ELECTRIC AUTO ASSOCIATION NEWS

APRIL 1990 Vol. XXII No. 4

Narrow vision on transportation

PRESIDENT BUSH has presented a parsimonious vision of how to meet the burgeoning needs of transportation. In fact his long-awaited national transportation policy, unveiled Thursday, would not begin to meet the needs, owing to the lack of realistic financing ideas. We can only assume this presentation is more political than substantial. We expect it is aimed at satisfying opinion that opposes federal tax increases, with the presumption that this pitch will be of little or no effect — that Congress will go ahead by itself and vote substantial money for highway and public transit needs.

For this is the opposite of what the Bush scenario calls for. He proposes a reduction of the federal role in transportation. His policy would shift more responsibility for paying the capital costs to states, local governments, and payers of transit fares, be they on subways or airliners. In fact it would terminate federal subsidy of Amtrak. This is an incredibly short-sighted notion, especially in view of the need to retain rail service as an energy-crisis alternative.

Bush also would reduce the federal subsidy for urban mass transit, with the view of letting localities pay more of the bill. This and other proposals ignore the fact that the transportation dilemma is a national problem whose impact is unevenly distributed. Hence large-scale federal assistance is required to help to even the financial impacts. By some estimates, $3 trillion would be required to meet the oncoming needs for highway repair and expansion, and improvements in the various and lagging forms of public transit. Meeting these expensive needs of a swelling population is related critically to meeting national clean-air standards, by expansion of rail transit, and reducing traffic congestion.

The president opposes legislation to raise the federal gasoline tax to help meet the massive needs. He would switch the responsibilities away from Washington by various means, including a return to toll roads in some cases, and application of other user fees and heavier local and state transportation taxes. He said solemnly that it's time "to invest in America's future," then he fled from the obligation to do so at the federal level. Congress should ignore all this, and proceed to raise the gasoline tax as needed and fund the transit programs required to prevent a transportation crisis.

MOTOR MOUNTING — HOW TO DO IT

by William Palmer

Mounting a motor where an engine was is one of the most difficult tasks in converting a car to electric power because it requires providing for several of the functions that were performed by the engine. These are:

* Supporting the flywheel and clutch in their proper positions.
* Maintaining precise alignment of the motor shaft and flywheel with the transmission shaft.
* Restraining the axial thrust of clutch operation.
* Supporting the front of the transmission.
* Transmitting restraining torque from the motor frame to the car frame so shaft torque will propel the car without the motor frame turning.

These functions can be performed by installing an adapter between the motor and the flywheel housing and a shaft coupling between the motor shaft and the flywheel. The adapter has one face which fits the flywheel housing like the engine did and the opposite face fits the motor mounting face. See Figure 1. Base or foot mounted motors are rarely used for car conversions.

Your adapter, motor and coupling assembly must hold the flywheel accurately in the same position in which the engine held it. You should measure this position carefully. Take the transmission with the flywheel housing out of the car and prop it face up with the flywheel in place, clutch fingers resting on the throwout bearing. Move the clutch operating mechanism to raise and lower the flywheel. With the flywheel in the lowest position, lay a straightedge across the housing face. If the flywheel protrudes out of the housing, use blocks of known and equal thickness to raise the straightedge clear of the flywheel. Make a side view cross section sketch, through the transmission shaft axis, of the flywheel, the flywheel housing and the transmission shaft. See Figure 2. Measure the distance from the plane of the housing face, in or out, to the surface on the flywheel which located it axially on the crankshaft. Mark that dimension on your sketch. That is where your assembly must hold the flywheel. Also Measure the location of the end of the transmission shaft relative to the plane of the flywheel housing face and mark that dimension on your sketch. You should measure any parts of the flywheel which protrude outside the plane of the flywheel housing face and show their diameters and distances on your sketch,so you can be sure the adapter face provides adequate clearance.

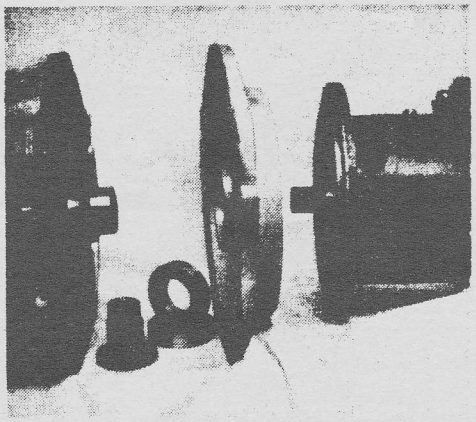

Figure 1. One adapter face fits the flywheel housing. The other fits the motor.

Now you should make another sketch looking axially into the flywheel housing. Show the housing periphery, the bolt holes through which the engine was fastened and the distance to each hole from the center of the transmission shaft. If you make both sketches into accurately scaled, full size, drawings you will find them useful.

Your adapter needs to be thick enough to hold the motor so its shaft end is close to, but not touching, the transmission shaft. Clearance of at least .05" is adequate. Some motors have extra long shafts. You may want to cut the shaft length to about 1" to 1 1/2" to avoid making the adapter unnecessarily thick. If you add the motor to your drawing, you can measure the required adapter thickness right from the drawing. See Figure 2 again. Adapters can be made several ways. But first you must decide whether you need bearings in your adapter. If your motor's shaft and bearings are suitable for supporting the flywheel and withstanding the axial thrust of clutch operation, then you don't need bearings in the adapter. Most commercial motors, intended for electric cars, such as Baldor, GE and Prestolite, do have adequate shafts and bear-ings. But aircraft generator shafts cannot withstand either axial or radial loads. So, adapters for them must have bearings. Two bearings are used to prevent the coupling from tipping due to the overhanging weight of the flywheel.

Now that you have established your adapter thickness and whether it needs bearings, you need to determine the size and shape of the flange which fits the flywheel housing. Use your second drawing

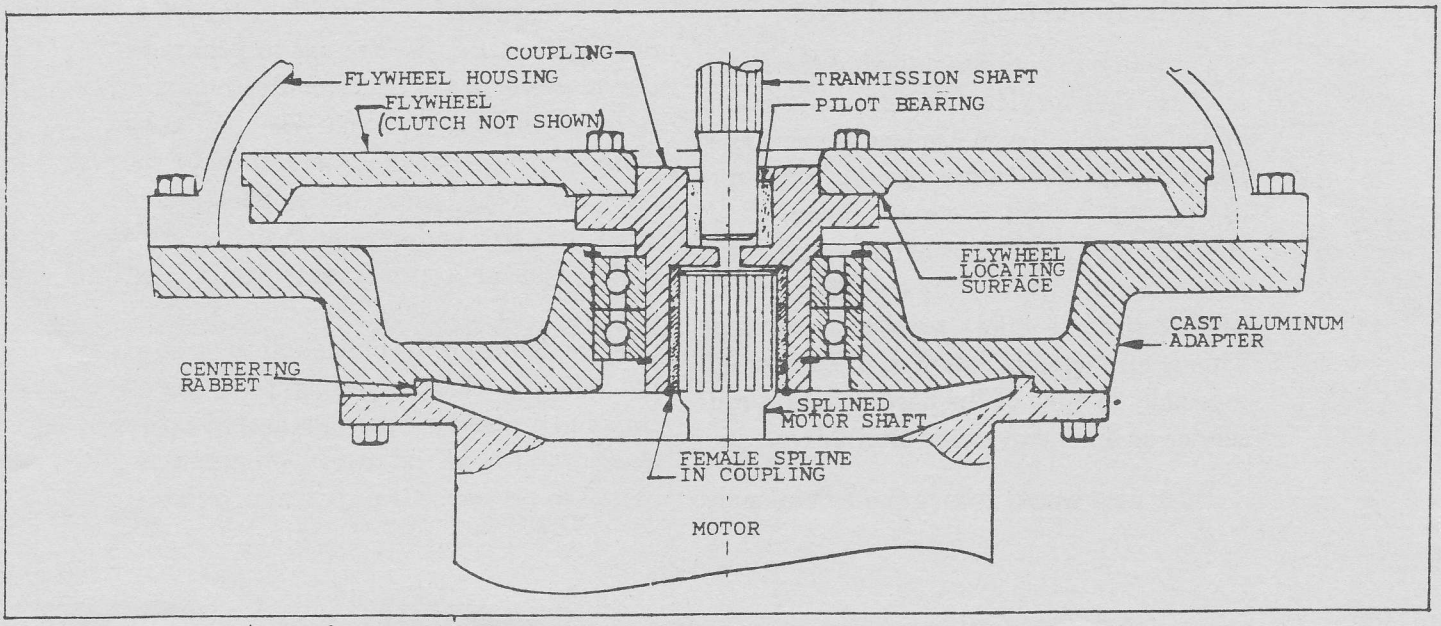

Figure 2: Top view cross section of motor mounted to flywheel housing with cast aluminum adapter with coupling and flywheel supported by bearings.

to decide what size circle, centered on the transmission shaft, will include all of the bolt holes with reasonable metal thickness around the farthest hole. Then decide whether a plain, round flange will be esthetically acceptable or if a contoured periphery which matches the shape of the flywheel housing is worth the extra effort and expense.

Adapters can be fabricated of aluminum or steel shapes, such as plates, blocks and tubes bolted or welded together. Weldments should be heat treated to relieve stresses which could cause warpage. Better adapters are made of cast aluminum. Castings are more rigid than bolted assemblies and are less prone to warp than welded construction. Castings also can be shaped for more pleasing appearance of the transition between a large flywheel housing face and a smaller motor face. See Figure 3. Casting requires a pattern, which is a model of the adapter, slightly oversize, to allow for shrinkage of the cast metal. The foundry uses the pattern to make the mold into which the metal is cast.

However it is made, the adapter must be machined to insure that its motor face and flywheel housing face are precisely parallel. To center the motor on the adapter, you need a rabbet which fits the machined shoulder on the motor face and is concentric with the bearing bore, if you use bearings in the adapter. If the engine was centered to the flywheel housing with a rabbet you need a similar rabbet on the flywheel housing face of the adapter.

Your shaft coupling can be made either from the end of the engine's crankshaft or machined from solid steel. See Figure 4. Your cross section drawing, with the motor added, will show what the coupling size needs to be. If you need bearings in the adapter, you can locate and size them on your drawing. The coupling must fit the flywheel and fasten to it the same way the engine's crankshaft did. This end of the coupling also must provide a bearing for the pilot stub on the end of the transmission shaft to support that shaft end and keep the clutch disc centered. Using the end of the crankshaft can simplify making the coupling, if the journal is large enough to fit the inside diameter of the adapter bearings, if they are used. The journal is the part of the crankshaft that turned in the engine's drive-end main bearing.

The motor end of the coupling needs a hole for the motor shaft to fit into. That hole must fit the motor shaft snugly and have a keyway or splines to match the motor shaft. Also, if adapter bearings are not used, the coupling must be fastened securely to the motor shaft to prevent axial slipping due to the thrust of clutch operation. That thrust is due to the force the clutch throwout bearing must apply to the flywheel and coupling through the clutch release fingers to disengage the clutch.

When you have your adapter and coupling, you need to locate the bolt holes for fastening the motor to the adapter and the adapter to the flywheel housing. Place the adapter on a table, motor side up and set the motor, in mounting position, on it. If the adapter's flywheel housing flange is contoured, rotate the motor so its terminals and other external features will point the way you want them to after the assembly is installed in the car. Use the motor face flange as a template to locate the motor mounting holes accurately on the adapter. If the motor frame is in the way, remove it from the face flange. Mark the hole locations with a transfer punch the same size as the hole. If you don't have transfer punches, use a twist drill and tap it twice, rotating it 90 degrees between taps, to produce a "+" mark for each hole center. Of course, if the motor holes are keyhole-shaped, mark only the small part of the hole.

To locate holes in the flywheel housing flange, you need to position the adapter center at the center of free radial play of the transmission shaft. Position the adapter with its flywheel housing face up. The shaft coupling must be in place. That means the motor must be mounted if the adapter does not have bearings. Set the flywheel housing, with transmission in place, face down on the adapter making sure the transmission shaft pilot stub is engaged in its bearing in the coupling. Make four scribe marks around the edge of the flywheel housing, 90 degrees apart. Slide the flywheel housing toward each scribe mark in turn as far as the radial play of the transmission shaft will allow it to go. That may be roughly 1/8". After each slide mark the adapter at the two scribe marks 90 degrees from the direction of the motion. After moving the flywheel housing all four directions you should have four pairs of marks on the adapter. Now slide the flywheel housing so each of its scribe marks is centered between its pair of marks on the adapter and clamp the flanges together. Now the assembly is properly positioned and you can proceed to mark the bolt hole locations the same way you did for the motor bolt holes. You should consider whether using through-bolts and nuts or bolts into tapped holes will be more appropriate for your assembly.

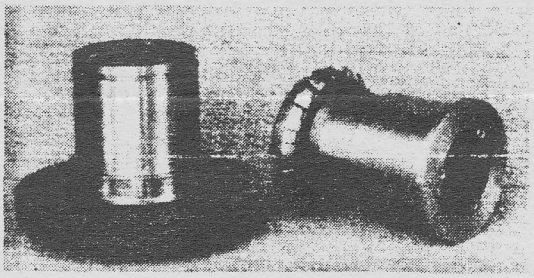

Figure 4. Shaft couplings made from Vega crankshaft hub (left) and solid steel (right) for Mazda.

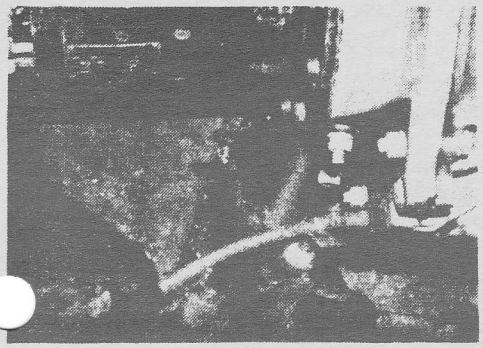

Figure 5. Angle bracket supports motor, adapter and transmission assembly on engine mounts.

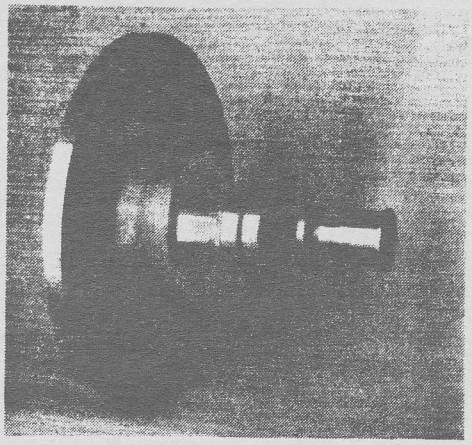

Figure 3. Cast adapter, bearings and shaft coupling.

Only two functions remain to be provided: supporting the front of the transmission and transmitting torque to the car frame. These are accomplished by two brackets, one fastened to each side of the adapter, which reach and fasten to the flexible mounts which supported the engine. These brackets can be made easily from angle iron and fastened to the adapter with two of the same bolts on each side which fasten the adapter to the flywheel housing. See Figure 5. The other end of each bracket fastens to the engine mount.

I hope this will make your motor mounting task easier. If you want a cast aluminum adapter and/or a coupling made from your crankshaft or from new material, please contact me. I'm at 44 Dior Terrace Los Altos, CA 94022 415 948-7677

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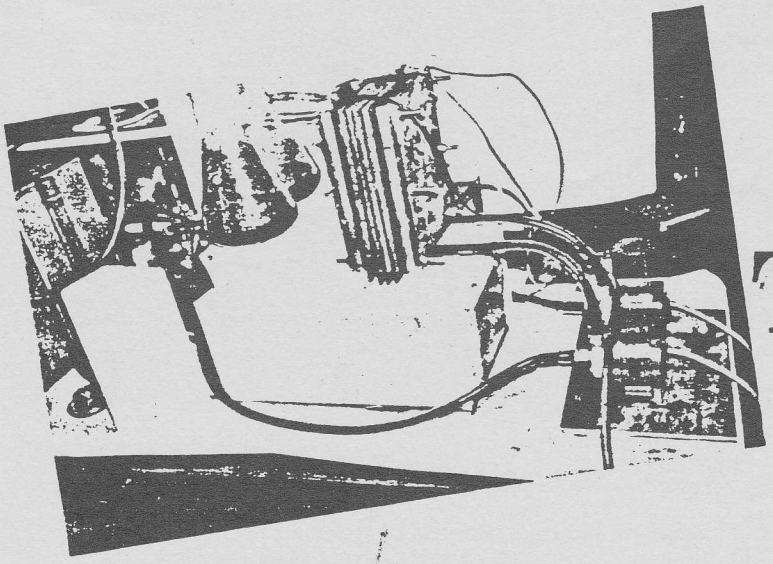
BATTERY BREAK THROUGH!



Experimental Vanadium Flow Battery connected to solution storage vessels (6-volt, 4-cell battery).

Recharge a battery in seconds!

Report by PETER BREWER

AN Australian scientist has made a breathrough in battery technology which could herald the arrival of the instantly rechargable electronic vehicle.

Using a method known as the NASA redox flow cell, a US-developed process in which electrically-charged fliud takes the place of charged plates, Dr Maria Skyllas-Kazacos has found a means of obtaining continual power without the usual problem of contamination.

According to calculations, 70 litres of battery fluid will run an average vehicle for more than 150 kilometres before recharging is required.

And the recharging would be almost as easy as filling your conventional car with petrol, except that two pumps would be required - one to scavenge the battery tank of the charge-depleted fluid and another to fill it again.

The fluid can be re-used indefinitely, and can be recharged like a normal battery!

Dr Skyllas-Kazacos and her research group have been working on this project for three and a half years and their experiments in the School of Chemical Engineering and Industrial Chemistry (faculty of Applied Science) at the University of NSW have yielded startling results which have eluded teams working on the same concept in Japan and USA.

The basis of the Australian discovery rests with the type of chemical used in the fluid battery. It is a compound of vanadium - a metal used rarely these days except in the manufacture of stainless steel.

The vanadium compound is dissolved in an acid solution. One solution is positively charged and the other negatively, then both are pumped through different cells in the fluid battery. The exchange of electrons between the cells creates the electric charge.

Problems with the fluid becoming contaminated or losing its effeciveness over a constant period of use and re-use have not surfaced yet, according to Dr Skyllas-Kazacos.

"We think this is the breakthrough we have been looking for - a battery that can be fully run down without any harm to its effectiveness whatsoever," he said.

One of the more immediate uses for the battery will be in remote areas of outback Australia, where wind generators and solar cells can be used to recharge the battery fluid, while a continuous flow of electricity was still being provided by the batteries.

It is also seen as a means of reducing reliance on back-up diesel generators for pumps.

The world licence for commercialisation of the battery has been purchased by a West Australian-based company, Agnew Clough, which mines and refines vanadium.

Dr Maria Skyllas-Kazacos and her research team, (l-r): Franz Grossmith, Michael Kazacos and Miron Rychcik.

Future Vehicles will Run with Solar Energy

Masaharu Fujinaka
Tokyo Denki Univ.
Tokyo, Japan

ABSTRACT

The practical usable solar electric vehicle (EV) was developed, and road test of this system for weather condition were conducted on city roads in Tokyo.

In this system, solar energy is converted into electric energy with two types of the photovoltaic (solar) cell, then the output is stored in the storage battery mounted on the EV. This battery-stored electricity is used in driving the motor and propelling the EV. This report describes results of these tests.

The main solar cells(=0.7kWp), made of polycrystalline Si, are mounted on the roof of a private house. The sub-solar cells(=80Wp), made of amorphous or single crystal Si, are mounted on the EV.

CONCLUSION

In the foregoing, I have presented the possibility of using the solar energy constantly pouring down upon the earth as the source of motive power even in the motor vehicle-oriented society, if the solar energy is converted into electric energy and stored. A private car is a tool for enjoying life, and if enjoyment is confined in the naturally permissible range, motor vehicle-oriented society will continue to flourish into the coming century even when the fossil energy resources stored in the past should become exhausted. I think this dream will soon be realized at my research laboratory.

The Development of Aluminum-Air Batteries for Electric Vehicles

E. J. Rudd
Eltech Research Corp.

ABSTRACT

The aluminum-air battery has unique features that make it an attractive candidate as a power source in an electric vehicle. The energy and power densities of the battery can provide driving ranges comparable to those of the internal combustion engine. The battery is a multi-component system as will be described and any development program must focus upon the several challenges:

(a) the need for high performance electrodes
(b) a cell design that allows rapid replacement of the anode, and
(c) separation of the solid product from the electrolyte.

AN ALTERNATIVE TO THE SECONDARY BATTERY as the power source in an electric vehicle is a fuel cell, i.e., a cell that generates power by consuming a mixture of a fuel and oxygen from the air. It has been shown that metals such as aluminum, zinc, lithium and iron may be used in a fuel cell and aluminum is a particularly attractive candidate. Aluminum metal has high energy and power densities, it is environmentally acceptable (as are the products of the cell reaction), it is easy to handle and has a large industrial base for its production and distribution. The challenge is to design and develop an aluminum-air battery system, the performance of which approaches that of the internal combustion engine, in terms of range, acceleration and refuelability.

SUMMARY

The aluminum-air battery has unique features that make it an attractive candidate as a power source in an electric vehicle. The energy and power densities of the battery can provide driving ranges comparable to those of the internal combustion engine (250-400 miles). It is not a secondary battery and must be mechanically recharged, so that the cell can be designed to allow facile replacement of anode plates (the fuel) and hence "rapid refuelability". Aluminum is environmentally acceptable, safe to handle and/or store and has a large industrial base for its production and distribution.

Although significant progress has been made, further effort is required to develop a viable battery system for an electric vehicle and should focus upon

a. a simpler cell design to simplify both the fabrication and assembly,
b. definition of the electrolyte management system, particularly the removal of solid products and addition of water to the battery, and
c. optimization in terms of cost and performance of the electrodes.

Ozone: One Gas, Two Environmental Issues

Introduction

Ozone is a naturally occurring gas made up of three oxygen atoms (O_3). Two different environmental issues exist concerning this important gas

- Stratospheric ozone depletion
- Tropospheric ozone pollution

This pamphlet briefly explains these two ozone issues, including their causes, effects, and possible solutions.

The ozone that forms in the stratosphere (the atmospheric layer 10 to 30 miles above the earth's surface) is "good" because it shields us from the sun's harmful ultraviolet radiation. Some man-made compounds, such as chlorofluorocarbons (CFCs) and halons, can reduce this ozone shield and may thereby increase human health risks. Ozone that forms in the troposphere (the atmospheric layer from the earth's surface to about 10 miles high) is considered "bad" because when it accumulates, it may harm human health, vegetation and materials.

Neither "good" nor "bad" ozone is emitted directly into the atmosphere; rather, both are produced from complex reactions of other chemicals. Some of these chemicals, such as volatile organic compounds (VOCs), have large natural as well as man-made sources. Other chemicals, such as CFCs, are only emitted from man-made sources. The environmental issues of stratospheric ("good") and tropospheric ("bad") ozone are distinct, but often confused. There may be a link between the "two ozones" because reductions in the upper atmospheric ozone shield could increase the ultraviolet radiation reaching earth's surface and accelerate the chemistry that forms ozone in the lower atmosphere.

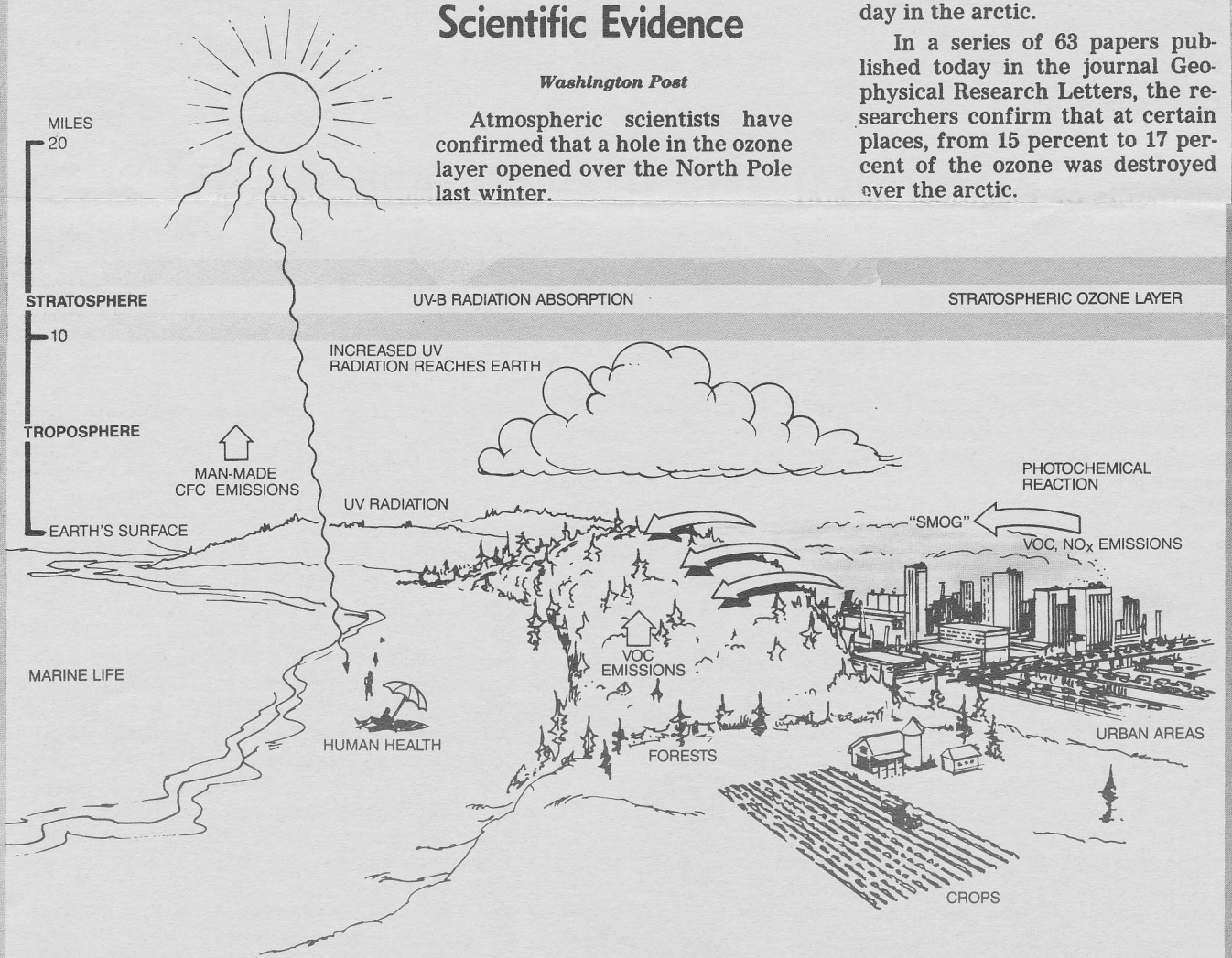
Northern Ozone Hole Confirmed by Scientific Evidence

Washington Post

Atmospheric scientists have confirmed that a hole in the ozone layer opened over the North Pole last winter.

Although it is not as large as the better-known hole that occurs annually over the South Pole, they say, all the ingredients are there for a severe ozone depletion someday in the arctic.

In a series of 63 papers published today in the journal Geophysical Research Letters, the researchers confirm that at certain places, from 15 percent to 17 percent of the ozone was destroyed over the arctic.



Depletion of the stratospheric ozone layer results in increased ultraviolet radiation reaching earth, which in turn leads to increased human health and environmental risks. Tropospheric ozone, created through photochemical reactions involving VOC and NO_x emissions from man-made and natural sources, also can affect human health and the environment.

The following is a list of books from the library of Rollin Armer that enabled him to build an electric car, two electric motorcycles and convert three Volkswagens to electric power:

Mechanics of Road Vehicles	Steeds, Autobooks Press
Racing and Sports Car Chassis Design	Costin and Phipps, Bently Press
Passenger Car Design and Highway Safety	Consumers Union
Electrical Engineering	Cook and Carr, John Wiley
Elements of Electrical Engineering	Cook, John Wiley
Electrical Elevators	Annett, McGraw-Hill
Electric Traction	Dover, Pitman
Electric Machinery	Fitzgerald and Kingsley, McGraw-Hill
Alternating Current Machines	McFarland, Van Nostrand
Direct Current Machinery	Kloffler, Kerchner, Macmillan
Brenneman, Electrical Engineering	Harwood, John Wiley
Electric Motor Control Fundamentals	McIntire, McGraw-Hill
Batteries and Energy Control Systems	C. L. Mantell, McGraw-Hill
Rewinding Small Motors	Braymer and Rowe, McGraw-Hill
Electrical Machine Design	Gray, McGraw-Hill
Elements of Electrical Design	Still, McGraw-Hill
Storage Batteries	G. W. Vinal, John Wiley
Electricity and Magnetism	Arthur F. Kip, McGraw-Hill
Alternating Current Machines	Mueller, McGraw-Hill
Motorcycle Engineering	P. E. Irving, Clymer
Marks Mechanical Engineers' Handbook	Baumeister, McGraw-Hill
The Direct-Current Traction Motor	Lightband and Bicknell, Business Books Ltd., London

(These are a few of the technical books in the library of Mr. Armer. Every book was useful. Some of them are very difficult to obtain. He does not loan any of them. He was very gracious to make this list when he was contacted about the EAA survey of electric vehicle owners. He has been away from electric vehicles for about ten years.)

February 1990, CLS

BIBLIOGRAPHY

MODERN BATTERIES: "An Introduction to Electro-Chemical Power Sources" by Colin A Vincents, Publ., By Edward Arnold, 3 East Read St. Baltimore, MD 21202. (ISBN 0-7131-3469-0)

Aircraft Spruce & Specialty Co. Catalog: Fiberglass & Composite materials and Info. Very good if you are interrested in light wt. P.O. Box 424 Fullerton, CA 92632 $5

COMPOSITE CONSTRUCTION: by Jack Lambie Available from Aircraft Spruce $15.95.

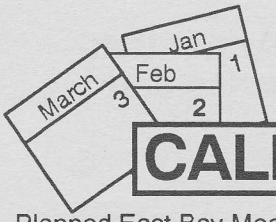
THE ARRL HANDBOOK: The best electronics course for the novice ever written in laymans language. Available at radio/TV & Ham supply houses.

US Navy BASIC ELECTRICITY: From Base PX.

GUIDE TO ELECTRIC AUTO CONVERSION: BY Bill Williams, P.O. Box 1548, Cupertino, CA 95015.

ELECTRIC CAR CONVERSION MANUAL: by Clarence Ellers, P.O. Box 111, Yashats, Or, 97498

CONVERT IT: by Michael P. Brown, P.O.#1113. Felton, CA. 95018



CALENDAR

Planned East Bay Meetings
A pril 14, 1990 - Steve Post - Curtis PMC Controllers

Santa Clara Meetings changed (because of Earthquake) to:
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Battery Council International 102nd Convention April 29-May 2
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AMERICAN TOUR de SOL May 23-27 1990 5 Day race through New England

WORLD SOLAR CHALLENGE-Due to start in Darwin, Austrila on Sunday November 11 1990. ENERGY PROMOTIONS P.O. BOX 290, Bribie Island Qld. 4507, Australia

One of our long time members, Lonnie Carter, has an electric car for sale. This is an 81 Nissan Electra 2 Door Sedan converted to electric drive. Asking $1500. If interested, call: Lonnie Carter, (602)943-5727

Nuclear power

It is distressing that the nation's dependency on imported oil has reached 54 percent of consumption, an all-time high. Dealing with this threat to our energy security and economy will be impossible unless utilities use less oil in the generation of electricity.

Unfortunately, we are turning away from the one large energy source — nuclear power — that could meet our increasing electrical supply needs without loading the atmosphere with more carbon dioxide, which is contributing to the "greenhouse effect." Have we scared ourselves by devoting too much time debating hypothetical risks regarding nuclear safety? Have we become numb to the real risks — environmental and economic — of our growing dependence on oil?

(I was assistant secretary for environment, safety and health at the U.S. Department of Energy from 1985-1988.)

MARY L. WALKER
San Francisco

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