F.V.E.A.A. NEWSLETTER

SEPTEMBER 1986

MEETING NOTICE

The next meeting will be friday **SEPTEMBER 19th**, at *CRAGIN FEDERAL SAVINGS & LOAN* 333 W. Wesley St. Wheaton, Illinois.
- Time - 7:30 P.M. *sharp*. Guests are welcome and need not be members to attend the meeting.

NOTE

Due to construction on Wesley St. in front of our meeting place, access to the parking lot must be made from the west side on West St.

FOX VALLEY ELECTRIC
AUTO ASSOCIATION
624 PERSHING ST. WHEATON, ILL. 60187

FIRST CLASS

ADDRESS CORRECTION
REQUESTED

BILL'S BOARD

RAFFLE CAR

At the last meeting several members agreed to work on getting the Raffle Car operational. We are purchasing batteries, installing them in the car, and getting it running. In addition the question of titling and licensing was discussed and opinions sought on insurance during the time members are "Proof-testing" the car. Progress reports will be made September meeting.

HAMFEST APPEARANCE

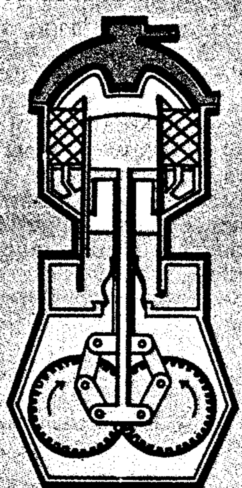
The discussion about our presence at Santa Fe Park concluded that the FVEAA should make an appearance with a car at the coming Hamfest in St Charles. Member Meyers will investigate and report at the next meeting. Our purpose is to make our program known to more persons and try to interest persons to become new members.

NEXT MEETINGS

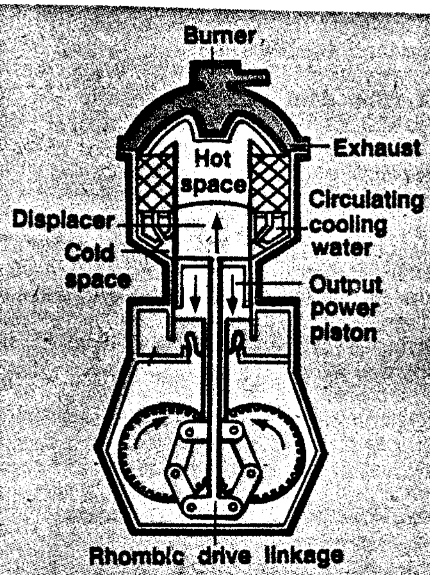
The sixth and final paper in the "Performance" series will be discussed at the next meeting. It will conclude the battery charging topic introduced last time. The October meeting will begin a discussion of our possible development of a hybrid car which could overcome the performance limitations of the all-electric we have been discussing.

The Stirling engine

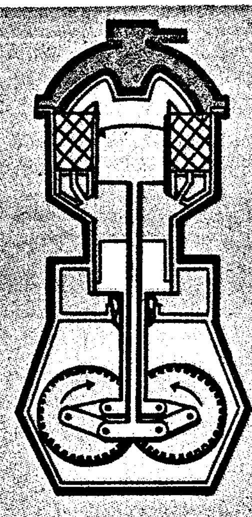
The Stirling engine, an old idea that is attracting new interest, can operate on a much wider variety of fuels than standard engines, including alcohol, vegetable oil, wood chips and coal, and is non-polluting as a result. It converts more energy from its fuel than standard engines do.



1 One operating cycle of the Stirling engine begins with gas in the hot space expanding when heated and pushing down the power output piston and displacer.



2 When the gas is almost fully expanded, the piston continues to push down but the displacer begins to move up to push gas out of the hot space and into the cold space.



3 The displacer is near the top of its travel when the gas contracts drawing up the piston which pushes the back into the hot space, thus restarting the cycle.

PUTTING PERFORMANCE IN YOUR ELECTRIC CAR-PART V

The June meeting discussion defined the electrical system as a 72-volt, single-string series connected arrangement using twelve 6-volt golf-cart batteries. In this paper, we will discuss the characteristics of various batteries available for our conversion project.

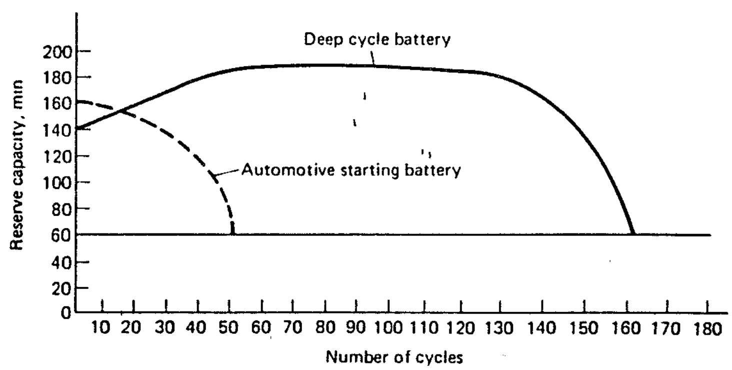
Operational life of batteries is the most important cost factor of electric car ownership. It is partly determined by use pattern, but battery type has an important effect. In Part III, we calculated acceleration current to be 390 amps at 72 volts for 6 seconds, and 60 mph cruising current of 265 amps. What is the best kind of battery to deliver these currents?

Let's start with a battery type that is most-familar, the Starting-Lighting-Ignition (SLI) unit in a conventional car. It is designed to deliver a brief, high current during starting followed by immediate recharge by the alternator system, and then by "float" at full charge. An SLI battery is rated by two factors, cold-cranking amperes (CCA) and reserve capacity.

CCA is the current a fully-charged battery at 0°F can deliver for 30 seconds to a 1.2 volts per cell level. A typical Group 27 battery has CCA rating of 300-600 amps.

The reserve capacity is used to measure the ability to provide power for lights, auxiliaries, and ignition. It is the number of minutes a fully-charged battery at 77°F can maintain a 25-amp current to a 1.75 volt per cell level. A typical Group 27 battery has a reserve capacity rating of about 100 minutes.

SLI battery electrical parameters (CCA and reserve capacity) may appear to meet our EV needs, except cycle life must be considered. To achieve CCA and reserve rating, the SLI battery contains a large number of thin plates which maximizes plate surface active area.) The SLI battery, when repeatedly discharged and charged sheds material off the plates with each cycle and has a limited life. Typical cycle life characteristics are illustrated by these curves: Since we don't want to replace batteries every month, the SLI design cannot be used for electric cars.



Cycle life characteristics at a low discharge rate (25 A), deep-cycle vs. SLI-type batteries. *(Courtesy of GNB Batteries, St. Paul, Minn.)*

To achieve longer battery life, a deep-cycle design must be used. These have fewer plates, but each is thicker than the SLI design. Also, the lead paste has a high density to help retain the active material during cycling. There are other design features such as premium separators, use of glass fiber matting to retain plate material, and capacity that is limited, when new, by electrolyte amount rather than by plate material. Deep cycle batteries are made in both 12 and 6-volt units.

The most-common 12-volt deep-cycle battery is made for RV, marine (trolling), or wheelchair use where the operational current is about 25 amps. A Group 27 size, about 12" long, 7" wide, and 9" high with a weight of 50-55 pounds has a 90-105 ampere hour rating at a 20-hour discharge. Battery internal resistance for this type is relatively high compared to 400 microhms typical for an SLI battery. This causes the terminal voltage to collapse with high currents. This battery type is not suitable for electric car use.

The following table is a listing of golf-cart type, deep cycle batteries for electric car use made by the Globe Battery Division of Johnson Controls:

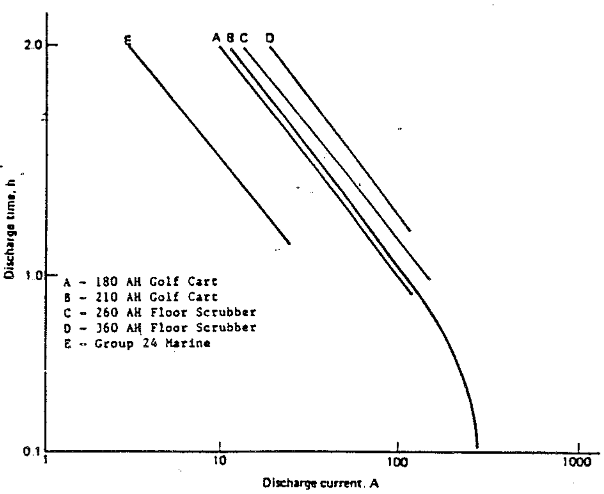
Typical Electric Vehicle (EV) Batteries

Battery model	BCI group	Volts	Plates per battery	Maximum overall dimensions, mm			Weight, kg	Ah at 2 h	Ah at 3 h	75 A (min)	Wh/kg at 3-h rate
				Length	Width	Height					
EV-250	U1	12	54	197	132	186	95	20	22	15	26
EV-675	24	12	78	260	173	225	22	55	59	39	31
EV-750	GC2	6	57	264	183	270	26	126	135	100	29
EV-800	27	12	90	306	173	225	24	62	68	45	32
EV-950	GC2	6	57	264	183	270	30	150	171	120	33
EV-1000	GC2	6	39	264	183	280	27	158	174	140	37

SOURCE: Globe Battery Div., Johnson Controls, Milwaukee, Wisc.

Cycle Life

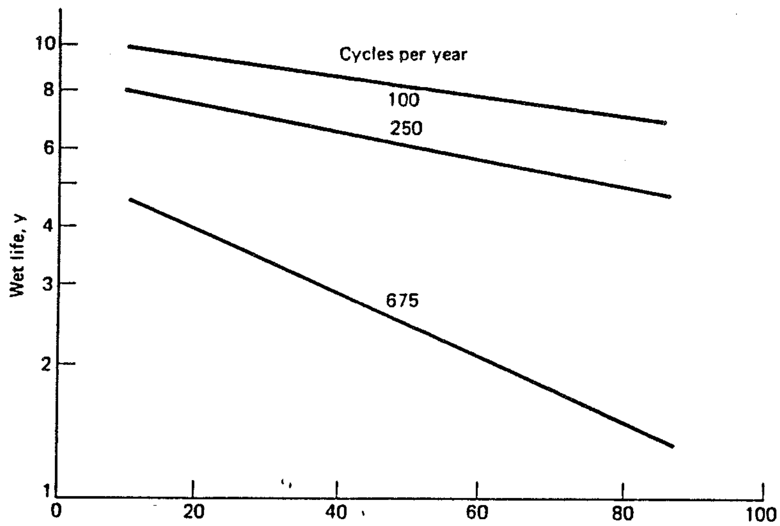
A golf-cart battery will have a normal operational life of 300-600 discharge-charge cycles when delivering rated 75 amps for rated time of 75-130 minutes. A number of factors affect cycle life. The most important are peak currents, depth of discharge, partial charge standing time, recharging practices, and temperature.



The discharge process in any lead-acid battery involves a localized conversion of electrolyte into water within the plate's pore structure as the plate lead oxide is converted to lead sulfate. This is reversed only by a slow diffusion process with electrolyte outside the pore area. Continued or repeated high currents deplete more pore areas and cause these to experience a condition where [illegible] sulfate. This can become permanent and will reduce battery life unless recharge is initiated to reconvert the lead sulfate back to lead oxide The accompanying curve illustrates how peak currents affect discharge time.

Members experience with their car conversions have proven the ability of the golf-cart battery to deliver the 390 amps of accelerating current, at least when fully-charged. There is a price paid for these peak currents; short discharge time and reduced battery life. System design must reduce the magnitude and duration of peak currents.

Depth of discharge and discharge frequency have an important effect on in cycle life. An investigation for Sandia Lab by Exide produced data for the following relationships:



Effect of depth of discharge and number of cycles per year on wet life,

Although the question of "how far will it go" is important to the electric car tyro, an experienced user will keep his driving distances between recharges to much less than maximum range.

An electric car battery standing in an partially-charged state for an extended period will have its cycle life reduced. Battery discharge results in formation of an insoluable lead sulfate film within the plate pore structure. This process is reversible on charging, unless the film remains long enough to be converted from a relatively porous mass to a hard-surfaced deposit. When this occurs, no amount of recharging will dislodge the film.

The electric car user should recharge the battery at every opportunity. Driving the car to work for half the maximum range, and letting it stand for a workday will shorten the battery life. You should negotiate a plug-in privilege at work.

In the next part, we will continue our examination of battery parameters.

W. H. Shafer
July 1, 1986

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EPRI
ENERGY MANAGEMENT AND UTILIZATION DIVISION

RP 1569

Technical Brief

The GM Griffon Electric Van

Description

The General Motors (GM) Griffon is an easy-to-drive, state-of-the-art electric van with range and power abilities that make it suitable for many contemporary service-fleet uses. Manufactured in Luton, England, by the Bedford Commercial Vehicles Division of the GM Overseas Commercial Vehicles Corporation, the GM Griffon is the first modern electric vehicle (EV) to be produced on an assembly line. It is also the first EV made and backed by a vehicle manufacturer with extensive experience in producing, marketing, and servicing vehicles. In addition to parts and service support, the van's manufacturers—GM and Lucas Chloride EV Systems, suppliers of the electric propulsion system—offer training programs, comprehensive warranties, and full vehicle documentation, including detailed driver's and maintenance manuals. The van is fully traffic compatible; it has a range of 50 to 60 miles between battery charges (and an extended range if intermediate battery charges are used) and a top speed of 50 miles an hour. Forerunners of the GM Griffon are in fleet service at over 150 sites in the United Kingdom, where they have proved highly reliable in over 2.5 million miles of operation. The GM Griffon is currently being introduced into service fleets at electric utilities and other companies in North America.

Specifications

The GM Griffon, which has a 106-inch wheelbase, provides a loadspace of 208 cubic feet and a payload capacity of 2000 lbs. Outwardly, the van is nearly indistinguishable from its gasoline-powered counterpart. The differences lie beneath the unit-body construction. The heart of the GM Griffon's electric propulsion system is its 216-volt, 184 ampere-hour battery. The battery is made up of 36 six-volt Chloride EV5T tubular-plate lead-acid modules. It has a single-point watering system, which minimizes routine battery maintenance. Its location below the floor of the vehicle allows unobstructed use of the entire loadspace and contributes to the van's excellent handling characteristics. In cold weather, a battery heating system preserves the battery's performance. An electronic pulse controller regulates the energy flow between the battery and the separately excited 40 kW dc motor, allowing smooth, continuous speed control. The van is equipped with both hydraulic and regenerative brake systems. The regenerative brakes, used in normal driving conditions, reduce energy consumption and brake wear. The van is recharged with a 240-volt ac single-phase off-board charger.

Applicability

The GM Griffon is produced as a cargo van, but it can easily be converted to a passenger or special-purpose van. Its 50-mile range and 2000-lb payload capacity make it suitable for many service fleet uses. The 33 GM Griffons currently operating in North America are being used for a variety of missions, including meter reading, plant maintenance, mail service, employee shuttles, van pools, parts delivery, airport operations, and promotional events.

Wheels are still turning in the drive for alternative energy

Chicago Tribune, Sunday, September 14, 1986

By Casey Bukro
Environment writer

WHEN THE ARAB oil embargo 13 years ago brought home some hard lessons about energy dependence, there was much talk about alternate energy sources that could ease this country's reliance on both foreign suppliers and exhaustible fuels.

It seemed like a dream to many Americans at the time, and since then the dream has been deferred, but not abandoned. Witness the Laguna Del Mar housing development in southern California, where Vernon and Marian Smith recently moved into a house that gets electricity from sunlight.

Photovoltaic panels adorn the roof of the Smith's $144,000 home, transforming sunshine into electricity that powers the family's household appliances. Any unused energy can be sold to San Diego Gas & Electric Co.

Solar power was one of the "renewable" energy sources that scientists focused their attentions on after the 1973 embargo and the launching of Project Independence. There was also renewed interest in wind-driven devices, along with more efficient car engines, fuels and batteries.

Some planners envisioned an era of energy self-sufficient homes and battery-powered cars. Government officials predicted that alternate energy sources would generate 20 percent of the nation's energy needs by the end of the century.

Instead, we are proceeding toward the promised era at a much slower pace. Renewable energy today provides only 7 percent of the nation's needs. A global oil glut and tumbling energy prices have sapped much of the urgency out of new energy research.

When the oil crisis ebbed, so did federal and private funding for energy projects that were competitive only in an era of $30- or $40-a-barrel oil.

Still, many experts continue to expect a significant shift in the way Americans obtain energy. The shift will get new impetus, the experts suggested, from renewed concerns about nuclear energy after the Chernobyl disaster in the Soviet Union and fears that burning coal could worsen the "greenhouse effect" that is trapping heat close to the Earth and causing global temperatures to slowly rise.

Last month, more than 700 scientists and scholars met at an Energy Conversion Engineering Conference in San Diego, only 30 miles from the Smiths' new home. Many of them insisted that the search for new energy sources is finally beginning to pay off.

Some expect photovoltaic [PV] power to stake a real claim on the U.S. marketplace within a few years. Lots of praise—but much less optimism—was lavished on the century-and-a-half-old Stirling engine, which experts said could offer a quiet and reliable motor that runs on anything from wood chips to coal.

These two technologies were the "stars" of the conference, but there were also reports on other alternate power approaches under research, including the use of steam and heat from inside the Earth, wind turbines, coal conversion and superconducting magnetic systems.

Most of these remain far from widespread use, according to the conference participants, and the hopes expressed for PV sound familiar. Even 10 years ago, PV was recognized as a potentially major development that could produce much homegrown electricity.

Dr. Robert Copeland, now with the Solar Energy Research Institute in Golden, Colo., called solar research a "crash and die program." And he laughed when reminded that solar enthusiasts in the 1970s said that sunshine is free. "The sunshine is free," he said. "The equipment to collect it is not."

PV cells have long been used as power sources in spacecraft, and for very special tasks like recharging the batteries of mountaintop communications equipment. On a smaller scale, PVs are used to pump water in New Mexico and light highway signs in California. PV sales amounted to $350 million in 1985, up from $300 million the year before.

But even though $1 billion has been spent on PV research over the last 20 years, the technology remains rare and costly. In 1980, a homesized PV system cost $50,000. And though the cost today is down to $25,000, it's still too expensive for widespread residential or commercial use.

"If you're building a house where a power company must bring the power lines in a couple of miles, PVs are probably more cost-effective right now," said Dr. William Schertz, chief of solar programs at Argonne National Laboratories in Du Page County.

"But if you are building in a subdivision where all you have to do is hook up to a line in the street, the utility is more cost-effective," Schertz said.

Andrew Krantz, the U.S. Department of Energy's solar program manager, compares the status of solar energy today with that of aviation earlier in this century—limited performance but great potential

"We're in the 1918 time period, when airplanes had open cockpits, two sets of wings and propellers," Krantz explained. "Nobody would have dreamed you could be sipping wine and having dinner on a plane traveling faster than a speeding bullet."

To make PV commercially viable, Krantz said, "You still need to reduce the price five-fold, from around $5 a watt to 50-cents." By comparison, Commonwealth Edison Co. in Chicago builds nuclear power plants at a cost of 80 cents a watt.

Krantz believes that PV costs will remain out of reach until the turn of the century at least, but Joseph Garcia, who spearheaded the Laguna Del Mar project, is more optimistic.

"In three to six years, photovoltaics could drop 50 to 70 percent in cost," predicted Garcia, vice president of a Scottsdale, Ariz., PV company and a land-development firm.

An obstacle to development of a full-scale solar power industry is the fact that energy technologies are too firmly entrenched to allow for sudden or rapid changes. The Edison Electric Institute, for example, reports that American electric utilities have about $390 billion invested in power generation, transmission and distribution systems fueled by coal, oil, gas and nuclear energy.

"Clearly, there is an immense investment in place," said Ted Eck, chief economist for AMOCO Corp. in Chicago. "Turnover is very slow. Generating plants last for about 40 years. In a mature industry like this, you don't make radical changes that massively impact how power is generated."

AMOCO is involved in PV research, but "we're still in a position of technological innovation," Eck said. "Existing technology is pretty efficient. It's not logical to think of abandoning equipment before it wears out. You don't tear down a new building because new technology is 5 percent better."

Commonwealth Edison, in cooperation with Illinois State University in Normal, is researching ways to produce commercial amounts of electricity through PV.

A typical PV cell is made of silicon. Photons of sunlight crashing against the silicon displace electrons, producing photoelectric energy that can be tapped.

Solar PV cells are thin, flat semiconductors that convert light energy into direct-current [DC] electricity. A single cell, regardless of size, will deliver a nearly fixed voltage, usually less than one volt.

Cells are usually assembled together in a series to provide a practical working voltage. The resulting package of cells is called a module or array. One or more modules, with control electronics and support structures, and in some cases storage batteries, make up a PV power system.

Solar cells with no moving parts will deliver electricity as long as light falls on them, though the power output is highest when the sun is directly overhead. As a result, some PV systems use tracking devices to keep the cells focused on the sun.

While proponents of PV foresee its eventual emergence into the mainstream energy picture, those who sing praises of the Stirling engine express little hope that it will soon replace the noisier, less efficient internal combustion engine that runs only on petroleum.

"Existing cars already are so good, most people believe auto

Energy

Continued from page 7

applications for the Stirling engine will come later," said Colin West, an energy researcher at the Oak Ridge National Laboratory in Tennessee.

Boosters of the engine, patented in 1816, see its future in other applications. One trick in new energy development is finding a niche that cannot be filled easily by other technology, West explained. For the Stirling, that means spacecraft engines and pumps, plus implantable artificial hearts.

Any fuel that produces heat can operate a Stirling engine, West said, including vegetable oil, alcohol, coal, wood chips, garbage or solar energy. A Stirling engine has two cylinders, one hot and one cold, and differences in temperature and pressure drive a piston silently to produce heat, cooling or power.

It is much quieter and more fuel efficient than gasoline and diesel engines. Almost every heat-seeking missile contains a miniature Stirling, which provides supercold refrigeration needed in such weapons. As a heat engine the Stirling can produce temperatures of 400 degrees Fahrenheit, and as a refrigerator it can generate cryogenic chills of 280 degrees below zero.

Some researchers, such as Dr. Graham Walker of the University of Calgary, speak almost lovingly of the Stirling. "This thing is not happy unless it is moving," he boasted, noting that it will run for hours even on hot and cold water. "They sound literally like sewing machines," he added.

Stirlings cost 3 to 10 times more than gasoline or diesel engines, but Walker said mariners might pay a premium for quiet boat engines.

Later, he said, might come locomotives, construction and earth-moving machinery, off-road vehicles and submarines powered by Stirlings. It would make sense, he added, to operate coal mining machinery with coal-burning Stirling engines.

But for every devotee, there were detractors at the energy conference. Charles A. Amann, head of engine research for General Motors Research Laboratories, dismissed the Stirling as too expensive, heavy and "difficult to fit under a hood."

The future of the Stirling is tied in part to the development of high temperature ceramic parts, which could make the engine even more efficient. A major obstacle is the tendency of ceramics to break. Scientists at the GTE Laboratories in Waltham, Mass., recently took a major step toward alleviating the problem.

Collaborating with researchers at the Oak Ridge lab, the scientists produced a material called silicon nitride matrix, with a silicon carbide whisker composite, that is 40 percent more resistant to internal cracking and 25 percent more resistant to breaking than non-reinforced ceramics.

The U.S. and Japan are racing to develop ceramic engines because of their potential advantages over conventional metal engines. Ceramic engines, which can operate at temperatures twice as high as current engines, are expected to be lightweight and resistant to wear and corrosion.

Another automobile-related innovation discussed at the San Diego conference was the possibility of battery-powered cars. Pandit Patil, chief of the U.S. Department of Energy's urban electric van program, believes they are closer than anyone suspects.

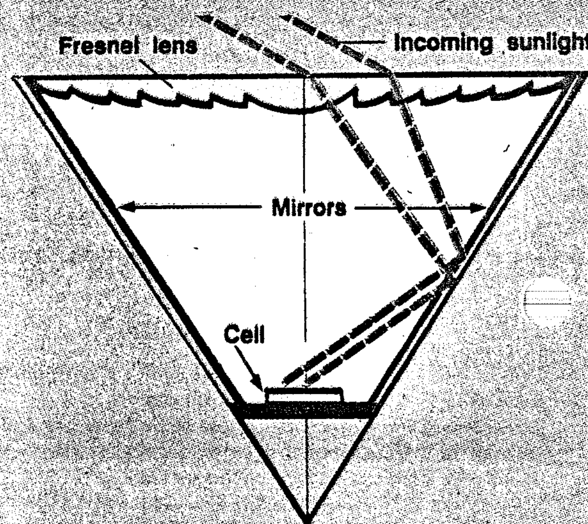
The greatest problem with electric autos has been batteries that had to be recharged after driving only 10 to 35 miles. In 1989, Patil predicted, Ford Motor Co. will produce a battery-powered auto that can go 75 to 100 miles on a recharge expected to cost around $4 or $5.

"Battery cost must come down," said Patil, because it now makes up about one-third the cost of an English model electric car that sells for $25,000.

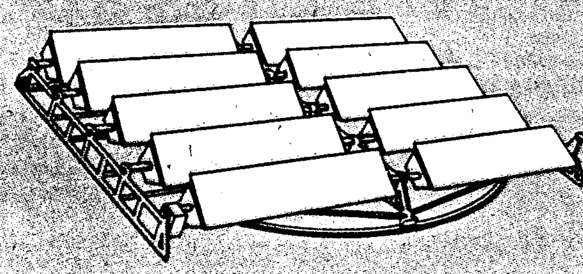
Photovoltaics

Solar photovoltaic cells allow the conversion of sunlight into electricity. One version of this technology is an array that features the Fresnel lens and a small cell—shown right resting upon a quarter.

Focusing sunlight in a photovoltaic cell starts with the Fresnel lens, a sheet of heavy plastic that is smooth on the outside and etched in fine sawtooth-like concentric ridges on the inside. The circular ridges bend light toward a single point.



Parabolic mirrors keep incoming off-center sunlight focused upon the solar cell. The sunlight excites electrons, which react to built-in barriers in the cell producing a voltage that can then be stored in a regular battery.



Fixed-in-place photovoltaic cells cannot take full advantage of the available light. Solar arrays on full-tracking mechanisms use a turntable for east-west tracking while gears rotate cells to follow the north-south progression of the sun.

OF INTEREST ??

F.V.E.A.A.