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Popular Science

THE *What's New* MAGAZINE

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NEW "BREAKTHROUGH" ELECTRIC CAR

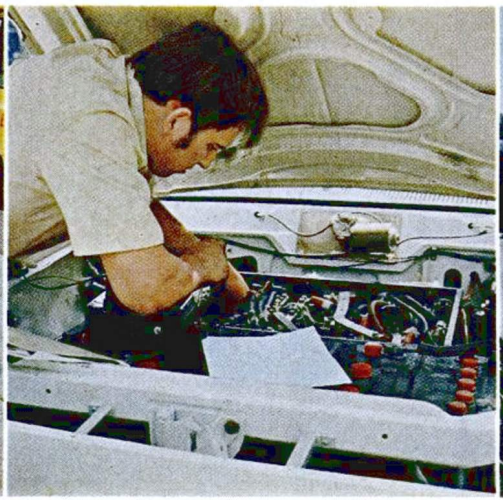
- 20-minute recharge
- 300 miles nonstop
- 90-mph top speed

The EFP stable now includes these electric cars: the Hornet-based EFP (left), EFP Battery Van (center), and Renault-based Mars II.

The EFP Battery Van runs on the power of 20 batteries. It has no clutch or transmission, and is reversed by a single toggle switch. Accelerator pedal selects from four battery combinations, and speed is maintained by constantly changing your foot position

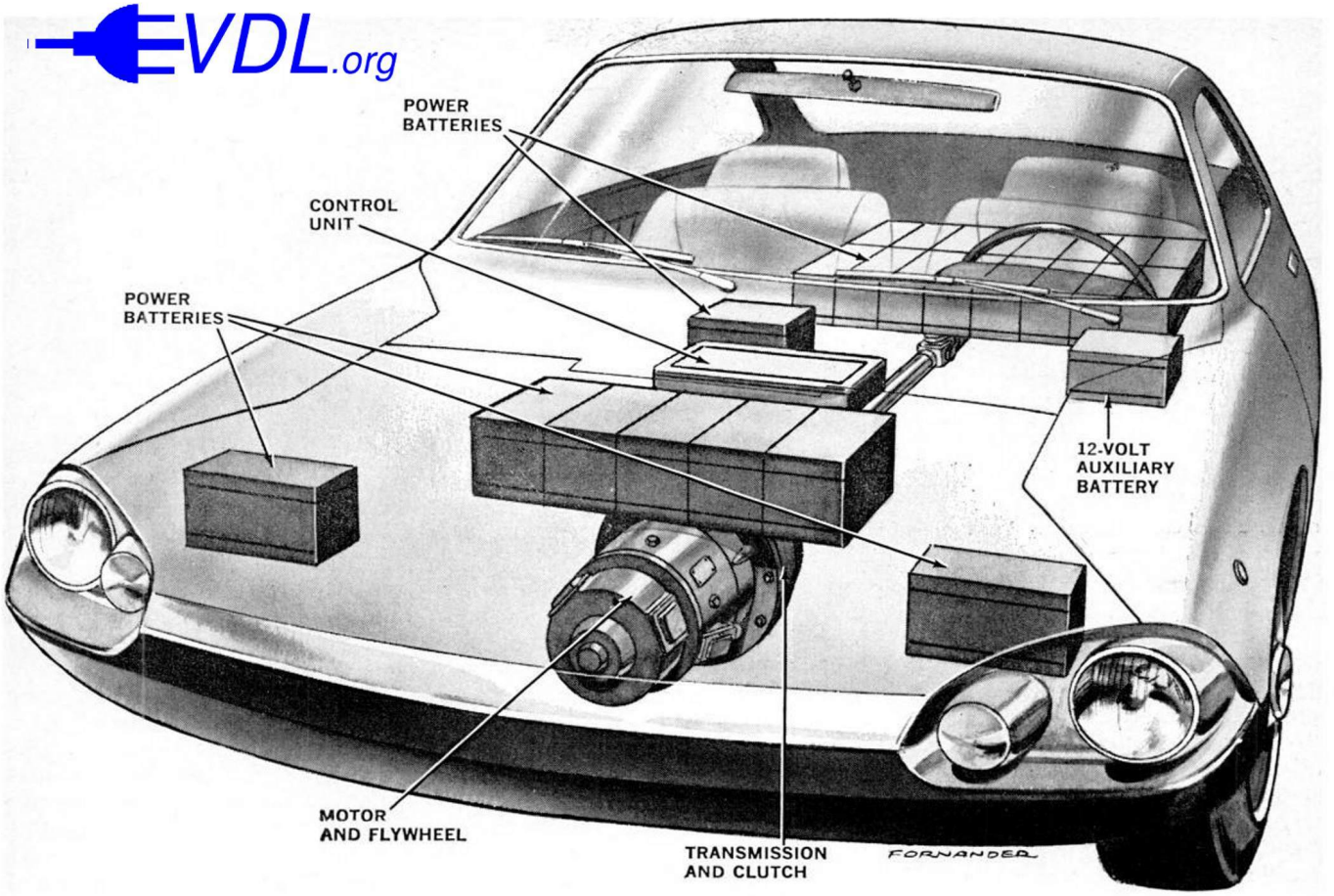
Full-scale mockup of the Voltair is shown by EFP president, Bob Aronson. The prototype of a 3,500-pound car with fiberglass body is now under construction. Its recommended top speed will be 90 mph, with a minimum range as high as 350 miles.

Batteries in the Mars II are stored where Renault 10's engine used to be—and also in front trunk. Mars II batteries weigh 1,900 pounds, raising vehicle's weight to 4,160.



Solid-state control unit weighing less than 100 pounds replaces the separate charger and Hartman control box of the EFP Electric, and also assures regenerative braking.

No trunk space was lost to batteries in the Hornet-bodied EFP Electric. They're stored up front, under the rear seat, and in a well below trunk. Curb weight is 5,300 pounds.



New Electrics Make Performance Breakthroughs

High speed and more range are putting battery-operated cars back in the running

By JOSEPH P. ZMUDA

Everybody knows that an electric car is a cumbersome land turtle of a vehicle, good only for carting around milk bottles, golf clubs, or little old ladies—right?

Wrong. The Voltair—a prototype electric seen in the cutaway drawing above and on our cover—will have a recommended top speed of 90 mph and the ability to reach 107 mph at overload for brief bursts. And it will have a range of 300-500 miles! A recharge takes only 20 minutes. Can it be possible? It sounds too good to be true, but a combination of the latest developments in electric-vehicle technology promises a real breakthrough in performance:

- Tri-Polar lead-cobalt batteries.
- Series-traction DC motor.
- Solid-state control unit.
- A patented fuel cell which trickle-charges the batteries at a constant rate.

These achievements come out of many years of experimental work by Robert R. Aronson and his company, Electric Fuel Propulsion, Inc., of Ferndale, Mich. Formerly head of a battery plant in New Orleans, Aronson made technical discoveries about batteries and motors he was quick to develop, then improve. He foresaw the need for a versatile, convenient-to-use electric auto that would also reduce air and *ear* pollution. (Electrics make only a slight whine even at highway speeds.)

And there is no doubt that electrics, with their high efficiency, can be cheaper to operate. Recharging at night, during off-peak hours, brings electrical power at half daytime rates.

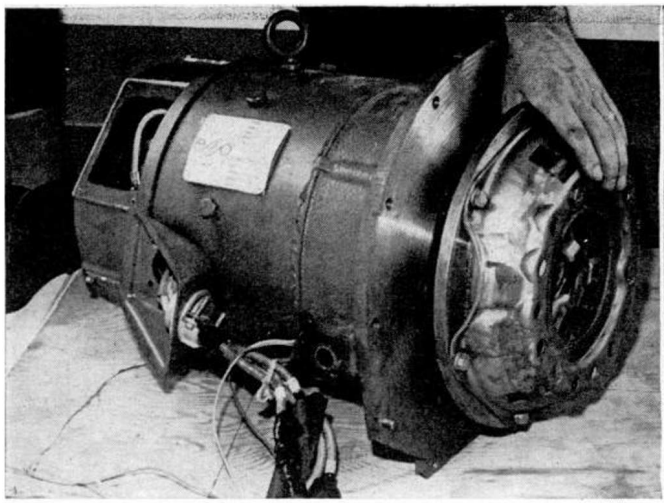
Reduced maintenance and fewer moving parts, especially, contribute to a battery car's economy. There's no oil to change, antifreeze to add, tune-ups to perform, or energy wasted running an engine on cold mornings. Battery power is ready to go instantly in any weather.

But let's go back to the Voltair's projected performance claims. What proof do we have that they aren't just dreams? To start with, there are the test results for a precursor of the Voltair. This car is the Hornet-bodied EFP Electric, which is now actually in production. It took first place for electric vehicles in the 1970 Clean Air Car race. Tests showed:

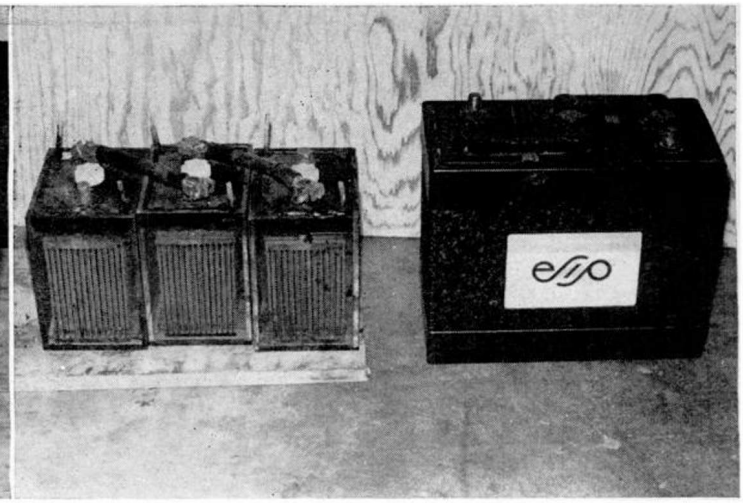
- Acceleration from 0-40 mph in 10 seconds.
- Sustained top speed of 70 mph, with short-interval overloads over 85 mph.
- An economical cruising speed of 55-60 mph and a corresponding battery range of 125 miles at fixed throttle.
- Quick recharging to 80 percent of battery capacity in 30 minutes, at less than a penny per mile.

Since the EFP Electric was designed, Aronson has made many improvements. His claims are realistic.

One of the key ingredients in the



EFP developed its own series-traction DC electric motor, capable of speeds from 0 to 7,000 rpm. It is mounted in place of engine, drives car with clutch and three-speed transmission.



Early Tri-Polar batteries (right) are almost double the size and weight of the newest version developed for the Voltair. New batteries have automatic electrolyte recirculation.

EFP's performance is the Tri-Polar lead-cobalt battery. A set of the batteries lasts 50,000 miles or five years, costs only $700—1.4 cent per mile. Resembling a standard lead-acid type both in appearance and operation, the Tri-Polar is structurally and electrically superior to all other inexpensive, non-exotic batteries.

The 29 positive and negative plates of each Tri-Polar cell are electrically bound at the top of the container and in two places at the bottom. These six current-collecting bars prevent vibration, buckling, and general movement of interior components. The cell is able to accept (during fast recharging) and deliver much higher currents than normal. The bus bars also heat the cold and dormant acid near the bottom, causing it to rise and circulate, improving overall efficiency.

The Tri-Polar is rated at 18 watt-hours per pound of weight, nearly twice the energy density of a standard battery at a cost only 20 percent higher. Addition of cobaltous sulfate and other proprietary chemicals allows the battery to be quick-charged at 400-500 amps DC without harmful oxidation of the lead plates or production of toxic gases. Shelf-life of one year represents a 300 percent improvement.

In addition to longer life and faster recharging, the Tri-Polar has a lower internal resistance and presents less of a voltage drop while in service. Discharge curves graphically illustrate that the potential of normal six-volt batteries falls to three or four volts when the battery is only half discharged. The voltage curve of a Tri-Polar is nearly horizontal, however, allowing its electrical energy to be utilized more completely.

Torque—and then some. Motion is provided by an EFP-developed series traction DC motor variable from 0-7,000 rpm. Although its electrical rating is only 20 hp, the figure refers to maximum continuous duty. There is little relation to the internal-combustion engine, which is top-rated. Demands of 120 hp can be made of the electric motor, especially at low rpm when torque is maximum and delivery is most efficient.

In fact, EFP engineers talk of "unwanted torque" because maximum power also means maximum current drain from the batteries. A three-speed transmission and clutch, along with an unusually high rear-end gear ratio of 4.44 to 1, allow the driver to select a motor-speed range and corresponding torque that don't waste battery power.

Acceleration in the EFP Electric is varied by a standard pedal linked to a Hartman controller. Nine power relays vary the arrangement of 24 six-volt batteries—from series/parallel to all in series—in 10 steps, which are selected by the degree of pedal depression. Changing gears allows greater flexibility: First gear is used in city driving, from 0-35 mph; second is for the intermediate range; third gear becomes important only at speeds above 60.

Solid-state controls. The Voltair will have new and lighter batteries, and a solid-state control system. The new batteries are half the size and weight of the Tri-Polars. They feature automatic recirculation of the electrolyte, allowing fast-charging in 20 minutes. Used in combination with Aronson's patented fuel cell which trickle-charges the batteries at a constant rate, the range of the Voltair will be at least 300-350 miles!

The Voltair's solid-state controller is called a three-in-one Dual Chopper. It was developed by the EFP-sponsored Electric Propulsion Laboratory at Cornell University. Two silicon-controlled rectifiers (SCR) allow no-step, infinitely-variable current/voltage selection with the accelerator pedal. Its maze of electrical components also contains a regenerative-braking feature.

Regenerative braking. This represents an important feature in stop-go traffic, over mountainous terrain, or in hilly areas like San Francisco, where it can add 15 percent to the battery range. To bring it into play, you remove your foot from the accelerator. Inertia propels the car forward, turning the motor as a generator that charges the batteries and quickly reduces vehicle speed. Touching the brake pedal brings regenerative action to maximum. Finally, at five mph or less, the car may be stopped by the brakes. These override the regenerative system at all times.

When can you buy a Voltair? Soon. Aronson plans to make 300 EFP Electrics by June; they'll sell for $10,000. The Voltair will come after that.

By producing 5,000 a year, the cost would be $6,850. In annual lots of 20,000 the figure might be as low as $4,000. According to EFP sales manager Jack L. Hunter, full-scale production would reduce the price to below that of present gasoline autos.

The early EFP Electrics are being sold to utility companies and government agencies interested in evaluating pollution-free transportation. (EFP No. 1 was bought by Arthur Godfrey.) Negotiations are also in progress with a car-leasing firm. Fleet-vehicle operators get the next opportunity to buy all-electrics, and finally they'll go to the public.

Aronson soon hopes to see plug-in parking meters that permit any electric vehicle to utilize its slow-charger; or, better yet, multiple fast-charging units in garages, shopping centers, and motels. Courtesy charge points have been set up in 76 such locations from coast to coast. PS