August 1987

MEETING NOTICE

The next meeting will be **August 21st**, 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 SEZ

A request has been made of COMMED for assistance in making our video. I hope to have a reply for a report to members at our August meeting. The material should be taped during the summer.

At the meeting, we will discuss what the members wish as programs for the remainder of this year.

License renewal applications should have ben received by all members with registered electric cars. These should be returned by Sept. 30.

I have asked if either the DOE or DENR wishes to exhibit our CLUB CAR at either the energy show in Palatine in September or during the October observance of USE ENERGY WISELY WEEK.

Members wishing to phone me during working hours may call 383-8005.

BILL

fold . . . .

F. V. E. A. A.

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

FIRST CLASS

ADDRESS CORRECTION
REQUESTED

Minutes FVEAA Meeting 7/19/87 at Cragin Federal Savings & Loan Office, Wheaton, IL.

President W.H. Shafer called the meeting to order at 6:45PM

There were 19 members present.

Treasurer V. Vana read the report of the club funds. Ther is a $781.56 dollar balance in the NOW checking account and $765.42 dollars in the savings account.

Amotion was made, seconded and passed to authorize use of the Club car at the ENR exhibit for the Illinois State Fair from Aug. 13 thru 24. The ENR Dept. of the Stateof Illinois is to Pay for moving the car from the Fox Valley area to Springfield and return and man the exhibit. Our literature re: our club membership is to be available at the the booth.

Your secretary left the meeting at break time.

Respectfully submitted,

Kenneth R. Woods

Kenneth R. Woods, Secretary

ADVANCED BATTERY FOR ELECTRIC VANS SETS NEW RECORD

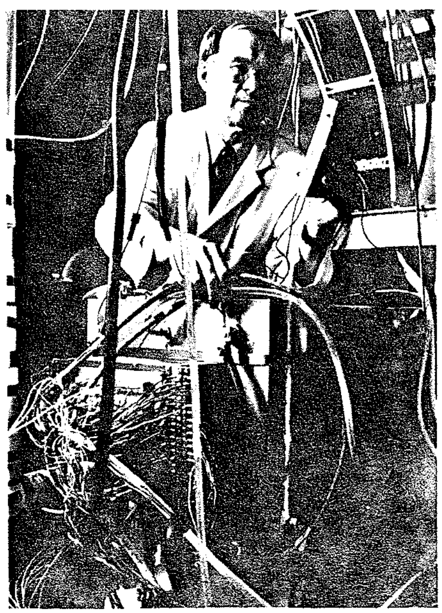
An advanced battery for electric vans has set a new distance record in simulated, stop-and-go driving tests at the Department of Energy's Argonne National Laboratory, near Chicago.

In tests controlled by a computer, the battery delivered the equivalent of 200 miles of stop-and-go city driving without recharging. The unit tested is a 36-volt module of the lithium-iron-sulfide (LiFeS) battery, consisting of three 12-volt modules. The battery was invented by Argonne and built by Gould Inc. of Rolling Meadows, Ill.

"This range exceeds our program goals by 100 miles and is three times as far as the best that could be achieved with a conventional lead-acid battery of the same weight," said Al Chilenskas, manager of Argonne's LiFeS battery program. The tests simulated use of the battery in a GMC Griffon van bearing a load of 900 pounds, including the driver.

Tests showed that single cells within the battery could be recharged in about an hour, he said.

Market studies funded by the Electric Power Research Institute (EPRI), the research-and-development arm of the utility industry, Chilenskas said, show that a battery that could provide a 100-mile range would allow the conversion to battery power of three million to four million gasoline-powered vans in commercial service in the United States.



An engineer at Argonne National Laboratory checks an experimental electric-van battery that delivered a record 200 miles of stop-and-go city driving without recharging in computer-controlled, laboratory tests.

"This range exceeds our program goals by 100 miles and is three times as far as the best that could be achieved with a conventional lead-acid battery of the same weight," said Al Chilenskas.

Such a battery, he said, would be a 216-volt version made up of 18 of the 12-volt modules tested. Each 12-volt module would comprise 10 series-connected cells, assembled into a single removable unit. Gould plans to build a full-sized 216-volt battery for testing at the Tennessee Valley Authority (TVA) in 1988.

For maximum efficiency, Chilenskas said, the battery operates at about 860° F (460° C). To help maintain this temperature, the battery is encased in high-efficiency, vacuum insulation.

Normal heat generated during battery discharge, he said, keeps the battery at the required temperature during the day. At night, the battery cools to its starting temperature of 860° F (460° C). A commercial van battery would be recharged each night in about eight hours.

Development of the electric van batt[ery] is funded by EPRI, the TVA and the U.S. Department of Energy's Office of Transportation Systems. Argonne National Laboratory is operated by the University of Chicago for DOE.

ROLLING RESISTANCE TEST

Anyone who is converting a vehicle to electric power is faced with some choices regarding the size of the wheels and tires (as well as the type of tires) that should be used. The East Bay/Contra Costa Chapter of the EAA tested the rolling resistance of some different sized wheels and tires on Lloyd Wenzel's 1974 Honda Civic. This model was originally equipped with 12" wheels. Lloyd had tried 13" wheels and also a set of 14" wheels in front and 15" wheels in back. Since the rolling resistance of a large wheel is generally less than that of a small wheel, it was decided to do some simple testing that would show whether or not larger wheels would provide significantly better performance for the Honda.

Increased wheel diameter can also have a negative effect on vehicle performance. Braking can be adversely affected because the mechanical advantage of the brakes is reduced (Lloyd has noticed this for the 14" and 15" wheels vs. the 13" wheels). Also, increasing the size of the driving wheels decreases the drive train gear ratio, thus causing the motor to operate less efficiently. (The Honda is a front wheel drive car.) With this in mind, it was decided to test three combinations of wheels:

1) 12" wheels front and back;
2) 12" wheels in front and 15" wheels in back;
3) 14" wheels in front and 15" wheels in back.

[illegible]nted on the 12" wheels were Michelin XZX 155SR12 steel belted radials inflated to their maximum pressure, 36 psi. The tires on the 14" and 15" wheels were Goodyear Vector P185/70R14 and P195/75R15 steel belted radials, respectively, inflated to their maximum presure, 35 psi. It was expected that combination 3) would have the lowest rolling resistance, that 1) would have the highest rolling resistance, and that 2) would lie closer to 3) than to 1) since all the batteries are mounted over the rear wheels. Combination 2) retains small wheels in front, which keeps the drive train gear ratio favorable.

It was originally intended to pull the test vehicle at constant speed on a level surface by hand using a 0-100 pound fish scale hooked to the bumper. The reading on the scale would indicate the force required to overcome the rolling resistance of the vehicle; this force divided by the weight of the car (2800 pounds) equals the coefficient of friction. It proved difficult to pull the vehicle smoothly in this way, and so another vehicle was eventually utilized to tow the test car at a speed of about 2 mph. The road surface was smooth. Due to a very slight road grade, readings were taken while the vehicle was pulled first in one direction and then in the opposite direction. The recorded value of pulling force is the average of these two readings. The scale value oscillated as the cars moved and so could be read only to about + or - 2 pounds. Also, it was difficult to prevent a slight acceleration or [illegible]eleration of the towing vehicle. Acceleration would falsely increase the scale reading, while deceleration would decrease the reading. The results of this test are recorded in this table:

OVER

TIRE SIZE, FRONT	REAR	PULLING FORCE:	COEFFICIENT OF FRICTION:	TIME:	SPEED:
12"	12"	28 #	.010000	10 sec.	Slight deceleration
12"	15"	25.5 #	.009107	10 sec.	Constant
14"	15"	25 #	.008929	8 sec.	Slight acceleration

(The column labeled "TIME" indicates the time in seconds that it took the two vehicles to pass over a measured part of the course. Although the last test was conducted slightly faster than the first two, one would not expect a large variation of the coefficient of friction between these speeds.)

It can be seen that there was not a large difference between the different sets of wheels. The best combination required about 10% less pulling force than the worst combination. As expected, the larger wheels did have a slightly lower coefficient of friction, even though they were thicker than the small wheels. The mix of small wheels in front and large wheels in back seems to be a good compromise between lower rolling resistance and higher drive train efficiency.

Is it worthwhile to use larger wheels, at least in back? On a level surface, running at constant speed, the major components of energy consumpti[illegible] by an electric vehicle are the rolling resistance and air resistance. We have measured the former; the latter can be estimated as

$$\text{Air resistance} = C_D\, A\, (V/20)^2 \text{ pounds}$$

where C_D = coefficient of drag
A = cross-sectional area of body in square feet
V = speed in miles per hour

(Reference: <u>Electric Auto Manual</u>, edited by Walter V. Laski, 1977, page 31)

For the 1974 Honda Civic, C_D = .514 and A = 17.54 square feet, so

$$\begin{aligned}\text{Air resistance} &= 9\ (V/20)^2 \text{ pounds}\\ &= 9 \text{ pounds @ 20 mph;}\\ &\ 20 \text{ pounds @ 30 mph;}\\ &\ 36 \text{ pounds @ 40 mph.}\end{aligned}$$

Therefore, improving rolling resistance about 10% by using larger wheels should result in an overall improvement in vehicle efficiency of about 8% @ 20 mph; 6% @ 30 mph; and 5% @ 40 mph.

Jon Gabel, 5/12/87

6-VOLT vs. 12-VOLT BATTERY STUDY

A comprehensive RCCC battery survey was made by the S-1 Electrical Study Group in March and April of 1971. This survey of RCCC affiliated fleets covered many details of battery use including mounting, connections, maintenance, sizes, special construction features, dry versus wet replacements and supply sources.

Unexpectedly, the data received from this survey suggested that the use of 6-volt or 12-volt batteries may have a significant effect on battery service and life. Thirty-nine of the reporting fleets specified battery size and voltage. Six of the 39 use 12-volt batteries. All of the 12-volt battery fleets reported experiencing longer battery life than fleets using 6-volt batteries.

The significance of these survey results prompted the study group chairman, Lloyd Gonyou, to ask Delco-Remy to initiate a study designed to determine the relative merits of 6-volt versus 12-volt batteries for line-haul trucks. The fleets surveyed were using two 8-D, 12-volt batteries instead of four 6-volt batteries to lower operating costs. Once the study was begun, however, it became apparent that four, Group 4-size, 12-volt batteries offered even more advantages. For this reason the following detailed battery study was made using 6- and 12-volt batteries of the same physical size and weight. The only difference in battery sets is the necessary change in wiring.

Five steps of evaluation were used in this study—

First, a complete, in-depth paper study was made to determine differences and effects during normal operation, both when encountering a battery service requirement and when service replacement is required.

Second, the most important of these differences, or sources of trouble, were simulated by setting up 6-volt and 12-volt circuits in a computer for instant analysis of power loss and other factors.

Third, most of these same potential trouble areas were set up in the laboratory for verification of both paper analysis and computer run.

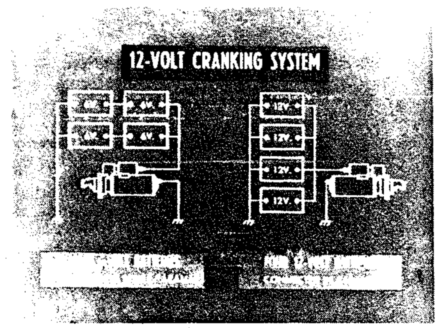
Fourth, live demonstration of 6-volt and 12-volt line-haul tractors for verification.

Fifth, field applications of 6-volt and 12-volt line-haul tractors for vertification.

On the basis of our study group analysis of comparable truck electrical systems using 6-volt versus 12-volt batteries, the 12-volt battery is recommended for line-haul trucks.

Here is a simplified schematic diagram of the two systems being compared. The system on the left uses four 6-volt batteries connected in series-parallel to provide 12 volts to the cranking motor. This system is the one used on most of the line-haul trucks today. The system on the right uses four 12-volt batteries connected in parallel to provide 12 volts to the cranking motor. The batteries in this system are of the same size, weight, and performance as those in the system on the left.

To make an evaluation of each system, all factors involving batteries were listed, such as, number of connections, wire size, high-resistance connections, open and shorted battery cells, service replacement, hold-down characteristics, and so on. Many of these items were then eliminated from the list when no possible system difference existed. For example, since the batteries are the same size and weight, battery hold-downs would be the same. Also, each battery has two terminals and leads must be connected to each, therefore the number of connections to the battery in either system is the same.

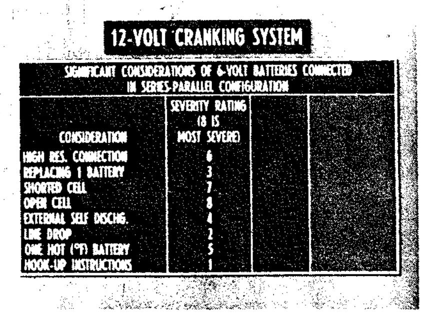


The final list contained eight considerations in which a difference may exist between a system using 6-volt batteries and one using 12-volt batteries.

These considerations are:

- A high-resistance connection at the battery
- Service replacement of one battery only
- Effect of a shorted cell
- Effect of an open cell
- Effect of an external self-discharge due to corrosion on the battery cover
- Effect of line drop between the battery and the cranking motor
- Effect of one hot battery in the system near the exhaust
- Hook-up difficulty

The next step in the study was to determine the relative importance of each of these considerations. Several line-haul truck electrical system specialists were asked to rate each of these considerations as to their severity. That is, if the situation exists, how severe would the resulting trouble be? The concensus of these people was that an open cell in a battery would be the most severe with a shorted cell being second. Hook-up difficulty probably would have the least impact.

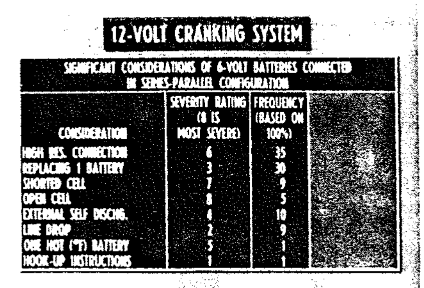


12-VOLT CRANKING SYSTEM

SIGNIFICANT CONSIDERATIONS OF 6-VOLT BATTERIES CONNECTED IN SERIES-PARALLEL CONFIGURATION

CONSIDERATION	SEVERITY RATING (8 IS MOST SEVERE)		
HIGH RES. CONNECTION	6		
REPLACING 1 BATTERY	3		
SHORTED CELL	7		
OPEN CELL	8		
EXTERNAL SELF DISCHG.	4		
LINE DROP	2		
ONE HOT (°F) BATTERY	5		
HOOK-UP INSTRUCTIONS	1		

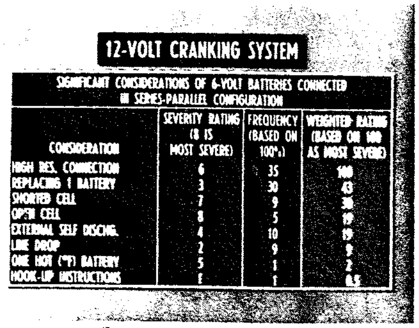
The second step in determining the relative importance of each of these considerations was to find out how often each might be encountered. Examination of field data disclosed that in 100 cases of trouble involving these considerations we could expect 35 to be due to high-resistance connections, 30 due to service replacement of one battery only, 9 due to a shorted cell in a battery, and so on down to hook-up difficulty which probably would cause trouble only once.



12-VOLT CRANKING SYSTEM

SIGNIFICANT CONSIDERATIONS OF 6-VOLT BATTERIES CONNECTED IN SERIES-PARALLEL CONFIGURATION

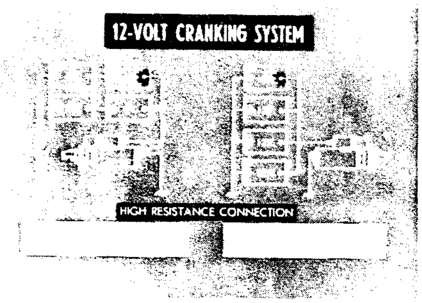
CONSIDERATION	SEVERITY RATING (8 IS MOST SEVERE)	FREQUENCY (BASED ON 100%)	
HIGH RES. CONNECTION	6	35	
REPLACING 1 BATTERY	3	30	
SHORTED CELL	7	9	
OPEN CELL	8	5	
EXTERNAL SELF DISCHG.	4	10	
LINE DROP	2	9	
ONE HOT (°F) BATTERY	5	1	
HOOK-UP INSTRUCTIONS	1	1	



12-VOLT CRANKING SYSTEM

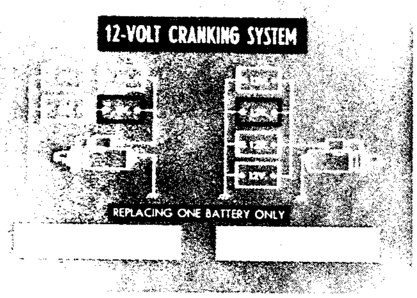
SIGNIFICANT CONSIDERATIONS OF 6-VOLT BATTERIES CONNECTED IN SERIES-PARALLEL CONFIGURATION			
CONSIDERATION	SEVERITY RATING (8 IS MOST SEVERE)	FREQUENCY (BASED ON 100%)	WEIGHTED RATING (BASED ON 100 AS MOST SEVERE)
HIGH RES. CONNECTION	6	35	100
REPLACING 1 BATTERY	3	30	43
SHORTED CELL	7	9	30
OPEN CELL	8	5	19
EXTERNAL SELF DISCHG.	4	10	19
LINE DROP	2	9	9
ONE HOT (°F) BATTERY	5	1	2
HOOK-UP INSTRUCTIONS	1	1	0.5

Multiplying the severity of the problem by the frequency in each instance, and setting the most severe equal to 100 will give us a weighted rating for each consideration. Each problem consideration has now been scaled from 1 to 100 with 100 being the most critical. This makes high-resistance connections stand out as the single most critical item in this study. Its weighted rating makes it almost as important as all the other considerations combined. Actually, the first five items represent 95% of the list as to importance while the last three items represent only 5%.



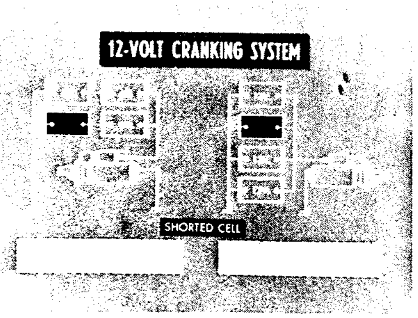
Now each system is shown with one high-resistance connection. In the 6-volt system the high-resistance connection reduces the performance of half the system. In the 12-volt system the same high-resistance connection results in reducing performance of only one-fourth the system.

This means that the 12-volt system offers a significant advantage when a high resistance connection is encountered. Since the power loss is much less in the 12-volt system, there will be more power available for cranking especially under marginal conditions.



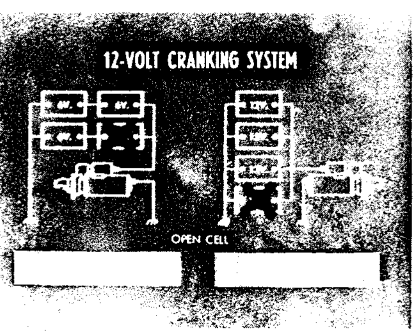
The next item to be evaluated is the effect of replacing only one battery in the battery pack. As illustrated here, we are considering the effect of replacing just one battery in each system. In a system using 6-volt batteries, the replacement battery will not introduce any problem or capacity loss, provided the state of charge and age of the replacement battery and the remaining 6-volt battery in series with it are the same. However, the chances of this happening are indeed extremely remote. This is why replacement of two 6-volt batteries instead of one, in a bank, is recommended to prevent system imbalance. This is one reason the 8D, 12-volt battery has advantages over 6-volt batteries as replacement of an entire bank instead of half a battery is guaranteed.

The replacement of a single battery in a system using four 12-volt batteries will not have any effect on other batteries in the system. Since each battery in this system is charged independently, the state-of-charge or age of the replacement battery can be at any level and still have no effect on the other batteries. After being charged once, the system will function as designed.



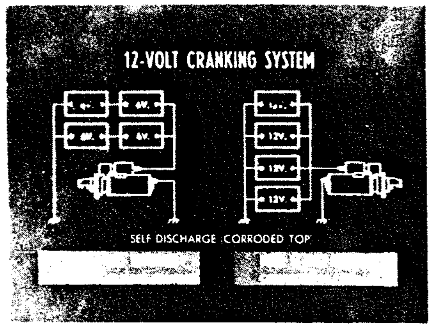
Here, one shorted battery cell is shown in each system. In the series-parallel system on the left, the shorted cell reduces the 6-volt battery to a lower voltage depending upon the degree of the short. The computer-run indicated that capacity is reduced by 43% during cranking. In the system on the right the computer-run indicated a reduction in capacity of 19%. In conclusion, a shorted cell in the system on the left reduces the battery capacity more than twice as much as in the system on the right—a 43% reduction compared with a 19% reduction.

This means that a 12-volt battery system will provide a distinct advantage when a short is encountered. In this situation, "less capacity loss" can be translated into more starts or the ability to start in much colder weather, as well as longer battery life. Normally, a battery with a shorted cell will eventually boil dry and then act as an open cell, which is the next consideration.



A battery with an open cell reacts the same as an open circuit in the leg in which the open cell exists. Therefore, the system with 6-volt batteries, on the left, acts as a system with two 6-volt batteries in series. Capacity is reduced 50% since only half the batteries can be used. In the 12-volt battery system, on the right, one battery is removed from the circuit with an open cell. Capacity is reduced only 25% and the 12-volt battery hook-up acts as a three-battery system.

Similar to the shorted cell consideration, the 12-volt battery system has a significant advantage over a 6-volt battery system due to "less capacity loss" when an open cell occurs.

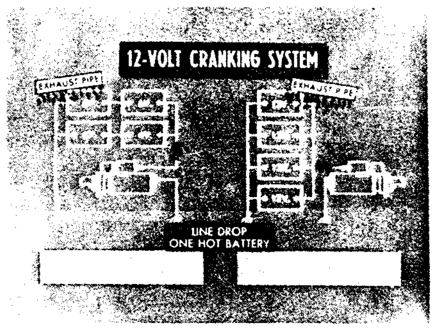


Examining the effect of self-discharge, due to an acid path on the top of a battery, shows that the self-discharge of a 12-volt battery will be twice that of a 6-volt battery. As indicated, the advantage lies with a system using 6-volt batteries.

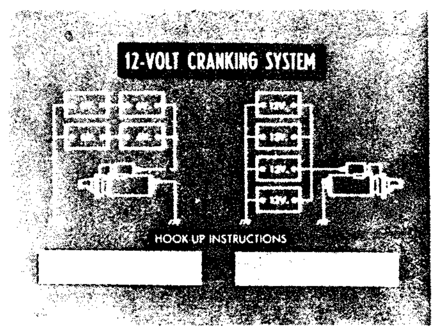
12-VOLT CRANKING SYSTEM

6-VOLT BATTERIES IN SERIES-PARALLEL		12-VOLT BATTERIES IN PARALLEL		
CONSIDERATION	WEIGHTED RATING	ADV.	DISADV.	COMMENT
HIGH RES. CONNECTION	100	X		LESS POWER LOSS
REPLACING 1 BATTERY	43	X		PROBLEM ELIMINATED
SHORTED CELL	30	X		LESS CAPACITY LOSS
OPEN CELL	19	X		LESS CAPACITY LOSS
EXTERNAL SELF DISCHG.	19		X	MORE SELF DISCHARGE
LINE DROP	9			
ONE HOT (°F) BATTERY	2			
HOOK-UP INSTRUCTIONS	0.5			

About 95% of the listed considerations have now been covered according to the weighted rating. Twelve-volt batteries have proven superior in 4 of the 5 considerations. The remaining three items to be covered are of relatively minor importance, when compared to the first five.



In this illustration, a battery mounted too close to a hot exhaust system, and voltage drop in the wiring are shown. In the instance of a hot battery, overcharge will occur in both systems. In the 6-volt battery system, the battery in series with the hot battery will limit the overcharge to a small extent, but both will be overcharged and fail. In the 12-volt battery system, only the hot battery will be overcharged and it will fail faster. In this situation, the system advantage can vary from one system to the other, depending on the temperature of the battery and operating conditions. In the instance of voltage drop in the wiring due to high-resistance connections or other problems, the advantage again can be with either system depending on cable size, length, and arrangement.



The last consideration is hook-up difficulty. Although quite low in significance, as far as potential field trouble is concerned, complicated hook-ups can be quite frustrating at times. The use of 12-volt batteries should simplify hook-up procedures since all positive connections will be hooked together, as will all negative connections. In 6-volt battery systems, some batteries are hooked positive to positive, some positive to negative, and some negative to negative. Because of this, a 12-volt battery system does offer a simpler hook-up procedure.

12-VOLT CRANKING SYSTEM

6-VOLT BATTERIES IN SERIES-PARALLEL		12-VOLT BATTERIES IN PARALLEL		
CONSIDERATION	WEIGHTED RATING	ADV.	DISADV.	COMMENT
HIGH RES. CONNECTION	100	X		LESS POWER LOSS
REPLACING 1 BATTERY	43	X		PROBLEM ELIMINATED
SHORTED CELL	30	X		LESS CAPACITY LOSS
OPEN CELL	19	X		LESS CAPACITY LOSS
EXTERNAL SELF DISCHG.	19		X	MORE SELF DISCHARGE
LINE DROP	.9	–	–	NO SIGNIFICANT EFFECT
ONE HOT (°F) BATTERY	2	–	–	NO SIGNIFICANT EFFECT
HOOK-UP INSTRUCTIONS	0.5	X		SIMPLER INSTRUCTIONS

Here is the completed chart. It shows the advantages to be heavily in favor of a system using 12-volt batteries. By adding up the weighted ratings favoring 12-volt batteries, and comparing with ratings favoring 6-volt batteries, the total favors 12-volt batteries by a 10 to 1 margin. Similarly, an analysis of 24-volt cranking systems produced advantages for use of 12-volt batteries almost identical to those already discussed. One disadvantage of 12-volt batteries, not previously mentioned, is the additional cells to be watered.

A GOOD DISCUSSION OF THE COSTS OF WATERING LEAD-ACID BATTERIES appears in the April issue of ***Alternate Energy Transportation,*** pages 3, 4 & 5. At $25/hour for labor, it costs about $200 per commercial van per year to water the batteries, if they are lead-acid and watered individually. Faster and cheaper methods, such as central point watering, are available; but it would be nice to eliminate the chore entirely. Of course this will be the case with some of the promising new candidates if and when they come on line. Meanwhile, Johnson Controls (at the urging of DOE) has been experimenting with the "gel-cell" lead-acid battery which of course is sealed. There are at least 400 vehicles equipped with these batteries presently on the road. Sandia National Laboratories in Albuquerque has been testing these batteries and have attained a range of nearly 100 miles under special conditions (See the DEVC Newsletter for May 1987 p5.).

From DEVC Newsletter, June 87

HAMFESTS 1987

Aug., 23 Sun. Commodore Fest
8:00 a.m. St. Charles Ill
Kane County Fairgrounds

Sept 13 Sun. 6:00 a.m. $3.00
Santa Fe Park 91st & Wolf
Rd. Willow Springs, Illinois

Sept 19 & 20 Two days $4.00
Expo Gardens W. Northmoor rd
off 6300 block Peoria, Ill.

Sept 26 & 27 6:00 a.m. $5.00
Lake County Fairgrounds
Rts. 45 & 120 Grayslake Ill.

Oct. 25 Sun. 8:00 a.m. $3.00
Waukesha Expo Ctr. Hwys. J &
FT off I-94 Waukesha Wisc.

Oct. 31 & Nov. 1st Two days
Norris Sports Ctr. Rt. 64 &
Dunham Rd. St. Charles, Ill.

Nov. 1st Sun. 7:00 a.m. $3.00
Lake County Fairgrounds
Rts. 45 & 120 Grayslake Ill.

* * *

Ford Motor Co. said it will offer a "shiftless" automatic transmission as an option beginning mid-year on its Fiesta sub-compact car sold in Europe.

The continuously variable transmission uses hydraulics and pulleys, eliminating the feel of shift points as in a conventional automatic.

Called the CTX for continuously variable transaxle, the new transmission offers efficiencies that compares well with standard-shift transmissions, which are most common in European cars.

* * *

WHOSE JOB IS IT?

This is a story about four people named Everybody, Somebody, Anybody, and Nobody.

There was an important job to be done, and Everybody was sure Somebody would do it. Anybody could have done it, but Nobody did it. Somebody got angry about that, because it was Everybody's job. Everybody thought Anybody could do it, but Nobody realized that Everybody wouldn't do it. It ended up that Everybody blamed Somebody when Nobody did what Anybody could have done.

KIPLINGER PUTS EVs SOLIDLY IN THE U.S. FUTURE

Kiplinger a prestigious group of observers of U.S. business, government and technology trends, has published a book called "The New American Boom". The following is a few Key notes from a two page article in "Electric Vehicle Progress".
BATTERY POWERED VEHICLES MAY REVOLUTIONIZE THE WORLDWIDE AUTOMOBILE INDUSTRY BEFORE THE TURN OF THE CENTURY!!
Hints at secret "Super Battery" research & Development. 1,000 lb. cars will run 1,000 miles @ up to 100MPH without refueling. Specialty EVs first as HYBRIDS will make a large impact before the year 2000. plus most of the performance EAA members have only dreamed of. "One of the Nation's Oldest and most Reliable Newsletters." Quote from THE WALL STREET JOURNAL!! (ed· except for the EAA newsletter of course).
I believe, how about you?