Electric Auto Association NEWS

MARCH 1985 VOL. XVII NO. 3

HI-TECH BATTERIES, LIMITED

USA Mail Forwarding Address: P.O. BOX 592996 • MIAMI, FLORIDA 33159 U.S.A.

PRESS RELEASE

Freeport, December 7, 1984

Hi-Tech Batteries Limited has just received approval from the Government of the Bahamas to operate a battery plant and lead smelter in Freeport, and has completed arrangements for the purchase of an existing pilot battery built in 1980 by Anglo-American Research Limited in Freeport for the production of fast charge propulsion batteries.

The Anglo-American pilot plant will be expanded into a new, 100,000 square-foot facility to be constructed in 1985 on a 20-acre site in the Heavy Industrial Zone of Freeport.

The lead smelter will make it possible for Hi-Tech to purchase inexpensive scrap lead from its customers in the United States for shipment to Freeport where it will be converted into pure lead at the smelter. Hi-Tech's customers in the USA are other battery manufacturers which produce batteries for electric vehicles such as fork lift trucks, mine locomotives, airport tugs, personnel carriers and golf carts. Hi-Tech will supply them with battery plates and/or battery cells for final assembly into finished batteries with exclusive, patented features such as fast rechargeability and automatic watering.

Over 30 issued patents and a number of pending patents have been licensed to Hi-Tech by Electric Fuel Propulsion Corporation (Delaware), and Electric Auto Corporation (Bahamas) Limited. This will give the company a head start in the production of advanced batteries for electric propulsion. The company will also continue development of several types of fuel cells and exotic batteries pioneered by Anglo-American Research Limited.

Hi-Tech has letters of intent and indications of interest from customers who project they will purchase of US$30 million per annum from the company. Among these is a commitment from Electric Auto Corporation of Freeport to purchase all of its requirements from Hi-Tech. Electric Auto is negotiating with several automobile distributors in the United States who project sales of 5,000 electric vehicles per year. This would translate into US$10 million in battery sales for Hi-Tech.

According to a Cleveland market research company, Predicasts, Incorporated, the present USA market for batteries will increase from US$2.4 billion to US$15 billion by 1995 due largely to growth in the market for electric vehicle batteries expected to accelerate sharply in 1990, averaging a real annual growth rate of about 8%.

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Contact Robert R. Aronson or Dr. Barry Iseard
809/352-9601 or 352-9831

THEORETICAL BENIFITS OF ELECTROLYTE RECIRCULATION

IS ELECTROLYTE RECIRCULATION WORTH THE COMPLEXITY?

by Paul Brasch

PART 2

In PART 1 last month I discussed my thoughts as to why electrolyte recirculation allowed more energy to be drawn from a lead acid cell. The recirculation produces mixing which allows the entire plate to be equally and evenly discharged due to the homogeneity of the electrolyte and its resultant consistent conductivity throughout its volume. No longer does the stronger, more conductive acid have the time to settle to the bottom of the cell due to its greater density. Thus producing a discharge pattern of greater depth of discharge toward the bottom and lesser toward the top of the cell. Due to a much more even depth of discharge over the whole plate surface and a higher conductivity during discharge,(due to mixing with the acid from around the outside area of the plates), the total energy withdrawn before the cutoff voltage is reached IS increased.

Since one is able to get more energy out of a battery utillizing recirculation, one might worry that the battery is being worked harder and therfore its life might be shortened. I believe that the opposite is true. This is because the battery is not being stressed more but is being stressed more EVENLY. Now nearly all of the paste and acid is evenly participating in the discharge reaction. Therefore when a battery or cell is not able to hold a charge or deliver its energy, it is probably due to the entire plate surface being exhausted rather than just the sides and lower portions of those plates. Thus I expect that the useful life should be increased.

Now lets consider what happens in a non-recirculated cell during charging. From the discussion on discharging in PART 1, you can see that the discharged battery or cell has its strongest (though now weak) acid at the bottom of the cell. And plates that are perhaps at 100% depth of discharge over the bottom half or third with some remaining non-reacted material at the upper portions. This means that once again that the higher current density should be at the bottom of the plates due to the lower resistance to current flow there. As the plate charges, the acid in the electrolyte gets stronger but this time it is allready down at the bottom of the cell. This time there is NO density inversion to produce density convection flow. The solution gets stronger and stronger at the bottom, even though the paste there is becoming more charged in a polarity to oppose the applied voltage.

As the opposing voltage increases and the active material approaches complete conversion in the lower regions, the opposition to current flow forces more current to flow in the upper, weaker acid regions of the plates. Also once the conversion is nearly complete but there is a charging voltage that is sufficiently greater than the cells opposing voltage, then dissociation of the water in the electrolyte starts to take place. This is the gassing stage and it finally forces a mixing of the electrolyte as the bubbles rise. This allows the upper regions to complete their charging and mixes the acid in preparation for discharging. This part of the theory is supported by the fact that without some gassing, one cannot obtain a full charge on a battery, and charge differences between cells progressively get worse.

If recirculation is utillized during charging then the electrolyte is mixed and the charge current should be distributed over the entire plate, especially if recirculation was used during discharge. If recirculation was not used during discharge then the same layering effect of depth of discharge would probably produce an increased current flow in the lower more discharged regions of the plates. But this should be much less extreme than before.

By now we can see that the usuall process of charge and discharge is an inherently uneven one in a common battery system. This uneveness probably results in premature death of the battery due to deep cycling of the lower regions even when the battery as a whole is not deep cycled. It also allows us to withdraw less energy per charge. And what about gassing?

We are told that a small amount of gassing is good as it mixes the acid. But we have been told by many battery experts that overcharging is the almost universal cause of battery failure. Could it be that ALL gassing is bad and that the more the worse? But electrolyte mixing is mandatory on charging so some gassing must be tolerated. Gassing evidently causes a loosening of the paste (active material) from the supporting grid. Just as frost and ice keeps chiping away at a shear rock face, the bubbles expanding on and in the rough surface of the paste loosen minute particles.

RECIRCULATION CON'T.....

With recirculation, gassing is not needed for mixing. And because the charging current is spread over the whole plate, the current density should be lower for any unit area. This means that the charge current to the whole cell or battery could probably be raised significantly before any gassing occurs. This is also true because the lower region of the cell is not being overcharged while the upper region is still waiting for stronger acid to start or finish charging as in a non-recirculated cell.

What this implies is that you should be able to charge your batteries in less time without gassing. As soon as you get any gassing that should be a sign that the whole cell is fully charged. It has been reported that Saied Motaei can recharge his battery pack in only 4 hours instead of the usual 10 hours by use of recirculation. That would seem to support this part of the theory.

If gassing is the major failure mechanisim of overcharging, and it can be all but eliminated through the use of recirculation, then this should also increase the life of the battery. This coupled with an evenly distributed discharge and charge cycling should yield a significant increase in the life of the battery system. Remember that if the life is extended then the amortized cost of the batteries goes down.

Now what are some of the disadvantages? First of all there is the complexity of keeping the electrolyte separate for each cell while still pumping the fluid. This is necessary to prevent shorting out the cells to each other. Second there are a lot of cells in a battery system and the separation and pumping must therefore be repeated many times. Thirdly there is an increased risk of acid spillage due to broken pumps, tubing or whatever. Fourthly the energy to run the pumps must come from the batteries themselves. And fifthly some control and monitoring system would be very useful to run the pumps at only the needed speed or to cycle them on and off and to monitor their operation and the cells performance to detect failures early.

These are truly a lot of hurdles to obtain improved battery performance. But if the cycle life is also improved it may well be worth it. We know now that range is extended by perhaps 20% and that charging time can be cut by 60%. We do not know what the cycle life effect is.

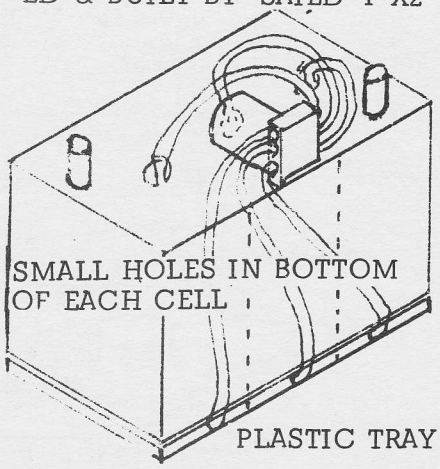
The above thoughts are based on individual facts and theory drawn from them. They can not be considered a scientific study. I would enjoy doing such a study and am considering such an undertaking. But for now we have only theory. However Globe-Union has done some studies of recirculated electrolyte batteries, But they never have offered any for sale I am told. Could it be that the life was increased so much that it would have cut sales or were there other problems? Until I or someone else publishes such a study, or we get several years life on a set, we can only be sure of increased range and decreased charging time versus the complexity added. That has to be the decision at this point. But remember that applying recirculation is something new and surely ways of simplifying and improving the methods used will be forthcoming.

Other areas of research needed include the minimum flow rates needed for both charge and discharge rates, longterm reliability of pumps and tubing, and development of the monitor and control circuitry.

And so the art advances. -30-

ACID RECIRCULATION SYSTEM

3 CELL MINI PUMP, DESIGNED & BUILT BY SAIED 1"X2"



..... Bald Head Island, off-coast at Southport, North Carolina, allows no gasoline vehicles — but it has more than a hundred EVs, mostly golf cars, and plenty of charging stations. The island's EV population is expected to move up quickly to somewhere around the 400 mark.....

SAFETY

REGENERATION AN ABSOLUTE MUST

As I have written many times, in order to duplicate the operation of an ICE car you must have regenerative braking(simulated compression). To me it is very scarry that the speed incresses when you let up on the accellerator. Remember every time you think STOP a thousand pounds of batteries says GO! The brakes on our small cars cannot last long.

In order to develop charging current the supply voltage must be higher than the battery voltage. Since the generator (motor) voltage goes down rapidly as the vehicle slows, we parallel the batteries to effectively double the current. When we switch the batteries from series to parallel with high inductive loads, there is danger of reverse current and inductive spikes which may damage the controller, relays, and even the batteries.

Saied has developed this system of buffer relays (resisters in series) and delayed bypass with sequential, aproximately one second delays between relay closings.

The 2 volt single cell is used to reverse the current in the series field, this is one way to make a series machine generate, you could also physically reverse the field with relays. This only applies to series motors not required on shunt or compound machines.

SEE FIG. 1

Text by Clarence Ellers.

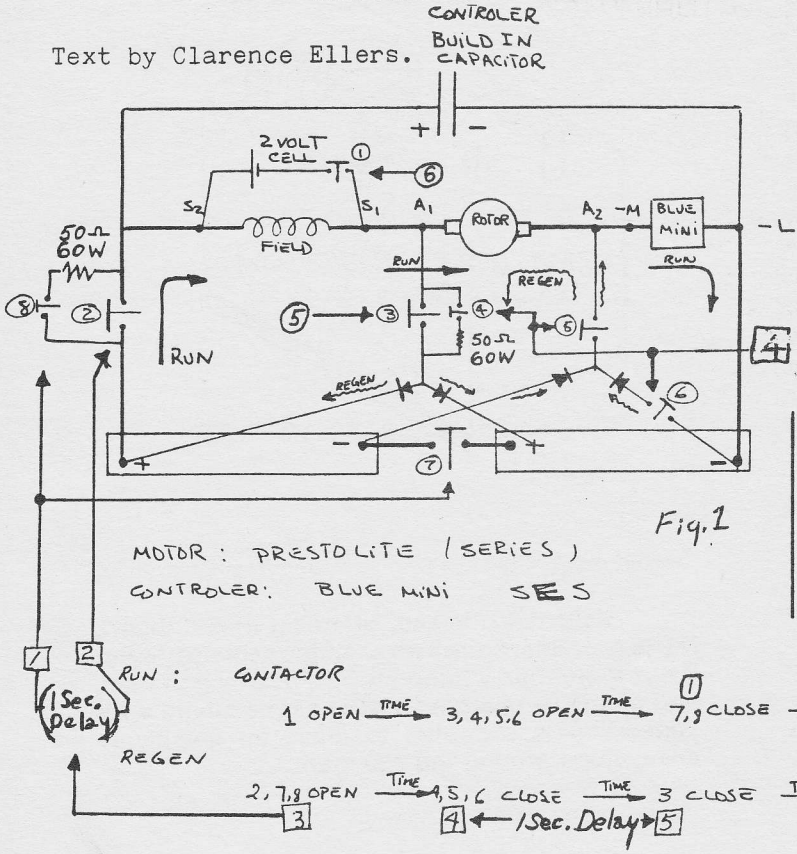
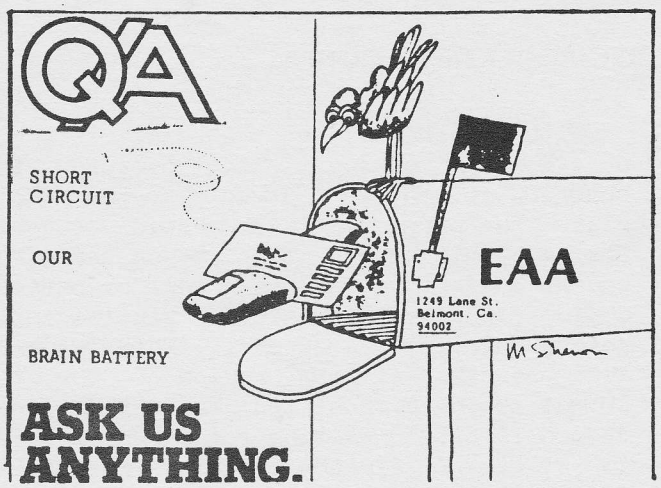


Fig. 1



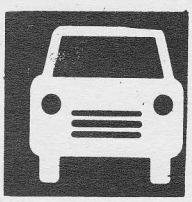
Q: What is a charge cycle?
A: When the cell voltage is 1.75 or less (less should never happen). This counts as a charging cycle. Otherwise its a case of 3 halves making a whole. Batteries should be kept FULLY charged at all times!!

Q: It is stated that heat is what distroys bateries, HOW HOT IS TOO HOT?
A: 125° F. max.. However, I feel that any detectable rise (by touch) during charging is too much and indicates either over charge, too high charging rate, or a bad battery. It is not a matter of melting anything, it is the possibility of changing the configuration of internal components warping, flaking, and/or moving.

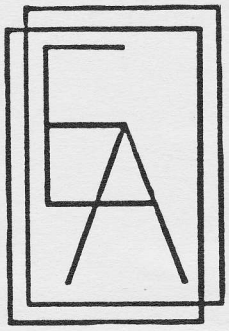
Q: How do you overcome the effects of cold weather on battery range.
A: Many of our members get very good performance in cold climates. Naturally keep batteries warm, insulate and pack tight, see "85" calendar. Keep car inside when not in use, use heaters in battery compartment. We will be showing some ideas on this soon. How about sending us some? TNX

Q: If N/I (Nickel/Iron) batteries are so good, where are they?
A: Two problems, cost and cycle life. In spite of the cycle reports we read, our sources say there is still a problem with battery life.

Questions by Don Cheesman S.E.V.A. Chapter Seattle. John Anderson of ALCO Batteries was our consultant



THIS HAS BEEN THE SYMBOL OF EXCELLENCE IN GASOLINE CARS FOR GENERATIONS PAST.



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* Errata; Feb. listed Willey's 300 Amp @ $395 should be $535

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THERE WILL BE A SCIENCE CE NTER SHOW, WE HAVE NO DATE, CALL FOR INFO.

For information call or write
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and "May the Current Be with You . . . ."

EXPO 86

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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.

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