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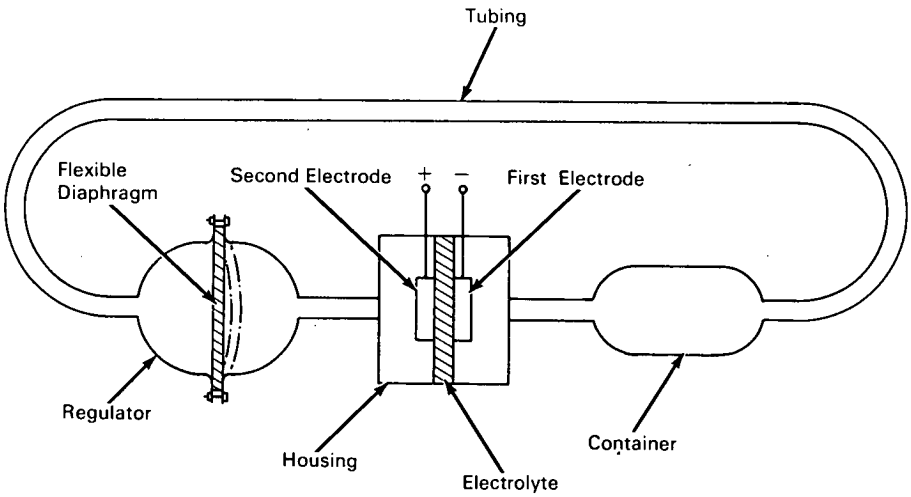
NASA TECH BRIEF

Regenerative Fuel Cell Combines High Efficiency with Low Cost



The problem: To provide an electrical energy storage medium that is lightweight, efficient, and inexpensive. Conventional storage batteries exhibit poor energy-to-weight ratios and are generally unreliable over a large number of cycles especially where deep discharge is a duty requirement. Prior-art fuel cells attain relatively poor efficiency, exhibit limited current density, and have limited useful life.

The solution: A hydrogen/oxygen regenerative fuel cell that features high efficiency and low cost and is adapted for a large number of cycles with deep discharge. The unit output achieves a high energy-to-weight ratio.

How it's done: The fuel cell consists of two gas-permeable electrodes contacting and separated by a body of electrolyte, all completely enclosed in a housing. The first electrode is of inert platinized nickel, the second electrode is of silver, and the electrolyte body is a fine, porous, nonconducting bed of asbestos that is partially saturated with an aqueous solution containing 35% potassium hydroxide by weight. When the cell is initially charged with a predetermined amount of electrical energy, electrolysis occurs in the electrolyte solution producing hydrogen gas from the first electrode and oxygen gas from the second electrode. The hydrogen gas is stored in a container connected to the first-electrode side of the housing and its pressure is controlled by a regulator connected to the other side of the housing and containing a flexible diaphragm through its center. Substantially all of the oxygen gas produced at the second electrode immediately combines with it to form silver oxide. Balancing of the gas pressures within the system is by action of the regulator diaphragm being expanded by the hydrogen gas so as to reduce the volume containing the oxygen gas.

When a predetermined amount of electrical energy is discharged from the cell, the silver oxide is reduced to pure silver and the gaseous hydrogen reacts with the

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hydroxyl ions formed at the silver electrode to produce water which is absorbed into the electrolyte bed. Thus the cell is regenerative, and, upon application of another charge, the gas-producing cycle will be repeated.

Notes:

1. This cell was charged at room temperature for a period of 2 hours with a current of 50 milliamps at 1.16 volts. It was then discharged at room temperature for 2 hours and delivered a current of 50 milliamps at 1.12 volts. Thus, voltage efficiency was about 96.5%, current efficiency about 95%, and power efficiency about 91.7%. Prior art normally failed to achieve 70% efficiency.
2. Energy-to-weight ratios in the vicinity of 70 watt-hours per pound have been achieved. Conventional wet batteries normally deliver from 5 to 15 watt-hours per pound.

Patent status: Title to this invention has been waived under the provisions of the National Aeronautics and Space Act (42 U.S.C. 2457 (f)), to Electro-Optical Systems, Inc., 300 North Halstead Street, Pasadena, California, 91107.

Source: Harlan Doyle, Harvey Frank, and Charles W. Stephens of Electro-Optical Systems, Inc. under contract to Western Operations Office (WOO-090)