TECHNOLOGY

Electric Autos—Not Yet

Practical competition for the combustion engine still seems to be many years away.

by John Ludwigson

Batteries are too heavy; fuel cells need exotic fuel; nuclear-electric generators are even heavier than batteries and produce less power.

That, in a nutshell is what's holding back development of a practical electric automobile. Until somebody comes up with a lightweight, efficient, durable and cheap way of storing or generating electricity, electric cars will remain in the engineering laboratory.

It's not that they can't be built or that they can't keep up with traffic. General Motors Corporation's Electrovair II, using silver-zinc batteries, will hit 80 miles an hour and, over most of its speed range, will actually out-accelerate a standard Corvair on which it is patterned.

Most likely power sources for the first, small electric cars are high-efficiency batteries that are available now such as the silver-zinc cells GM chose to power Electrovair.

But the difficulty with these, according to figures from the Yardney Electric Corporation which makes the cells, is the cost of the silver. About $1,200 worth would be contained in the batteries for a small town car, Yardney vice president Andy Leparulo recently advised a committee of the U.S. Senate.

Fortunately, he observed, the silver would be entirely recoverable when the battery was worn out. The batteries would cost around $800, exclusive of the silver, he said.

The advantage of such batteries over

Electric Car Performance
(identical battery and motor weights)

	Standard Compact	Electric: Lead-Acid	Silver-Zinc	Sodium-Sulfur
Car Weight	2960	3320	3320	3320
Range (60 m.p.h.)	333	0	43	70
(city traffic)	250	10	37	82
Acceleration (0-10 sec.)	436 ft.	355 ft.	408 ft.	408 ft.
Time in seconds to pass a 50 m.p.h. automobile	12.2	insufficient power	22	22

Ford Motor Co.

The problem with Electrovair, and all other battery-powered cars, is range. While the Corvair can go up to 300 miles on a tank of gas, its electric cousin runs out of power after 50 miles.

Two possible solutions to the weight-mileage problem are receiving concentrated attention from the nation's auto makers and others concerned with portable electric power. They are revolutionary types of super-efficient batteries and fuel cells.

Nuclear-electric power generators now in use are reliable, long-lived and can produce almost any amount of power when linked together. They are largely ruled out for automobile use, however, because they are uniformly heavy—shielding makes up most of their weight—and expensive.

conventional lead-acid cells now used in cars is mainly in the amount of electricity they can store for a given battery weight and size. On this basis, silver-zinc cells may be up to seven times as efficient as lead-acid cells, storing from 40 to 60 watt-hours per pound of battery weight instead of 8 to 12.

A car made to use silver-zinc batteries—the most efficient now available —would run about 150 miles at speeds up to about 60 miles an hour on a single charge at a cost of about nine cents a mile, Leparulo added.

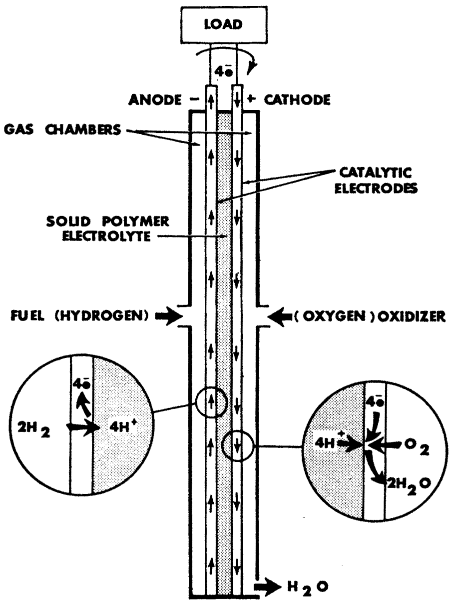
Better batteries are coming. A Federal Power Commission report on Development of Electrically Powered Vehicles (SN: 3/11) notes that no less than six private companies are each working hard on different concepts.

The companies and their batteries are: General Atomics, zinc-air; General Motors, lithium-chlorine; Ford Motor Company, sodium-sulfur; Atomics International, sodium-air (two-step); Lockheed, lithium-copper fluoride; and Gulton Industries, lithium-nickel halide.

"The zinc-air and sodium-sulfur batteries appear to be nearest to practical solutions," the report observes. Neither, however, is yet anything more than an experimental prototype. Theoretically, a sodium-sulfur battery should store about twice the electricity per pound of battery weight as a zinc-air battery. And zinc-air batteries can be more than six times as efficient on a watt-hour per pound basis as conventional lead-acid cells.

The major drawback to the sodium-sulfur system is that it must operate at temperatures around 572 degrees F. The zinc-air battery suffers from high cost and difficulty in maintaining the shape of the zinc anode after repeated recharging.

However, the Power Commission points out, ". . . the theoretical principles employed in the development of novel secondary battery systems, as well as fuel cells, are not new. Current research . . . is directed primarily toward development of practical batteries (or fuel cells) that could be adapted to vehicle propulsion."



General Electric

Solid polymer electrolyte cell

Fuel cells have already proved their reliability and performance in providing power for several of the Gemini space flights. Their use in cars, however, is another story.

Basically, fuel cells are much like batteries, but with one exception. In a fuel cell, the reactants—such as hydrogen and oxygen in the Gemini cell—are continuously fed into the cell and by-products of their reaction—water in a hydrogen-oxygen cell—are continuously removed. As long as this continues, electricity is generated.

Rechargeable batteries—called secondary cells—also produce power from a chemical reaction, but are limited by the amounts of reactant contained within them. When all the reactants in the cells are used up, the reaction can be reversed and the original reactants restored by sending a flow of electricity back through the cell.

Fuel cells have several advantages. Among them is the ability to produce a constant level of output, unhampered by the chemical by-products that slowly cut down the performance of secondary cells. A fuel cell-powered car could be refueled in about the same time as an ordinary car while battery-powered vehicles would require hours to recharge their cells.

Probably the major barrier to fuel cell use is cost; next would come availability of the hydrogen and oxygen reactants used in the most advanced—and most efficient—fuel cells. Cells using less exotic fuels such as alcohol and propane are being studied.

An experimental installation of a hydrogen-oxygen fuel cell was made by GM in a 1966 GMC Handivan powered by a 125-horsepower alternating current induction motor.

While this system had much greater range than the battery-powered Electrovair, the weight and bulk of the fuel tanks and cells took up much of the van's capacity.

GM engineers cited three principal obstacles to production of a competitive electric vehicle: high cost of the power source, whether batteries or fuel cell; limited operating range of battery-powered vehicles; and high cost of the high-power semiconductor devices.

A likely possibility for practical electrical vehicles was proposed to the Senate Commerce Committee by the president of the Electronics Division of the Union Carbide Corporation.

Why not, asked Dr. Robert A. Charpie, combine the steady power production of fuel cells with surge power from batteries for peak power operation?

Hydrogen could be a cheap fuel, according to Dr. Charpie. The present price of about 20 cents a pound could come down to 10 cents if it were marketed widely enough, he declared.

Combination of a fuel cell using such cheap fuel with a nickel-cadmium battery for peak power would minimize power plant weight, volume and costs, according to the Union Carbide official.

But, such optimism for electric propulsion with fuel cells is not shared by the FPC. ". . . it does not appear," the report concludes, "that a practical fuel cell, well suited for vehicle propulsion, will be developed for many years."