Secondary Cells Accumulators Lead Acid Automotive Battery Information

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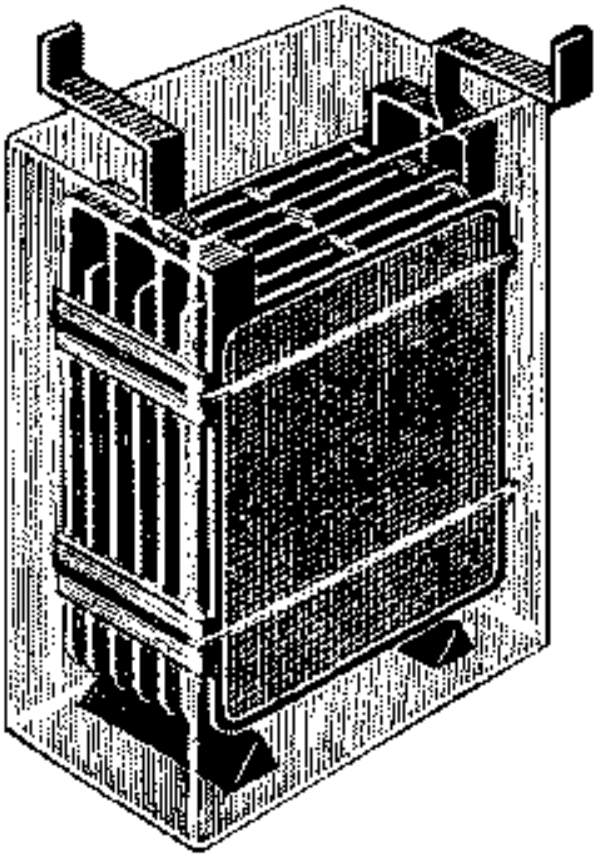

Picture 1. Lead Acid Secondary Cell

The lead acid cell is the most successful secondary cell in our history. **M. Planté** discovered the lead acid type cell in 1859. In this design the two plates were rolled up and separated by felt or a similar material. Thereafter **H. Tudor** improved upon this secondary cell in 1883 and by **Lucas** in 1894. Only the original Edison **Ni-Fe** (Nickel Iron) secondary cell is comparable to the lead acid for some of its beneficial properties.

When two lead plates immersed in dilute sulfuric acid and current flow established, one lead plate becomes the anode and the other a cathode. The anode becomes coated with lead peroxide $\mathbf{PBO_2}$ while the cathode remains unaltered. When the charging current is interrupted and the two terminals connected by a wire, a polarization current is obtained that is passes through the cell in the reverse direction to that of the original charging current. The electrolyte is 346-gram high purity $\mathbf{H_2SO_4}$ and 864-gram distilled water. Electrolyte density increases during charge and decreases during discharge.

The nominal voltage of the lead acid accumulator is 2.2 Volt when fully charged and some time elapsed. This value should not be allowed to fall below 1.85 Volt. Because this value alone is too low to be useful, car batteries are usually made from three or most often six cells. There is talk of using four such batteries in series to allow even lower gas mileage and more deaf drivers.

This kind of arrangement is usually referred to as an accumulator or storage battery. Many times such cells are called storage cells. That term is highly inappropriate, as no electricity is stored, but a conversion of electrical energy into chemical energy takes place and vice versa. Frequent charging and discharging forms the battery plates. The plate material becomes spongy lead that increases the surface area thereby allowing larger current output. On current cell designs the plates are made as a grid and a paste that is made from oxides of lead and sulfuric acid is pressed into them. Invariably lead sulfate is formed.

During forming charge the following reactions take place:

At the Positive Plate: $\mathbf{PBSO_4}+SO_4+2H_2O = \mathbf{PbO_2}+2H_2SO_4$

At the Negative Plate: $\mathbf{PbSO_4}+H_2 = \mathbf{Pb}+H_2SO_4$

During the discharge the following reactions take place:

At the Positive Plate: $PbO_2+H_2+H_2SO_4 = \mathbf{PbSO_4}+H_2O$ Simplified: $\mathbf{PBO_2}+H_2SO_4 = \mathbf{PBSO_4}+O$
At the Negative Plate: $Pb+SO_4 = \mathbf{PbSO_4}$ Simplified: $\mathbf{PBSO_4}+2H = Pb+\mathbf{H_2SO_4}$

Combined: **Charge** --> $PbO_2 + Pb + 2H_2SO_4 = 2Pb+SO_4 + 2\ 2H_2O$ <-- **Discharge**

It appears that during the passing of current through the cell from the negative to the positive plate, sulfuric acid is electrolyzed. The hydrogen travels with the current and liberates on the positive plate.

The chief benefit of this type of cell are low internal resistance, thus high currents are available. For that reason it is used in every automobiles for starting. It is also inexpensive and can be charged easily. A good rule to expect 1 ampere for every 40 square inches of plate surface. Automotive cells are never single plate construction.

Previous Page