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“BATTERY SYSTEM INCORPORATING TIN ANODE”

COUNCIL OF SCIENTIFIC & INDUSTRIAL RESEARCH,  
RAFI MARG, NEW DELHI-1, INDIA, AN INDIAN REGISTERED BY INCORPORATED UNDER THE REGISTRATION  
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*The following specifications particularly describes and ascertains the nature of this invention and the manner in which it is to be performed :—*

*This is an invention by Dr. Prem Behari Mathur and Narasimhan Venkatakrishnan, both of the Central Electro-chemical Research Institute, Karaikudi-3, Tamil Nadu, India, both Indian citizens.*

This invention relates to new family of batteries wherein porous tin metal electrode is used as anode in conjunction with conventional battery cathodes, in alkaline medium.

Hitherto zinc or cadmium anodes have been coupled with silver oxide cathodes to constitute a high energy density alkaline battery. Zinc or cadmium anodes have also been coupled with nickel oxide, mercuric oxide and manganese dioxide cathodes in other alkaline batteries. Tin metal has not been used so far as anode material with these cathode materials in the design of a battery system.

With the advance in modern technology, the requirements of sophisticated power sources are growing day by day. Since conventional battery fails to meet one or other of the stringent specifications like power density, time of activation,  $-10^{\circ}\text{C}$  and tropical temperature reliability, shelf-life, non-spillability, service-life, cycle life, each newly discovered battery system is acquiring a definite area of application because of possessing certain specific characteristics. Similarly, the Tin-family of batteries will have its own region of application because of possessing certain characteristics.

The use of zinc or cadmium electrodes as materials for anodes in alkaline batteries is open to objection that the zinc as well as cadmium electrode have wide variation of voltage during discharge or exhibit appreciably low electrode potential resulting in the low cell voltage of silver-cadmium or nickel-cadmium battery.

The object of this invention is to obviate these disadvantages of the conventional alkaline batteries by substituting Tin for zinc or cadmium as anode material in alkaline batteries.

To these ends, the invention broadly consists in developing of a new family of batteries wherein porous tin electrode is used as anode in conjunction with cathodes of the oxides of a few metals of IB, IIB and VIII group of Periodic Table in alkaline media. The porous tin anode is fabricated out of fine grade pure tin metal powder. The powder is pressed to form porous plates. The tin electrodes are fabricated by placing conducting wire leads between the two porous tin plates and pressing them to form two ply plates. The plates are used as anodes in conjunction with metal oxide cathode, alkaline electrolyte and paper, cloth, or plastic material separator.

The incorporation of Tin as anode material in alkaline batteries in place of conventional zinc or cadmium anodes renders the following advantages :

1. The cell system possess the characteristics of quick activation with alkaline electrolyte.

2. The cell system possesses higher voltage than the cells using cadmium anode.
3. The cell possesses long shelf life under unactivated condition.
4. The cell system is a new addition to the high energy density family of batteries.

The following typical examples are given to illustrate the invention :

#### EXAMPLE 1

Coupling pressed Tin powder electrode with a metal oxide cathode such as silver oxide, a cell is fabricated. Fine Tin powder of +100 mesh is pressed in a suitable die to form porous tin plates. These plates were cut to  $1'' \times 1''$  size. After placing silver wire leads in between two such plates, they were pressed to form two ply electrodes. The tin electrode is wrapped in cellophane paper/filter paper/nylon cloth which acts as a separator.

The cathode is fabricated by charging porous sintered silver electrode until it is completely converted to silver oxide. The electrode is wrapped in filter paper/nylon bag. The cell is assembled by placing silver oxide between two porous Tin anodes, all of 1 sq. in. area. The entire assembly is placed in a plastic container. The cell is activated with concentrated solution of potassium hydroxide.

Following are the performance characteristics of cell :

Open Circuit voltage	: 1.5 V
Operational voltage	
At room temperature at $0.4 \text{ A/in}^2$ to $0.05 \text{ A/in}^2$	: 1.45 V – 1 V
At $-10^{\circ}\text{C}$ temperature at $0.1 \text{ A/in}^2$	: 1.15 V – 0.9 V
Capacity efficiency between $0$ and $-20^{\circ}\text{C}$	: 65 to 95%
Time of activation	: Less than 0.2 secs.
Short circuit current	: 3 A at 0.925 V

#### EXAMPLE 2

As in example 1, except that the silver oxide cathode was fabricated out of pressed silver oxide powder. The cell gives similar performance as in example 1 except that it operates between 1.2 V and 1 V.

Price : TWO RUPEES

## EXAMPLE 3

As in example 1, except that mercuric oxide is used in the fabrication of Tin-metal oxide cell. The Tin-mercuric oxide alkaline cell operated at 0.95 V to 0.775 V range. The cell system has 1.04 V as its open circuit voltage. The system is found to work as a power source.

## WE CLAIM

1) A battery system wherein a porous tin metal electrode is used as anode element in conjunction with a cathode made out of a metal oxide like silver oxide, nickel oxide and like substances separated by a separator material like cellophane paper, filter

paper, plastic fabric and activated by an alkali solution.

2) A battery system as claimed in claim 1 wherein the porous tin metal anode is fabricated by pressing tin metal powder, cutting it to required size and then placing conducting wire lead in between two such tin plates and pressing them again to form a single tin electrode.

Dated this 27th day of January, 1971.

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