Naval Surface Warfare Center (NAVSEA) Crane Division

Battery Charger and Power Reduction System and Method

(US Patent No. 7,573,235 B2)

Mini Market Study Report

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Sponsored by:

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MARKET STUDY REPORT

Technology Synopsis

This invention is a Battery Charger and Power Reduction System and Method. The patent is on the algorithm associated with the power reduction method of the technology. The technology is a shunt-type, Lithium-ion battery charging device with a power dissipation/power reduction method. The shunt style charging circuits are used to clamp the charging voltage of each series connected battery to a "precise" predetermined voltage setting. The method controls the amount of power being used by the battery charger by monitoring the batteries level of charge during charging and by reducing the magnitude of the charging current. Generally, these charging circuits “shunt” or push excess current around each series connected battery while essentially holding each battery's voltage constant at some predetermined voltage level. More specifically, it has the ability to charge Lithium-ion batteries in series while still maintaining control of each individual cell.

A benefit of using shunt regulators is that they are inexpensive to build and are able to achieve precise charge voltage levels. On the other hand, however, they are very inefficient in operation because of the large amounts of power that they dissipate during the shunting action. While shunt regulators are usually designed to dissipate full power for extended periods-of-time, the use of these higher power levels may shorten the lifetime of any associated electronic circuitry and may require the addition of some form of supplemental cooling.

Therefore, a need exists for the usage of this technology to reduce the likelihood of overcharged or exploding batteries, reduce shortened battery life cycles, and reduce devastating effects to the charger caused by the generation of heat.

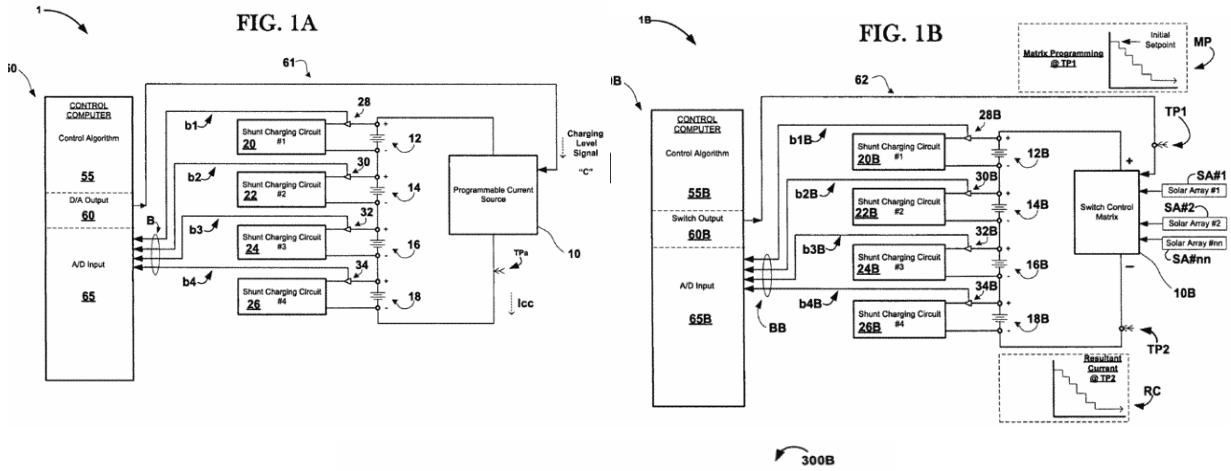
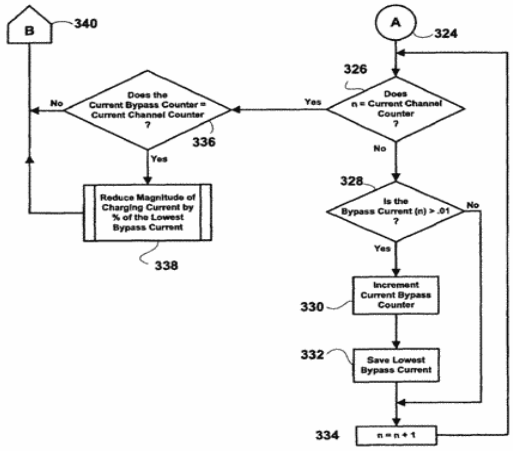


FIG. 3B



Potential Applications

Industry	Industry Segments	Application Segments
A. Global Battery	1. Lithium-ion(industrial size)*	1. Battery Management Systems for Alternative energy vehicles(EV, HEV, PHEV) Battery management systems 2. Battery modeling
C. Military**	1. Aerospace	1. Satellites – Thermal management

*The focus is on industrial sized batteries, although the algorithm could be incorporated into a microchip, it does not make sense to use it for standard batteries having low voltages, such as for consumer products (laptops, cell phones, etc.)

**In regards to the Military industry, the satellite community has already shown interest in this technology, but it requires additional R&D and major modifications for use.

Competing Technologies

Company Name	Product Name	Application
Electro Craft Systems	Battery Management System	protects Lithium Battery packs from over-charge and over-discharge
GS YUASA LITHIUM POWER	LEV50, Lithium ion Rechargeable Battery	Satellites – Thermal management
QUALLION	Matrix & Safe Lyte	Satellites and Electrical Vehicles
A123 SYSTEMS	Energy Core pack	*EV, HEV, PHEV
LG Chem LG Chem Power Inc.	Lithium-ion battery pack	*unique safety-reinforced separator to minimize potential thermal runaway due to an internal short
SANYO Panasonic ideas for life	Lithium-ion battery module (18650-type)	*heat-resistant metal oxide insulating layer between positive and negative electrodes to prevent short circuits and overheating
NSWC –Crane Div NAVSEA CRANE Surface Warfare Center Division	**Battery Charger and Power reduction system and method**	**Precise control: building Li-ion model, Unique algorithm to reduce battery overcharge and overheating**
* Electric Vehicles(EV)/Plug-In Hybrid Electric Vehicles(PHEV)/Hybrid Electric Vehicles(HEV)		

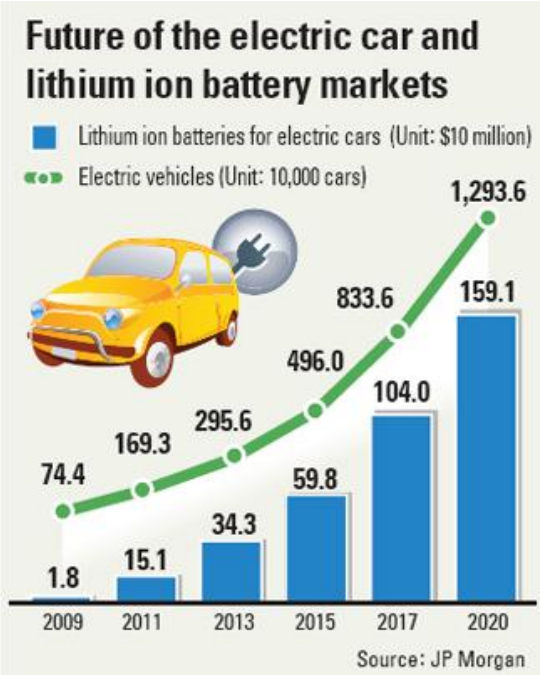
Competitive Advantage

The Battery charger and power reduction system and method's competitive advantage is that it is a cost-effective, precise device that combines a normal shunt style charging circuit, with a patented algorithm reducing the possibilities of an overcharged battery, allowing for the control of individual cells in multiple series. Lithium-ion batteries within the electrical vehicle market have improved significantly over the years with the introduction of advances in Lithium-ion cell technology. However, much more improvement is needed. Many electrical vehicles use lithium-ion batteries that contain cobalt dioxide, the same battery chemistry used in laptops proving to be very dangerous. This danger is extreme, seeing as they can catch fire easily, because they have their own oxygen in each molecule[1] Explosion of Lithium-ion batteries is an important safety issue that is faced when dealing with batteries that have been overcharged or over heated. The Battery charger and power reduction system and method provides the solution to this problem because it allows for the precise control in building lithium-ion battery models. In addition, electric vehicles currently use series and parallel strings, if they used this technology each string could have its own control, providing a key advantage for EV battery manufacturers.[2] Current technologies on the market focus on minimizing internal shortages and overheating, but not on the fact of the battery being overcharged, which can potentially shorten battery life and cause damage to the battery charger from excessive heat.

Market Opportunity

The market opportunity within the battery industry for electrical vehicles is large and growing. The demand for lithium-ion batteries is increasing dramatically as electric-car technology improves and prices drop.[3] Further, expected recovery and growth in the automotive sector and resurgence of information technology and telecommunications sectors is poised to benefit the Global battery chargers market, which is said to exceed US $11.9 Billion by 2015[4]

Industry experts say that in the near future Li-Ion batteries will replace nickel hydrogen batteries, which today enjoy around 95 percent of the global market for use in hybrid electric cars. According to JP Morgan, the global EV market will expand from 740,000 units this year to around 12.9 million units by 2020.

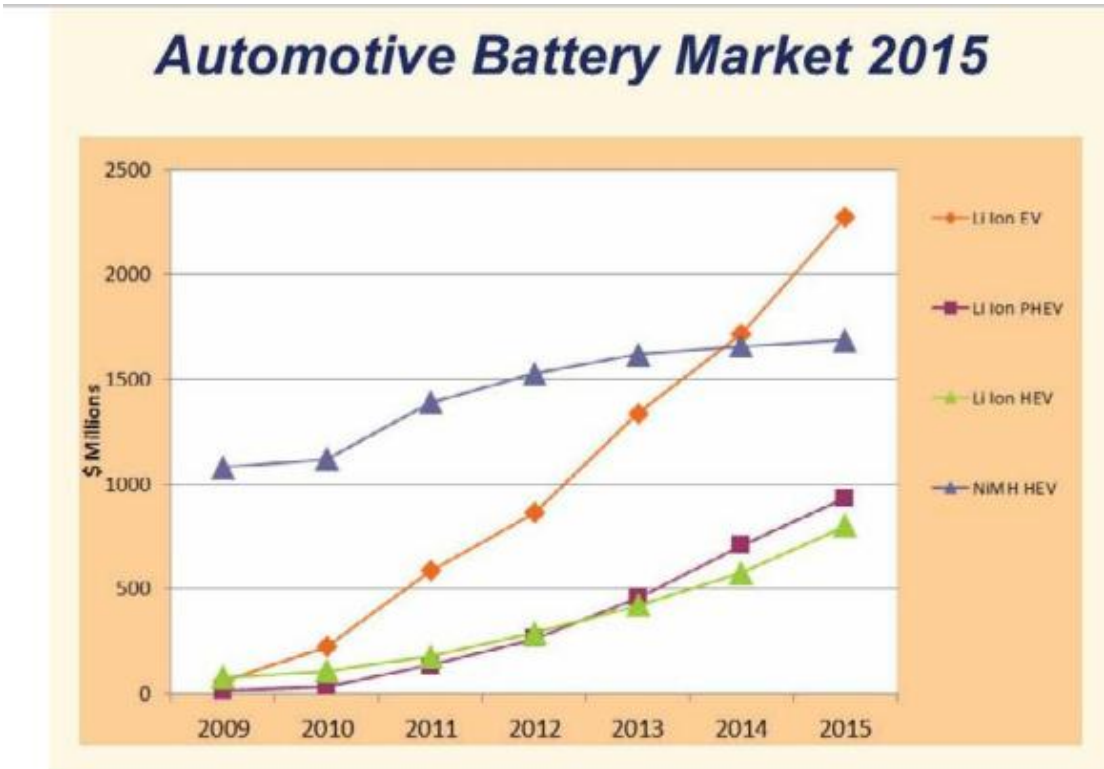


[1] See Inventor Interview with Evan Hand
[2] See Inventor Interview with Evan Hand
[3] http://www.time.com/time/magazine/article/0,9171,1975337,00.html#ixzz1ReMxQ16q
[4] http://www.electronics.ca/presscenter/articles/1325/1/Global-Battery-Chargers-Market-to-Exceed-US119-Billion-by-2015/Page1.html

Up to now, the lithium ion battery market has been predominantly consumer (90% as of today) but new, diversified applications including alternative energy vehicles, i.e. xEV(Electric Vehicles/Plug-In Hybrid Electric Vehicles/Hybrid Electric Vehicles) and ESS (Electrical Storage Systems), are expected to provide the new growth engines.[5]

According to a recent report from Amadee+Company, Lithium ion batteries were first proposed in the 1970's and commercially developed in the 1990's. Since then, the market for lithium ion batteries has grown to $11 billion (2010) and is expected to reach $43 billion by 2020. With the growth in Lithium-ion batteries on a steady rise, the demand for lithium-ion battery chargers will increase as well. Therefore, providing validation on the opportunities the battery charger and power reduction system and methods technology will have.

In addition, according to AAB's Menahem Anderson, sales of lithium batteries will overtake those of nickel metal-hydride in the next few years.[6] Being that electrical vehicles are a segment of the automotive industry, and without batteries, automobiles would not function properly, it can be safe to conclude that this research further validates the large opportunity within the Electrical Vehicle battery market for this technology.



Potential targets for licensing

In regards to licensing this technology, a variety of major players had to be sought out. Major players who were profiled in the Battery Chargers Global Strategic Business Report were positioned as the most likely candidates for potential licensing. Based off of the report and additional market research, companies such as Sanyo, Panasonic Corporation of North America, Saft America, Yuasa Battery Inc. (GS-Yuasa), Johnson Controls, A123 Systems, Quallion, and LG Chem power, Inc. would be the best candidates to seek interest in licensing opportunities. They are all leaders in the advancement of Lithium-ion technology with a specific focus on alternative energy vehicles. However, a particular focus

[5] http://www.renewableenergyworld.com/rea/partner/amadeecompany/news/article/2011/02/global-lithium-ion-batteries-market-to-reach-43-billion-by-2020
[6] http://www.nxtbook.com/nxtbooks/sae/11EVSD0525/#/8

should be concentrated on Panasonic who has partnered with Sanyo to give electrical vehicles a new edge in the market. Panasonic recently took a majority stake in Sanyo, the world's biggest lithium-ion battery manufacturer.[7]

- **Panasonic – Sanyo Electric, Co Ltd.** Sanyo Electric Co., Ltd. and Hitachi Vehicle Energy, Ltd. will each begin supplying lithium-ion secondary batteries for HEVs to foreign automotive manufacturers from 2010. Sanyo Electric will act as a supplier for Audi AG, part of Germany's Volkswagen Group, while Hitachi Vehicle Energy will supply its lithium-ion batteries to General Motors Corporation[8] .Tesla Motors' announced that the electric Giant Panasonic will be the automaker's sole supplier of electric vehicle battery packs. As part of the partnership, Tesla and Panasonic will also work together on developing cheap and efficient lithium-ion batteries--a venture that has the potential to benefit the entire EV industry.

- **A123 Systems** develops and manufactures advanced lithium-ion batteries and energy storage systems that deliver high power and energy density, long life, and excellent safety performance. The company's game-changing technology enables customers to commercialize innovative products for the transportation, electric grid and commercial markets. A123's advanced lithium ion energy storage solutions enable higher performance and increased efficiency in passenger and commercial electric vehicles (EVs), hybrid electric vehicles (HEVs) and plug-in hybrid electric vehicles (PHEVs).[9]Last year, A123 Systems got a $249 million federal grant to open at least three lithium-ion-battery plants in Michigan that will employ hundreds of workers. Michigan is home to or close to many of the plants where electric vehicles are being made, of course, and the state has a surplus of skilled workers.[10]

- **LG Chem Power Inc.** is a North American subsidiary of LG Chem Ltd., one of the world's largest producers of lithium-ion batteries for automotive (Hybrid Electric Vehicles - HEVs) and non-automotive (commercial, military, conversion, and portable equipment) applications. As such, the company has accumulated expertise in the development of safe, high-power/high-energy, compact, and lightweight lithium-ion battery systems.[11] They are targeted to be the partner of choice for vehicle manufacturers utilizing Lithium Ion Energy Storage Solutions for Hybrid Electric Vehicle (HEV), Plug-In Hybrid Electric Vehicle (PHEV), and Electric Vehicle (EV) applications. With increased investments and leading-edge technology, LG Chem/LGCPI is poised to become one of the world's principal battery manufacturers for the HEV, PHEV, and EV industries.[12]

- **Quallion LLC** produces a number of primary and rechargeable cell and battery configurations for use in the medical, military and aerospace markets, with revenues divided evenly across these three market segments[13] Senator Alex Padilla announced that Quallion LLC, a battery manufacturer based in Sylmar, CA, will receive a state grant of over $5.8 million to mass-produce standardized, lower-cost Lithium-ion (Li-ion) batteries for electric vehicles and other green technologies. The $5.8 million grant from the California Energy Commission (CEC) is in addition to a $1 million grant they received last year, making their total grant awards from the CEC over $6.9 million.[14]

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[7] http://www.fastcompany.com/blog/ariel-schwartz/sustainability/tesla-teams-panasonic-ev-batteries
[8] http://e2af.com/trend/090220.shtml
[9] http://a123systems.com/solutions-transportation.htm
[10] http://www.time.com/time/magazine/article/0,9171,1975337,00.html#ixzz1SQ3YAatM
[11] http://lgcpi.com/about.shtml
[12] http://www.compactpower.com/bpack.shtml
[13] http://www.quallion.com/sub-c-competitive.asp
[14] http://www.electricvehiclesresearch.com/articles/senator-padilla-announces-6m-grant-to-build-better-ev-batteries-00003421.asp?sessionid=1

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GS-Yuasa creates complete battery systems for North American clients within the Military, Aviation, Space, HEV, EV, and Undersea industries. As a complete power solutions provider, GS Yuasa Lithium Power can provide everything from cells to complete battery systems.[15] Currently they are in the process of expanding their advanced prototyping and test capability for battery and charger products[16]

- **ElectroCraft Systems** was incorporated in 1995 to provide Electronic Products for Electric Vehicles and Renewable Energy as well as Design Services in Power Electronics. The mandate was to Design-Manufacture innovative Chargers, Controllers and Instruments to help advance the Electric Transportation and Sustainable Energy fields towards a better world to live in.[17]

TABLE 5 Developers of Lithium-Ion Technology Cells for HEV Applications

Company	Cathode	Anode	Packaging	Structure	Shape
Toyota	NCA	graphite	metal	spiral	prismatic
Panasonic	NMC	blend	metal	spiral	prismatic
JCS	NCA	graphite	metal	spiral	cylindrical
Hitachi	NMC/LMO	hard carbon	metal	spiral	cylindrical
NEC-Lamilin	LMO/NCA	hard carbon	pouch	stacked	prismatic
Sanyo	NMC/LMO	blend	metal	spiral	cylindrical
GS Yuasa	LMO/NCA	hard carbon	metal	spiral	prismatic
A123 Systems	LFPO	graphite	metal	spiral	cylindrical
LG Chem.	LMO	hard carbon	pouch	stacked	prismatic
Samsung	LMo/NMC	graphite	metal	spiral	cylindrical
SK Corp.	LMO	graphite	pouch	spiral	prismatic
EnerDel	LMO	LTO	pouch	spiral	prismatic
AltairNano	NMC/LCO	LTO	pouch	stacked	prismatic

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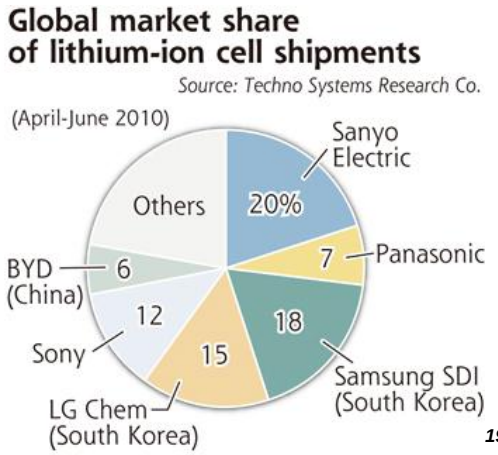

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<u>Validation of Chosen Licensee Targets</u>. Below, table 5 lists the top developers of Lithium-Ion technology cells for HEV applications and the graph taken from Techno Systems Research Co. displays the global market share of lithium-ion cell shipments being controlled by Sanyo Electric and LG Chem.

Keys to Commercialization

Last August, the Department of Energy announced $2.4 billion in grants to accelerate the development of electric vehicles and the batteries that will power them. So far, $1 billion of that money has been awarded to companies like Johnson Controls, A123 and LG Chem, but that money has yet to pay real dividends.[20] With the licensing of the battery charger and power reduction system and method technology, there is a large opportunity for those dividends to become fruitful. The focus should therefore be to target manufacturers of battery management systems having a special focus on alternative energy vehicles (i.e. LG Chem, A123 Systems, Panasonic Group – Sanyo Co. Ltd, and similar manufacturers). However, before those companies are contacted for licensing, performance tests against current competitor's technology to quantify the devices competitive advantage must take place. In order for this technology to

[15] http://www.gsyuasa-lp.com/index.html
[16] http://www.gsyuasa-lp.com/Aboutus.html
[17] http://www.evcraft.com/aboutus.
[18] http://www.ipd.anl.gov/anlpubs/2008/02/60978.pdf
[19] http://www.evbatteryforum.com/sanyo-to-shift-new-battery-plant-into-overdrive/
[20] http://www.hybridcars.com/news/johnson-controls-ceo-hybrid-and-ev-battery-market-immature-27942.html

be acknowledged within the industry as something of valuable interest, feedback from the head of R&D needs to be gained in understanding what elements a performance test should include; in order to be considered for evaluation. By quantifying the technology's competitive advantage potential licensees will be able to better see the opportunity. In addition, focus on determining their process for in-licensing or new product integration, as well as their interest in the use of this technology. By leveraging those company's opportunities and goals to advance lithium-ion technologies, our technology can potentially provide the solution to the issues they face that have them at a standstill.

Curtis Aldrich of GS-Yuasa has voiced interest in potentially licensing this technology only if it can provide reliability and lower their costs for manufacturing. His direct words: "we would be interested in using the technology for battery management on space application for the manufacturing of space batteries. Focusing on the mechanical and thermal aspect. If the technology can provide reliability and lower manufacturing costs, that is what we would be most interested in." Therefore, when contacting Mr. Aldrich to potentially integrate the technology into GS-Yuasa's product line for use with Lithium-ion batteries in satellites, the focus should be on leveraging the technology's capabilities to lower manufacturing costs and its reliability. This, however, cannot be validated without the proper performance testing as stated previously. Mr. Aldrich Contact information can be found in the appendices.

Within the industry there are several conferences which would be very beneficial in attending. The opportunity to promote the technology at these different conferences will not only bring awareness to the technology, but will provide an opportunity to network with and possibly even setup exploratory discussion with potential licensees. Therefore, to take advantage of those opportunities, the technology should be exhibited at the advanced automotive battery conference being held in Orlando, Florida at the Omni Orlando Resort at Championsgate on February 6-10, 2012.This conference provides fresh information on battery technologies and the advanced automotive battery market, as well as a focal meeting place where equipment and material suppliers come together with prospective customers from the battery industry, and cell and battery suppliers with customers from the automotive industry.[21] For further information on becoming an exhibitor, contact Exhibitor-sponsors@advancedautobat.com . Another opportunity for raising awareness within the industry, would be to attend the National Alliance for Advanced Technology Batteries annual meeting/conference being held in Louisville, Kentucky on September 7-8, 2011. This year's meeting and conference will be a unique and innovative program that will examine some of the most important topics facing the U.S. advanced battery industry.[22] For further information on becoming an exhibitor James Greenberger should be contacted by email jgreenberger@naatbatt.org, or by telephone: 312-588-0477. The visibility of this technology at these conferences will aid in speeding up the process of commercialization.

[21] http://www.advancedautobat.com/conferences/automotive-battery-conference-2012/index.html
[22] http://events.r20.constantcontact.com/register/event?llr=5kjlyfdab&oeidk=a07e3yxwr9k4d31bff3

Appendices

NAVAL SURFACE WARFARE CENTER – CRANE DIV (NSWC CRANE)

Evan C. Hand, Logootee, IN (US) Inventor

Phone: 812. 295.3844

Email: Ehand09@frontier.com

Background information:

NSWC Crane's total focus is to support the warfighter by leveraging its technical capabilities for the rapidly changing combat environment. NSWC Crane provides comprehensive support for complex military systems in three focus areas: Strategic Missions, Electronic Warfare/Information Operations and Special Missions.

NSWC Crane delivers technical solutions directly into the hands of the warfighter, ensuring safer missions and saving lives.

In the case of Evan C. Hand, he is a perfect person to interview, as he is the inventor of the battery charger and power reduction system and method technology. He can further assist me with information on potential contacts and a deeper understanding of the technology itself, as well as the background of why it was invented and what their internal needs were. Evans insight will be beneficial in determining how the technology has been fielded, as well as the technology's key advantages, market potential, and suitable applications.

Key questions and answers:

Q. I'm hoping to gain some additional background information on this technology, could you provide insight on why it was invented and what the internal need prior to its creation was?

A: NASA realized a need for testing batteries for the spacecraft – Crane was into testing military batteries, so they hired them. They provide testing for the air-force, marines, army and private industry.
There was a requirement from major sponsors to charge lithium ion batteries in series, but be able to control the individual cells as well.
Every cell varies on how long it takes to charge
The technology has a computer controlling charger source, which monitors the bypass of the circuits, and starts reducing the total charge current
The patent focuses on the algorithm to do the control and power management
Initially couldn't control individual cells

Advantages with Technology	Disadvantages without Technology

• Saves both cost and space • Very precise, has ability to hold to 10, 000 parts. 1 and 1000 parts is currently used = 1 millivolt • Reduces amount of power wasted • Control of individual cells in multiple series	• Wastes a lot of power • Increasing wear and tear on components(caused by heat)

Additional benefits:

- Designed to be repaired quickly (takes approx. 15 minutes to repair)
- Made so that a technician with normal skills can repair it
- Has ability for the entire board to be swapped out with unplug capacity

Q. Can you briefly clarify the individual components that form this system and how difficult they are to manufacture?

A: There are no special requirements for parts. The newer boards are radiation hardened, because they are used in space on satellites. The parts can be found easily. Regular battery circuit board with shunt style clamp. The algorithm is what makes it unique.

$300 per board – $150 for parts and $150 to populate (hand done)

Q. Currently how is this technology being used in the field?

A: Currently it is being used within the battery testing lab. It will be used in satellites in the near future – it aids in their thermal budget, which uses excess energy from photo cells to keep the satellite warm

Space vehicles and space stations – however, it is not original technology. Has been hardened and shrunk to fit for space applications

Q. You've worked with this technology for a number of years, what kind of feedback concerning the technology or application usage have you obtained from other people?

A: The algorithm hasn't been deployed; however, it would help with their thermal budgeting.

Q. In regards to applications, could you provide insight on what specific or alternative applications you could see this technology being used for, as well as its key advantages and market potential?

A: Automotive use – electric vehicles
Electric vehicles currently use series and parallel strings, if they used this technology each string could have its own control. It can protect the battery from overcharging – safety advantage. Also, consistent overcharging reduces the life of the battery and causes lithium metal to be plated out (metal pulled out of the system) making it not useable.

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It gives precise control – which is needed in building battery models – the better control you have the better your model will be.
Satellite use - By using this technology for satellites, they are given the ability to switch out photo cell panels to reduce heat or use the dissipated energy.
Circuit can reach 230 degrees Fahrenheit – tested with a thermal imager – bounced right back, normally maxes out at 140

What's currently out on the market:

Tessla – current roadster –they use some type of technology in their cars to manage their batteries
Aero-vironment- they test batteries
PEC – European comp.
Macor
Arbin
Bitrode
Eda- electronic development association

Q. Concerning the history of the technology, has there been any previous trials for commercialization, if so what were the details of the outcome.(Including, but not limited to , if and how it was marketed, names of major players and interested parties, etc.)

A: no

Q. In addition to interested parties, could you list what their major concerns were with the technology or any information on discussions that came about in regards to the technology.

A: Interest from satellite community to incorporate the technology into satellites

Q. Are you familiar with the leading companies in the field of industrial sized lithium-ion battery manufacturing? I am looking to contact a few key players in that industry, but would like your opinion on who would be the most beneficial company to contact in order to acquire some beta customers to test the technology. Do any come to mind?

A:

Battery Manufactures	Saft America	Quallion
Japanese manufacturers	Sanyo	Gs-yuasa(largest battery manufacturer)
Battery charger manufacturer	Aeroflex	Eagle picher

Q. In regards to the flexibility of the battery charger to be configured for standard sizes/shapes, it is safe to say that the term "standard" is referring to industrial sized batteries only, correct?

A: It is readily scalable
The algorithm can be applied to any size, but is limited by the hardware that you pick to apply the circuits.

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Can be used for all types (theoretically)

Q. Do you see a greater opportunity in licensing occurring if this technology was potentially scaled down for commercialization in non-industrial applications?

A: The algorithm could be incorporated in a microchip – doesn't make sense to use for standard batteries with low voltages
Also in different lithium ion technologies, such as standard off the shelf consumer batteries – they are made up of cobalt dioxide (cheap). It can catch fire easily, because it has its own oxygen in each molecule

Q. What are the limitations of the technology that will only make it useful in certain applications? More specifically being used as a common charging source for multiple series-connected batteries as opposed to parallel circuits?

A: Doesn't do parallel circuits, only series – if it did parallel, it would have to have perfectly matching impedances, which is close to impossible.

Q. In addition to possible limitations, what would hinder the device in operating or functioning at its optimal capacity in terms of environmental conditions, such as temperature?

A: The technology relies on heat dissipation, at -40 degrees Fahrenheit, things quit working (limited by components used)

Q. The patent states that the present invention is a battery charger that incorporates a useful and improved shunt-style charging system, does the device embody a more efficient shunt, than shunts used in other systems, or does it embody a more efficient shunt system.

A: The technology uses a regular shunt. The algorithm is what reduces the energy.

Additional information:
Charging time depends on size of the cell
Normally on a 90 minute cycle

- Discharge – 60; 30 to get back in

As battery ages it takes longer to charge
To charge a new battery it takes 45 minutes

Key Observations:

After speaking with the inventor, I have come to the conclusion that the electric automotive industry would provide the most opportunity for potential applications for commercializing. The top electrical car that came to mind, was the Tessla roadster, which should be researched further. The fact that they use technology currently on their batteries is a plus. It would be wise to determine what the technology they use consists of and from there find the advantages our technology has over theirs. If our technology is in fact more beneficial, their manufacturer should be contacted to find out what their interest towards licensing our technology would be. Although the technology is readily scalable using it for off the shelf

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consumer batteries would serve no purpose, as this system is for larger voltage batteries that are in series and not in parallel. In addition seeking out companies that test batteries would also prove to be fruitful, since this technology has been previously used as a testing device for battery modeling. The interest from the satellite community can be used as a licensing tactic for some companies. Providing validation that the technology can be used in thermal management is very important in lithium-ion technologies use in alternative energy vehicles and within the satellite community.

A123 Systems

Dr. Bart Riley
Founder/VP R/D/CTO

Phone: 617.778.5700 ext: 111704

Email: unknown

Comment: Was contacted several times. Has not returned phone call. There is no directory for contacts. You must have a specific person to speak to, otherwise operator cannot transfer the call.

A123 Systems, Inc. (Nasdaq: AONE) develops and manufactures advanced lithium-ion batteries and energy storage systems that deliver high power and energy density, long life, and excellent safety performance. The company's game-changing technology enables customers to commercialize innovative products for the transportation, electric grid and commercial markets.

A123's Nanophosphate® Engine Start Battery, which is designed as a longer-lasting replacement for lead-acid starter batteries to reduce weight and improve fuel economy, was selected to R&D Magazine's 2011 R&D 100, which salutes the 100 most technologically significant products introduced into the marketplace over the past year.

In regards to Dr. Bart Riley he brings more than 15 years of experience in technology development and commercialization in the advanced materials, portable power and superconductor industries to his role as CTO and vice president of research & development at A123 Systems. His insight about our technology and potential applications, would be very beneficial in having this technology commercialized.

GS-Yuasa Lithium Power

Curtis Aldrich

Sales and marketing manager

Phone: 1.888.479.8272

Email: Curtis.aldrich@gsyuasa-lp.com

GS-Yuasa Lithium Power is a company dedicated to creating complete battery systems for North American clients within the Military, Aviation, Space, HEV, EV, and Undersea industries. As a complete power solutions provider, GS Yuasa Lithium Power can provide everything from cells to complete battery systems. The GYLP battery systems include smart battery monitoring and protection circuitry, cell balancing, and options for charging.

GYLP currently has an engineering staff with a total of almost 60 years of product development experience in the battery and aerospace fields, and they are still growing. They have expertise in cells, electronics, and mechanical engineering. Currently they are in the process of expanding their advanced prototyping and testing capability for battery and charger products

In regards to Curtis Aldrich, he is the proper person to contact, because he is the sales and marketing manager, in charge of presenting new technologies to the company for potential integration.

Key questions and answers:

Q. Could you explain, in general terms, how you review and consider new potential technologies?

A: Conduct market research, create a compliance matrix. Determine where we can we buy the technology, how much does it cost to develop in house. We are a Japanese company, that operates in Alpharetta, Georgia. For many years we have taken Japanese products and tried to find a market for them in the states.

Q. What is the exact process for getting a technology such as this integrated into GS-yuasa?

A: I am the point of contact and responsible for putting a market driven specification together. Which, I then present to my bosses. We all sit down and determine based on my information and the specific requirement having to do with safety, provided by the engineering side, the technologies working potential. We also look at product specification.

Q. Because every organization has a unique structure, who is the right person in this company to contact regarding a technology that is coming from an in-licensing approach?

A: Curtis Aldrich. Sales and marketing manager

Q. Do you see this technology being integrated into existing devices within the company, or do you think this technology would be better as a standalone device?

A: It depends, requires review of the detail of your technology, a product depth analysis, and what we are starting with vs. what we need.

Q. Who would this technology be best suited for? Do you see multiple applications of potential interest?

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A: Contract manufacturers in battery management. In regards to electrical vehicle batteries they focus on the cells level technology. The automotive companies such as Mitsubishi they tend to have their own management technology for their electrical vehicles. We would however be interested in using the technology for battery management on space applications for the manufacturing of space batteries. Focusing on the Mechanical and thermal aspect. If the technology can provide reliability and lower manufacturing costs, that is what we would be most interested in.

Q. Do you have access to any market reports or other material that you could share in terms of defining the relevant market size, etc?

A: Have market reports, but no information that you wouldn't be able to find, by just doing a simple google search.

Key Observations

July 11, 2011, Curtis Aldrich

In regards to the interview with Curtis Aldrich, he has stated that the company would only be interested in using this technology if it could provide reliability and if it could lower their costs of manufacturing. In the event that it could, there would be an interest in it for its use with manufacturing satellite batteries. Therefore, a strong focus should be on quantifying this technologies ability to reduce cost for manufacturing and its reliability. Mr. Aldrich has stated that he is the contact person for integrating new technologies within the company. He is responsible for providing his company with market data on technologies that would benefit their company. Which makes him a great follow up candidate for the potential licensing of this technology.

LG Chem Power, Inc.

Dr. Mohamed Alamgir
Research Director

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LG Chem Power Inc. is a North American subsidiary of LG Chem Ltd., one of the world's largest producers of lithium-ion batteries for automotive (Hybrid Electric Vehicles - HEVs) and non-automotive (commercial, military, conversion, and portable equipment) applications. As such, the company has accumulated expertise in the development of safe, high-power/high-energy, compact, and lightweight lithium-ion battery systems

LGCPI targets to be the partner of choice for vehicle manufacturers utilizing Lithium Ion Energy Storage Solutions for Hybrid Electric Vehicle (HEV), Plug-In Hybrid Electric Vehicle (PHEV), and Electric Vehicle (EV)

applications. With increased investments and leading-edge technology, LG Chem/LGCPI is poised to become one of the world's principal battery manufacturers for the HEV, PHEV, and EV industries.

Dr. Mohamed Alamgir is research director for LG Chem Power Inc. (LGCPI), a leading developer of lithium-ion batteries for hybrid electric vehicles (HEVs). He brings over 25 years of experience to his current position, where he is primarily responsible for the research, development and engineering of LGCPI battery cells. He joined LGCPI in 2000.

In regards to Dr. Alamgir, he is the proper person to contact, because he has received the information in regards to the technology. He would be the person to follow up with to seek out LG Chem's interest in adopting this technology.

Quallion LLC

Hisashi Tsukamoto
President and Chief Technology Officer

Phone: 818.833.2000

Email: unknown

Quallion LLC produces a number of primary and rechargeable cell and battery configurations for use in the medical, military and aerospace markets, with revenues divided evenly across these three market segments.

The company currently employs over 85 people, with a large engineering department capable of supporting multiple research and development and prototyping projects simultaneously

Senator Alex Padilla announced that Quallion LLC, a battery manufacturer based in Sylmar, CA, will receive a state grant of over $5.8 million to mass-produce standardized, lower-cost Lithium-ion (Li-ion) batteries for electric vehicles and other green technologies

Dr. Tsukamoto, Quallion's co-founder, is one of the world's foremost experts in Li-ion battery technology and serves as Quallion's Chief Executive Officer and Chief Technology Officer. Prior to joining Quallion, he worked at Japan Storage Battery for 19 years. He has 30 years of research and management experience most in the area of lithium ion batteries

In regards to Dr. Hisashi Tsukamoto, he is the proper person to contact, because he currently serves as the President and Chief Technology Officer for the company. He oversees operations and all research and development efforts.