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E. MARHENKEL  
PRODUCTION OF GALVANIC DRY CELLS  
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Fig. 1

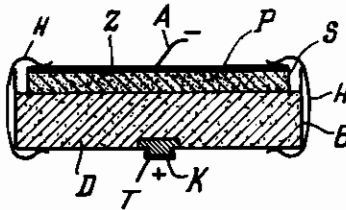


Fig. 2

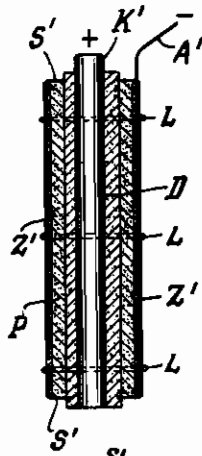
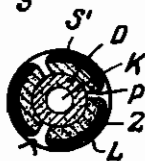


Fig. 3



INVENTOR  
Erich Marhenkel  
By Wm. S. Pritchard  
attorney.

# ALIEN PROPERTY CUSTODIAN

## PRODUCTION OF GALVANIC DRY CELLS

Erich Marhenkel, Berlin-Tegel, Germany; vested  
in the Alien Property Custodian

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This invention relates to certain improvements in the production of galvanic dry cells of the type having an electrode which is in contact with an electrolyte containing a swelling agent, and a depolarisation counter-electrode. For the sake of simplicity, the first mentioned electrode will be hereinafter referred to as the "zinc-electrode", and the counter-electrode will be hereinafter referred to as the "carbon" or "depolarisation electrode", although I wish it to be understood that other suitable electrode materials may be used in place of zinc and carbon.

According to the invention, the zinc electrode is separately covered with the electrolytic paste, and the depolarisation electrode is also made separately, the two electrodes then being pressed together and maintained in their compressed position. The compression of the electrolytic paste with the depolarisation electrode is required in order to attain an intimate contact over the whole surface of this electrode. Before being assembled with the finished depolarisation electrode the zinc electrode is covered with one or more layers of the electrolyte which contains the swelling materials and has been applied to the zinc electrode in the required composition and quantity. This layer, or layers, are so composed that their outer surface (i. e. the boundary layer between the electrolyte paste and the depolarisation electrode) before assemblage of the electrodes is capable of withstanding a pressure of at least 160 grams per square centimeter, and when exposed to this pressure in contact with an absorbing layer of the type represented by the depolarisation electrode owing to its capillary forces does not yield more than 5 cubic millimeters of liquid per 1 square centimeter of its exterior surface or boundary layer.

An electrolyte mass or paste of this kind can be made in various manners. For instance, the electrolyte liquid may be provided with a proportion of a swollen swelling agent in excess of that required for binding the electrolyte. If, for example, native starch, or substances containing native starch, or other substances requiring an additional treatment in order to be transformed into a swelling form are used, the electrolyte mass is heated to a degree, or left untouched for a length of time which is sufficient to cause swelling of the swelling agents. Where native starch is used, the same is preferably subjected to a temperature of about 60 to 80° C in order to be converted into swelling starch.

Suitable swelling substances are, for instance, native starch or products containing native starch, alkyl cellulose ether, tragacanth, agar-

agar, swelling cellulose, polymeric vinyl alcohol, inorganic adsorbents, such as, kieseguhr, silicic acid gel, pumice stone powder, or mixtures thereof.

5 It is also contemplated, in accordance with the present invention, that fibrous materials, such as, cut wadding or short fibres, such as, staple fibre, may also be added to the electrolyte, in order to solidify the electrolyte paste.

10 It is old to use as an electrolyte-carrier paper substances withstanding the loosening tendency exerted by the depolarisation electrode, but paper on being subjected to pressure readily yields the absorbed liquid; moreover, elements using paper carriers have a relatively high internal electric resistance, since the electrolytic conduction is established only through the pores of the paper which are filled with the electrolyte liquid.

15 According to another known method the electrolyte is entered into the element in its original non-thickened condition. In order to be able to pour the electrolyte into the element in one batch, a film of the swelling substance, e. g., the starch, is applied to the zinc electrode and the electrolyte is filled into the empty space remain-  
20 ing between this film and the depolarisation electrode. According to another known method the zinc cup after insertion of insulating disks on its bottom is filled with a swelling substance, for  
25 instance flour dough, and placed into boiling water for swelling the starch. On removal of the zinc cup from the water bath the flour paste not adhering to the zinc mantle is poured out and the depolarisation electrode is inserted in such a  
30 manner that between the flour film and the depolarisation electrode a free space is left which is filled with the electrolyte containing flour. The cell is now again placed into boiling water to swell the starch that has been filled in. The second boiling operation may be omitted if suitable  
35 thickening agents are added to the paste.

I have found that in dry cells made in accordance with the present invention the electrolyte paste or liquid separated therefrom can be  
40 effectively prevented from penetrating the air channels of the depolarisation electrode and rendering the parts concerned of the inner depolarisation surface ineffective by obstruction of said air channels. This desirable effect is not attained in the two methods last mentioned, since  
45 in these methods electrolyte liquid which has not yet thickened comes into contact with the depolarisation electrode.

Furthermore, it will be noted that an electrolyte in the form of a soft paste as it was com-

mercially used so far, is unable to resist effectively to the tendency by the depolarisation electrode of becoming loose by itself, as a result of the formation of chemical reaction products during the discharge of the element.

#### Examples

*Example 1.*—30 grams of ammonium chloride, and 10 grams of zinc chloride (water-free) are dissolved in 100 grams of water. 40 grams of wheat flour are admixed to 100 cubic centimeters of this solution. This mass constituting the electrolyte containing the swelling agent is applied to the zinc electrode in a layer having a thickness of 3 millimeters, and heated to 70 to 80° C for about 3 minutes to convert the flour into the gel state. The depolarisation electrode and the zinc electrode are then assembled to form the complete element.

*Example 2.*—30 grams of ammonium chloride, 15 grams of zinc chloride (water-free), and 5 grams of calcium chloride (water-free) are dissolved in 100 grams of water. 30 grams of tragacanth powder and 7.5 grams of pumice stone powder are admixed to 100 ccm of this solution and the mass is applied on the zinc electrode in a layer having a thickness of 3 millimeters. The zinc electrode thus provided with the electrolyte layer is then let stand for a period of 12 to 15 hours. The depolarisation electrode and the zinc electrode are then combined to form the element.

*Example 3.*—32 grams of wheat flour and 5 grams of cotton wadding are finely distributed in 100 cubic centimeters of a solution of magnesium chloride having a concentration of 30° Baumé. This mass is applied to the zinc electrode in a layer having a thickness of 3 millimeters and the zinc electrode thus provided with the electrolyte is then allowed to stand for a period of 24 hours. The starch of the wheat flour is converted into swelling starch by the magnesium chloride. The depolarisation electrode and the zinc electrode are then assembled to form the element, in the manner hereinafter described in connection with the drawings.

*Example 4.*—25 grams of ammonium chloride and 5 grams of calcium chloride (water-free) are dissolved in 100 grams of water and 35 grams of swelling starch are added to 100 cubic centimeters of this solution. This mass is applied to the zinc electrode in a layer of a thickness of 3 millimeters and the zinc electrode is then let stand for 10 hours, whereupon the zinc electrode and the depolarisation electrode are assembled to form the complete element.

The advantages offered by the electrolytic paste in accordance with the present invention become apparent with elements in which the depolarisation is effected by air, and with other elements with surface depolarisation. Furthermore, this electrolyte paste offers advantages where the element is fitted with a depolarisation electrode whose inner structure must not be altered by yielding or absorbing electrolyte liquid, or by loosening.

The output of dry cells, more particularly, of cells with surface depolarisation, can be further enhanced by bringing pressure to bear on the electrolyte layer of the zinc electrode during the discharge of the element, for forcing the electrolyte paste into contact with the deeper-seated layers of the depolarizer which are still effective. The pressure of the electrolyte paste is produced as a result of the fact that the volume of the electrolyte is growing during the discharge, the

electrolyte being liquefied by the formation of zinc chloride at the boundary layers between the zinc and the electrolyte. In order to cause the pressure due to the expansion of the electrolyte to become effective in the direction of the depolarisation mass, a seal is provided for the electrolyte at this point, this seal being liquid-tight, pressureproof and sufficiently resistant to the chemicals of the electrolyte.

According to an important feature of the present invention, such a seal is produced in this manner that the electrolyte paste is filled into a separate container, preferably in the form of a shallow disk or cup, which is filled approximately to its rim and then with its rim is fixedly pressed upon the depolarizer mass and secured in this position. The container may consist of any insulating material, e. g., synthetic resin, which is not liable to be substantially attacked chemically by the electrolyte or by the reaction products produced during the discharge of the element. The zinc electrode is accommodated in this container. Where the container does not consist of insulating material, but is formed, for instance, by the zinc electrode proper, the rim of the container according to the invention is protected against electric contact and short circuit with the depolarizer layer by means of a non-conductive separating layer. To this end, for instance, a narrow strip of strong paper may be arranged between the zinc edge and the depolarizer layer, but preferably the rim of the container and the adjacent portions thereof are provided with an insulating coating of insulating lacquer or varnish, paraffine paper, collodion, compound mass or any other suitable material. According to a further modification the zinc electrode may be forced over the upper or lower rim of a ring of synthetic resin and tightly turned over.

The invention will be better understood by reference to the following detailed description in connection with the accompanying drawing showing by way of example and purely schematically two embodiments of the invention and in which:

Fig. 1 is an axial section through a dry cell having the invention applied thereto.

Fig. 2 is an axial section showing a modified form, and

Fig. 3 is a cross section of Fig. 2.

Similar characters of reference denote similar parts in the different figures.

Referring now to the drawing in greater detail, and first to Fig. 1, it will be seen that an outer cup or container B of insulating material has incorporated in its bottom wall a carbon electrode K which with a projection of reduced diameter extends through said bottom wall, the terminal T being in the form of a cap forced upon said projection, as usual. The container B is filled with the depolarizer mass D which has been pressed into the same. Another shallow container S of insulating material accommodates a zinc electrode Z engaging the bottom thereof, and the electrolyte paste P. A terminal wire A is soldered to the zinc electrode and passed through the bottom wall of the container S. The interior container S is firmly engaged with the depolariser mass, in such a manner that its rim is impressed into the mass, and secured in this position by means of clamps H, or other suitable means, such as, lacing, cementing, or the like. In case of cementing, the interior container S is advantageously so dimensioned that

it fits into the outer container with a slight clearance only for entering the cement.

During the discharge of the element the electrolyte paste P is liquefied only in the interior of the container S, at the boundary layer between the electrolyte paste P and the zinc plate Z, while the non-diluted paste P owing to the expansion pressure produced as a result of its growing volume is forced to penetrate the depolarisator mass. This process is promoted by the fact that contemporaneously therewith at the portions of the mass D facing the zinc electrode, through dissolution of ammonium chloride crystals or other combinations, pores have been formed which can be filled up by the expanding electrolyte paste.

It will thus be seen that there is no chance for the paste P to escape through between the containers S and B, the more so as the depolarisator mass D is compressed additionally under the edges of the container S. Another advantage resides in the fact that the portion of the depolarisator surface not covered by the interior container S may serve for ventilating the depolarisator mass.

Referring now to the embodiment shown in Figs. 2 and 3, it will be seen that a central carbon rod K' is surrounded by the depolarisator mass D which need not be encased, while three sector-shaped shells S' containing the zinc electrodes Z' and the electrolyte paste P are held in tight engagement with the depolarisator mass D by means of laces L, by cementing, or by any other suitable means. Three terminal wires A' constitute the negative pole.

Where a plurality of flat elements are piled up in a series arrangement, it is not necessary for the interior shell of each element to be secured in position by clamps or similar means, but it will

be sufficient to combine the assembled elements in the form of a block, for instance, by lacing, binding wire, and thus to fix the inner cups or shells.

The provision according to the present invention of a separate cup or shell for the electrolyte offers the advantage that the electrolyte paste can be poured into this shell for solidification and thus does not come into contact with the depolarisator mass in its soft state. Hitherto, on the contrary, the electrolyte was filled into the element in a non-thickened condition, with the result that the depolarisator layer already after a short time was extensively impregnated by the electrolyte. According to an important feature of the present invention, on the contrary, the electrolyte liquid admixed with thickening agents can be poured into the container provided therefor, and then converted into the gel state.

In order to produce elements of the atmospheric oxygen type the depolarisator electrode may contain active carbon and/or other oxygenous matter, such as, indigo white, cerium salts and the like. The advantages mentioned above of increased efficiency by encasing the electrolyte will always become apparent with surface depolarisation, also, for example, where depolarising agents like perborates or persulfates, such as, ammonium persulphate, or chlorides, such as, ferrichloride, are used.

The method and product of the present invention have been described in detail with reference to specific embodiments. It is to be understood, however, that the invention is not limited by such specific reference but is broader in scope and capable of other embodiments than those specifically described and illustrated in the drawing.

ERICH MARHENKEL.