April 1971

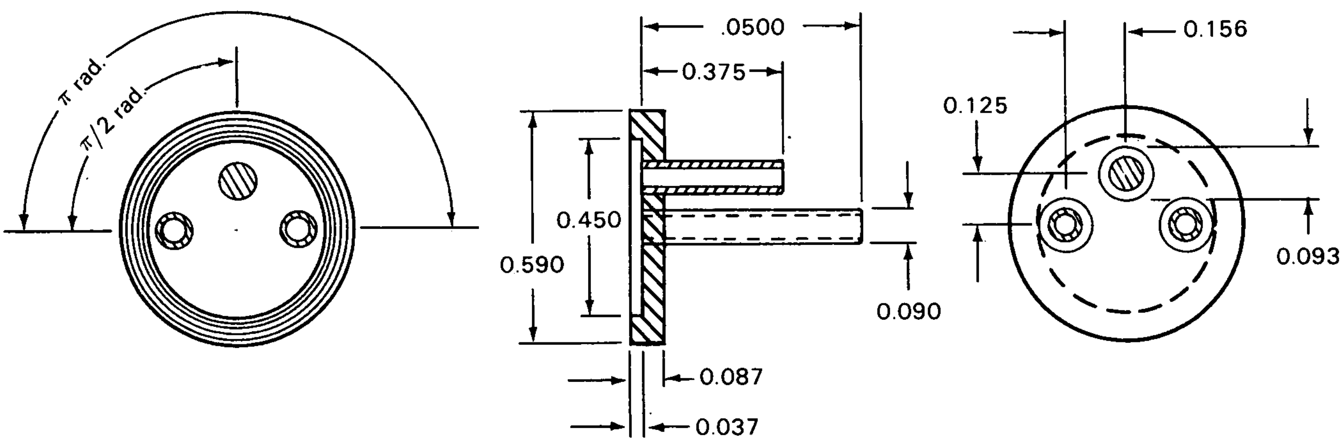
Brief 71-10064

NASA TECH BRIEF

Goddard Space Flight Center

Miniature Fuel Cells Relieve Gas Pressure in Sealed Batteries

Miniature fuel cells (see fig.) within sealed silver-zinc batteries consume evolved H_2 and O_2 rapidly enough to prevent the battery from rupturing due to pressure. The fuel cells do not significantly increase the weight of the battery and can operate in all phases of battery life.



A fuel cell has a long, effective life in the open gas-flow mode. Eight cells, ranging in electrode area from 0.25 to 5 cm^2, operated successfully in a battery-simulating environment for from 4000 to 8000 hr, and they could last longer. The fuel cells can also operate for long periods in the dead-end gas-flow mode. Six, of similar electrode areas, were effective for from 1900 to 6000 hr in a similar environment.

Over long periods, fuel cells having electrode areas of 0.25, 1.0, and 5.0 cm^2 can consume H_2 at not less than 1.6, 6.3, and 10.6 cm^3/hr, respectively. For one month or longer, cells operated on mixtures of H_2 and O_2 in the battery anode and pure oxygen in the cathodes. Cell electric output roughly doubled between 298° and 3130°K, while output at 273°K was about 80% of that at 298°K. The relationship between the cell's open-circuit voltage and the hydrogen concentration in an anodic mixture of H_2 and O_2 was determined experimentally. The results should be useful in determining the gaseous contents of battery cells.

Because both gases are evolved, two fuel cells are required for complete control of gas pressure during all phases of operation of a silver-zinc battery. During open-circuit stand or low-level operation of the battery, however, one fuel cell (to consume H_2) is sufficient.

Two fuel cells, each with a 1 cm^2 electrode area, limited the pressure rise in 100-amp-hr battery cells to ≤ 110.9 kN/m^2 during a 2-hr discharge at 20 amp (40% depth of discharge) and a 22-hr charge at 2 amp. The ratio of evolved gases, H_2:O_2, was 2.7:1 in one

(continued overleaf)

battery cell and 3.8:1 in another. The rate of evolution can vary between cells. Under identical conditions, the evolution of both bases was six times higher in one silver-zinc cell than in another. Average gassing rates for H_2 and O_2, respectively, were 0.08 and 0.03 cm^3/hr in one battery cell and 0.49 and 0.13 cm^3/hr in another.

The water produced by the fuel cells could be used for life support, and there are indications that such fuel cells could also be used in nickel-cadmium and lead-acid battery cells.

Note:

The following documentation may be obtained from:

National Technical Information Service
Springfield, Virginia 22151
Single document price $3.00
(or microfiche $0.95)

Reference:
NASA-CR-80339 (N67-12969), Small Fuel Cell to Eliminate Pressure Caused by Gassing in High Energy Density Batteries

Patent status:

No patent action is contemplated by NASA.

Source: H.A. Frank of
Douglas Aircraft Company
under contract to
Goddard Space Flight Center
(XGS-11370)