F.V.E.A.A. NEWSLETTER

April 1985

MEETING NOTICE

The next meeting will be Friday April 19th, at Mid America Federal Savings 250 E. Roosevelt Rd. Wheaton, Illinois. - Time - 7:30 P.M.

GUEST SPEAKER

We have a good meeting planned for this month. The speaker will be Al Chilenskas, an employee of Argonne National Laboratories and is concerned with the develovment of 'lithium-aluminum/iron sulfide' batteries. He is manager of a joint project with the Electric Power Research Institute of the Department of Energy and the TVA. The objective of the project is to develope a full scale vehicle battery. Al has a B.S. degree in electrical engineering from the University of Illinois and lives with his family in Western Springs, Ill.

LETTER FROM THE PRESIDENT

We will also have a report of the results of our first fund raiser, and this is a reminder to bring your surplus items to the club meeting for sale at future hamfests.

Thank you.

Dana Mock
President

NOTE

The 1985 Membership List in last months newsletter has been found to contain some errors. An error free and updated list will be included in next months newsletter.

F.V.E.A.A.

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

FIRST CLASS

Argonne employees given patents

by Ann Hamman

Hinsdale resident Hiroshi Shimotake has 17 patents with his name on them, but none of them will mean a windfall profit for the inventor.

The patents, you see, do not belong to Shimotake but to the United States Department of Energy, which has sponsored Shimotake's work at Argonne National Laboratory since 1968. Any citizen can use the patents free of charge.

But just how and when Shimotake's inventions will be used depends on the price and future supply of gasoline.

"Most of them are related to new types of batteries which can power an electric car," Shimotake said. "For eventually we will run out of petroleum. Temporarily the price of gasoline has been coming down, but this is only a temporary dip. We have to prepare for an eventual shortage and alternate means of mass transportation."

Although we don't see any electric cars on local streets, Shimotake said some have been used by postal workers in California, by workers at Disney Land and Disney World and even by parking meter attendants in Naperville.

"They didn't last long (in Naperville)," he said, "The batteries are not very efficient in cold climates.

"Several small companies are building electric cars, and GM and Chrysler are looking into them, though they're not marketing them yet. The costs are too high if they are not mass-produced. But it could be more competitive. There is no demand now."

Shimotake, who was born and raised in Tokyo, came to the United States to attend Northwestern University in 1963. He received his master's and doctor's degrees from Northwestern and moved to Hinsdale in 1968.

"I have a sort of scientific inclination," he said. "My father is a pharmaceutical chemist."

Through his work on batteries that are lighter in weight and more energetic, Shimotake is doing the unseen work that may lead to a new way of driving in the future.

Other patent recipients

Shimotake is one of the 49 Argonne scientists who were honored Monday at a special presentation at Argonne. The scientists, engineers and technicians were responsible for the 36 patents granted for research development during 1984.

Other area inventors who were honored in addition to Shimotake were John Dawson and Neng-Ping-Yao of Clarendon Hills; Charles August of Darien; and David Baxter, Henry Karplus and Robert Smither of Hinsdale.

Their patents had to do with a variety of sophisticated scientific methods such as focusing X-rays and gamma rays, converting waste heat into electricity and measuring flow velocity in a solid/liquid mixture.

Argonne, which is near Lemont, is one of the nation's largest federally funded research and development centers. It carries out broad programs of research in the physical, biomedical and environmental sciences under the aegis of the University of Chicago for the DOE.

BCB **has introduced** a new series of fast-recovery diodes designated the FR4000 series. Those are special application parts that feature two paralleled inverted diodes on the same substrate. As a result they will pass current in either direction and BCB engineers claim that new doping techniques make the voltage drop across the diode less than one microvolt in either direction

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Rumors that have been flying around the computer industry for months were confirmed at last November's Comdex show in Las Vegas. A new breakthrough in ULSI (*U*ltra *L*arge *S*cale *I*ntegration) fabrication techniques has produced a new computer. All the circuitry needed for the device is contained on one chip that is housed in a package that measures less then ¼-inch square. The display is an improved version of the LCD's currently being used in miniature TV sets. The increased efficiency of the new LCD's, however, has made possible resolution fine enough to feature an 80 × 24 character display, with each character being formed by an impressive 18 × 26 matrix. The keyboard for the new computer is similar to the ones found on the calculator watches, and features 56 keys for input of a complete ASCII character set including upper- and lower-case letters. Because of the single IC design, the computer measures only 1 × 2 inches. It is powered by body heat, with a silver-oxide battery for memory backup. Dubbed the *Wrist Computer*, it is available with either a stainless steel or brushed gold finish. An executive, deluxe model is planned that will have all of the above features as well as a numeric keypad and ten user-definable keys.

FVEAA

BATTERY DETERIORATION

by Hans Koski

Battery deterioration has been ignored generally but now we have Don Gillis's interim report on the Battery Usage/Life Survey which indicates very poor life mileage obtained by EAA EVs. Other sources have reported poor life in some fleet EV tests so we are not alone.

Why do EVs fall so far short of laboratory tests such as those on the EV106 showing full capacity and voltage maintained for 500 cycles at 75 amperes? Don's survey and the rallies may give some clues.

A recent listing of the 1982 rally provides new data on the EVs that might help in putting this picture in focus. The chart below presents this information with the cars divided into four groups of varying efficiency based on the assumption that all cars have new batteries with available stored energy based on the manufacturer's rating. By dividing the stored energy by the rally mileage a watt-hour per mile value is obtained for each car.

The watt-hours per mile value is calculated as follows:

$$\text{wh/mi.} = \frac{(75)(\text{minutes @ 75a.})(\text{nr. of batts})(\text{v./batt.})}{(60)(\text{miles in rally})}$$

When these values were calculated for the cars in the 1982 rally they seemed to be naturally divided into four groups with the range of wh/mi. shown at the head of the columns. The cars in GroupI probably have new or nearly new batteries. The cars in the other columns then have older batteries and/or mechanical problems or they have higher running losses. The wh/mi. then consists of a basic loss figure for the car and an increased or decreased amount for any loss changes and an unknown amount that is actually the amount lost due to battery deterioration and is not available from the original battery capacity.

The chart shows several items that affect the efficiency of the EVs. The cars are grouped by battery manufacturer and each car is represented by motor manufacturer or type / number of batteries / make or model of car. The other symbols are: "#" for parallelled batteries and "R" for relay type control.

The lines with arrow points show where that car was in the 1981 rally (to the left), or the 1983 rally (to the right). Gillis's Bradley (Gr.IV Globe) would have been in Gr. I in 1981 but his batteries had deteriorated 60% by the 1982 rally. John Newell's Fiat (Gr. IV Globe) would have been in Gr. I in 1981 but he had a dragging brake in 1982. Some of the others probably are combinations of battery deterioration and mechanical or electrical problems. There are six EVs with relatively small amounts of change between rallies that show a change of 10 to 30 percent. These may be representative of battery deterioration in EVs and Gillis's 60% may be unusual. More likely the other drivers did not drive as much as Gillis but they may or may not obtain greater battery life ultimately.

Santa Clara Rally - 1982

	Group I	Group II	Group III	Group IV
	100-200 wh/mi.	200-260 wh/mi.	260-320 wh/mi.	320-700 wh/mi.
	70-124 mi.±	55-75 mi.±	25-60 mi.±	20-40 mi.±
Globe	Presto 20 Fiat Presto 20 Saab G.E. 16 R Honda Baldor 16 Honda Baldor#16 VWdb Presto 14 VWdb	Aircr.# 16 R Aztec Presto 12 Aquila	Aircr.# 12 R VW sed.	G.E. 16 R Bradley Aircr.# 16 R Aztec Aircr. 12 Fiat
Trojan	Aircr.# 20 VWdb Baldor 13 Vega Aircr. 10 VWdb	Presto 16 VWdb Presto 16 Ford Aircr. 12 R Bradley Aircr. 8 R Renault	Baldor 16 Ford Baldor 12 Vega Aircr. 12 R Datsun Tr. Aircr.# 10 R VW sed.	Aircr.# 18 R Metropolitan Aircr.# 14 R Datsun Truck Aircr.# 14 R VW sedan Aircr. 8 R Audi
Alco	Presto 20 Honda Baldor 16 Honda Presto 16 Aztec	G.E. 16 Bradley China 12 Datsun Tr.	Comm.# 12 R Nordskog	
Sears	Presto 12 Honda Baldor 12 Fiat		Aircr. 12 Karman	Honeywell # 16 HMV Aircr. 12 Fiat
Clyde	Aircr. 14 R Le Car			
Presto	Aircr. 12 Honda			
Exide		Baldor 19 Vega Presto 12 Fiat		
Wards				Baldor 6 Midget
Total Cars	16	10	7	10

The distribution of the cars with different manufacturer's batteries is interesting and might show some pattern of deterioration. The Alco battery is a new brand and its price has attracted a number of EV owners. The distribution of the Alcos in Groups I thru III then represents almost new batteries with the more efficient cars in Gr. I and some with battery deterioration and lower efficiency in Gr. II and III. The Trojans apparently have been in steady use with regular replacements with batteries in varying states of deterioration. Globe is unusual with half of the users in Gr. I. This may be partially due to recent changeouts to larger battery packs.

Motor losses have been brought to the forefront by Russ Kaufman's recent report on motors. His graph of the motor input at 30 mph in test car runs showed the Prestolite MTC4001 required 140 wh/mi., 2CM76 170, 2CM88/77 190, EA40/G29 190. These values are all within GroupI and the 1982 graph does show several aircraft motors in GroupI. The Baldor and Prestolite predominate in GroupI but the aircraft are distributed with a concentration in Group IV. Are these breakdowns, deteriorated batteries, or motor problems? Most of the aircraft motors are used with parallel batteries and with relay control. The relay control systems are efficient but may have breakdown problems. The parallel battery cars increase from GroupI to IV indicating a problem there. If parallel banks of batteries are used a monitoring system is essential to verify that the banks are equally loaded and to spot bad batteries. If the batteries are wired in a permanent series-parallel system then it is almost impossible to monitor the system and to isolate trouble. Unbalanced battery banks could cause rapid battery deterioration.

The number of batteries and the weight of the car are important factors. The average number of batteries in Groups I thru IV are 15, 14, 12, 13. the average curb weights of cars in Groups I thru IV are 2571, 2643, 2694, 2390. The better cars have more batteries and are lighter weight. More batteries (higher voltage) less current. Less weight lower rolling losses, less current. Less weight lower peak current during acceleration or hill climbing.

The outstanding characteristic of the 1982 graph is that out of 11 Hondas and VW dunebugs 10 are in Gr. I. The other 32 are distributed in Gr. I thru IV. Do these Hondas and dunebugs have uniformly low running losses or is it driving technique. Do they have new or slowly deteriorating batteries?

The running losses - tire, aerodynamic, chassis - come with the car when we acquire it but the manufacturer doesn't give the figure. Formulas give a rough figure. There is a test to determine the running losses which would give us a more accurate and consistent figure for each car.

If we had an accurate figure for each car, then we would have the true basic wh/mi. and all the variations noted above would be deviations from this basic figure.

The test for losses is made by coasting the car to terminal speed. This test would verify what the Hondas and dune bugs have and would show the other 32 if their car is the problem or the conversion. In 1981 and 1982 I made some coasting tests and presented the results at SEVA meetings. If anyone is interested I will send copies of these tests.

If all the above factors don't explain everything then driving technique has to be considered. This is so personal that it can't be factored -- easy on the amperes and brakes, easy on acceleration and hills.

Possibly the most important factor affecting battery life is the way we charge. It has been stated by someone in the battery industry that no battery has been ruined by discharging, only by charging. There might be some truth to that statement. There is some question of whether to charge every night or when the battery has been discharged to the maxim limit. Discharging to the limit means that the battery is deteriorating each night at partial discharge, but this may not be serious. An empirical battery formula indicates best battery mileage life by charging at 40 to 80% discharge with maximum life at 60%. Charging at 60 to 80% may be the safest way to avoid charging trouble. The chargers are basically designed to charge a fully discharged battery in 6 or 8 hours, but when they charge a partially discharged battery they may overcharge. A charger that depends on fixed time periods could ruin the batteries unless the owner resets it for the particular condition. Voltage sensing chargers should be able to charge at the best rate for any discharge condition. The proper charging rate can be verified by visual inspection to see that gassing is at a minimum.

Some cars in the rally may have used regeneration. This is another method of charging the battery and should be controlled just as closely. The argument against this is that when you use regeneration it follows discharge greater than the amount of regeneration. That may not always be true and when you regenerate it may be at a rate of several hundred amperes. If you are looking for longer battery life, use regeneration but control it.

On the 1982 rally chart we have identified trends that seem to indicate battery deterioration and factors that appear to improve efficiency of the EV. Now if we keep track of what our EV is doing and what we are doing we should be able to improve battery life mileage.

In Russ Kaufman's tests at 30 mph the Prestolite motor required 140 wh/mi. In the 1983 rally with the same installation his calculated wh/mi. was 158. This verifies the battery capacity and gives a good base - you know what the car requires; you know what the new battery can produce. Farther down the line you can repeat the tests, make 30mph road tests and your own rally run. Modify your car or charging procedure, and keep track of what is happening to the battery. This will help you and if you report the results to Don then everybody benefits.

ADD BATTERIES?

by Hans Koski

Russ Kaufman's recommendation to add batteries appears to be confirmed in a number of cases but at the same time there appear to be some disappointing results. Some EVs may be good candidates for added batteries while others may not. The following table shows how EVs perform in general:

# of batteries	Rally Miles Better	Good	Average
8	50	38	32
10	58	46	38
12	70	56	47
14	82	66	55
16	96	77	66
18	112	90	74
20	128	103	85

The better cars are generally light, 35 to 40% battery weight. They probably are not candidates for increasing batteries - they probably have the maximum already installed.

The good cars could benefit from added batteries

The average car should have three changes - add batteries, go to the better batteries and reduce weight. The average EV is overweight and would still be overweight with added batteries and may produce disappointing results unless lightened.

IVEAA

"VEHICLES FOR ELECTRIC CONVERSION"

AMC	Gremlin	'71		6 Cyl.	96"	2503#	C IE BR HE HD
	Hornet	'71		6 Cyl.	106"	2754#	C IE BR HE HD
	Gremlin	'73				2674#	See Above
	Hornet	'73				2948#	"
Buick	Skyhawk	'76		V6	97"	2871#	C HE HD
Chevrolet	Vega	'71		4 Cyl.	97"	2110#	C IE B BR
	Vega	'73				2249#	See Above
	Monza	'75		4 Cyl.	97"	2500#	C B
	Chevette	'76		4 Cyl.	94.4"	1970#	C BN
Ford	Pinto	'71		4 Cyl.	94"	1949#	C IE
	Maverick	'71		6 Cyl.	103"	2478#	C IE BN HE HD
	Pinto	'73				2124#	See Above
	Maverick	'73				2728#	"
Mercury	Bobcat	'75	(Pinto)	4 Cyl.	94"	2549#	"
Olds	Starfire	'76		V6	97"	2783#	C HE HD
Pontiac	Astre	'75	(Vega)	4 Cyl.	97"	2521#	C IE B BR
Alfa Romero	Typ. All	'71-				2375#	E P
Arrow	(Plymth)	'76		4 Cyl.	92.1"	2110#	IE
Audi	90	'71		4 Cyl.	98"	2117#	FWD IE B
	Fox	'73		4 Cyl.		2442#	FWD IE B
Austin	Marina	'73		4 Cyl.	96"	2156#	FWD IE BR BE P
BMW	2002	'71		4 Cyl.	98.5"	2028#	C E BN
		'73				2260#	
Colt	(Dodge)	'71		4 Cyl.		2020#	IE
		'74				2205#	
Cricket	(Plym)	'71		4 Cyl.		1897#	IE
Datsun	1200	'71		4 Cyl.	90.6"	1587#	IE C
	1600	'71		4 Cyl.	95.3"	2039#	IE C
	PU	'71		4 Cyl.	99.6"	2127#	IE HD C
	210	'76		4 Cyl.	92.1"	1897#	IE C
	F10	'76		4 Cyl.	94.3"	1970#	IE BR C
	710	'76		4 Cyl.	96.5"	2299#	IE C
	610	'76		4 Cyl.	98.4"	2395#	IE C
	PU	'76		4 Cyl.	100.2"	2310#	IE HD C
Fiat	850	'71		4 Cyl.	79"	1480#	RD IE B BE
	128	'71		4 Cyl.	96.4"	1735#	FWD IE B BE
	124	'71		4 Cyl.	95.3"	1962#	C IE B BE
	850	'73				1590#	See Above
	128	'73				1760#	"
	124	'73				2038#	"
	128	'74				1890#	"
	124	'74				2499#	"
Honda	600	'71		2 Cyl.		1200#	FWD IE B P
	Civic	'73		4 Cyl.	86.6"	1536#	FWD E BN
	Civic	'74				1605#	See Above
	Civic	'75				1748#	"
	Accord	'76		4 Cyl.	93.7"	1993#	"
Jaguar	XKE	'71		6 Cyl.	96"	2570#	C E BE P
Jensen	Healy	'74			92"	2116#	E P
LUV	(Chev)	'73		4 Cyl.	102.5"	2450#	C IE B HD
MG	Midget	'71		4 Cyl.	80"	1512#	C E B BE
	MGB	'71		4 Cyl.	91"	1920#	C E B BE
	Midget	'74				1746#	See Above
	MGB	'74				2394#	"
Suburu	Star	'71		4 Cyl.	95.2"	1420#	FWD P B
	DL	'73		4 Cyl.	96.6"	1840#	FWD IE B
	GL	'73		4 Cyl.		1860#	FWD IE B
	DL	'74				2040#	See Above
	GL	'74				2000#	"
Toyota	Corolla	'71		4 Cyl.	95.7"	2170#	C IE B
	Corona	'71		4 Cyl.	98.8"	2310#	C IE B
	Celica	'71		4 Cyl.	95.5"	2270#	C IE B
	Hi Lux PU	'71		4 Cyl.	99.8"	2440#	C IE B HD
	Corolla	'76				2225#	See Above
	Corona	'76				2576#	"
	Celica	'76				2545#	"
	Hi Lux PU	'76				2455#	"
Triumph	Spitfire	'71		4 Cyl.	83"	1708#	C E B BE P
	TR6	'71		4 Cyl.	100"	2156#	C E B BE P
VW	Sedan	'71		4 Cyl.	95.3"	1786#	RD E B
	Kar. Ghia	'71		4 Cyl.	94.5"	1874#	RD E B
	Fastback	'71		4 Cyl.	94.5"	2117#	RD E B
	Sq. Back	'71		4 Cyl.	94.5"	2161#	RD E B
	Type IV	'71		4 Cyl.	98.3"	2315#	RD E B
	Tr. Pnl.	'71		4 Cyl.	94.5"	2491#	RD E B
	Sedan	'75				1896#	RD E B
	Rabbit	'75		4 Cyl.	94.5"	1830#	FWD E BN
	Dasher	'75		4 Cyl.	97.2"	2068#	FWD E BN
	Scirocco	'75		4 Cyl.	94.5"	1950#	FWD E BN

CONT. OVER

Sosy Corporation has announced a working prototype of the long expected "TV on a chip." At the present time the prototype IC measures 2 × 3 feet, and is 6 inches thick.

Madza	1200	'71	4 Cyl.	97"	1630#	C	IE	B	
	616	'71	4 Cyl.		2015#	C	IE	B	
	808	'73	4 Cyl.	91"	1960#	C	IE	B	
	RX2	'73	R	97"	2355#	C	IE	BR	B
	RX3	'73	R		2188#	C	IE	BR	B
Opel	Kadett	'71	4 Cyl.	95.1"	1712#	C	IE	B	P
	1900	'71-'77	4 Cyl.	95.7"	2125#	C	IE		
Peugeot	304	'71	4 Cyl.		1854#	P			
Porsche	914	'71	4 Cyl.	96.5"	1973#	RD	E	B	P
	911	'71	6 Cyl.	89.5"	2238#	RD	E	B	P
	911	'75			2425#	RD	E	B	P
Renault	R10	'71	4 Cyl.	89"	1907#	FWD	IE	BE	
	R12	'71	4 Cyl.	96"	2050#	FWD	IE	BE	
	R16	'71	4 Cyl.	105.8"	2271#	FWD	IE	BE	
	Le Car	'76	4 Cyl.		1819#	FWD	IE	BE	
Saab	96	'72	4 Cyl.	98.3"	2545#	FWD			
	99	'72	4 Cyl.		2480#	FWD			

C-	Conventional front engine rear drive	BN-	Engines tend not to blow
FWD-	Front Wheel Drive	BR-	Vehicle has a bad reputation
RD-	Rear engine, rear drive	BE-	Vehicle has poor engineering
IE-	Inexpensive vehicle	HE-	Heavy engine-over 500#
E-	Expensive vehicle	HD-	Heavy Duty vehicle
B-	Engines tend to blow	P-	Parts availability problem

Ball Labs has announced the discovery of a new atomic particle, the anti-neutrino. According to the report issued by the researchers, the particle has all the characteristics of the neutrino but is opposite in charge.

Each time you change tires or wheels, you're re-engineering the speedometer drive system.

Dialing it in

How accurate is your speedometer? Here's an inexpensive way to tell using a stopwatch and a highway that's marked off in miles:

First, get a passenger to go along with you. We don't recommend you perform this test by yourself. Have your passenger hold the stopwatch, and head out onto a marked highway, like an interstate, where you can maintain a steady speed for a mile or more at a time.

Have your passenger start the stopwatch just as you pass one of the mile markers, then hold your speed as steady as possible until you stop the watch at the next mile post.

Compare the number of seconds shown on the watch to the chart at right to find out what speed you were actually traveling. If your test turns up a significant error, and particularly if that error means you're actually traveling faster than your speedometer indicates, you might want to take your bike in to a speedometer repair shop and have a repairman check it for you.

Seconds per mile	Speed (in mph)	Seconds per mile	Speed (in mph)
120	30	78	46
116.4	31	76.8	47
112.8	32	75	48
109.2	33	73.2	49
105.6	34	72	50
102.9	35	70.6	51
100.2	36	69.2	52
97.2	37	67.9	53
94.8	38	66.7	54
92.4	39	65.5	55
90	40	64.3	56
87.6	41	63.2	57
85.8	42	62.1	58
84	43	61	59
81.6	44	60	60
80	45		

All times rounded off to the nearest tenth of a second.

THEORETICAL BENIFITS OF ELECTROLYTE RECIRCULATION or IS ELECTROLYTE RECIRCULATION WORTH THE COMPLEXITY?

by Paul Brasch

PART 1

Electrolyte recirculation is any method of mixing or circulating the electrolyte in an electrochemical battery system. Since the well known lead acid system is the most cost effective and available battery today, as it has been for the last 125 years, we should consider any idea that might aid performance.

The electrolyte serves two purposes. It acts as a reservoir for the chemical reactants and it provides a route for ions to flow between the electrodes (plates) so that they can act as charge carriers forming a path for conduction. The electrolyte is composed of water and sulfuric acid. Pure water is an insulator. The higher the concentration of charge carrier impurities (the stronger the acid), the greater the ease of charge flow (the higher the conductivity or the lower the resistance). Obviously the stronger the acid the better, up to the point of destruction of the active material and paste.

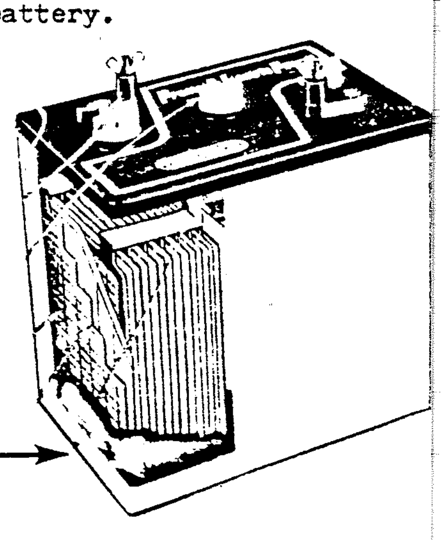
Now lets consider what happens in a battery as it is discharged. Most of the current will flow through the path of least resistance. This will be where the acid concentration is the strongest. And where is that?

Think of how the batteries are tested for charge, by using a hydrometer because sulfuric acid is more dense than plain water. This is because it also has heavy sulfer atoms (atomic weight 32) in it besides light hydrogen (atomic weight 1) and oxygen (a w 16) atoms in it. Chemically H2O is atomic wt 18 and H2SO4 is a w 98 or about 5 times the weight of water on a molecule for molecule basis. This means that the sulfuric acid will settle to the bottom of each cell and the weaker electrolyte concentration will rise to the top. This will occur as the battery discharges even if the electrolyte was well mixed before the start of discharge due to recharging. As the battery is discharged the stronger acid continues to settle to the bottom causing a tendency to discharge the cell plates faster there as the resistance is less there. As the solution is weakened at the bottom due to discharge, the weaker/lighter solution floats to the top and is replenished with fresher/stronger acid. from the sides and bottom. This process will continue untill the effective resistance to discharge is higher at the bottom (due to depleation of usable active material) than further up the plate. Gradually the area of greatest discharge rate will work its way up the plate area but it does this through a weaker and weaker acid mix.

Now what if the acid solution is stirred or recirculated (mixed) via a pump? The effective resistance of the electrolyte should be very uniform over the entire plate surface. This should greatly decrease or eliminate the "current hogging" effect described above. This means that the plate surface should be evenly used throughout the discharge. It should also be discharged through a lower resistance due to the mixing of the acid with the entire volume of acid. This means that more engery could be withdrawn before the terminal voltage drops. This is what DOES happen. The range IS increased with recirculation. And because the whole plate is used more evenly, the battery should last longer.

This is only the effect on discharge. The same principles apply on recharge, and are probably even more important for life extension of the battery.

Stronger acid eats away lower end of plates



COOL IC'S

A major advance in semiconductor cooling techniques was announced last month by YoYodyne of Los Angeles. The encapsulating material of the semiconductor is cast with a series of channels buried inside it. All the channels are interconnecting and join a pair of common input and exhaust fittings at one end of the IC (see above). A small gate valve is incorporated in the device and it controls the flow of coolant being pumped through the IC by a compressor located on the circuit board. YoYodyne claims that one compressor can adequately cool up to twelve standard 7400 series IC's and that power requirements are minimal, although the special compressor used in the new technique requires a separate three-phase, 440-volt line.

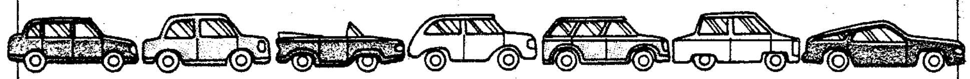
The actual coolant can be as simple as distilled water, but a special fitting is needed if a pressurized refrigerant such as freon is used. Preliminary literature from YoYodyne indicates that the results of supercooling have produced dramatic results. A standard 78-series regulator didn't fail until over three hundred amperes were drawn from it. That was accomplished by using liquid nitrogen as a coolant, and YoYodyne was quick to point out that the techniques involved were still "in the early experimental stages."

Cars & crash-test results

For the past six years the National Highway Traffic Safety Administration (NHTSA) has been conducting crash tests on new cars. Dummies are placed in the driver and passenger seats to compare how different cars perform in head-on collisions at 35 miles per hour.

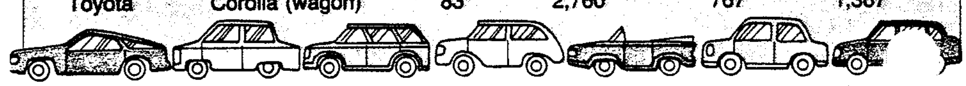
The chart below lists the 50 1983, 1984, and 1985 cars that performed worst on the test. A score of 1,000 or more in the head-injury column means the accident may have seriously injured or killed the driver, passenger, or both. One fact to note: In the tests the dummie wear seat belts; for persons who don't buckle up, chances of surviving a serious accident are substantially reduced. For a complete list of cars tested since 1979, call the NHTSA's hot line—1-800-424-9393.

—*M.H.J.F.*



CRASH-TEST RESULTS FOR 50 RECENT-MODEL CARS

MAKE	MODEL	MODEL YEAR	VEHICLE WEIGHT	HEAD INJURY DRIVER	HEAD INJURY PASSENGER
AMC	Jeep Cherokee	84	3,645	850	1,548
Buick	Le Sabre	83	4,120	882	1,084
Buick	Park Avenue	85	3,850	1,550	662
Buick	Regal	84	3,700	781	1,074
Cadillac	De Ville	85	3,850	1,550	662
Chevrolet	Caprice/Impala	83	4,120	882	1,084
Chevrolet	Chevette	84	2,746	1,886	1,306
Chevrolet	Monte Carlo	84	3,700	781	1,074
Chrysler	E Class/New Yorker	83	3,110	947	1,010
Datsun	200 SX	84	2,880	1,992	582
Dodge	600/600 ES	83	3,110	947	1,010
Dodge	Aries (wagon)	83	2,910	656	1,221
Dodge	Caravan	84	3,791	973	1,200
Dodge	Colt Vista (wagon)	84	2,980	1,530	1,004
Dodge	Conquest	84	3,170	1,118	1,035
Ford	Bronco II (4×4)	83	3,845	789	1,038
Ford	Crown Victoria/ LTD Crown Vict.	84	4,313	1,094	1,019
Ford	EXP	83	2,590	1,744	796
Ford	F-150 (truck)	84	4,076	1,362	1,443
Ford	Mustang (conv.)	84	3,560	894	1,112
Ford	Tempo	84	3,080	2,955	1,104
Isuzu	Impulse	84	3,230	1,769	2,454
Lincoln	Town Car	84	4,313	1,094	1,019
Mazda	626	83	2,900	1,196	1,087
Mercury	Grand Marquis	84	4,313	1,094	1,019
Mercury	Topaz	84	3,080	2,955	1,104
Mitsubishi	Mighty Max (truck)	83	3,094	1,475	1,934
Mitsubishi	Montero	83	3,873	1,641	1,415
Mitsubishi	Tredia	84	2,740	1,314	1,521
Nissan	300ZX	84	3,370	789	1,038
Nissan	Pulsar	83	2,460	1,139	1,134
Nissan	Stanza	84	2,814	1,459	2,216
Oldsmobile	98 Regency	85	3,850	1,550	662
Oldsmobile	Cutlass Supreme	84	3,700	781	1,074
Oldsmobile	Delta 88	83	4,120	882	1,084
Peugeot	505S	83	3,617	819	1,157
Plymouth	Colt Vista (wagon)	84	2,980	1,530	1,004
Plymouth	Conquest	84	3,170	1,118	1,035
Plymouth	Reliant (wagon)	83	2,910	656	1,221
Plymouth	Voyager	84	3,791	973	1,200
Pontiac	1000	84	2,746	1,886	1,306
Pontiac	Grand Prix	84	3,700	781	1,074
Pontiac	Parisienne	84	4,140	No data	1,055
Renault	Encore	84	2,600	912	1,045
Renault	Sportwagon	84	3,102	2,053	2,721
Toyota	Corolla (wagon)	83	2,760	767	1,367



SYMBOL	CODE (h)	OFFICIALLY DESIGNATED MEANING
	60	HAVE A NICE DAY

NICE DAY

The American National Standards Institution has announced the introduction of a new symbol to be incorporated in the standard ASCII character set (see above). The code will be 96 decimal or $60h. A spokesman said that this was only the beginning of a new series of characters to be introduced over the next year or so.