Electric Auto Association NEWS

MARCH 1984

A BRIGHT LIGHT IN THE TUNNEL

Detroit Edison and 20 other major U.S. electric utility organizations representing 33 operating companies have announced the formation of the Electric Vehicle Development Corporation (EVDC). The new organization's purpose is to direct a unified national effort amoung electric utilities to encourage the rapid development of mass-produced electric vehicles.

EVDC will conduct market assessments, evaluate electric vehicle applications and develop vehicle specifications for on-the-road application.

"EVDC will help get electric vehicles into applications--particularly commercial use--in which the mass-produced versions have a cost-advantage for fleet users," said Gerald J. Nicholas, administrator, new product applications, Marketing.

Detroit Edison has been successfully demonstrating how electric cars can fulfil the transportation needs of the typical family for the past two years and, in addition, has become involved in a number of other projects to support the development of a mass-produced electric vehicle.

To date, nearly 50 Detroit Edison volunteer employe drivers have logged more than 250,000 miles, consuming an average of 0.8 kilowatthours per mile.

Through this and other efforts, the company has become deeply involved in contributing to the development of electric vehicle technology because widespread use of such vehicles would not only save scarce fossil fuel resources--oil and gasoling--but also would add to the company's sales and at the same time benefit all of the company's customers. Nighttime charging of electric vehicles would make efficient off-peak use of the company's generating facilities, thereby helping to keep down overall energy costs to all customers.

On the heels of its successful electric car program, Detroit Edison recently signed a second contract with the U.S. Department of Energy (DOE) to conduct extensive demonstration tests on new electric vehicle battery designs.

Through 1984 the company will test and evaluate nickel-zinc batteries, state-of-the-art lead-acid batteries and a new electronic battery monitoring system.

"The new DOE agreement will give Detroit Edison the opportunity to perform on-the-road testing of highly advanced battery systems and equipment in addition to maintaining the company's ongoing electric car demonstration program," Nicholas said. "This new contract represents another step in the continuing process of developing the electric vehicle industry--an effort aimed at bringing electrics closer to mass-production."

Under the DOE agreement, the company will operate two electric cars fitted with nickel-zinc battery packs from the Delco-Remy division of General Motors Corp.

Meanwhile, the University of Michigan recently completed a pilot study to identify the potential market for commercial (fleet) electric vehicles in the company's service area. This study was funded by Detroit Edison and the Electric Power Research Institute (EPRI).

"The study identified a potential market of 47,000 gasoline-fueled commercial vehicles in Southeastern Michigan that could be replaced by electric vehicles," said Nicholas "This means that electric vehicles could be used in these applications today if they were mass-produced and cost-competitive with gasoline vehicles."

These encouraging results, Nicholas said, have led to an expanding study of the national commercial market by U of M, funded by EPRI.

Where is the World Going in Batteries?

EAGLE-PICHER INDUSTRIES of Joplin, MO has provided us with an up-to-the minute status report on their Nickel-Iron (NiFe) batteries EV's (for an earlier report, see EVC Paper No. 8315, AET 11/'83): "At '83's end we placed several 6V modules under test both at our facility and at the National Battery Test Laboratory (NBTL), which demonstrated 55 WH/kg. This is an increase from 50 WH/kg at the end of '82. The full scale battery tests currently underway in the Northrup vehicle fleet and more recently at TVA continue to show excellent results. A number of 6V modules have been placed in the European sector SAB-NIFE Company in Sweden. Batteries and modules are now under test and evaluation by FIAT Daimler-Benz and Volkswagen. Results to date have been very good, with evaluation continuing into 1984.

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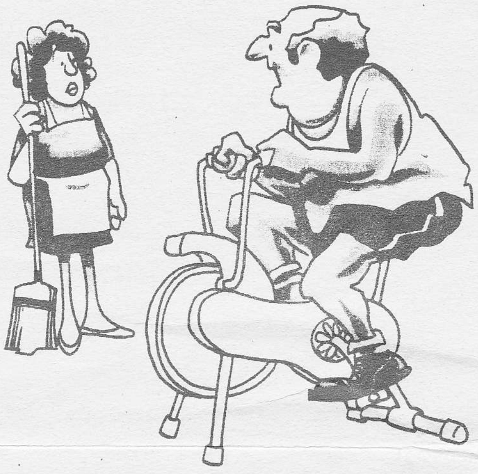
200 MILERS STILL ON FRONT BURNER

Gulf & Western's "electric engine" zink-chloride battery has been tested with good results.
Lawrence Livermore has had some very good test with the Aluminum-Air Battery.

THE TVA TEST ON THE GLOBE EV2300 INDICATES THAT ABOUT 30% IMPROVMENT IN RANGE CAN BE EXPECTED FROM THERNAL CONTROL AND PULSATED ELECTROLYTE.



"Do you realize that if I had put this thing on the road Monday morning, I'd be in San Francisco by now?"

EPRI ET Program Summarizes Strategy and Targets

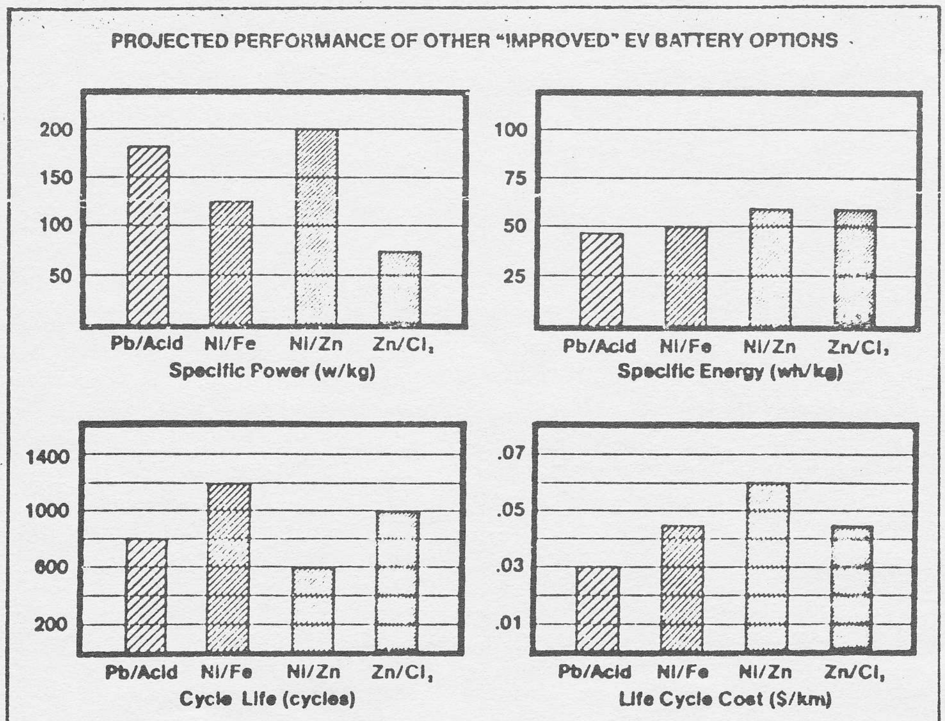


FIGURE 3

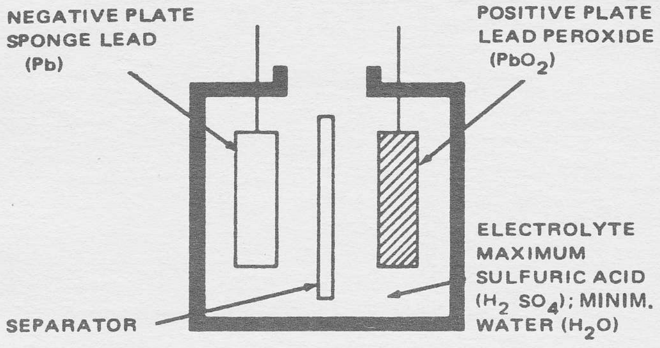
In 1982 performance milestones and achievements in this area included the evaluation of the Gould maintenance-free lead/acid battery. In-process are field and bench testing of the Globe electrolyte-pulsating lead/acid battery, the development of a starved electrolyte lead/acid battery, the acquisition of Eagle-Picher Ni/Fe, GM-Delco Ni/Zn, and EDA Zn/C12 battery systems for field and bench testing, and projects to develop advanced battery system prototypes for in-vehicle testing. Options here include Zn/C12, Zn/Br2, Na/S, and Li/FeS.

Projected performance of other "Improved" EV battery options are represented in Figure 3.

How Your Battery Works

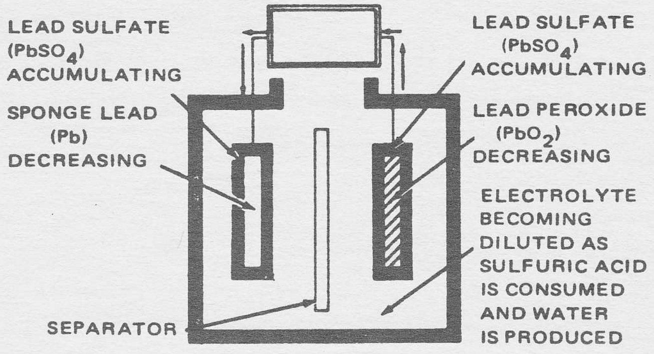
COME ON! YOU DID'NT REALLY KNOW???????

FULLY CHARGED BATTERY



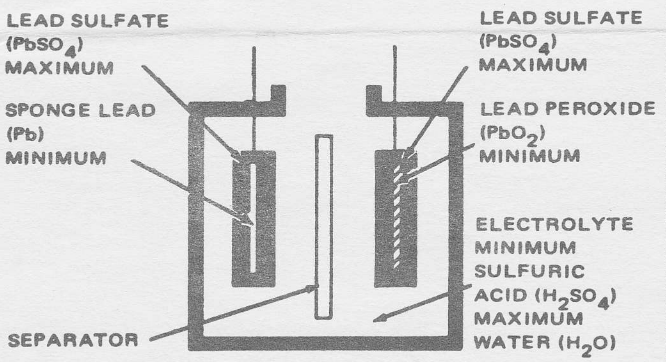
In a charged battery, active material of the negative plate is sponge lead (Pb); active material of the positive plate is lead peroxide (PbO_2); the electrolyte contains sulfuric acid (H_2SO_4) and a minimum of water.

BATTERY DISCHARGING



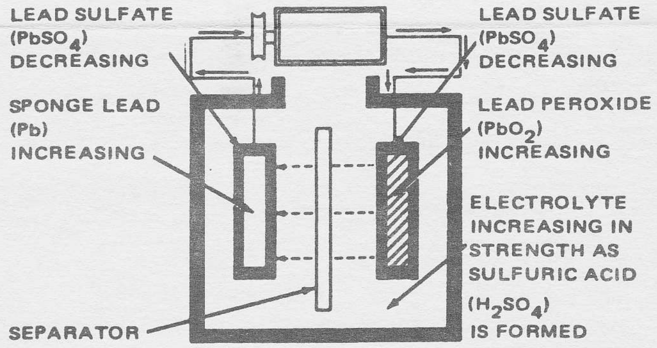
When the battery discharges, the electrolyte reacts with both the positive and negative plates . . . oxygen from the lead peroxide in the positive plates combines with hydrogen from the sulfuric acid to form water . . . lead from the lead peroxide combines with the sulfate from the sulfuric acid to form lead sulfate . . . hydrogen from the sulfuric acid combines with oxygen from the lead peroxide to form more water . . . lead from the sponge lead in the negative plates combines with the sulfate from the sulfuric acid to form lead sulfate . . . and electric current flows.

DISCHARGED BATTERY



In a discharged battery, most of the active material from negative and positive plates has been converted to lead sulfate ($PbSO_4$), and the electrolyte is greatly diluted with water (H_2O).

BATTERY RECHARGE



When the alternator recharges your battery, the chemical reaction between plates and electrolyte is reversed . . . lead sulfate from positive and negative plates reacts with the electrolyte to form sulfuric acid . . . removal of sulfate from the negative plates restores sponge lead as the active material . . . oxygen from the water recombines with the lead in the positive plates to form lead peroxide . . . and the strength of the battery is restored.

THE BOTTOM LINE

40Million ELECTRICS

YES!! 40 MILLION VEHICLES IN THIS COUNTRY TRAVEL LESS THAN 40 MILES PER DAY LEAD ACID CAN DO IT.

DOODLES: 75AMPS. GOOD MAX. AVG. HP 10, IDEAL LOW VOLTAGE 60 VOLTS FOR GOOD SPEED. IDEAL HIGH VOLTAGE 120 VOLTS. 75 AMPS @ 40 MPH 2HRS.=80MILES BELOW 60V. PARR. BATTERIES.48V. JUST A MITE SLOW. GOODBY,CLARENCE.

Battery Weight Ratio

It's your first and most important EV decision

In the EV rallies it's no accident that the leading cars have a high battery weight ratio. In the 1982 Santa Clara rally the 20 battery cars averaged 43%, the top 16's 40%, the top 12's 33%. The 12's didn't do too well until in 1983 Bob Steinfeld went 73.8 mi. with 40% battery ratio. A high ratio does not guarantee high mileage unless other things are done right, but it guarantees better acceleration and hill climbing characteristics.

The problem is how do you correlate your desired mileage and other characteristics with a practical car? If you're a newcomer to the game you probably couldn't get an answer to this question.

The chart below is intended to answer that question. First pick the mileage you want -- make this double your commute or routine daily mileage. This allows some reserve mileage and a limit of discharge to 80% to prolong battery life. Then if you have a car go to the right from mileage to the approximate pre-conversion curb weight. If it's in a band lower than 35% add 2 batteries -- you get more mileage and might go up 5% in battery ratio; 2 more might get another 5. Now if you have room for the batteries, fine; if not, drop down two -- satisfied? If not, consider another car and go through the process again.

This chart was based on analysis of the 1981 and 1982 East Bay rallies and was checked with the 1982 Santa Clara rally. Full results of the 1983 International rally would further verify or modify the chart.

BY--HANS KOSKI

Expected Rally miles		EV curb weight/Pre-conversion curb weight					
		Number of Batteries					
105min. batt.	135min. batt.	10	12	14	16	18	20
15	20	3200/2650					
20	25		3900/ 3200				
25	30	2500/1950		4600/3800			
30	40		3050/2400		5300/4325		
35	45	2025/1475		3600/2800		6000/4900	
40	50		2500/1800				6700/5450
45	55	1700/1150			4175/3200		
50	65			2975/2150		4750/3550	
55	70	1450/900	2100/1400				
60	75				3450/2475		5300/4050
65	80	1250/700	1800/1100	2500/1675			
70	90	1100/550				3900/2700	
75	95		1575/875	2150/1325	2900/1925		
80	105						4375/3125
85	110		1400/700			3300/2100	
90	115			1875/1050	2500/1525		
95	120						
100	130			1650/825			3700/2450
105	135				2200/1225	2850/1650	

Battery weight ratio

20%

25%

30%

50%

45%

40%

BATTERIES TO ADD OR NOT TO ADD

By Russ Kaufmann

Many of todays electric vehicles employ 16, 18, 20 or more propulsion batteries; others have a few as 6 batteries. Is there an advantage to be gained by using more batteries, or is there a point of no return? This Article will measure the battery load using battery packs containing from 4 to 32 batteries. Battery discharge time will then be computed, which will net vehicle range. Factoring in the total cost of the battery pack, the cost per mile for the life of the pack will be found. Finally, battery cost per mile will be determined for a vehicle having extra batteries on board and thus discharging them less than 80%.

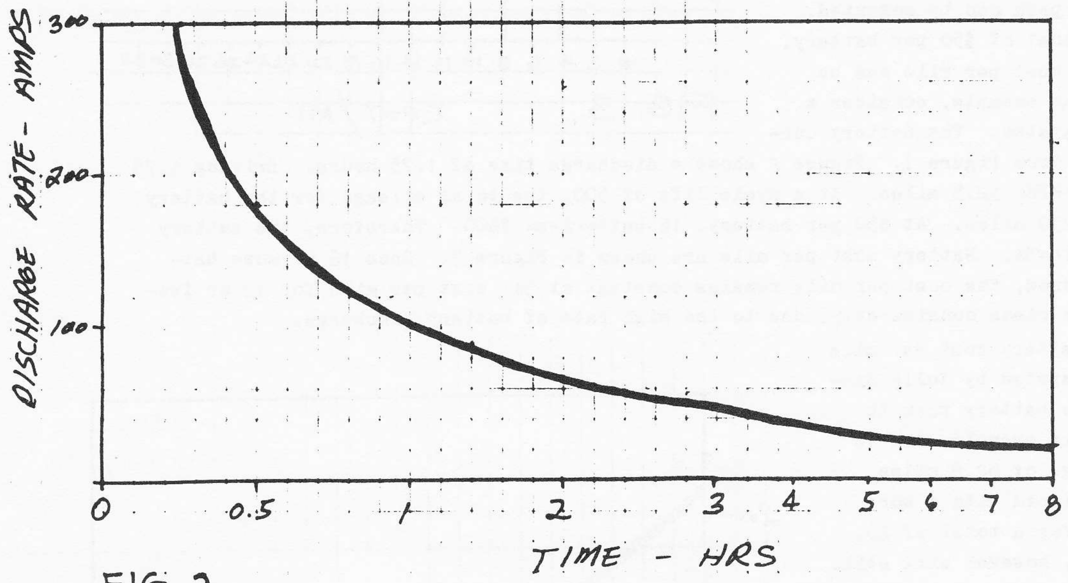
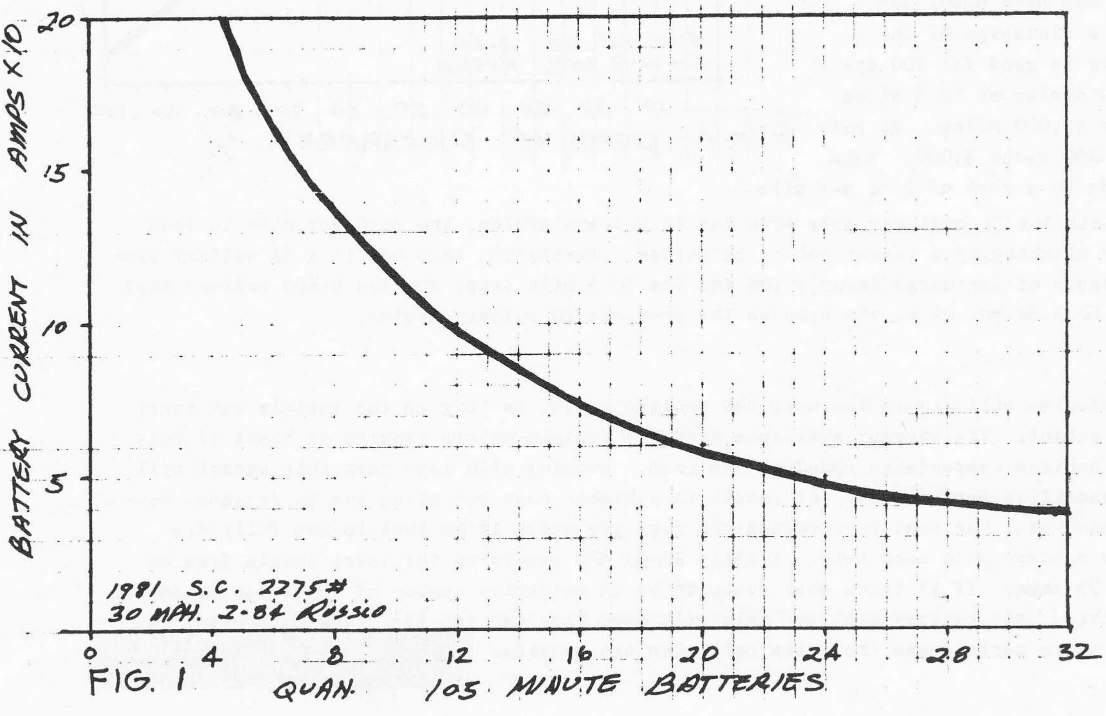


FIG. 2

Figure 1 shows the battery current drawn for a vehicle traveling 30 miles per hour down a level road. Currents are plotted for battery packs ranging from 4 to 32 batteries. Note that the greater the quantity of batteries used, the less the battery current. This is because the vehicle uses the same horse power to travel at 30 MPH, no matter how many batteries are on board. Since HP= volts x amps, as the battery voltage increases, the current (amps) to propel the vehicle <u>decreases</u>. Battery and vehicle weight have an insignificant effect on the HP, as long as the vehicle is not accelerating on a level road, and has a low rolling resistance.



1981 S.C. 2275#
30 MPH. 2-84 Rossio

FIG. 1

Figure 2 shows the time 105 minute lead acid batteries will last under various discharge rates until each 6 volt battery reaches 5.25 volts at 80°F. Note that high discharge rates over 100 amps discharge the battery very fast, whereas discharge rates under 75 amps discharge the battery much more slowly. This is due to a substancial increase in the batteries internal resistance during high discharge rates due to the depletion of electrolyte in the vicinity of the battery plates. Thus high discharge rates are to avoided.

By using data from Figures 1 and 2, the vehicle range at 80% discharge can be determined from the time run at the speed of 30 MPH. Assuming a life cycle of 500 at 80% discharge, the total mileage for the life of the battery pack can be computed. Assuming a cost of $50 per battery, the battery cost per mile can be found. As an example, consider a 16 battery system. The battery current is 75A from Figure 1. Figure 2 shows a discharge time of 1.75 hours. Driving 1.75 hours at 30 MPH= 52.5 miles. At a cycle life of 500, the total mileage for the battery pack is 26,250 miles. At $50 per battery, 16 batteries= $800. Therefore, the battery cost per mile=3¢. Battery cost per mile are shown in Figure 3. Once 16 or more batteries are used, the cost per mile remains constant at 3¢; cost per mile for 12 or fewer batteries rises considerably, due to the high rate of battery discharge.

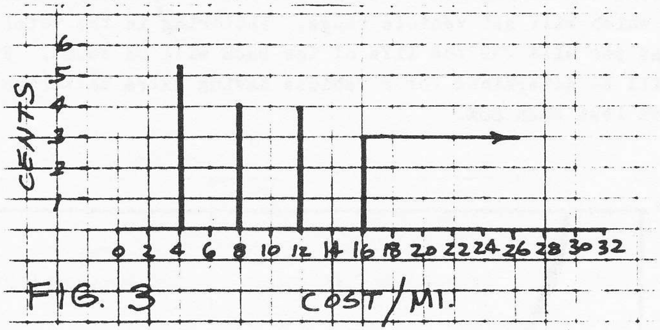


FIG. 3

Thus far, battery cost per mile has been computed by fully discharging the battery pack to 80%. In this example, the 16 battery range of 52.5 miles will be replaced with 4 more batteries, for a total of 20. The vehicle, however will still be driven the same 52.5 miles, thus not fully discharging the batteries. The new discharge will be 60 amps instead of 75 amps, from Figure 1. This corresponds to a 0.8 less discharge rate or a battery discharge rate of (.8) (.8)= 0.64 depth of discharge. Figure 4 depics battery cycles vs. depth of discharge. So far an 80% discharge has been used, but with only a discharge of .64 the battery is good for 800 cycles. 800 cycles at 52.5 miles per cycle= 42,000 miles. 20 batteries at $50 each= $1000. This corresponds to a cost of 2.3¢ per mile.

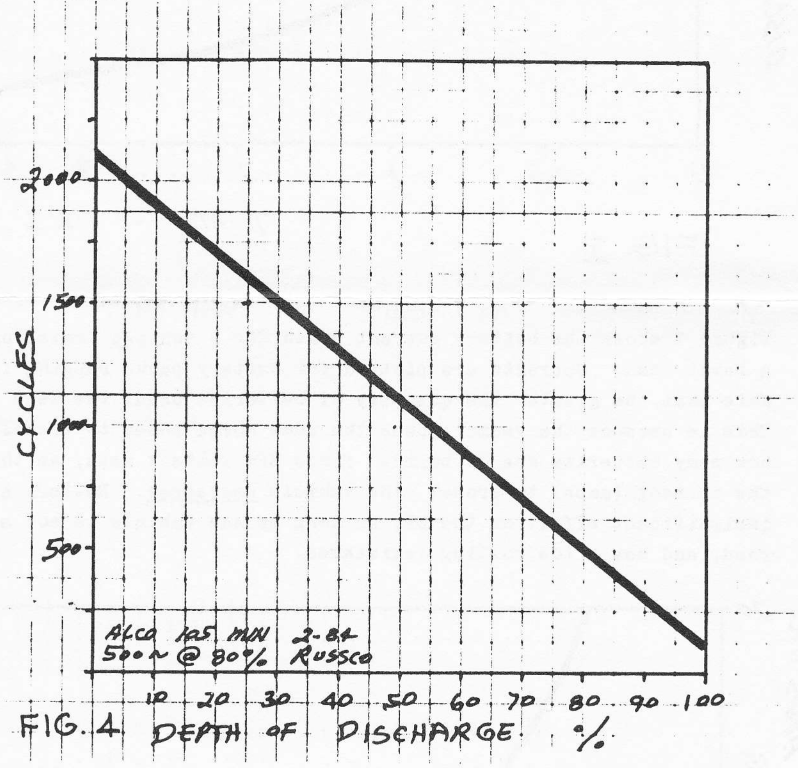


FIG. 4

Compared with the 3¢ cost per mile with the 16 battery system, the cost per mile is less than fully discharging a lesser set of batteries. Stretching this out to a 32 battery system, the depth of discharge is only 40% for the 52.5 mile trip, but the $1600 battery cost works out to 2.3¢ per mile, the same as the previous 20 battery system.

Summary

Adding batteries will always increase the vehicle range, as long as the vehicle can carry the added weight. The current available electric vehicle motors require at least 12 batteries to achieve respectable speed on the road. Running with less than this amount will not only sacrifice performance, but result in a higher cost per mile, due to frequent battery replacement. For best performance and cost per mile, it is best to not fully discharge the battery pack each trip. Ideally 25-30 MPH speeds on the level should draw no more than 75 amps. If it takes what seems to be an excessive number of batteries to accomplish this, the battery cost per mile will more than pay for the extra batteries, let alone the extra performance the extra batteries can provide.

RUSSCO ELECTRO-MECHANICAL ENGINEERING

BATTERY LIFE AND USAGE PROFILE

D.R.Gillis

This is an interim report on the Battery Usage/Life Survey. We have been compiling data for 10 months and have enough respondents to give you some meaningful feedback.

First I would like to thank those that took the time to respond to the survey, your efforts will be appreciated by many others. A special note of thanks is due John Newell, John has been diligent about getting the surveys to all the members.

This summary is restricted to information supplied by vehicle owners/users and does not include any hearsay.

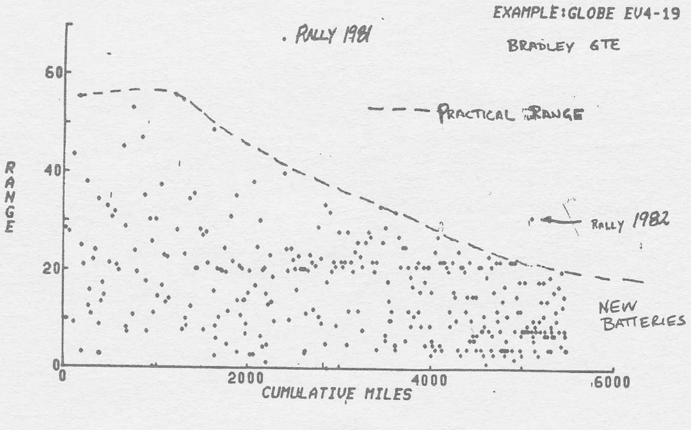
* A total of 31 vehicles were included in the survey.
* The response rate was 3.8%
* The average vehicle weight was 2470 pounds
* The average number of batteries per vehicle was 12.
* The average distance between charges was 22 miles.
* The average maximum range for a single charge was 43 mi.
* The average mileage at pack replacement was 3578 miles.
* The maximum miles on any battery pack was 10,000.

The satisfaction** of the respondents is listed in the table below for the battery manufactures with more than 10% response.

Manufacturer	Yes I would purchase again (percent)	Will NOT purchase again (percent)	No Response (percent)
Globe Union	38	50	12
Trojan	50	0	50
Alco	66.6	0	33.3
Exide	33.3	33.3	33.3

** As more responses are received we will eventually report satisfaction in terms of MILES AT REPLACEMENT.

Those who gave a detailed listing of their usage profile allowed a complete analysis, as listed below for a set of Globe Union Batteries.



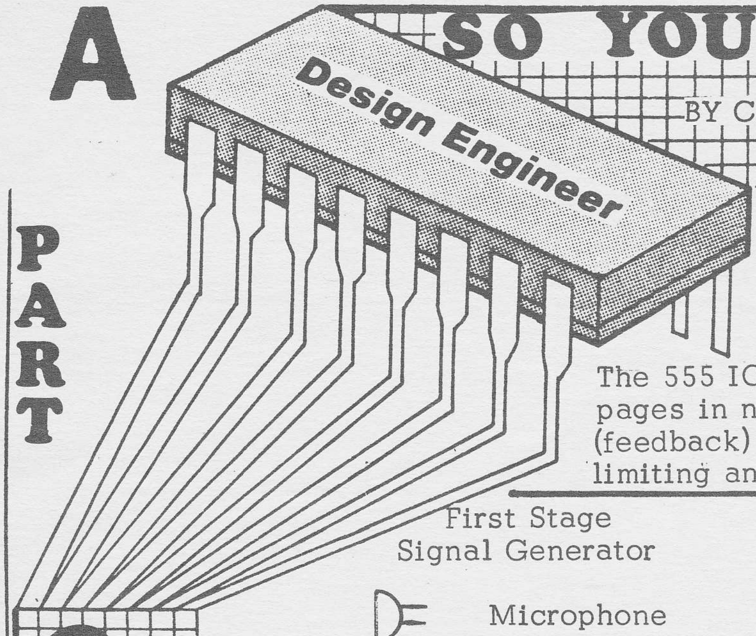
9/20/82

The survey has been rewritten and will be continued, your response will help keep us all informed.

A SO YOU WANT TO BE Design Engineer

PART 2

BY CLARENCE ELLERS

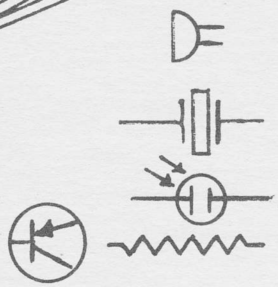


ANATOMY of an ELECTRONIC CIRCUIT

LEARN BY DOING!! Try building some simple circuits using the Engineer's Notebook (RS) and the Amateur's Handbook.

The 555 IC is one of the most versatile units ever made, 6 pages in notebook. There are dozens of internal circuits (feedback) from final to preceding stages for sync, current limiting and etc.

First Stage
Signal Generator



Microphone

Crystal Piezo Elect.

Solar Cell

Heat Sensor Resister or Transister LM334

Electronic Generator Integrated Circuit

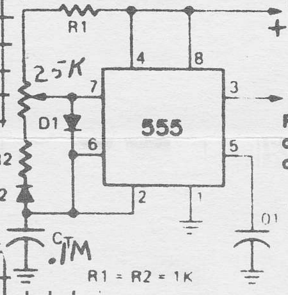
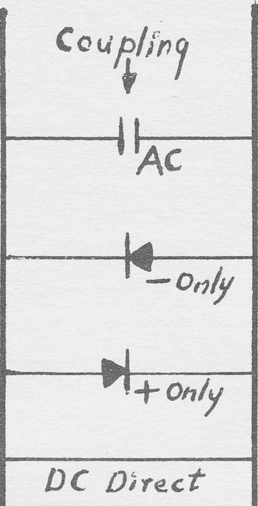


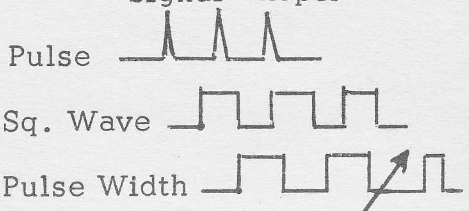
FIG. 17—ASTABLE MUTIVIBRATOR with duty cycle variable from 0 to 100% and frequency constant.



Second Stage
Signal Modifier

Preamplifier or D.C. Amp. to increase signal from generator to usable value.

Signal Shaper



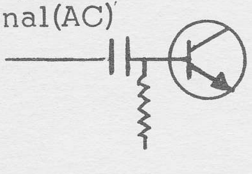
IC or Transister may be included in 1st stage IC like SG3524 in Feb.

Third Stage
Buffer
or Intermediate Amplifier

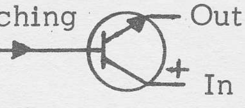
May Need 2-3 or More Stages to Obtain Needed Gain to Drive Power Amp./Switch Final Stage.

Usually Simple Amp,/switch Depends on how complex Signal.

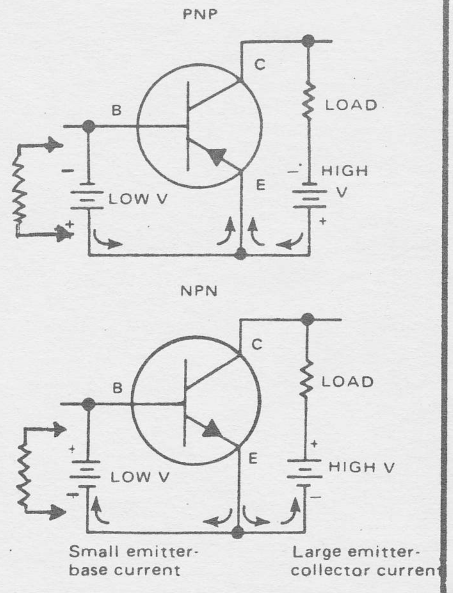
Complex Signal(AC)



DC Switching Control



Final Stage
Power Amp./or Switcher



(Note that only difference is reversed battery polarity and opposite direction current flow)

Gain Considerations – Due to complex scope of this subject only one gain parameter will be considered. This parameter is common-emitter small-signal dc current gain, referred to as h_{FE}, beta, or β. From standpoint of common applications, following general rules should be used as guideline. High gain devices (h_{FE} from 300 up) will find usage in preamps, RF stages, and converters. Medium gain devices (h_{FE} from 100 to 300) will find usage in RF and IF stages, oscillators, mixers, drivers, etc. Low gain devices (h_{FE} up to 100) will find usage in output stages, AGC, drivers, video amplifiers, etc.

Transistor Biasing – Occasionally bias resistor(s) may have to be changed in order to achieve proper circuit operation. Following two diagrams are intended to show typical PNP and NPN circuit current flow and biasing voltages:

EV Marketplace

'69 Renault sedan with Westinghouse motor has controller meters and electric controls good shape. $500. Oravilli Smith PO 5030 Salton City, Ca 92275

'71 Vega Electric, J & H G-32 motor, 14 T-105 Trojan batteries, binary relay control, regenerative braking, $1200 (408) 225-0458, San Jose, Ca.

For Sale-2CM77 motor $100, 130 ft. 2/0 cable $50, transformer-220 in96 & 12v out $50, Simpson meters-from $10, controllers-EVC,Inc.500amp., 12-96VDC, transistorized $600 HB Elec. 450 amp, 24-96VDC, SCR, $500 w/accel. module, rev, switch & bypass contactor, 500 amp HB contactor w/12v.coil $20, Call (619) 453-2231 or even.(619)277-3166 Roger.

RENAULT LEOPARD $5,900 600 miles runs perfect. CITI car '76 6000mi. $1500. Chester Jones Walnut Creek 939-2067

'63 VW bug, EA40, shunt, field weakening, regenertive braking to 7MPH, $1500. 38 Chev Mailtruck, $500. 415-525-3636 Lou MacMillan, 1937 Russell, Berkely, Ca 94703

---

69 Toyota, 96V, PMC Controller, Baldor motor, Fan, 16 J250, L 12v deep cycle Eie Hard Batteries, Tow bar, overload springs. On board charger. Asking $1200 Must Sell Make Offer: 209-952-7370 - John Allison 1108 Rosemarie Ln., Stockton.

EV COMPONENTS NEW & USED

New: Motor-mounting **ADAPTERS** & shaft **COUPLINGS** custom made: from $200.
Willey Model-9 **CONTROLLERS**: $695.

Used: **MOTOR** Prestolite model MTC-4001, 20 hp, 96 volts: $600.
CONTROLLER Pulsomatic SCR 350 A. up to 140 V.: $300.
BATTERY CHARGER, Lestronic model 9455, 115/230 V. in, 12 & 72 V out, 16/25 amps: $300

Bill Palmer 44 Dior Terrace, Los Altos, CA 94022, 415 948-7677

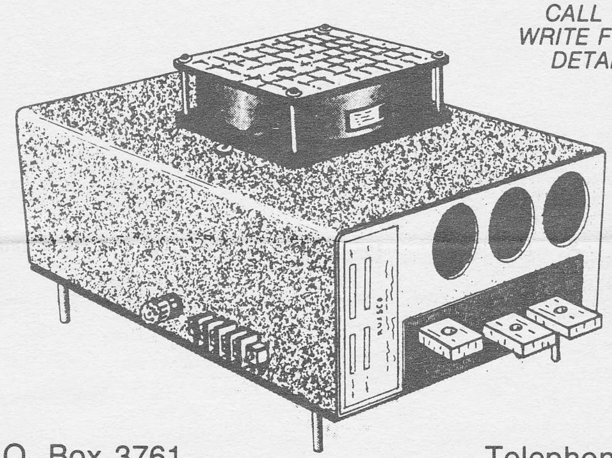
WANTED: TRANSISTOR MJ 10200 to replace faulty on in controller. Morris Saari 13535 53rd Ave. So., Seattle, Wa. 98168 206-243 -0510

ELECTRIC VEHICLE DRIVE SYSTEM

$695

- HV-400 CONTROLLER
- FUSE, 400 A
- CIRCUIT BREAKER, 200 A
- CONTACTOR, POWER
- ACCELERATOR CONTROL

CALL OR WRITE FOR DETAILS



P.O. Box 3761
Santa Rosa, CA 95402

Telephone:
(707) 542-4151

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ELECTRO-MECHANICAL ENGINEERING

NOTICE!!!NOTICE!!!NOTICE!!!

RENEW!! WE NEED YOUR SUPPORT!! RENEW!!!

ADS must be received with payment by the 10th. of the month, for the following month's issue. AD rate is min. 1 to 5 lines $5.00, 1/4 Pg. $15.00, full Pg. $50.00, full Pg. 2 sides $80.00. Wanted, Trade, For Sale, etc. Mail to EAA 1249 Lane St. Belmont, CA. 94002

WHATS HAP'N

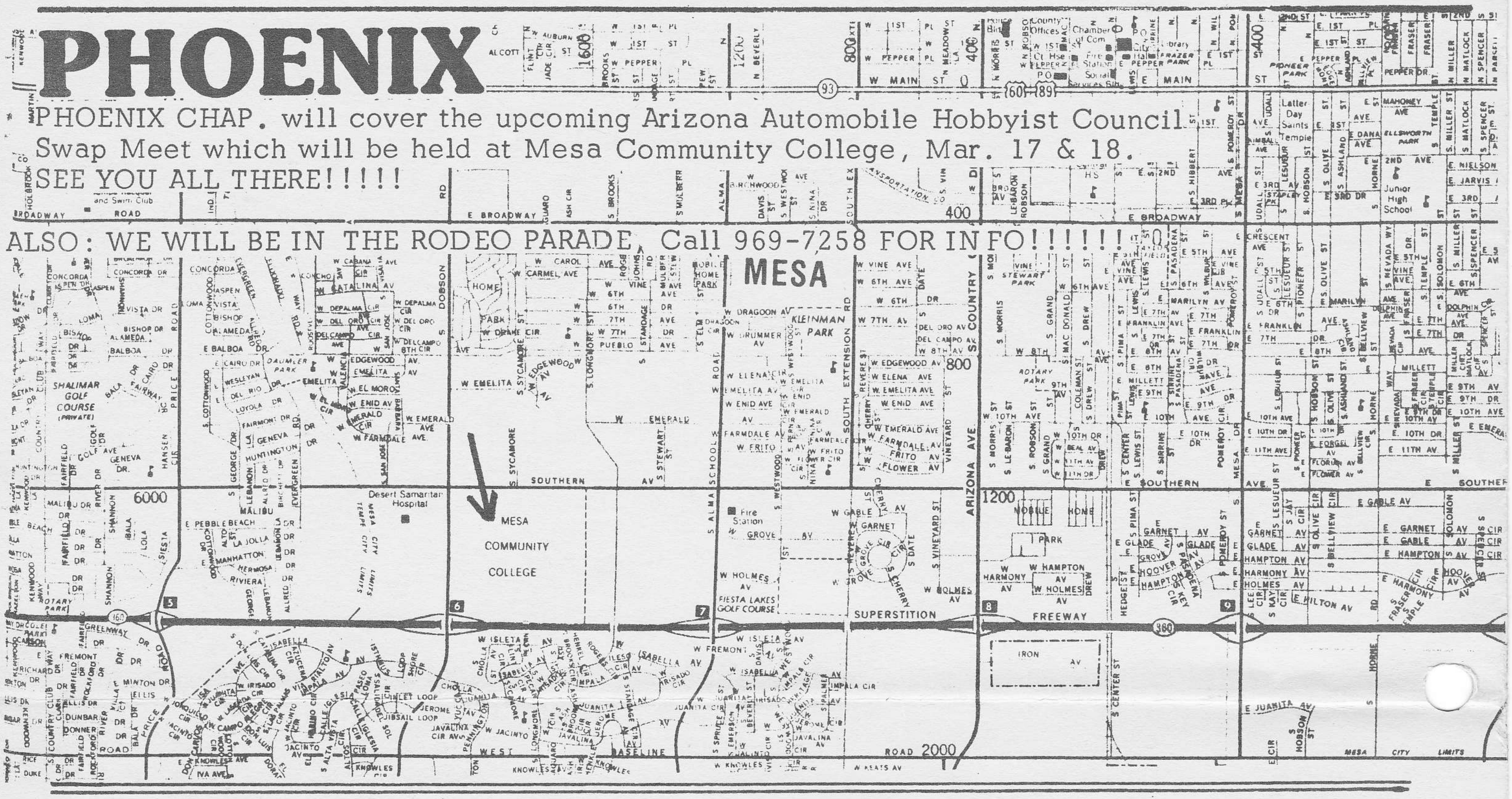
Peninsula

PENN. CHAPTER MARCH 3rd meeting, San Bruno Library from 10-to 12 a.m. Mr. Stan Skokan is guest speaker. Topic: STATE-OF-THE-ART OF ELECTRIC CAR INDUSTRY. His experience in ELECTRIC VEHICLES INC. qualifies him on the subject of THE ELECTRIC CAR INDUSTRY. DON'T MISS THE MEETING!

PHOENIX

PHOENIX CHAP. will cover the upcoming Arizona Automobile Hobbyist Council Swap Meet which will be held at Mesa Community College, Mar. 17 & 18. SEE YOU ALL THERE!!!!!

ALSO: WE WILL BE IN THE RODEO PARADE, Call 969-7258 FOR INFO!!!!!!!



ATTENTION !!!! SANTA CLARA CHPT. HAS A NEW PERMANENT MEETING PLACE MERCURY SAVINGS, CUPERTINO, 19376 STEVENS CREEK BLVD. 1/2 BLOCK EAST OF WOLFE RD. FEB. 18th 1984.

* * *

EDITORS: - Walter Laski - John Newell - Bill Palmer - Paul Brasch - COMPILED AND PUBLISHED By Clarence Ellers. SEND IN YOUR PERSONAL AND CLUB NEWS AND COMING EVENTS. ARTICLES _ COMMENTS etc. all correspondence to address below.

Electric Auto Association NEWS
MARCH 1984

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