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

Specification No. 98158. Application No. 98158, dated 27th February 1965. Complete specification left on 22nd November 1965. (Application accepted 25th November 1966.)

Index at acceptance—14D2 [LVIII(1)].

IMPROVEMENTS IN OR RELATING TO ALKALINE MANGANESE DIOXIDE WET CELLS.

PROVISIONAL SPECIFICATION.

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

THIS IS 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) AND SHRI SRINIVASAN VENKATESAN (CITIZEN OF INDIA), SENIOR LABORATORY ASSISTANT, CENTRAL ELECTROCHEMICAL RESEARCH INSTITUTE, KARAIKUDI-3 (MADRAS STATE).

The following specification describes the nature of this invention.

This invention relates to improvements in or relating to Alkaline Manganese Dioxide Wet Cells.

Hitherto it has been proposed to use Lechlanche type wet cells with ammonium chloride/zinc chloride solution as electrolyte and manganese dioxide/carbon/ammonium chloride cathode sack element and zinc anode.

This is open to the objection that the efficiency of utilisation of the active material is very low. The cathode has to be cleaned from time to time to remove the crust of crystalline material and the process of cathode making is very involved. Chemical or high grade ores only can be used for depolarisation.

The object of this invention is to obviate these disadvantages by using alkaline solution as electrolyte and a cathode which may be of the normal type or specially designed as described below and zinc anode.

To these ends, the invention broadly consists in :

1. using alkaline solution as electrolyte ;

2. making the cathode element by mixing the variety of powdered depolariser manganese dioxide with a conducting variety of carbon and a suitable binder and pressing in specially designed conducting matrix.

The following typical examples are given to illustrate the invention :

1. The electrolyte used is the hydroxides of alkali and/or alkaline earth metals.

2. The cathode is a mixture of suitable proportions of a conducting variety of carbon like graphite or any other type and any type of powdered manganese dioxide ore either low or high grade. This is mixed with a suitable quantity of a binder which does not get soaked in the electrolyte leading to crumbling nor gives high resistance to the block and pressed into specially designed conducting matrix.

3. The conducting matrix which is the subject of our co-pending Indian Patent Application No. 98157 is of metal and the thickness of the electrode is such that complete utilisation is effected without much internal resistance increase during operation of the cell.

4. Cells of any size, 1000, 1500 or 2000 hours of service above 0·8v. cut off can be designed with the above type of matrix electrodes and the utilisation of active materials is always maximum, *i.e.* 100%.

5. Cells of any desired capacity 100, 250 or 500 A.H. with any desired drains 5, 10 or 20 amp. continuous can be designed.

The following are the main advantages of the invention :

1. This new cell obviates the necessity of using high grade ores only and also the use of electrolytic or chemical variety to increase efficiency.

2. The cathode can be made with any low grade ore and the impurity in the ore (any oxide other than manganese dioxide) does not affect the performance of the cell or the utilisation of the active material, *i.e.* manganese dioxide.

3. Even if the cathode is made of low grade ore, the cell life is determined by the percentage of available manganese dioxide in the ore.

4. The theoretical utilisation efficiency is achieved in this process for any ore whereas in the conventional wet cells, it is far less than 100 even for high grade ores.

5. The voltage characteristics fall in the range 1·45 to 0·8v. during useful life of the cell and the entire manganese dioxide is used up within this range.

6. As a consequence of (4), if high grade ores are used, the amount of active material needed to give a specific period of life is less than half that is necessary for the conventional ammonium chloride type Lechlanche wet cells.

7. The cells of the new type are much cheaper than the conventional ones due to the following reasons.

(*a*) Sodium hydroxide is used in place of costlier ammonium chloride ;

(*b*) The alkali can be regenerated by lime and reused ;

(*c*) The quantity of alkali needed also is less than the ammonium chloride ;

(*d*) The quantity of manganese dioxide and carbon needed is less as efficiency is high.

8. This invention obviates the use of expensive central carbon collector rods.

9. Due to its capacity to deliver any desired current, it can conveniently replace the air depolarised cells and cupric oxide cells.

10. The cells are capable of delivering twice the current output at 100% higher operating voltage from one cupric oxide cell. So one alkaline manganese dioxide cell can replace four cupric oxide cells.

R. BHASKAR PAI,

Patent Officer,

COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH.

Dated this 18th day of February 1965.

Price : TWO RUPEES.

COMPLETE SPECIFICATION.

COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH, Rafi Marg, New Delhi-1, India, an Indian Registered Body incorporated under the Registration of Societies Act (Act XXI of 1860).

This is an invention by Dr. MICHAEL ANGELO VINCENT DEVANATHAN, Scientist, Central Electrochemical Research Institute, Karaikudi-3, Madras State (Citizen of Ceylon), SHRI NARAYANAN RAMASAMY, Senior Scientific Assistant, Central Electrochemical Research Institute, Karaikudi-3, Madras State (Citizen of India), and SHRI SRINIVASAN VENKATESAN, Senior Laboratory Assistant, Central Electro chemical Research Institute, Karaikudi-3, Madras State (Citizen of India).

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 alkaline manganese dioxide wet cells.

Hitherto it has been customary to use Lechlanche type wet cells with ammonium chloride/zinc chloride solution as electrolyte and manganese dioxide/carbon/ammomium chloride cathode sack elements and zinc anodes. This is open to the objections that—

(a) The efficiency of utilisation of the active material is very low;

(b) The process of making the sack elements (*i.e.* the cathode) is an involved process consisting of several steps;

(c) The cathode has to be periodically cleaned to remove the crust of crystalline material.

The main object of this invention is to develop an alkaline manganese dioxide wet cell which will obviate these disadvantages.

According to the present invention the alkaline manganese dioxide wet cell consists of an alkaline solution as electrolyte wherin zinc is used as anode and wherein the cathode is made by pressing a cathode mix comprising manganese dioxide/ carbon mixture in the matrix electrode described in our co-pending Indian Patent Specification No. 98157.

The fabrication of the cathode is done by pressing the cathode mix consisting of manganese dioxide/ carbon mixture in a newly designed and patented matrix made up of mild steel or any other metal suitably treated to withstand the solution attack. This matrix is a highly conducting one. The electrolyte used is the hydroxides of alkali and/or alkaline earth metals. The cathode mixture is made by mixing suitable proportions, say between 85-95% of the manganese dioxide ore with 15 to 5% of carbon like graphite or acetylene black. The manganese dioxide may be of a low or high grade ore. The cathode mix is mixed with a suitable quantity of a binder like alkali etc., mixed with a suitable wetting agent and then pressed in the specially designed conducing matrix. The binder should be such that it will not increase the resistance of the block but at the same time will not result in the crumbling of the entire block. The conducting matrix which is the subject of our copending Indian Patent Application No. 98157 is of metals like mild steel etc. suitably treated to withstand alkali attack and the design of the electrode is such that complete utilisation is effected without much internal resistance increase during operation of the cell. The matrix is made with thin mild steel sheets inside a m.s. frame of a suitable size with vertical and/or horizontal strips welded or soldered or hot dip tinned to the square frame or of expanded metal with similar treatments.

The above mentioned method of making the electrode makes it easy to design cells of any size, 1000, 1500 or 2000 hours of service above 0·8v. cut off. The use of the special mix pressed into the matrix results in near complete utilisation of all the active materials.

Cells of any desired capacity say 100, 250 or 500 A.H. can be designed easily to give desired drains of 5, 10 or 20 amp. continuously. Thus a 250 A.H. alkaline MnO_2 cell can be constructed to give drains of 6 to 8 amperes continuously. Because of the large active area to volume ratio of the electrode itself, the current density is reduced and hence passivation of the anode and the accompanying polarisation is avoided.

The following typical examples illustrate the construction of the alkaline manganese dioxide wet cell.

1. The electrolyte used is the hydroxides of alkali and/or alkaline earth metals.

2. The cathode is a mixture of suitable proportions of a conducting variety of carbon like graphite or acetylene black or any other type and any type of powdered manganese dioxide ore either low or high grade. This is mixed with a suitable binder and then it is pressed into the specially designed matrix electrode made in a square, cylindrical or any other form with m.s. strips or expanded metal or any other gauze treated property to resist alkali attack.

3. Any desired capacity, time and current drain can be achieved by the use of series-parallel coupling of the plates in the cell.

4. Cells of high capacity (*i.e.* of 100, 250 or 500 A.H.) coupled with an ability to give sustained currents of 5, 10 or 20 amps. can be easily designed.

The following are the main advantages of the invention:

1. This new cell obviates the necessity of using high grade ores only and also the use of electrolytic or chemical variety to increase efficiency.

2. The cathode can be made with any ore, high grade or low grade. The presence of impurities (oxides of other metals etc.) does not come in the way of the 100% efficiency and complete utilisation of the active material, *i.e.* manganese dioxide.

3. Even if the cathode is made of low grade ore, the cell life is determined by the percentage of available manganese dioxide in the ore.

4. The theoretical utilisation efficiency is achieved in this process for any ore whereas in the conventional wet cells using $NH_4Cl/ZnCl_2$/sac. elements, the utilisation efficiency is far less than 100% even for high grade ores.

5. The open circuit voltage of the cell is 1·45v. The voltage characteristics fall in the range of 1·45v. to 0·8v. during the life of the cell. Within this range of potentials, the utilisation of manganese dioxide is completed in full, *i.e.* all the available manganese dioxide is used.

6. As a result of (4) above, if high grade ores are used, the amount of active material needed to give a specific period of life is less than half that is necessary for the conventional NH_4Cl type Lechlanche wet cells.

7. The cells of the new type are much cheaper than their conventional counterparts because:

(*a*) alkali is used in place of costlier ammonium chloride;

(*b*) the alkali can be regenerated with lime;

(*c*) the quantity of alkali needed is also less than the ammonium chloride;

(*d*) the quantity of MnO_2 and C needed is less for the same capacity since utilisation efficiency is high.

8. The use of the special design matrix disposes of the costly central carbon rod current collector.

9. Due to its capacity to deliver any desired current, it can conveniently replace the air depolarized as well as cupric oxide cells.

10. The cells are capable of delivering twice the current output at 100% higher operating voltage from one cupric oxide wet cell. So one MnO_2 cell can replace 4 CuO cells.

The invention relates to a method of constructing an alkali manganese dioxide wet cell for use as low, medium and high current source. This gives a high efficiency and complete utilisation of active materials. This can very easily compete with air depolarised cell and cupric oxide cell because of its high voltage and high current giving capacity.

The use of a new cathode block containing MnO_2 as depolariser prepared with a new matric patented earlier in alkaline wet cells is within the scope of our invention.

We claim :

1. An alkaline manganese dioxide wet cell which consists of an alkaline solution as electrolyte wherein zinc is used as anode and wherein the cathode is made by pressing a cathode mix comprising manganese dioxide/carbon mixture in the matrix electrode described in our co-pending Indian Patent Specification No. 98157.

2. A cell as claimed in Claim 1 wherein the electrolyte consists of hydroxides of alkali and/or alkaline earth metals.

3. A cell as claimed in Claim 1 or 2 wherein the alkali is regenerated with lime.

4. An alkaline manganese dioxide wet cell constructed substantially as hereinbefore described.

R. BHASKAR PAI,

Patent Officer,

COUNCIL OF SCIENTIFIC & INDUSTRIAL RESEARCH,

Dated this 10th day of November 1965.

MGIP Sant. SL.—37 Patent/68—23-9-69—100.