal ammoniac, thereafter causing evaporation of the water in said protective ring to an extent which causes deposition of said sal ammoniac contained in said protective ring in an amount sufficient to provide a relatively hard and tough casing for said protective ring consisting of said sal ammoniac.

10. A core for dry cells of the type herein described adapted to be used without a wrapper thereon made in accordance with the process defined in claim 1.

11. A core for dry cells of the type herein described adapted to be used without a wrapper thereon made in accordance with the process defined in claim 4.

12. A core for dry cells of the type herein described adapted to be used without a wrapper thereon made in accordance with the process defined in claim 7.

13. A core for dry cells of the type herein described adapted to be used without a wrapper thereon made in accordance with the process defined in claim 8.

14. A core for dry cells of the type herein described adapted to be used without a wrapper thereon made in accordance with the process defined in claim 9.

15. A dry cell of the type herein described comprising a zinc can and a gelatinized electrolyte, and an unwrapped core made in accordance with the process defined in claim 1.

16. A dry cell of the type herein described comprising a zinc can and a gelatinized electrolyte, and an upwrapped core made in accordance with the process defined in claim 4.

17. A dry cell of the type herein described comprising a zinc can and a gelatinized electrolyte, and an unwrapped core made in accordance with the process defined in claim 7.

18. A dry cell of the type herein described comprising a zinc can and a gelatinized electrolyte, and an unwrapped core made in accordance with the process defined in claim 8.

19. A dry cell of the type herein described comprising a zinc can and a gelatinized electrolyte, and an unwrapped core made in accordance with the process defined in claim 9.

20. The process of producing dry cells which consists in forming a core by molding a mass of a depolarizing mixture which includes in its composition a quantity of sal ammoniac, applying to the bottom of said core a protective ring of a strong solution of sal ammoniac and wood flour, causing a portion of the sal ammoniac to be taken into solution and thereafter causing a portion thereof throughout the region of the surface of said core and said protective ring to be deposited by the evaporation of moisture in amount sufficient to provide a relatively hard and tough casing for said core and protective ring, consisting of said sal ammoniac, thereafter placing a liquid gelatinizable electrolyte in a zinc can, placing said core and protective ring in an upwrapped condition centrally in said can and maintaining the core so positioned while gelatinizing the electrolyte under the influence of heat and finally sealing the top of the can to form a completed cell.

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CERTIFICATE OF CORRECTION.

Patent No. 2,095,421. October 12, 1937.

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It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 4, second column, lines 19 and 48, claims 16 and 20 respectively, for "upwrapped" read unwrapped; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 23rd day of November, A. D. 1937.

Henry Van Arsdale,
Acting Commissioner of Patents.

(Seal)