

# F.V.E.A.A. NEWSLETTER

March/April 1993

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## NEXT MEETING

April 16 @ 7:30pm  
College of Dupage  
Student Resource Center  
Room 1046

Use Lambert Rd. Entrance, Lot 7 at the Southeast corner of 22nd & Lambert.  
Nonmembers are always welcome!

**Director**

John Stockberger  
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## MEMBERSHIP INFORMATION

Membership to the Fox Valley Electric Auto Association is open to the public. Anyone interested in electric vehicles or electric transportation are encouraged to join. The cost to join is \$15 per year from November to November. If joining in the middle of the year the cost is \$1.25 for every month remaining til November of that year. The cost for new members joining this month is \$10.75.



## Fox Valley Electric Auto Association

336 McKee Street  
Batavia, IL 60510

### First Class

John Emde

6542 Fairmount Avenue  
Downers Grove, IL 60516  
USA

ADDRESS  
CORRECTION  
REQUESTED

## PRESEZ

This newsletter is for both March and April to make up for the loss of a newsletter last month. You will notice there are a few more pages than usual.

At the next meeting Ted Craft will show the second half of ElectroAutomotive's conversion video that we started last month. The reviews so far have been very positive.

I have tried to be selective of the articles chosen for this newsletter so as to not include alot of the same old "GMs has got the Impact and Ford has the EcoStar" kind of articles. The article from the Wall Street Journal on the European car market I found to be a great summary of what our overseas pals are doing.

A big thanks to John Emde for offering to assist in the printing, folding, stamping, stapling, sticking and colating of the newsletter. This is going to be a tremendous help. Thanks also to Steve Clark for taking the minutes at the Febuary Meeting, as well as a thanks to John Emde, Carl Chapman and Ken Woods for the article contributions to the newsletter and library.

There is an exciting EV related event coming up June 25 - 27 that only occurs once every three years. The Sunrayce '93 is a solar electric race from Texas to Minneapolis. This race is considered to be the North American trials for the World Solar Challenge which is held in Australia this August. I will be giving a talk at the festival in Minneapolis on EVs. I strongly recommend this event if you can make it. I will include more information in upcoming newsletters as well as have information at the meetings.

Douglas F. Marsh

## MINUTES OF FEBRUARY 19, 1993 FVEAA MEETING

The monthly meeting at the College of DuPage, Glen Ellyn, IL was called to order by President Marsh at 7:00 PM. There were 16 members and 4 guests present.

President Marsh explained that computer problems prevented the publication of this month's newsletter. He stated that 2 newsletters would be disseminated with the next six weeks. This, prior review by the membership of the Jan. meeting minutes was impossible & approval was tabled.

President Marsh announced a book donation to the association library - "The Clean Fuels Report" by J.E. Sinor Consultants Inc.

Treasurer Corel reported \$2,055.36 in the savings account & \$1363.15 in the checking account for a total of \$3418.51. The report was unanimously approved.

Director Emde recorded the "Beyond 2000" show from the Discovery Channel on Cable TV & the membership viewed it.

Members Richard Johnson & Steve Clark reported on progress of Ad Hoc Design competition Committee.

President Marsh reminded members by circulating an ad copy for an Electric Town Car for sale by member Krajnovich.

Member Ness donated NiCad battery literature to the association library and discussed his supply source as being surplus aircraft batteries.

The members discussed: 1) The association library and the need to consolidate and organize it. 2) Legislation approving 10% federal income tax credit for EV purchases. The association is waiting clarification correspondence.

Member Clark will ask Vice President Woods to arrange guest speakers.

Tabled approval of Ad Hoc Design Committee expenditures pending receipts. Unnamed members humorously expressed concerns that expenses might include accomodations at the Hilton Tower, Penthouse Suites plus chartered air fare & misc. fees & purchases at the Detroit Information Workshop with a side trip to the Montreal Winter Carnival to explore EV usage.

The meeting was adjourned at 9:28 pm.

Submitted by Steven F. Clark

Secretary Pro Tem

# Building electric hybrid is job one for U. of I. engineering students

By Rich Warren

In another era, college students would attempt to cram as many of their bodies as possible into a Volkswagen Beetle. Today they're trying to cram as many batteries as possible into a Ford Escort.

An engineering design team of about 60 students at the University of Illinois in Urbana-Champaign is competing with teams from 29 other universities in a contest sponsored by Ford Motor Co. to build the best electric car.

The winning teams in ten categories will share \$75,000 in prizes.

Twelve of the schools are building a car from the ground up, but for the U. of I. project and that of 17 other schools, Ford is donating a new Ford Escort wagon to be converted to electric power.

Ford Hybrid Electric Vehicle Challenge Manager Thomas Hall, who oversees the project, also credits co-sponsors, the U.S. Department of Energy and the Society of Automotive Engineers.

"The purposes of the challenge are to improve the cooperative link between the automobile industry, the government and leading engineering and technical colleges," said Hall. "We're hoping we'll interest young people in become automotive engineers and attract better students to it."

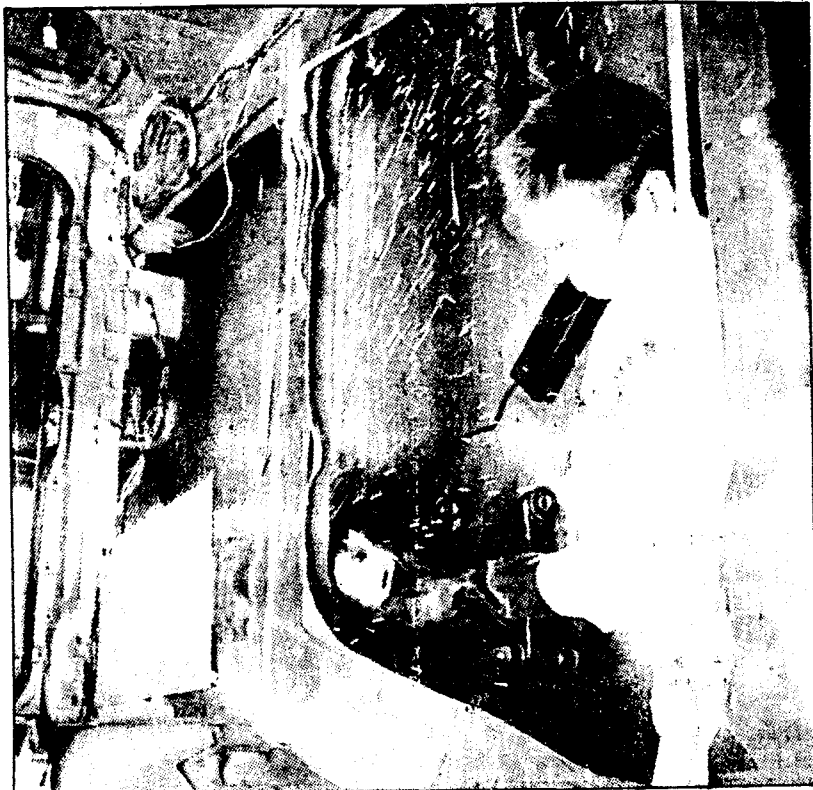
At Ford the project has become a magnet for its young engineers.

"My job is solely to be their mentor," said Hall. "About a hundred young Ford engineers, three to five years out of school, are actually putting on this event for Ford Motor Co. They're working as volunteers after hours."

Ford generated the idea in December 1991. The project began in February 1992 at the U. of I. with 40 students. A total of 150 students have participated, with the current team at 60.

The group is nearly evenly divided between electrical and mechanical engineering majors, with a few students from the general, civil and industrial engineering curriculums.

Thirty students sit informally in a lecture hall of the William Everitt Laboratory building on Green Street, the main drag on the U. of I. campus. They're batting ideas back and forth about pulley sizes, torque controls and time constants. Faculty adviser Dr. Philip Krein, an associate professor of electrical and computer engineering, is guiding the discussion.



Photos for the Tribune by Mark Cowan/AP

U. of I. student Erich Livengood works on hybrid electric car that will compete with 29 others in a Ford-sponsored contest.

The electric car group is scrambling to prepare its prototype for display. It must nearly complete the final version by Ford's March visit and present the car for judging June 1 in Dearborn, Mich.

The project has progressed at impressive speed. It takes an automaker such as Ford three years to design a new car with a large, full-time professional staff. Undergraduates around the country, working part-time, are completing the task in a little over a year. There are six consulting faculty members at the U. of I., including Krein's counterpart in mechanical engineering, Dr. Robert White.

The goal of the competition as viewed by the college is to show the ability and quality of U. of I. students and to give those students practical engineering experience.

Two students shepherd the project. Rob Weinstock is the electrical engineering team leader and Philip Guziec is the mechanical engineering team leader.

Rather than risk damaging the blue Escort donated by Ford, the students try their ideas on a beatup gray 1983 Escort that was once a university propane fuel demonstra-

tion vehicle. They call this car "The Mule," and it rides like one. A 110-pound, 25-horsepower electric motor and a small lawnmower engine have taken the place of a 250-pound, 1.9-liter, 93-horsepower, 4-cylinder engine.

Guziec recalls that most of the prototype's parts came off the shelf.

"We purchased a Sears Craftsman motor generator auxiliary power unit that was on sale at the time, which after this project can be used on other student projects," he said.

"We bought some cheap lead-acid batteries. You have to purchase these, you can't simply use old car batteries. Most of the rest of the parts were either donated or lying around."

Weinstock and Guziec pointed out that, with little state funding for the project, it's supported mostly by donations. Johnson Controls, for example, provided most of the specialized batteries for the final car. And students raise funds as an extracurricular activity. The students need \$110,000 to complete the \$250,000 project. The new Escort needs more new parts than the prototype did.



Livengood (from left), Rob Weinstock and Philip Guzic are among 60 U. of I. engineering undergraduates adapting a Ford Escort to run on battery power.

Though California requires the availability of zero-emission vehicles—dedicated electric cars—by 1998, the competition calls for a hybrid. So the U. of I. design team created its hybrid by adding a 53-pound, 620-cubic centimeter, 22-horsepower, ethanol-fueled engine. This two-cylinder, four-stroke aluminum engine runs a generator that charges the lead-acid batteries.

The engine spews very little pollution because of its small size and use of ethanol. Running it full-throttle at a constant speed translates into high efficiency and very low emissions. Guzic claims ethanol works better when used alone than when mixed with gasoline. The Department of Energy is providing an additional \$3,000 grant for using alternative fuels.

A conventional gas gauge shows the quantity of ethanol in the tank. It has taken students six months to design an accurate bar graph meter that shows the amount of battery charge remaining. So a driver has to read gauges to know driving range.

Batteries alone propel the U. of I. electric car for 40 miles before requiring a six-hour charge. Guzic said the range meets 80 percent of driving needs if the driver recharges the car while at work. However, the small charging engine extends the range to more than 150 miles.

The charging engine switches on automatically when the batteries are low, though it can be manually

locked off to meet local pollution regulations.

The car easily cruises at 70 miles an hour and accelerates faster than the original Escort.

Designers plan to include all the amenities of conventional cars, including motor, air conditioner and radio. An auxiliary heater, for northern climes, may have its own fuel supply like the booster heaters on the old Beetles. The air conditioner will be partially solar powered.

Weinstock noted that a fleet of purely electric cars could strain the nation's power generating capacity.

"Charging five cars in five minutes consumes enough electricity to power an entire city block," he said.

Work on the project was well underway by the time the new Ford Escort arrived. Its internal combustion engine received a two-month reprieve as the students spent time testing its performance. They would then compare this data to that of the electric propulsion system.

It's time for a test drive. In a university workshop, where the cars are parked, the new Escort is swaddled in protective mats.

The prototype Mule, however, is raring to go into the frigid night—without the heater that will warm the final car.

The interior of The Mule looks like any other aging Escort. The only difference is a small, touch-sensitive computer panel with a

digital readout mounted in the center of the dash. Computer software governs the prototype. The driver can re-program settings using the touch pad while driving.

The designers can fine-tune the performance to get the correct values for the final car.

The Mule accelerates around the parking lot like a real animal with a swarm of bees on its tail. The Mule enters the street silently but starts to kick. The three engineers quickly reprogram it from the touch pad.

An offer to buy the U. of I. electric car, which Weinstock and Guzic estimate to be worth \$40,000, is turned down. (The two engineering students claim mass production could bring the cost down to \$20,000.)

The university gains custody of the car, which will tour the state for one year, making a stop at the Illinois State Fair as a guest of the Illinois Corn Marketing Board, at the end of the project.

Ford retains the rights to use the technology developed for the car. Hall said Ford has asked for the rights to negotiate royalty terms with the universities for ideas or patented processes the students develop.

"We're trying to protect the schools so they can go out and patent their best ideas, but we have a chance to say we would like to use it in one of our cars in the future," he said.

# MINUTES OF MARCH 26 1993 FVEAA MEETING

The meeting in the Student Resource Center of the College of DuPage was called to order by President Marsh at 7:46 PM. There were 10 members and two guests present. Bad weather reduced attendance.

Treasurer Corel reported \$ 1365.77 in the checking account and \$ 2055.36 in the savings account. His report was approved.

Member Clark asked that the minutes of the December and January meetings be approved. After noting a date change of November 20 in the December minutes, the approval vote was unanimous.

President Marsh reported a continuing recovery from the computer "head crash" in January which affected the February Newsletter. He stated his intention to make a future newsletter a double issue.

We were given information by a guest about the Chicagoland Inventors Council that meets monthly in Hammond, IN.

Woods reported on the response he received from Congressman Hastert regarding the applicability of a tax credit for a recycled and converted EV. There was a brief discussion of this topic.

Most of the meeting was devoted to a review of FVEAA EV Infrastructure Design Competition entry being prepared by the 5 members of the competition committee. Numbered copies of the most-recent draft were distributed by Member Johnson. Member Clark noted the entry would be copyrighted in the names of the 5 principal authors. Discussion copies were collected at the end of the meeting for this reason.

The draft text review was led by Member Shafer. There was considerable discussion about the practical single charge range of an EV. The draft indicates 20 - 120 miles. The lower limit represents a range achieved by FVEAA members who have experience driving their converted cars. The upper range is that demonstrated by GM's IMPACT. A motion to reduce the upper range to 80 miles was discussed and failed.

After the review, a motion to approve the draft text as the FVEAA entry, subject to additional fine tuning by the competition committee at their final two meetings was made and unanimously approved.

A videotape made by Mike Brown of Electroautomotive, PO Box 113 in Felton CA, 95018 that was purchased by a FVEAA member was viewed. Time permitted running about half of the tape. The latter part will be scheduled for the April meeting. The meeting was adjourned at 10:40, closing time for the College.

Submitted by Secretary

## FOR SALE

Mechanix Illustrated Electric town car by Owner/Builder:  
George Krajnovich  
17W381 Eisenhower Rd.  
Oakbrook Terrace, IL 60181  
(708) 834-0370

Asking 50% of material building costs less batteries.

The 2500Watt Hybrid is powered by a B&S 5 hp and 8 hp drive motor (Baldor) both removed this spring while upgrading to a 12hp G.E. Motor. Can be purchased separately.

1982 Electric Car with plans, tow bar	\$2900
Hybrid Unit complete with controls	\$450
8hp Baldor Motor with adapters	\$400

For information and/or demonstration ride give me a call. I have aspirations of converting my Caravan, old one that is, to electric.

## For Sale

3 foot 19" standard computer racks with casters. Perfect for test equipment mounting. \$15.00 each. Contact Doug Marsh (708) 879-8089.

## FOR SALE



12 VDC 115MA BRUSHLESS 7 BLADE  
2-3/8" x 1" THICK 15 C.F.M.  
USE FOR COMPUTERS - POWER SUPPLIES  
BATTERY CHARGERS - CONTROLLERS  
VENTILATE YOUR BATTERY BOX  
WHOLE HOUSE FAN FOR DOLL HOUSE  
HOVER CRAFT - CAR DEFROSTER  
VENTILATOR FOR DOG HOUSE  
THE POSSIBILITIES ARE ENDLESS  
\$4.00 ea. 10 or more \$3.50 ea.  
John Ende (708) 968-2692

# European Car Makers Still Push Plans, Though Slowly, to Make Electric Autos

By CACILIE ROHWEDDER  
And ROBERT L. SIMISON

Staff Reporters of THE WALL STREET JOURNAL

BRUSSELS—Although Volkswagen AG recently backed out of an electric-car project with Swatch, European auto makers are still pushing toward battery-run cars, albeit slowly.

VW itself expects to offer an electric version of its popular Golf subcompact early next year, although it doesn't expect to sell very many. Fiat SpA is making and selling a few electric versions of its Panda and Cinquecento subcompacts; PSA Peugeot-Citroen is testing electrified small cars; and even Daimler-Benz AG's Mercedes-Benz division and Bayerische Motoren Werke AG are fiddling with electric cars.

Aside from a few government-sponsored trials and experiments, though, don't expect to see many battery-powered cars humming around Europe any time soon. Despite the idea's allure among some environmentalists, the technology simply hasn't been invented that would make electric cars practical for most uses. Today's batteries won't power a car far enough, and they take too long to recharge.

## Not Taken Seriously

"Nobody is taking it seriously," says Peter Schmidt of Auto Industry Data Ltd. in England, an industry consulting group. "The prime requirement," he says, would be for a mandate, as the state of California has in the U.S.

Starting in 1998, California will require that zero-emission vehicles—electrics—account for 2% of each auto maker's sales in the state; the proportion is to rise to 10% in 2003.

This has spurred U.S. car makers to come up with electric cars quickly.

Ford Motor Co. and Chrysler Corp. have converted existing gasoline-powered vehicles to electric models. But as with European experimenters, they've had their share of starts and stops. And General Motors Corp., in December, said its budget forced it to shelve its ambitious plan to mass produce its Impact electric car, although it will continue to work on prototypes. The Big Three U.S. makers also are planning to collaborate on electric-car technology.

Japanese car makers, big players in the U.S., also are pursuing electric-car development.

The threat of more California-style requirements is prompting Europe's auto makers to stay current on electric-car development. Other U.S. states may follow California, and at least some European cities eventually may require electric cars in an attempt to clear the air in polluted downtown areas.

## Trials in Europe

Indeed, European governments are backing trials here and there. In Germany, the Ministry for Science and Technology is sponsoring a large-scale experiment on the eastern German island of Ruegen. There, VW, Mercedes, BMW and the Adam Opel AG unit of General Motors Corp. are testing electric models.

And in France, the government signed an agreement last July with Electricite de France to install battery recharging facilities in 22 French cities by 1995. The plan is to set up small service stations where electric cars can plug into devices resembling parking meters for a six-hour to eight-hour recharge. There also will be recharging points at large gas stations, where electric-car drivers will be able to pop in for a "quick" 10-minute recharge that will be good for about 20 kilometers (12.4 miles).

While such realities make car marketers despair, they don't daunt the true believers in the future of electric cars. Nicolas G. Hayek may be one of them. The chairman of Societe Suisse de Microelectronique & d'Horlogerie SA, the maker of Swatch watches, is sticking with his dream of producing a cheap, trendy, environment-friendly minicar, despite VW's defection.

## Other Candidates

Mr. Hayek says that his company, also known as SMH, is studying offers from several car companies interested in taking the place of VW, which pulled out to save money. But SMH declines to identify the candidates. Recent news reports have mentioned Peugeot, Renault, Mercedes, AB Volvo and Opel. Spokesmen for all of them have said they aren't interested.

Anyhow, Mr. Hayek maintains that SMH may not need a car-company partner, and at least one electric-car developer believes him. "They could quite easily go ahead without VW," says Sir John Samuel, a director of Clean Air Transport Svenska AB. "Swatch could use VW as a component supplier; we do."

## Delay in Production

Clean Air Transport is an Anglo-Swedish concern that has been developing an electric car for the California market with assistance from the city of Los Angeles. As recently as September 1991, Sir John and his colleagues were promising to put their car, a luxury four-passenger electric with an auxiliary engine, on sale in early 1993. Now, they say, production isn't slated to start until late 1994.

What happened? Clean Air Transport officials say it has taken longer than expected to line up the \$30 million in additional financing that they needed. But they say \$20 million is in place and they are looking for someone willing to risk the final \$10 million.

Meanwhile, Europe's established auto makers are proceeding cautiously, mostly experimenting with electric versions of existing car models. Some of them see electric cars fitting into the relatively new phenomenon of the two-car European family. "In the morning," says Uwe Mahla, a BMW spokesman, outlining a scenario for the future, "the family discusses where they go. Whoever has the shorter way, takes the electric car."

Here is a look at what some of Europe's car makers are doing with electrics.

—VW early next year plans to start producing the "City-Stomer," an electric Golf capable of traveling 90 kilometers at the speed of 50 kilometers an hour without recharging. VW hasn't set a price, and it says it will build only 100 at first. VW is also testing a "hybrid" version, which would have an auxiliary engine to extend the car's range.

—FIAT has been selling electrified Pandas and Cinquecentos for about \$20,000 each, which Fiat says is its cost. A spokesman says sales have come to a few hundred units and have been mostly to public utilities. Depending on battery configuration and other variables, the cars can go 100 to 150 kilometers without recharging. "This shows that Fiat can move to the stage of initial production," a spokesman says.

—PEUGEOT is planning to sell electric versions of its Peugeot 106 and Citroen AX models in 1995. The idea is to acquaint the public with electric cars before Peugeot takes the step of offering a purpose-built electric car at the end of the decade. The auto maker hopes to sell the battery-powered models at the same price as its conventional cars. They will need to be recharged after 120 kilometers and have a maximum speed of 160 kilometers an hour.

—MERCEDES-BENZ later this year plans to build 500 to 1,000 electrified versions of its 190 compact car. Unlike some of the other auto makers, which sometimes convert the rear passenger area into a battery compartment, Mercedes aims to preserve interior room by placing the batteries under the hood and in the trunk.

—BMW is testing electrified touring models and small passenger cars at Ruegen, but it isn't planning to go into production with electric models. Its efforts had a five million-mark (\$3.2 million) setback recently when the prototype of a new small electric vehicle, which BMW exhibited at the Frankfurt auto show in 1991, went up in smoke after a battery charger short-circuited.

# Using Spin to Power Electric Cars

By GLENN RIFKIN

When General Motors introduces its battery-powered Impact in the middle of this decade, the electric automobile will be powered by a souped-up version of a conventional lead-acid battery. But even though G.M. believes this energy source can make the Impact a viable alternative to gasoline-powered cars, the auto maker concedes that the lead-acid battery may not be the long-term answer for electric vehicles.

California has given G.M. and the other auto makers a powerful incentive to develop practical electric cars by requiring the companies to insure that 2 percent of their vehicles have zero emissions by 1998. The auto industry's principal focus is on improving the conventional battery, which has a limited power storage in relation to its weight and takes several hours to recharge.

Yet even as some scientists and engineers are rethinking the way energy is stored in electric vehicles, others are updating the ancient concept of a mechanical whirling dervish: the flywheel.

## Testing New Materials

Small groups of university and national laboratory researchers, along with a start-up company in Bellevue, Wash., hope that a flywheel built of new materials will be able to store enough energy to make practical the long-sought ideal of an electric car with a range and acceleration competitive with conventional cars.

"Technically, nothing holds us back today," says Richard F. Post, a researcher at Lawrence Livermore National Laboratory in Livermore, Calif., who is seeking industrial partners to build a flywheel system. "The materials and the design principles are available. What holds us back? There is a huge battery industry but there is no flywheel industry."

The principle of the flywheel is based on kinetic energy, which is the energy of a moving object. Because a flywheel has a heavy rim, once a force sets it spinning, the wheel tends to keep spinning — a property that makes a flywheel a reservoir of energy. As power is added, the flywheel speeds up; as energy is drawn off in the form of useful work and wasted friction, it gradually slows.

A potter's wheel, propelled by the occasional spin of its axle by the potter's foot, is a time-tested version of the flywheel. And most combustion engines, including auto engines, use flywheels to convert the jerky motion of the engine's exploding cylinders into a smooth and continuous source of power for the drive train.

## The concept of a potter's wheel is applied to autos.

The concept of using flywheels to power electric vehicles has been around for decades. Buses in Switzerland were powered by giant steel flywheels 40 years ago, but the buses had to be recharged at each stop. Today, flywheel enthusiasts say, advances in technology and materials make the idea more feasible.

In theory, a flywheel for producing electricity for an electric car would be made of extremely strong composite materials that could spin up to 200,000 revolutions a minute without breaking apart, and would be mounted on special bearings to reduce the friction-caused slowing to a negligible amount. At such speeds even a lightweight flywheel is capable of storing enough energy and producing enough power to run an electric car.

The flywheel's energy would be tapped through electromagnetic means. Magnets spinning on the flywheel would be placed so they passed near coils of wire in a battery housing. This would induce an electric current in the coils. The power would be sent to an electric motor that would drive the axle.

American Flywheel Systems Inc., the Bellevue, Wash., company that received patents last June for its flywheel design, contends its device could power an electric car for 300 to 600 miles on each charge compared with the current 100 miles per charge for G.M.'s Impact.

The company says its device could produce 60 to 90 watt-hours a pound. The battery in the Impact stores 12 to 15 watt-hours a pound, which is only enough energy to keep a night light burning about two hours.

By plugging into a standard household electrical outlet, the flywheel could be "spun up," or recharged, overnight — or as fast as 15 minutes at a special high-powered "flywheel filling station." Proponents say the cost of the electricity would be competitive with that of gasoline.

## Other Projects

Flywheel research is also being conducted at Oak Ridge National Laboratory in Tennessee and at the University of Ottawa in Canada. Uniq Mobility, a Denver company, is working on a flywheel that would be integrated with an extremely dense motor to form a hybrid vehicle for urban driving. Ray A. Geddes, Uniq's chairman, says Ford, BMW and Fiat have expressed interest.

But flywheel technology still faces many hurdles set by nature and public confidence. The American Flywheel Systems design has yet to be turned into a prototype, and skeptics say that until one is working, the device is just another unproved idea.

The Energy Department has joined Ford Motor, G.M. and Chrysler in the United States Advanced Battery Consortium. John R. Wallace, the chair-

man of the consortium and the director of Ford's electric vehicles program, said the consortium had not ruled out sponsoring flywheel research. But he acknowledged that the consortium was concentrating on improving conventional batteries.

One concern about flywheels is that the rapidly spinning large wheel, like a gyroscope, would have an inertia of

its own. A driver might turn a corner, but the car's flywheel would want to proceed straight ahead.

A second hurdle, which flywheel designers say they have already overcome, is the possibility that the extremely high speeds would cause the flywheel to break apart, sending shrapnel-like pieces in all directions.

## Benefits Are Foreseen

Should the current bugs be ironed out, flywheels have advantages that make them attractive, at least to theorists. They can produce great acceleration, eight times the horsepower per pound of a V-8 engine. And a concept called regenerative braking would allow energy to be recaptured as the vehicle decelerates instead of being dissipated as heat.

Even better, the flywheel could conceivably last for 200,000 miles or more and is nontoxic, while the lead-acid battery in the Impact must be replaced every two years.

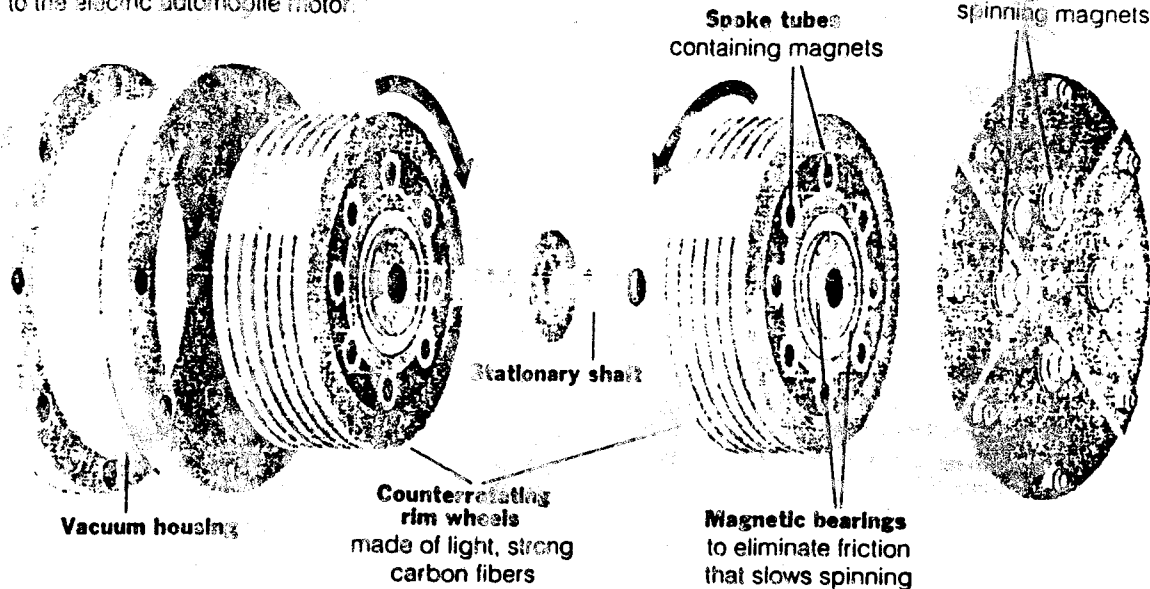
Based on some of Dr. Post's original concepts, Jack G. Bitterly, an aerospace scientist, and his son Steven set to work on flywheels. In 1990, they founded American Flywheel Systems. Mr. Bitterly, a former engineer with the National Aeronautics and Space Administration, created balancing techniques for high-velocity spinning masses used in developing the space shuttle. He envisioned three main flywheel developments.

The first was to increase the structural integrity of the flywheel's rim, which is reinforced with carbon-com-

## A Prototype for a Flywheel Battery

Kinetic energy, or the energy of a moving object, is the principle behind the flywheel battery, proposed as a power source for electric cars. As the wheels rotate, magnets placed on the spoke tubes produce current that provides power to the electric automobile motor.

**Pickup coils**  
Coiled wires that pick up electromagnetic current generated by spinning magnets



source: American Flywheel Systems

The New York Times

posite fibers, through a special filament winding technique. He then developed spoke-like connectors that could expand with the rim at high speeds and still provide overall stability. The idea was an efficient means of spinning the rim to store energy and of extracting useful power while slowing it down.

The Bitterlys built the rims and tested them to destruction. They discovered that when a flywheel made of composite fibers broke apart, it produced a fluff of "cotton candy" material rather than the high-velocity shrapnel that steel flywheels produced when they disintegrated.

### Seeking Support

Edward W. Furia, the president of American Flywheel and a former official of the Environmental Protection Agency, has found some backing from a Dutch bank and is also seeking support from auto makers and the Federal Government.

He is seeking \$10 million to build a prototype, which he says can be ready in 12 months, with a production model to follow in another 12 months. He said economies of scale achieved by mass production would bring the price of the flywheel device near to that of a gasoline engine.

"It's the nature of innovation that when a new technology is proposed, there is always institutional inertia," Mr. Furia said. "It's a knee jerk reaction to say it won't work."

## 1993 HAMFESTS

April 18

Rockford Hamfest  
Rockford Metro Center  
300 Elm St.  
Rockford, IL  
8:00 am - 3:00 pm

May 16

KARS Hamfest  
Will County Fairgrounds  
I-57 Exit 327  
Peotone, IL  
6:00 am - 3:00 pm

May 30

Chicago Amateur Radio  
DeVry Institute of Tech.  
3300 N. Campbell  
Chicago, IL  
8:00 am - 3:00 pm

June 13

Six Meter Club  
Santa Fe Park  
91st & Wolf Rd.  
Willow Springs, IL  
6:00 am - 5:00 pm



# EV racers rely on time-tested batteries

By Jack Keebler

BRAINNEWS SERVICE

PHOENIX — Although carmakers continue to grope for a miracle battery breakthrough, pragmatic electric-car builder-racers continue to rely on lead-acid batteries as the chemistry of choice.

Carmaker engineers indicate that although research for new high-powered batteries is providing insights, near-term lead-acid batteries will likely power production electric vehicles because of their recyclability, safety, low cost and well-understood recharge strategy.

Last year's Arizona Public Service Solar and Electric 500 ended abruptly when a race lead car battery belched clouds of toxic gas. Burning eyes and throats sent crowds scurrying and forced organizers to evacuate the track and call in a hazardous waste team.

The public, racers, organizers and carmaker engineers at that event were all taking notes and learning, in that case the hard way, about the pros and cons of electrically powered vehicles.

But at this year's third annual event, organized by the Solar and Electric Racing Association of Phoenix, the only thing in the air March 5-7 was the excitement of watching electrically powered cars buzz Phoenix International Raceway's one-mile oval. Prize money totaled \$90,000.

"People come here with components and try them under the most extreme conditions," said David Smith, a program management specialist with Chrysler Corp.'s TEVans project. "There are extremes here you might never see under regular consumer use. So it provides an opportunity to test the durability of new batteries and driveline stuff."

General Motors, Ford Motor Co., Chrysler and Honda engineers tried to keep a low profile as they cruised the pit and work areas scribbling notes and talking to race-team members.

Although some carmakers were race team co-sponsors, their level of sponsorship was not readily apparent because the vehicles, their crews and the pit area were devoid of automaker insignia.

The only official factory effort was the gasoline-powered GM APV minivan, which paced races with a manufacturer license plate.

From spindly, insect-looking solar-powered three-wheelers to open-wheeled racers that resembled Indy 500 vehicles, the racing was intense bumper-to-bumper stuff with choreographed, 17-second pit stops and showcase technology and workmanship. In the Open Full-Sized class, one racer lapped the track at 100.253 mph setting a national closed-course one-mile record, while solar lightweights zipped along at a steady 30 mph.

Contestant skill levels ran the gamut from college physics professors to high school students.

General Electric Co., which sponsored many of the high school student vehicles, also was prominent at the race.

Said Maurice Isaac, GE's manager of automotive technical programs: "If just one of these kids here comes up with the answer to the battery range problem, then all of the money spent on events like this will have been well worth it."

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## Battery Study May Be Key to Electric Cars

By Mark A. Stein

Los Angeles Times

Arizona State University researchers have developed a rubbery conducting substance that may make it possible to combine the superior energy storage of lithium batteries with the convenience of dry cells, a potentially important step toward mass-producing practical electric cars.

Key to the new concept, which scientists said still may be years from the marketplace, is a reversal of the ratio of the two main ingredients most often used in experimental electrolyte, the chemical substance that conducts electricity inside the battery.

Rather than lightly "salting" some plastics to make a solid electrolyte that conducts poorly, chemistry professor Charles Austen Angell and his colleagues tried adding a little plastic to a vat of molten lithium or aluminum salts.

The resulting rubbery electrolyte stores energy well and releases it quickly, they reported last week in the journal *Nature*.

Private and government scientists are aggressively studying these lithium-polymer cells because of their potential to hold more energy in less space than conventional lead-acid batteries. Better batteries can make electric cars weigh less, accelerate faster and go longer between recharges, thus making them more competitive with gasoline-powered cars.

"Batteries are the thing that give you the range and cost the most, so you want them to be as light, compact and powerful as possible," said Richard Schweinberg of Southern California Edison. The utility is part of the Advanced Battery Consortium, which is spending \$53 million on battery research. Most is focused on lithium-polymer technology.

Some scientists criticized the electrolyte recipe cited by Angell and his colleagues as impractical. The article discusses electrolytes with lithium chloride or aluminum chloride, salts that readily absorb moisture from the atmosphere. This is a problem because the water they absorb can corrode other vital battery components.

"Turning it all around—making a polymer-in-salt instead of a salt-in-polymer—is a good idea, a clever approach," said one scientist, a competitor in lithium-polymer research who agreed to speak only if not named. "But this particular combination [of salts] isn't going to do it."

Angell, in a telephone interview, said he and his colleagues, Changle Liu and Eduardo Sanchez, concede that "the salts we used in our demonstration are probably not acceptable in commercial applications."

"But," he added, "there are a lot of other candidates that we hadn't tried because they were difficult to handle or difficult to obtain."

# Electric commuter cars to debut here by '95

By David Iyata

Imagine stepping off the 5:05 train from Chicago to Roselle, sliding a credit card through a slot and checking out a little electric "station car" that you'd drive home to Schaumburg and bring back the next morning.

Or instead of driving from your home in Chicago to a job in Oak Brook, you'd take a morning Metra train to Hinsdale, pick up a station car for the short jaunt to your office, and return the car

that evening for the train trip back to the city.

Electric cars are on their way to debuting here by 1995 as part of a nationwide demonstration of the station car by nine transit agencies, including Chicago's Regional Transportation Authority.

"It's a tremendous thing for the RTA to get this," said John Straus, director of program development at Packer Engineering Inc., a Naperville firm that has been advising the RTA on station cars.

"Think of the implications for employers like Sears, Roebuck and Co., with 5,000 people in Hoffman Estates," Straus said.

No longer will you have to keep an old beater around for those home-to-station trips, or run down your fancy new car driving to and from work every day, paying the costs of gasoline, upkeep, insurance, license fees, parking, tolls and the like.

And unlike an ordinary shuttle bus, a station car also would let you run personal errands on the

way to and from the train.

Station-car backers aim for two markets: People who yearn for the freedom of driving their own cars, without the hassles of ownership; and major employers subject to the federal Clean Air Act, which requires companies to reduce workers' trips in conventionally powered vehicles by 25 percent by 1996.

As part of the demonstration, the RTA will get 50 station cars out of a combined order of 405. Other vehicles will go to transit

authorities in Atlanta, Boston, Los Angeles, Orange County (Calif.), Sacramento, San Diego, San Francisco and Washington, D.C., according to Martin J. Bernard III, manager of the National Station Car Consortium.

The Oakland, Calif.-based consortium is an organization of transit providers, electric utilities, federal energy laboratories, automakers and academics.

"This will be the first big purchase of electric vehicles," Bernard said. "The game is to get the numbers up to get reasonable prices for the kind of quality we want."

A request for proposals is going out to manufacturers, Bernard said. At this early stage, he added, no one can say how much the cars will cost.

In a study for the RTA last year, Packer Engineering quoted one manufacturer's estimate that a demonstration fleet of 50 prototype vehicles could cost \$300,000 to develop and \$20,000 per car to produce.

With the consortium order, manufacturers presumably would bear the development costs in hopes of winning a contract to build hun-

dreds of the vehicles.

"This really has to be a national effort. The cost for only 50 or 100 or 150 cars would be very high, but when we start talking about numbers of electric vehicles that eventually could be in the thousands, we're starting to look at costs that could be more reasonable," said Marc Hillier, assistant executive director of the RTA.

Hillier noted that the demonstration also would put people behind the wheels of electric cars years ahead of the first production models expected out of Detroit—largely because the showroom cars will try to match the range and performance of today's gasoline-powered vehicles.

Not so with the humble station car. The vehicle probably will have a range of only 45 miles in stop-and-go suburban driving, range being

sacrificed to keep battery costs low, Bernard said.

Every station car will, however, have to meet federal crash worthiness standards, Bernard said.

They may come in two- and four-seat configurations—the larger cars to satisfy a request by Orange County transit officials that the vehicles be usable in train-to-work carpools.

But an earlier idea of the RTA's—to conserve space by building the cars as stackable units, with fold-up noses like shopping carts—was jettisoned by the consortium to simplify the vehicle order.

"This demonstration is not to test the technology, but to test transit riders' acceptance of station cars," Bernard said. "The technology already is there for electric vehicles for short to moderate-range trips."

As for who will pay for this demonstration, Bernard said, "We assume that federal monies will fund 50 percent of the cost."

The balance, he added, "I'd expect to be covered by the state, the local electric utility, possibly certain communities and of course the RTA."

To conduct the local demonstration, the RTA will be scouting suburban Metra stations as possible station-car staging sites, and looking for a rental car agency to establish rules for letting out the vehicles, Straus said.

The RTA also may seek a major suburban employer to test a corporate station-car pool for reverse commuters—people who would take public transportation to the suburbs if only there was a convenient way to get from the Metra station to one's workplace, Straus said.