AUTOMATICALLY ACTIVATED, 300 AMPERE-HOUR SILVER-ZINC CELL

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In many long term planetary applications, it is necessary to have additional power available for experiments during planet encounter or landing. To fulfill this requirement, it has been the practice to include some type of battery, usually nickel-cadmium or silver-zinc, for this additional power. Four major problems have arisen:

(1) Maintenance of the battery during long periods of storage.

(2) Lack of reliability of the battery with respect to cells in series.

(3) Degradation of the cells of the battery during the portion of the flight prior to encounter or landing.

(4) Internal gassing because of chemical or electrochemical reactions, especially in silver-zinc cells.

Development has been geared toward solving these problems. Silver-zinc cells can now be stored for at least five years in the dry state, i.e., without electrolyte. The purpose of our program has been to develop a large, single silver-zinc cell for which the electrolyte would be stored in a separate tank. The cell would be filled with electrolyte, i.e., activated, when the additional power was required.

Figure 1 shows the prototype unit, which consists of a 300-A-hr cell and the electrolyte storage tank. The tank contains approximately 900 cm^3 of electrolyte. Plastic tubing was used on the prototype to permit the flow of electrolyte to the cell. The two terminals on the tank are for activating the filling mechanism.

Figure 2 is a schematic of the cell/tank system, which is referred to as the Unicell. The electrolyte is contained in a collapsible neoprene bellows.

Fluid flow is indicated by arrows. The operation of the unit is as follows:

(1) When additional power is required, a 3-A pulse is applied to the terminals on the tank.

(2) The pulse activates an explosive device which forces the knife through a copper diaphragm and at the same time releases the spring which applies force to the piston.

(3) The piston moves down, thereby collapsing the bellows and forcing the electrolyte into the cell through the hole cut in the diaphragm.

(4) Any air or gas in the cell is forced into the spring enclosure. However, it is proposed to have a soft vacuum in the cell to eliminate any interference with cell filling.

The purpose of the membranes, or discs shown on the cell assembly, is to diffuse any gases, such as hydrogen or oxygen, that may evolve during cell filling or cell operation.

The proposed application is shown in Figure 3. The main power source would be a solar array or RTG coupled to the load through a conventional converter regulator. Additional power, when required, would be supplied by the Unicell and the low-voltage converter regulator. A converter has been developed to regulate 50 to 100 W at 28 V. The regulation is accurate to 1 percent, and the efficiency is approximately 75 percent (Reference 1). This development eliminates the problems previously discussed:

(1) The cell does not have to be maintained during flight.

(2) The control of a single cell is simpler; it is possible to obtain ten times as many cycles from a single cell as from a series of five cells.

(3) Degradation of the cell before encounter is negligible.

(4) Internal gassing is essentially eliminated by the excellent charge control afforded by single cell operation. The diffusion membranes control any gassing that may occur.

In addition, it is estimated that the use of a large capacity single cell will result in a 50 percent reduction of battery weight.

REFERENCE

1. Pasciutti, Edward R., "Low Voltage Conversion Regulation From Unconventional Primary and Secondary Sources", NASA Technical Memorandum X-63118, January 1968.

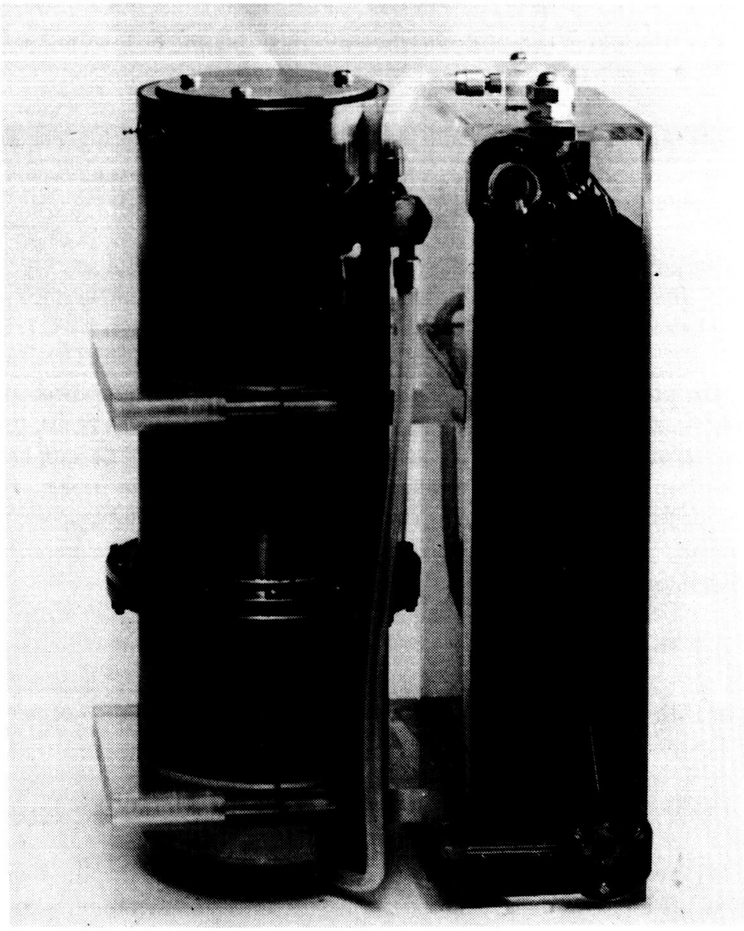

Figure 1—Prototype unit.

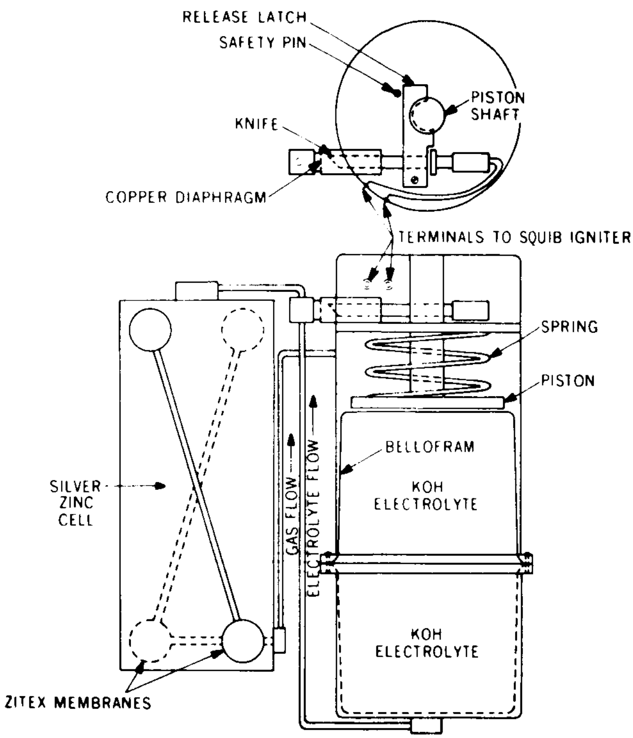

Figure 2–Schematic of Unicell.

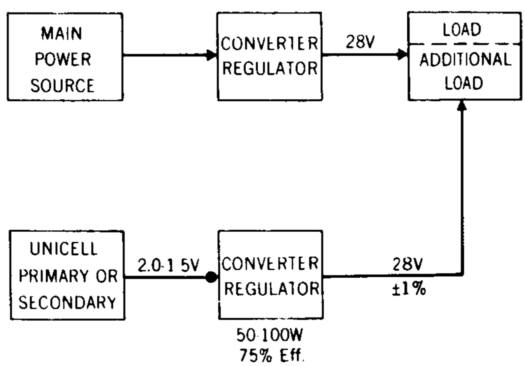

Figure 3–Application of Unicell.