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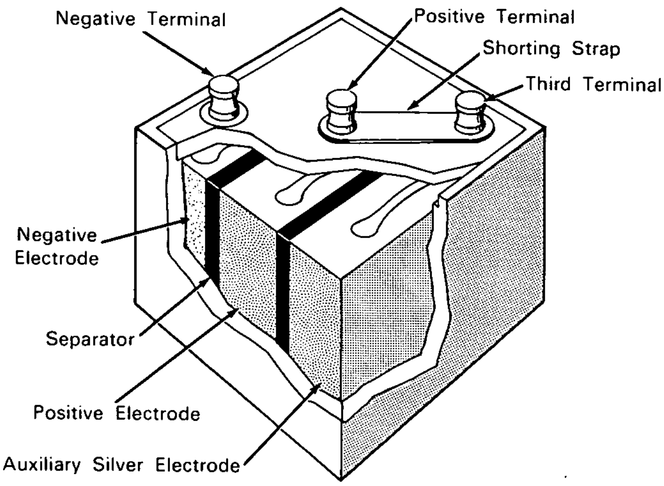
NASA TECH BRIEF

This NASA Tech Brief is issued by the Technology Utilization Division to acquaint industry with the technical content of an innovation derived from the NASA space program.

Auxiliary Silver Electrode Eliminates Two-Step Voltage Discharge Characteristic of Silver-Zinc Cells



The problem: Eliminating the two-step voltage discharge characteristic of silver-zinc cells. The operating voltage of a fully charged silver-zinc cell remains at about 1.7 volts until the cell is about 20% discharged; it then drops to about 1.5 volts and remains at this level until the cell is 95% discharged. The two-step voltage discharge characteristic of silver-zinc cells results from the fact that the silver electrode has two active materials: divalent-silver oxide (AgO) and monovalent-silver oxide (Ag_2O). The electrode potential of AgO is 0.3 volt higher than the electrode potential of Ag_2O. Many applications, particularly in electronics, require a steady voltage supply during the battery-discharge cycle.

The solution: An auxiliary silver electrode which is electrically connected to the positive terminal only during discharge.

How it's done: The two-step voltage discharge characteristic is eliminated by using the AgO capacity on the surface of the positive electrode to charge an auxiliary silver electrode to the Ag_2O state. The auxiliary silver electrode is assembled in the cell in such a manner that it is electrically isolated from the positive and negative electrodes. It is connected to a third terminal.

In operation, the cell is charged to its nominal cutoff, with the third terminal electrically isolated from the charging circuit. The third terminal is then connected to the positive terminal by a shorting strap of nominal resistance (0–20 ohms). Surface AgO on the charged positive electrode reacts electrochemically with the silver in the auxiliary electrode to reduce the AgO on the charged electrode and correspondingly oxidize some of the silver on the auxiliary electrode to Ag_20. The higher voltage that would result from the

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AgO on the electrode is thus eliminated, and a substantially constant voltage is obtained during discharge. Adjustment of the amount and quality of silver in the auxiliary electrode permits the voltage decrease to be tailored to suit the requirements of the cell. No capacity is lost from the cell, and both the auxiliary and positive electrodes are discharged to a common end voltage.

Notes:

1. The use of this innovation results in higher energy density in a secondary cell than would result from charging the silver electrode to the monovalent (Ag_2O) stage. This increase in energy density could improve the marketability of silver-zinc and silver-cadmium cells.
2. In a secondary battery, each cell must be provided with a lightweight switching mechanism.
3. For further information about this invention inquiries may be directed to:
   Technology Utilization Officer
   Goddard Space Flight Center
   Greenbelt, Maryland 20771
   Reference: B64-10114

Patent status: NASA encourages the commercial use of this invention. It has been patented by NASA (U.S. Patent No. 3,118,100), and royalty-free license rights will be granted for its commercial development. Inquiries about obtaining a license should be addressed to NASA Headquarters, Washington, D.C. 20546.

Source: The Electric Storage Battery Co.
under contract to Goddard Space Flight Center
(GSFC-169)