MARCH 1989

MEETING NOTICE

The next meeting will be **Mar. 17th**, at *CRAGIN FEDERAL SAVINGS & LOAN* 333 W. Wesley St. Wheaton, Ill. -Time - 7:30 P.M. *sharp*. Guests are welcome and need not be members to attend the meeting.

THE PRES SAYS

Our February meeting time was restricted due to the illness of our regular doorman at Cragin Federal. We wish him a speedy recovery.

At our March 17th (St Patrick's Day) meeting, the technical discussion will define the petro-electric car performance parameters. In preparation it would be helpful if members have in mind what acceleration is desirable, what design top speed should be, what range on battery power should be sought, and what fraction of road load power should the engine-generator deliver. This issue of the bulletin contains an updated version of the summary paper distributed at the February meeting.

We will also discuss at the meeting the status and plans for the Rally at Triton on May 6th, and have a report on the Consumer Week event on April 27th.

Bill

F. V. E. A. A.

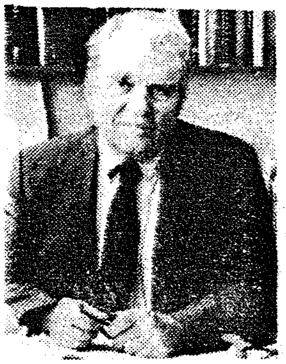
FOX VALLEY ELECTRIC AUTO ASSOCIATION
624 Pershing St. Wheaton, Il 60187

FIRST CLASS

ADDRESS CORRECTION REQUESTED

AN ARMY TRAVELS ON ITS GAS

By Andy Rooney



War is expensive, but peace isn't cheap, either.

Never mind how much it costs to buy airplanes, tanks, battleships and submarines. The fuel bill for moving these vehicles around on land, sea and in the air is astronomical. The number of the gas meter for running all Defense Department vehicles this year will come to about four billion dollars. Don't forget, too, that fuel is cheap these days.

All the fuel for our armed services is bought by one government agency, the Defense Fuel Supply Center. They told me they're paying $17.00 a barrel for fuel in 1989. Can you believe they're still doing that 99 cents thing at this level?

There are 42 gallons in a barrel and while the $17.00 is the price the Defense Department pays suppliers, the Fuel Supply Center figures that when they add in the cost of storing and transporting the fuel, the cost of a barrel is $21.65.

The Army uses 8 percent of the fuel, the Navy 35 percent, the Air Force uses about 56 percent of the total. The left-over miscellaneous figure is probably for the generals' and admirals' cars. (There are 1,050 generals and admirals.)

A brand-new M-1 tank right off the showroom floor, with all the extras — and it doesn't come any other way — costs $2,500,000.

If the initial price of a tank seems high, consider what it costs to take one on a training maneuver. The M-1 burns a gallon of fuel every 1,100 yards it travels. It slurps up two gallons per mile over the kind of rough terrain tanks are supposed to be able to travel on.

The fuel tank in an M-1 tank holds 500 gallons, so when a soldier in the tank corps at Fort Bragg drives up to a gas tank and says "Filler 'er up," it isn't like having his father's Buick.

Even so, what an M-1 tank burns is petty cash compared to what the Air Force uses. The F-16 fighter plane has a tank capacity of 1,000 gallons. It burns 500 gallons an hour. ***If you hear that sonic boom and see a silver streak in the sky, it's quite a bit of your tax money going by for the defense of the country.***

The B-1 bomber consumes enough fuel to make the F-16 look as though it was on a diet. ***The B-1 has tanks that hold 33,000 gallons!*** It's difficult to conceive of an airplane that can lift that much when you think that gas weighs about six pounds a gallon.

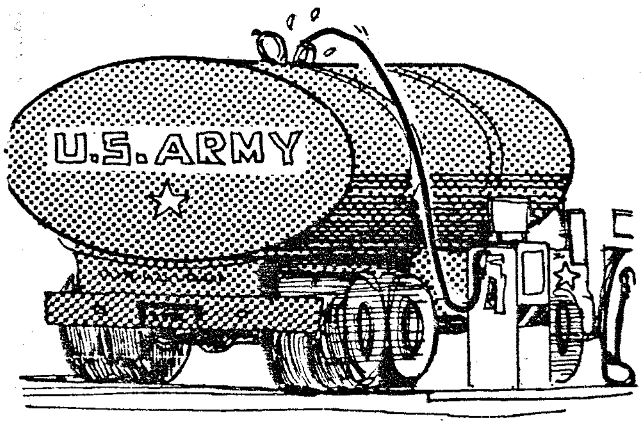
The B-1 burns 2,000 gallons an hour and it might take up to 60,000 gallons for a B-1 to fly from Kansas City to Moscow and back, so it would have to be refueled in the air. Is it any wonder we want peace with the Soviet Union?

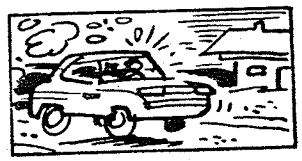
The Navy alone spends one billion three hundred million dollars a year on fuel ... give or take a few hundred million dollars.

The Army replaced the old, reliable Jeep with a new vehicle called "The Hummer." They cost $20,000 each and the Army bought 54,000 of them. Not a bad order for some car salesman. The Hummers get 14 miles per gallon.

And for four billion dollars, the armed services don't even get their windshields washed when they get gas.

(c) 1989 Tribune Media Services

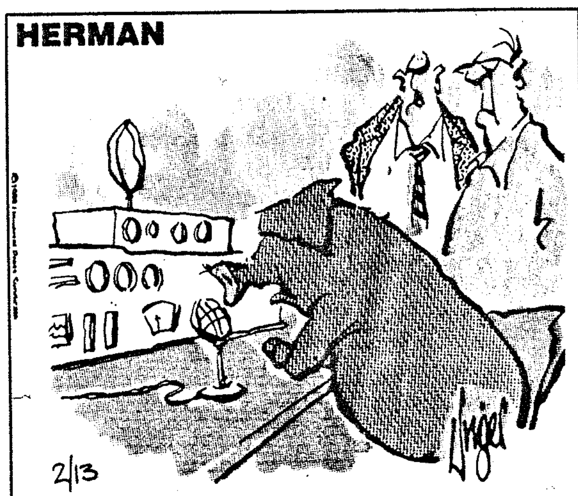




A car with manual shift averages two miles more per gallon than one with automatic shift.

MIDWEST LOCK & KEY COMPANY

KEYS CUT BY WIND & SOLAR POWER
1400 ELSTON ST. • MICHIGAN CITY, IN 46360 • 1 - (219) 874-3171
HAROLD PASCHACK, LOCKSMITH • BONDED AND INSURED
A FVEAA Member



"You never seen a ham operator before?"

PETRO-ELECTRIC DESIGN REVIEW

Several times the FVEAA has started a design review of a petro-electric (Hybrid) vehicle. The purpose of this paper is to assemble the parameters derived from past discussions to lay a groundwork for continuation of the project at future meetings. This topic was indicated as a priority matter at the December, 1988 meeting of the Organization.

WEIGHT

The design consensus arrived at a vehicle curb weight of 2500 pounds, allocated as follows:

Item	Weight	Percent
Batteries	820	32
Motor	100	4
Controller	25	1
Charger	30	1
Cables	30	1
Misc Electrical	15	1
Engine	70	3
Alternator	20	1
Transmission & Drive	190	8
Chassis	1200	48
Total	2500	100

SYSTEM VOLTAGE

The system voltage selected was 100 volts (Nominal)

BATTERIES

Nine 12-volt modified deep-discharge battery modules each weighting 80 pounds were selected to provide system voltage. Batteries of this type are not presently commercially available. One 12-volt auxiliary battery would also be required.

MOTOR

The basic motor for preliminary discussion was that designed by John Newton for the Kit Car Project. It has a nameplate rating of 100 volts, 200 amperes, 3500/8750 rpm, 4 poles, 25 horsepower. This design may require modification to provide the desired acceleration.

ENGINE

There was quite a bit of discussion concerning the engine. A continuously-running, light-weight diesel would have a low specific fuel consumption and have efficiency advantages. An outboard-motor type 2-stroke engine was suggested. This would have weight and size advantages. A motorcycle engine was suggested as a possibility for the first demonstration vehicle. This would have the advantage of low-cost availablility from a wrecked motorcycle. Previous investigation has indicated it requires 18 Kw (25 horsepower) to keep a 2500 pound car rolling at a continious 60 mph.

The engine-generator can be any desired fraction of the power required for either steady-state driving or acceleration. For example, a 14 horsepower engine (10Kw) driving an alternator could be selected which would provide 100 amps while the engine was employed. On batteries alone the vehicle is expected to have a range of about 15 miles. Engine power is sufficient to move the car at a steady 45 mph.

An electric-start motorcycle engine with 150-250 cc displacement was thought to be adequate. If the engine is water-cooled, it could provide a heat source for winter operation, but the first demonstration car might employ an adequately-ventilated, air-cooled engine. The engine also offers an opportunity to include a belt-driven air conditioner providing summer operation comfort.

A great deal of attention would be required to provide a proper mounting, exhaust silencing, and emission level if a 2-cycle engine is selected. The latter may not be vital in a demonstration car but the incongruity of an "electric" car trailing blue smoke must be considered. A "package" assembly for mounting on a modified rear bumper was suggested.

ALTERNATOR

A automobile-type heavy-duty alternator operating at about 8,000 rpm and modified to supply the desired current at 100 volts was suggested. The alternator could be belt-driven by the engine to match engine and alternator desired rpm.

SYSTEM CONFIGURATION

It was the consensus that a series configuration of the engine-alternator-battery-motor was the best arrangement for purposes of the FVEAA project. The series connection will allow the engine to be operated at a constant rpm, constant power level. The speed control would be entirely electrical.

CONTROLLER

The control system is an important design consideration. There has been no discussion of this element. Among the options are:

1. Continuous engine operation.

2. Selective operation with the engine started automatically in response to battery charge level.

3. Selective operation with the engine start by the vehicle driver, possibly depending on trip range.

Discussion at the 2/17/89 meeting indicated further work should begin by establishing the petro-electric desired performance and then selecting equipment which will meet requirements.

W. H. Shafer
2/19/89

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.

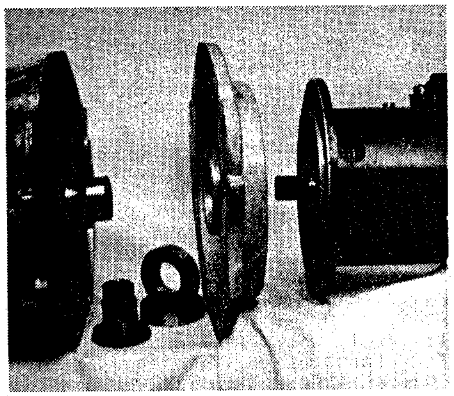


Figure 1. One adapter face fits the flywheel housing. The other fits the motor.

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

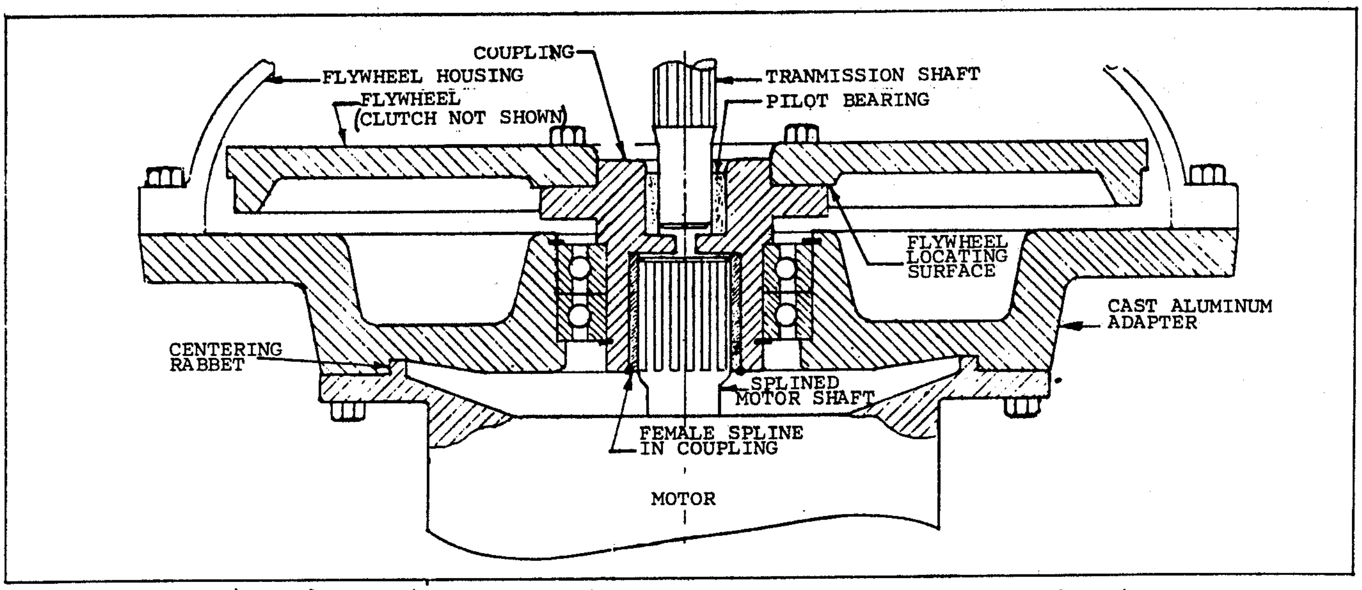


Figure 2: Top view cross section of motor mounted to flywheel housing with cast aluminum adapter with coupling and flywheel supported by bearings.

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.

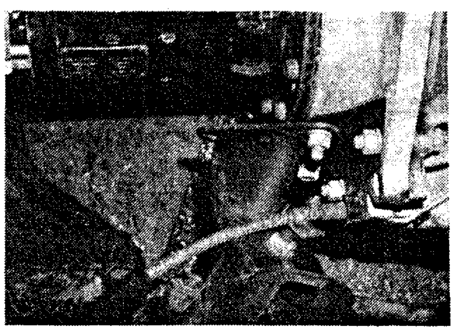


Figure 5. Angle bracket supports motor, adapter and transmission assembly on engine mounts.

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.

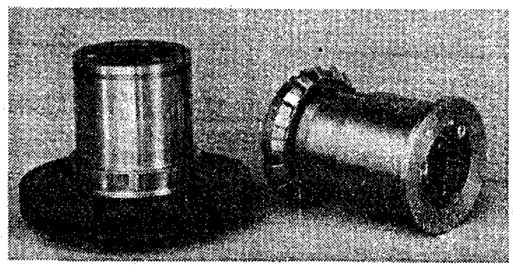


Figure 4. Shaft couplings made from Vega crankshaft hub (left) and solid steel (right) for Mazda.

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.

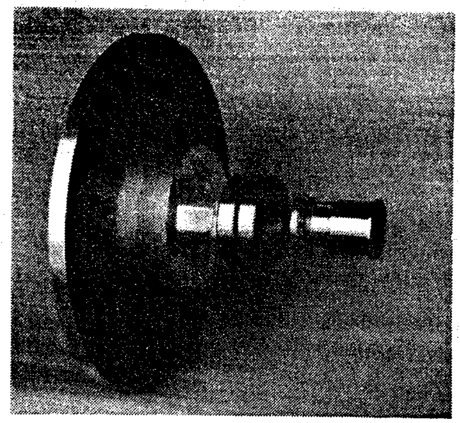


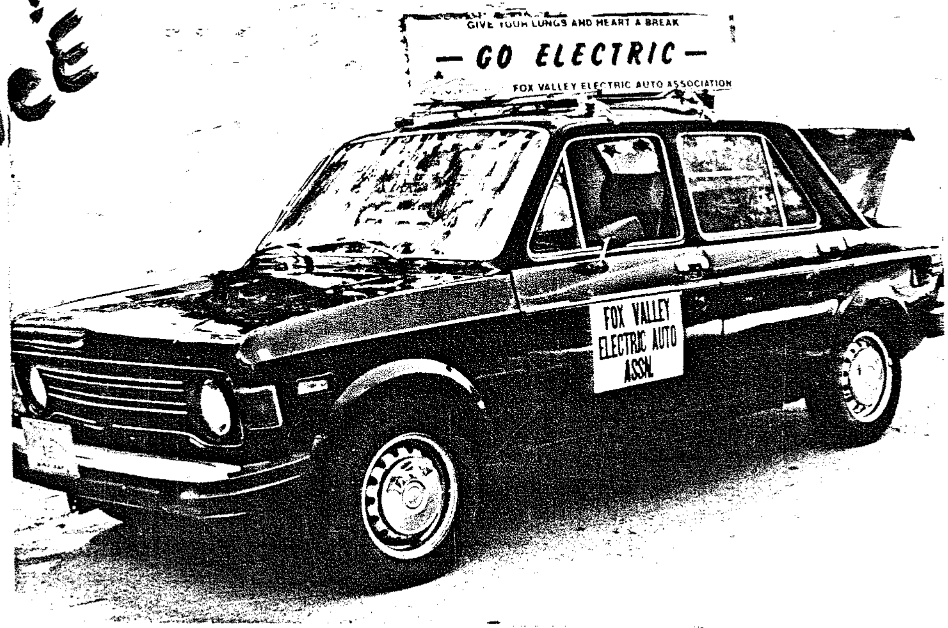
Figure 3. Cast adapter, bearings and shaft coupling.

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

FOR SALE

LAST CHANCE!



TECHNICAL SPECIFICATIONS

CAR	FIAT Model 128, Model year, 1975 Curb weight of converted vehicle,_ .... pounds.
MOTOR	28-volt, 400-ampere, shunt wound, DC, 6000 RPM. Maximum power output about 19 Horsepower.
PROPULSION BATTERY	12 modules; each 6-volt, 75 amperes continuous for 105 minutes @ 77 degrees F. Series-parallel connected, six modules in each series connection. Battery weight 750 pounds
CONTROLLER	Custom designed and made by: Electric Auto Crafters 2S643 Nelson Lake Road Batavia Ill. 60510 36 volts DC, 400 amperes 14 Kilowatts.
BATTERY CHARGER	Custom designed and made by Electric Auto Crafters Use on 115-volt, 20-amp AC circuit Approximate time to recharge, 4-8 hours
PERFORMANCE	Top speed in 1st gear MPH 2nd gear MPH 3rd gear MPH 4th gear MPH

FINAL NOTICE

$2000.

FOX VALLEY ELECTRIC AUTO ASSOCIATION
624 PERSHING AVENUE
WHEATON, ILLINOIS 60187

Your Battery

It takes all kinds.

Two types of batteries are available for use in your vehicle—*low maintenance* and *maintenance-free*. All batteries have terminals (the posts onto which you connect your battery cables) on the top or on the side of the battery. Some batteries have removable vent caps when you want to check or add water. Maintenance-free batteries normally do not require the addition of water.

However, all batteries, no matter what kind, require a minimum of care. If you provide this care, you will be assured the longest possible life and maximum performance from your battery.

BE CAREFUL.

All batteries, including maintenance-free, emit hydrogen gas. **HYDROGEN GAS CAN EXPLODE** if not treated with respect. You can show respect for hydrogen gas by never smoking or creating a spark near the battery. Sparks can be caused by touching tools to both battery posts at the same time, or by not following the proper installation procedures.

It's a good idea to wear safety goggles and rubber gloves when servicing your battery, because the battery is filled with diluted sulfuric acid, which can cause acid burns. If it gets on your skin, wash it with water. If it splashes in your eye, flush with large quantities of water and call a doctor immediately.

When you're working on your battery, always disconnect the ground cable first—normally the negative (−) one. Touching the positive (+) cable with a tool when the ground is still connected is more likely to cause sparks . . . and sparks can cause a *battery explosion!*

It's also wise not to wear rings or other metal jewelry when you're working near a battery. Just like metal tools, an accidental touch of jewelry to a battery post may cause sparks or a short circuit which can burn you.

REMEMBER: NO SMOKING AROUND BATTERIES! KEEP SPARKS AWAY!

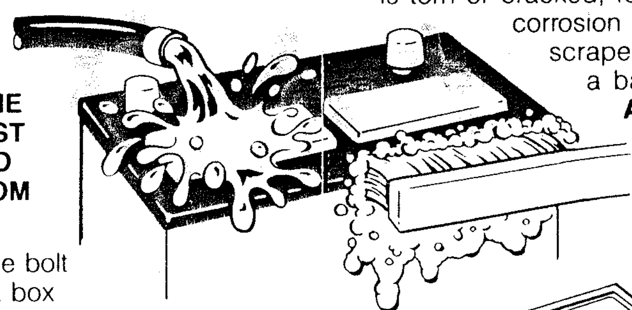
How to check it out.

Electrolyte level—In non-maintenance-free batteries, check the electrolyte level at least once a month or so. The fluid level of your battery should be at the circular or triangular lip on the bottom of each fill hole. To avoid problems, don't let the level fall below and don't fill it above this level. For best results add distilled water a little at a time to avoid overdoing it and flooding your battery. Ordinary tap water will do if distilled water is not available.

It's a good idea to check a maintenance-free battery at least once a year. If the level is low, your charging system may be malfunctioning and a professional check-up is indicated.

Keep it clean. As long as your battery shows no signs of corrosion, a nice cool shower will do the trick. Leave your battery in the vehicle and spray water on it from a garden hose.

If there *is* evidence of corrosion on or around your battery, the battery should be removed and cleaned as follows.



Removing the battery.

ALWAYS DISCONNECT THE GROUND (−) CABLE FIRST BEFORE PROCEEDING TO REMOVE A BATTERY FROM ANY VEHICLE!

If your battery cables are the bolt type, loosen the nuts with a box wrench. (Other types of wrenches may round off a nut.) If necessary, apply some oil if a nut is hard to turn. Never try to force a clamp from a battery post. It can break. Once a bolt is loosened, use a cable puller to remove the clamp from the terminal. If the cable is damaged or the bolt stripped, replace the cable.

If your battery cables are the spring type, squeeze the ears of the clamp with pliers and turn the clamp as you lift it up. Again, if the clamp is damaged, replace the cable.

Next, remove the battery from your vehicle using a battery carrier.

Once the battery is removed, wash it down with a pasty mixture of baking soda and water. Cover the vent holes in the battery caps because otherwise the baking soda solution will neutralize the acid inside the battery. Scrub corrosion away with a stiff bristle brush. When you're through, rinse the battery with plain water.

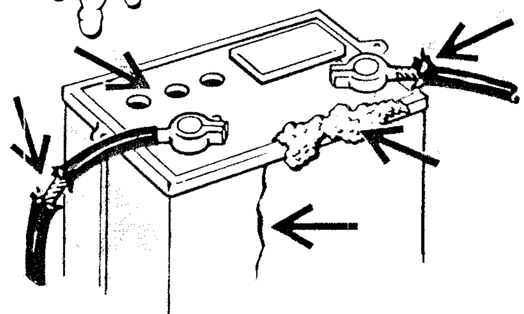
Follow the same cleaning procedure with battery cables, battery tray and holddowns wherever corrosion is present.

Terminals and posts.

Use a terminal-and-post-cleaning brush to clean cable terminals and battery posts. You may also use sandpaper, but if you use sandpaper too often it may enlarge the holes in your cable terminals and "whittle down" the battery posts. So be careful not to remove too much material from post and cable ends.

Battery cables.

Be sure that no bare wires are showing. If insulation is torn or cracked, replace the cables. To remove corrosion (gray or white deposits), just scrape or brush it off. Then clean with a baking soda and water paste. **After the cables are reinstalled,** apply a prepared grease over the connected cables and posts. This grease is available from your battery dealer.



NEVER HAMMER ON THE CABLES OR POSTS. THIS WILL DAMAGE YOUR BA[illegible]RY.