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# NASA TECH BRIEF

*Marshall Space Flight Center*

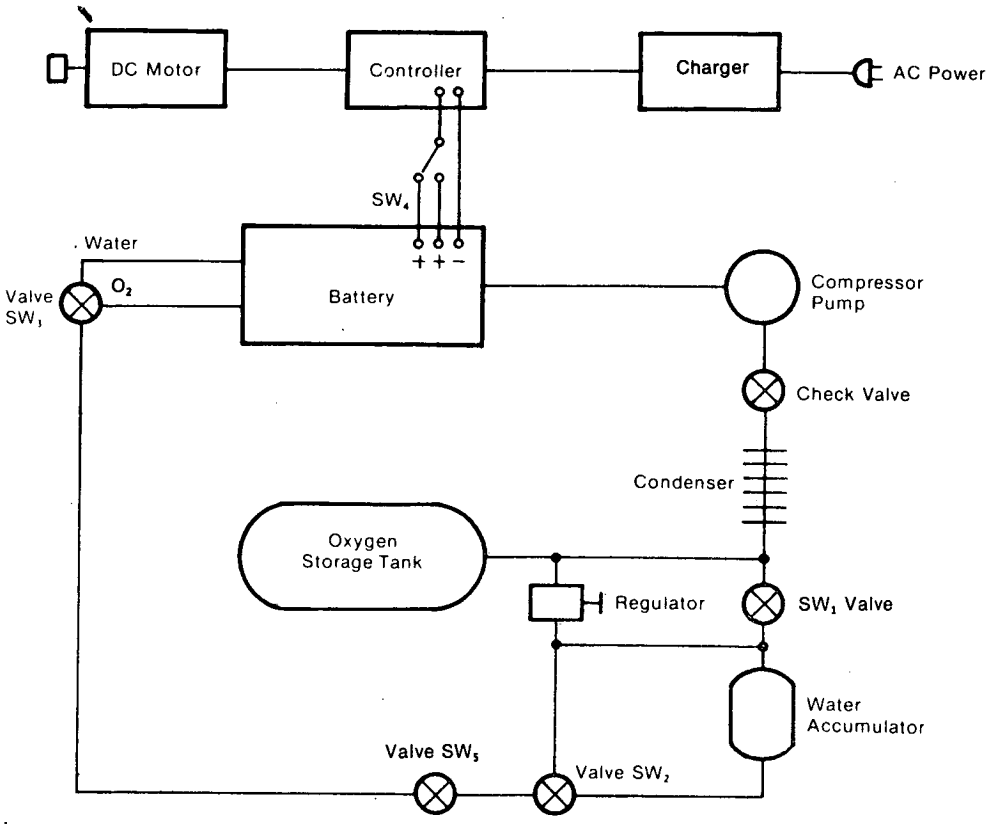


## Lead-Oxygen Closed-Loop Battery System

A recently-proposed, lead-oxygen closed-loop battery system has a feature that makes it more practical than previous systems. Calculations show that this new battery can deliver up to 35 watt-hours per pound (77 watt-hours per kilogram), as opposed to a conventional lead-acid battery that delivers 10 to 15 watt-hours per pound (22 to 33 watt-hours per kilogram). This weight reduction is due to the replacement of the solid lead-peroxide electrodes used in the conventional battery with a metal current-collector screen, a catalyst, and a Teflon membrane. Oxygen is fed into the cell through this membrane.

The system operation is described by reference to the block diagram. Before a charge cycle, the oxygen valve $SW_1$ is closed, $SW_5$ is open, and the two-way valves $SW_2$ and $SW_3$ are open to allow oxygen to flow from the regulator to the battery. Switch $SW_4$ is still connected to the positive discharge grid.

The system is plugged into an ac power line for the charge cycle. The controller then switches the valves $SW_2$ and $SW_3$ to allow the remaining oxygen pressure to convey the water stored in the water accumulator to the cells in the battery. After the water is returned to the cells, the controller then closes valve $SW_5$,




Lead-Oxygen Battery System

switches two-way valves $SW_2$ and $SW_3$ to open the regulated oxygen pressure lines to the battery and to close off the water route. $SW_1$ is then opened. $SW_4$ is switched to the positive charging grid, the oxygen pump (compressor) is started, and the charging cycle has begun.

As the charging progresses, oxygen is released at the positive charging grid and the pump (compressor) moves the oxygen from the battery through the check valve and the condenser to the oxygen storage tank. Air cools the condenser fins, and the resulting water condensate drops into the water accumulator.

During the charge cycle, some water evaporates from the electrolyte and must be returned to the cells before the next charging cycle. The charger converts the commercial ac power to dc. The controller regulates the charging current to protect the battery. When the battery is fully charged, the controller turns off the charging circuit, closes the $SW_1$, opens valve $SW_5$, and switches $SW_4$ to the discharge grid.

During discharge, the controller regulates the output voltage and the current, as required by the load demand. Oxygen, which surrounds the cells, is admitted through the cell membrane (Teflon). A recombination electrode is required to recombine the hydrogen released at the negative plate with the oxygen to form water.

**Note:**

Requests for further information may be directed to:

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**Patent status:**

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