

GOVERNMENT OF INDIA : THE PATENT OFFICE, 214, LOWER CIRCULAR ROAD, CALCUTTA-17.

Specification No. 99033, Application No. 99033, dated 17th April, 1965. Complete specification left on 17th January, 1966. (Application accepted 12th January, 1967.)

Index at acceptance—14B + D2[LVIII(1)].

PROVISIONAL SPECIFICATION.

IMPROVEMENTS IN OR RELATING TO ANODE MOUNTING FOR HIGH PERFORMANCE CELLS.

COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH, RAJF MARG, NEW DELHI-1, INDIA, AN INDIAN REGISTERED BODY INCORPORATED UNDER THE REGISTRATION OF SOCIETIES ACT (ACT XXI OF 1860).

The following specification describes the nature of this invention.

THIS AN INVENTION BY DR. MICHAEL ANGELO VINCENT DEVANATHAN (CITIZEN OF CEYLON), SCIENTIST, CENTRAL ELECTROCHEMICAL RESEARCH INSTITUTE, KARAIKUDI-3 (MADRAS STATE). SHRI NARAYANAN RAMASAMY (CITIZEN OF INDIA), SENIOR SCIENTIFIC ASSISTANT, CENTRAL ELECTROCHEMICAL RESEARCH INSTITUTE, KARAIKUDI-3 (MADRAS STATE), SHRI SRINIVASAN VENKATESAN, (CITIZEN OF INDIA), SENIOR LABORATORY ASSISTANT, CENTRAL ELECTROCHEMICAL RESEARCH INSTITUTE, KARAIKUDI-3 (MADRAS STATE).

This invention relates to improvements in or relating to ANODE MOUNTING FOR HIGH PERFORMANCE CELLS.

Hitherto it has been proposed to use the anode material like zinc in a pressed powder form or paper mounted with amalgamated powdered anode material with a suitable binder or homogenous gelled anode. These were used as anodes in high performance cells like the alkaline manganese dioxide cell and the mercuric oxide cell. Mesh size of the anode metal was carefully controlled as also the amalgamation to ensure high utilisation of the anode.

These methods are open to the objections that

1. A very careful controlling of mesh size and amalgamation of the anode is needed.

2. In the forms like the pressed powder anode, electrolyte is not available at the place where it is most needed, but stored in the electrolyte reservoir-cum separator. This leads to lower rate of utilisation of the anode material.

3. In the gelled anode type, a very careful control of conditions of gelation is needed to ensure proper gel consistency and optimum performance without passivation.

4. In the anode mounted on paper, special methods are to be employed and the anodic dissolution does not start simultaneously at all the grains of the anode. This leads to passivation of the first few layers of the anode resulting in an ohmic drop as the reaction proceeds.

The object of this invention is to obviate these disadvantages by using amalgamated anode metal powder mixed with an inert filler in proportions ranging between 2 to 25 per cent. by weight as the anode in high performance cells.

To these ends the invention broadly consists in using the anode metal powder like zinc amalgamated by a proper method such as the one described below. This is mixed with suitable fillers like starch and cellulose which are capable of absorbing the electrolyte. Inhibitors like chromate may be added in the electrolyte and the anode mixture is allowed to soak *in situ* after assembly of the cell.

The following typical examples are given to illustrate the invention:

EXAMPLE 1.

The amalgamation is done by any of the normal processes or by adding small amounts of mercuric oxide to a well stirred suspension of the anode powder in strong sulphuric acid till there are no gas bubbles observed on the zinc.

EXAMPLE 2.

The amalgamated metal powder is mixed with ordinarily available inert absorbing filler like cellulose in proper portions to ensure maximum intake and conductance.

EXAMPLE 3.

The mixture may be put in the dry state in the cell and is allowed to soak completely and gellify by adding the electrolyte which may be alkaline as in alkaline cells.

The following are among the advantages of the invention:

1. *Ease of production*: This method of powder mounting is very simple and effective. It avoids the necessity of using binders as in paper mounted with zinc or control of conditions like temperature, concentration as in the case of gelled anode.

2. *Universal applicability*: This method is very versatile and can be applied usefully in any high performance primary cell, alkaline or otherwise, and is independent of the cell geometry. That is, it can be used equally well for 'cathodic envelope' as well as 'Central Cathodic Type Cells' and also in button type cells.

3. *Absence of passivation*: The electrolyte is available at the point where it is most needed, i.e., at the metal powder. As a result of this type of mounting, the entire volume of the zinc reacts simultaneously leading to very low current density which retards passivation sufficiently to ensure maximum utilisation.

4. *Discharge characteristics*: Owing to the entire anode material being effective simultaneously, the actual current density is sufficiently low as to give a much flatter discharge characteristics, e.g., in a mercuric oxide cell employing such an anode, the voltage drop during continuous discharge never exceeds 100 mv. as against the normal drop from 1.23 v. to 0.96 v. in conventional cells.

5. *Higher power*: As a result of the above advantages, the cells show a lower *iR* drop on load leading to higher operating voltage. Thus more power is obtained from cells using this type of anode mounting.

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Dated this 2nd day of April 1965.

COMPLETE SPECIFICATION.

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The following specification particularly describes and ascertains the nature of this invention and the manner in which it is to be performed.

This invention relates to improvements in or relating to ANODE MOUNTING FOR HIGH PERFORMANCE CELLS.

Hitherto it has been customary to use powdered anode material in the pressed powder or paper mounted form for use in alkaline primary cells of the high per-

Price: TWO RUPEES.

formance type, i.e., HgO alkaline MnO₂ cells. This suffers from the disadvantage that (a) the entire area of the anode material is not effective simultaneously in the case of pellet anode, (b) the mounting process to be carefully controlled.

This invention obviates these disadvantages by using amalgamated anode metal powder, viz. zinc of high purity with a filler that is non-reactive and suitable binder and pressing it on to a conducting matrix of wire gauze or nickel plated perforated mild steel sheet or tinned mild steel gauze or any type of matrix base.

It has been proposed before to use paper or cellulose material as substrate for zinc mounting and to use the container, also of zinc, as current collector.

According to the invented method of anode mounting of zinc for use in alkaline cells by mounting zinc on to a substrate, amalgamated anode metal powder, viz., zinc of high purity is used and the substrate consists of a conducting flexible metallic matrix which serves as current collector also. Thus, the anode is made by mounting the amalgamated zinc anode material or to the conducting flexible metallic matrix, matrix.

The amalgamation is solution phase. Zinc powder of high purity with a non-reactive filler and a binder is pressed on to a metallic matrix of galvanised iron wire gauze or tinned mild steel gauze or treated mild steel substrate.

The anode may be used in alkaline cells of the high drain type. It can be employed for layer type H. T. sources construction of alkaline cells.

The following points illustrate the process :

1. The powdered anode material of high purity, e.g., zinc or manganese flakes, is amalgamated in a controlled way.

2. The amalgamated zinc powder is mixed with 2-per cent. by weight of an inert filler like cellulose or sodium carboxymethyl cellulose or any other filler that is not attacked by alkali.

3. This powder mix is pressed on to a matrix electrode. Alternately sufficient water is added to the mixture so that it is converted to a thick suspension and the paper is soaked in it and dried between 50 to 60° C.

This powder mounted or metal substrate mounted anode is used with any cathode material in alkaline medium.

The following points briefly describe the process :

1. Amalgamation of the powder is carefully controlled in an easy way as follows: The powdered zinc anode of high purity is mixed with 1 to 10 per cent. by weight of mercuric oxide and kept suspended in water. Concentrated sulphuric acid is added in small quantities. The suspension is stirred till the vigorous gasing subsides due to amalgamation. The suspension is allowed to settle, filtered, washed and dried at room temperature. Alternatively, the amalgamation can be carried out in the usual way by treating with a mercury salt with zinc.

2. The amalgamated zinc powder is mixed with 2-25 per cent. by weight of an inert absorbent filler like cellulose or methyl cellulose and small amount (2-10 per cent.) of a sugar like glucose. The mixture is ground and sufficient quantity of water is added to get the required consistency, for making either the matrix supported anode or the pressed powder anode.

3. If a paper mounted anode is needed, the required length of the paper which is of the absorbing type is soaked in a thick suspension of the above mix and allowed to dry between 20-80° C. This gives a flexible adherent zinc powder on the paper.

4. If powder pressed on to a metal grid or matrix is needed, the powder mixed with water is strewed on the matrix or gauze and pressed in a hydraulic press.

The following are among the advantages of the invention :

1. The amalgamation is simplified and degree of amalgamation can be controlled readily.

2. Due to the presence of the absorbent non-reactive filler, these anodes suitably treated in a cell are preferable to other types made by conventional means as the electrolyte reservoir is always available in the zinc anode mix itself. So a separate reservoir for electrolyte is avoided.

3. In the case of powder mounted anodes, they are very flexible; at the same time the zinc deposit also is adherent. This can be folded or rolled and hence they are most suited for pencil type cells.

4. In the metal grid or matrix or gauze mounted anodes, the substrate acts as a good mechanical support as well as an electronic conductor to carry the current from the reaction centre, namely the zinc anode. This type of construction of the anode facilitates the fabrication of flat and layer type cells of the high performance type. These are necessary for dry cells for H.T. use.

Noteworthy features.

1. The invention provides a simple method for controlled amalgamation of the anode material and making of the anode for use in high performance cells.

2. Such powder mounted anodes can be used in conjunction with any cathodic depolariser like HgO, MnO₂, CuO, Pb₂ in alkaline medium.

3. The metal matrix supported anodes are ideally suited for the fabrication of flat or layer type mercuric oxide or manganese dioxide cells.

4. The above type of fabrication simplifies the assembly procedure and such flat cells can be used for the construction of H. T. sources.

We claim :

1. A method of anode mounting of zinc for use in alkaline cells by mounting zinc on to a substrate wherein amalgamated anode metal powder, viz. zinc of high purity is used and wherein the substrate consists of a conducting flexible metallic matrix which serves as current collector also.

2. A method as claimed in Claim 1 wherein the anode is made by mounting the amalgamated zinc anode material on to the conducting flexible metallic matrix.

3. A method as claimed in Claim 1 or 2 wherein the amalgamation is solution phase.

4. A method as claimed in any of the preceding claims wherein zinc powder of high purity with a non-reactive filler and a binder is pressed on to a metallic matrix of galvanised iron wire gauze or tinned mild steel gauze or treated mild steel substrate.

5. A method as claimed in any of the preceding claims wherein the anode is used in alkaline cells of the high drain type.

6. A method as claimed in any of the preceding claims when employed for layer type H. T. sources construction of alkaline cells.

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Dated this 13th day of January 1966.