TECHNOLOGY

Fuel Cells to Run Electric Cars

Electric cars, buses, trains and submarines may use a revolutionary source of electricity in the near future. Fuel cells promise to generate electricity directly from chemicals.

By ALLEN LONG

ELECTRIC AUTOMOBILES far superior to the runabouts of grandma's day may be on the way back to the American market. Quietly operating without the putt-putt of a bad muffler or the gnashing of gears, the electric cars will have a new heart tucked away in their chrome-plated bodies.

This new heart will be a fuel cell—a revolutionary device for generating electricity directly from chemicals at an efficiency that even beats the biggest, fanciest power house in the world. Instead of driving into a filling station for a tank of gasoline, you may instead drive in and ask for a "ball" of hydrogen.

As long as the fuel cell is supplied with its basic chemicals, it silently and efficiently generates electricity. Unlike conventional batteries now found under hoods, the fuel cell does not require electrical recharging. When the fuel cell's chemicals react, free electrons are released and can be made to circulate in an electric circuit.

Dr. Herman A. Liebhafsky of the General Electric Research Laboratory says the electric car could be here in five years.

Chrysler Corporation's DeSoto division already has started work on the Cella I, which it calls an "idea car" for the exploration of advanced engineering concepts. DeSoto hopes to perfect this fuel-cell car "within the next generation."

Buses, Trucks and Trains

The car likely will have an individual electric motor driving each wheel. The motors will be connected in a circuit that obviates differential gears, yet allows one wheel to turn a little faster than another on curves, but with a safeguard against spinning a wheel at high speed in a ditch or an icy road.

But the private passenger car is not the only vehicle that fuel cells may power in the future. Far-seeing scientists and engineers foretell use of fuel cells for powering city buses, trucks, trains, communications gear and satellite instruments. A submarine running on fuel cells could cruise for long periods underwater but would have more quiet stealth than one running on nuclear power.

Resembling a big battery, the fuel cell could offer these advantages when used in cars: No smog-producing chemicals exhausted; silent operation; more miles per penny because of its 65% to 80% efficiency in making electricity, particularly at traffic speeds; no fuel used when the car is stopped in a traffic jam.

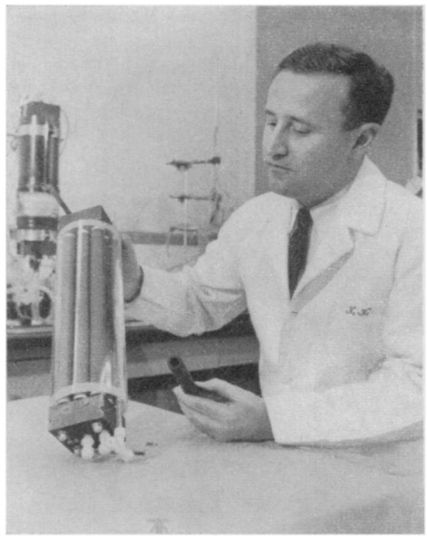
All this may sound extraordinarily optimistic—and indeed some hurdles remain to be leaped before these goals can be attained. But remember that only five years ago a prediction that the U. S. would put a 13.4-pound satellite in orbit about the sun March 3, 1959, would have been labeled by many as "incredible," "fantastic" and "science fiction."

The Army Signal Corps already uses fuel cells to power its portable radar set capable of spotting a single enemy half a mile away. The Silent Sentry, as it is called, can be hidden on the front line, thanks to fuel cells which obviate noisy engine-driven generators.

Fuel cells also have already been used to power an experimental Allis-Chalmers tractor. The tractor can tug a multiple-bottom plow through parched, packed earth with a pull of 3,000 pounds. Fuel cells also have been made to operate an electric saw, a fork-lift truck and welding equipment.

Exactly what is a fuel cell? It is a battery-like device, but it operates on a different principle. It has two electrodes immersed in an electrolyte, a liquid that conducts current. When hydrogen is fed into one electrode and oxygen to the other, a chemical reaction takes place through a potassium hydroxide electrolyte. Water is formed, but in the process negatively charged electricity accumulates on the hydrogen electrode.

If the cell is not connected to an electric circuit, voltage builds up to about one volt and the reaction stops. If connected to an electric motor, however, a trickle of electricity will flow from the hydrogen electrode through the motor and back to the oxygen electrode. If enough cells are connected in series, so that each adds its strength to the other, enough electricity can be generated to make the motor run. The cells will continue to generate power as long as oxygen and hydrogen gas are supplied.



NEW POWER PACKAGE — The device being held by Dr. Karl Kordesch of the National Carbon Company is a fuel cell capable of generating electricity when hydrogen and oxygen gases are fed into its special nine hollow, porous carbon electrodes. In operation, the fuel cell is filled with potassium hydroxide. It generates electricity as long as hydrogen and oxygen are fed in, and requires no recharging.

Oil as Fuel

Other chemicals could be used instead of hydrogen, and considerable research work is now being conducted in this respect. For example, the Esso Research and Engineering Company is understood to be investigating use of oil for a fuel-cell power plant for home basements.

The first practical demonstration of the fuel cell was made in 1959 by British engineer Francis T. Bacon, who has worked on them since 1932. Powering a fork-lift truck, the 2½-kilowatt Bacon fuel cell operates at about 400 degrees Fahrenheit and fuel pressures of 400 to 600 pounds per square inch. Under light load, the fuel cell has an efficiency of about 70%—in brilliant contrast to a high efficiency of about 40% for a sharply engineered steam-electric power plant. Fuel cell efficiencies approaching 100% are theoretically possible.

In the U. S., Research Laboratories of the National Carbon Company (a division of Union Carbide Corporation) have concentrated on developing a fuel cell that operates at room temperature and atmospheric pressure, and that uses air for its oxygen supply. The cell will work on hydrogen gas of commercial purity.

At least 20 American companies are reported to be developing fuel cells for practical applications in everything from outboard motors to space-going satellites.

One of the problems awaiting solution is containing the hydrogen gas in a compact tank. It has been suggested that strong, lightweight, ball-like pressure vessels made of polyester resins and glass fibers, used in some airplanes, might serve to package hydrogen gas.

Liquid hydrogen, vaporized for the fuel cell as needed, also is a possible power package. Although liquid hydrogen has been comparatively scarce, it can be made in large quantities. Recently it was announced that the U. S. is developing a revolutionary new liquid hydrogen and oxygen rocket engine. This suggests that techniques for routine production, cold-storage and handling of liquid hydrogen may soon be at hand.

All of these developments will help draw

the fuel cell closer to practical everyday applications for the average citizen.

As one group of scientists seeks to improve the fuel cell's inner parts, another group may seek to shrink the fuel cell's size, while still another group may juggle chemicals to find the optimum combination for power production. Another group may compare the several types of fuel cells.

Space scientists, meanwhile, will be developing storage and handling facilities for hydrogen, and suddenly—perhaps in the near future—all the pieces of the puzzle should drop into place.

And presto! your next lawn mower runs on hydrogen. Furthermore you can mow at any hour of the day without acoustically assaulting your neighborhood with putt-putt-putt.

Some visionaries believe the fuel cell is such a promising source of inexpensive electricity that aluminum companies—which require large amounts of power in the electrochemical process of reducing bauxite to aluminum—someday will be clustered about natural gas sources rather than hydroelectric dams.

The reason is that natural gas may be one potentially good fuel for a fuel cell. Generating power via fuel cells in natural gas areas might actually prove to be cheaper than generating it hydroelectrically at big dams—where water to turn the turbines costs nothing!

Science News Letter, January 16, 1960

Questions

ARCHAEOLOGY—What was red sulfide of mercury used for by ancient people? p. 37.

GENETICS—Who are the Nobel Prize winners in medicine for 1959? p. 38.

GEOPHYSICS—How many years back can thermoluminescence date an object? p. 35.

TECHNOLOGY—What is the "silent sentry" used by the Army Signal Corps? p. 42.

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Do You Know

Introduced commercially less than three years ago, high-density *polyethylene* achieved a 90,000,000-pound sales volume in 1959 to set a pace as America's fastest growing major plastic in history.

The five major *wool exporting countries* are Australia, New Zealand, Union of South Africa, Argentina and Uruguay.

Tektites, small chunks of black glass that may come from outer space, have been found in the U. S. only in Texas and Georgia.

The nation's schools received nearly $67,000,000 worth of *surplus foods* during fiscal 1959 through the National School Lunch Program.