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LEAD ACID**5601945****BATTERY ELEMENT CONTAINING
POROUS SUBSTRATES**

Clough Thomas J Grover Beach, CA, UNITED STATES assigned to Ensci Inc

A battery element comprising an organic resilient porous substrate having sulfuric acid contained in the pores of the porous substrate. The porous substrate is useful in the active material of lead acid batteries.

5601953**BATTERY GRIDS**

Schenk Raymond L Marysville, MI, UNITED STATES assigned to Venture Enterprises Incorporated

An improved battery grid for use in lead-acid batteries has been formed which has resistance to the detrimental effects of grid growth. The improved battery grid has been formed to relieve stress at predetermined locations. Specifically, stress is released by having an overdeveloped reticulum and/or flexible junctions including where the reticulum meets the frame and/or by having either no borders or borders which are released from the reticulum through use of the battery. This battery grid can be a positive grid formed on a continuous casting machine and has a growth relief mechanism to accommodate the condition of imperfect grain formation without interruption of the reticulum.

5604058**BATTERY GRIDS, METHOD AND
APPARATUS**

Wirtz John O Port Huron, MI, UNITED STATES assigned to Wirtz Manufacturing Co Inc

A continuous cast positive grid of lead having substantially improved corrosion resistance and decreased growth in a positive plate of a lead-acid

battery and a continuous cast negative grid of lead having substantially increased tensile strength for a lead-acid battery. A web of lead is continuously cast with a series of succeeding grid blanks of uniform thickness which are cold worked to reduce the positive grid thickness by at least 3:1 and the negative grid thickness in the range of about 1.5:1 to 2.8:1 preferably by passing through the nip of each of a plurality of successive compression rollers. Electro-chemically active paste is applied to the reduced webs, preferably flash dried, and individual pasted grids are cut from the reduced and pasted webs to provide positive plates and negative plates for a lead-acid battery. The reduced positive grids have a microstructure with substantially smaller grains and a more uniform grain structure and the reduced positive and negative grids have substantially increased tensile strength after full age hardening compared to as cast continuous grids after full age hardening.

5607484**METHOD OF FORMING BATTERY
PLATE ASSEMBLIES FOR WET
STORAGE CELL BATTERIES**

Redden Galen; Luzader Rex E Gypsum, KS, UNITED STATES assigned to Exide Corporation

Battery plate envelopes include a sheet of porous film material having a folded widthwise bottom edge and overlapped lateral edges to thereby form a pocket for receiving a battery plate therein. The overlapped lateral edges are joined to one another by a lengthwise extending series of discontinuous joining regions with adjacent ones of the discontinuous joining regions being separated by respective unsealed regions. These unsealed regions thereby establish respective lateral channels through which fluid (e.g., electrolyte employed in a wet storage battery) may pass to the interior pocket, and hence to the battery plate. The discontinuous joining regions are most preferably formed by passing the sheet material through the nip between opposed joining rings, each of which is provided with a series of triangularly-shaped teeth with smooth land areas formed between adjacent teeth series.

5607797**LEAD ACID STORAGE BATTERY AND
METHOD FOR MANUFACTURE
THEREOF**

Hasegawa Toshiro; Shimoda Kazuhiko; Makino Kunio;
Tomioka Mitsuo Toyohashi, JAPAN assigned to
Matsushita Electric Industrial Co Ltd

The present invention relates to a lead acid storage battery and provides a lead acid storage battery having a high durability against complicated vibrations such as perpendicular and horizontal vibrations and the combination of these vibrations applied by vehicles or machines on which the battery is installed and having a long shelf life. A polyolefin resin having good fluidity is heat molten and poured into two portions above and near the left and right ends of the plate group comprising positive and negative plates having lugs at nearly the center portion so that the resin reaches at least one of the inner wall or inner partition wall, thereby to form a beam-shaped plate fixing member.

5611128**BATTERY GRIDS, METHOD AND
APPARATUS**

Wirtz John O Port Huron, MI, UNITED STATES
assigned to Wirtz Manufacturing Co Inc

A continuous cast positive grid of lead having substantially improved corrosion resistance and decreased growth in a positive plate of a lead-acid battery and a continuous cast negative grid of lead having substantially increased tensile strength for a lead-acid battery. A web of lead is continuously cast with a series of succeeding grid blanks of uniform thickness which are cold worked to reduce the positive grid thickness by at least 3:1 and the negative grid thickness in the range of about 1.5:1 to 2.8:1 preferably by passing through the nip of each of a plurality of successive compression rollers. Electro-chemically active paste is applied to the reduced webs, preferably flash dried, and individual pasted grids are cut from the reduced and pasted webs to provide positive plates and negative plates for a lead-acid battery. The reduced positive grids have a microstructure with substantially

smaller grains and a more uniform grain structure and the reduced positive and negative grids have substantially increased tensile strength after full age hardening compared to as cast continuous grids after full age hardening.

5615717**ELECTROLYTE DISTRIBUTING SYSTEM
AND METHOD**

Cheiky Michael C Santa Barbara, CA, UNITED
STATES assigned to Dreisbach Electromotive Inc

A method of providing electrolyte to an electrolyte starved battery includes the steps of supplying electrolyte from a source to a dispenser and dispensing the electrolyte from the dispenser in a preplanned sequence to each of a number of electrolyte inputs in the electrolyte starved battery. Related devices for accomplishing such a method are also disclosed.

5617005**METHOD AND APPARATUS FOR
CHARGING LEAD ACID BATTERIES**

Brown Fon R; Nelson Robert Mesa, AZ, UNITED
STATES

Battery charger apparatus and method includes a clock to provide timing information and logic to control the charging time of a battery being charged. The logic also controls a discharge time period in which the battery being charged is discharged for a relatively short period of time. After the discharge time, the voltage across the battery terminals is sensed by the logic to determine the state of the charge of the battery. The pulsing of the battery, in which the charging times and discharging times are alternated, and then the sensing of the battery voltage, is controlled by the logic to provide the charging of a battery in the shortest possible time period.

5618641**BIPOLAR BATTERY CONSTRUCTION**

Arias Jeffrey L Downey, CA, UNITED STATES
assigned to Bipolar Power Corporation

The Bipolar Battery Construction disclosed and claimed above solves the problem of constructing a bipolar battery with a desired, uniform, constant, pressure between each bipolar plate and separator in the battery cell stack. The provision of such a pressure dramatically increases battery life, and increases the power of the cell stack. Compressive force is provided by spring-loaded clamping internal to the battery. A sealed battery case provides common confinement of gases and vapors from all cells, minimizing battery sealing requirements. An inhibitor device is provided for minimizing or eliminating leakage current between adjacent battery cells through electrolyte, avoiding self-discharge of the cells. Insulation minimize temperature gradients in the cell stack which assures uniform and stable performance.

5624770**BATTERY WITH SIDE WALL RIBS**

Gummelt Klau; Bumle ohle Christia Garbsen,
GERMANY assigned to VB Autobatterie GmbH

A lead storage battery with a monobloc container receives plate groups in cell compartments which are adjustable in width using a series of side wall ribs. Each rib includes a cell connector formed on the container wall, which is in turn provided with support portions which extend into the container compartment to define a roughly T-shaped cross-section. Each rib is further joined to the bottom of the container along its cross-section. Since the support portions are aligned with, or substantially aligned with the container wall, a large-surface support is provided for receiving a plate group, preventing the potential for wearing into the outermost electrodes of the plate group during vibrational stress, and the failure of the mass which can then result.

FUEL CELL**5601936****METHOD OF OPERATING A FUEL CELL**

Dudfield Christopher D; Dicks Andrew L
Loughborough, UNITED KINGDOM assigned to
British Gas plc

A fuel cell is operated at a temperature which is not greater than substantially 250°C, has an electrolyte which can be a solid polymer electrolyte, a liquid phosphoric acid electrolyte, or a liquid alkaline electrolyte, and a cathode and an anode each comprising a platinum catalyst. Hydrogen fuel gas is supplied to the anode and a gaseous oxidant, for example oxygen is supplied to the cathode. The cathode and anode are both connected to first and second circuits in parallel. The first circuit includes a load to be powered by the fuel cell and a first switch. The second circuit includes a battery and a second switch. The switches are operated by a control. When the first switch is closed the cell powers the load and the second switch is open. When the first switch is open the second switch is closed so the battery

5618642**BATTERY SEPARATOR WITH SODIUM SULFATE**

Samii Abbas; Choi Wai M Belmont, MA, UNITED STATES assigned to Daramic Inc

A battery separator having sodium sulfate incorporated therein in order to reduce and/or eliminate hydration short problems in batteries. The preferred method of adding sodium sulfate directly to the separator is via the use of sodium sulfate-containing silica as a separator filler added during the process of manufacturing the separator. The present invention is also directed to a battery separator containing a relatively high level of sodium sulfate, and to batteries which incorporate such separators.

applies a reverse D.C. potential the anode and cathode. The first switch is closed and the second switch is open for a time period T1 which is substantially at least ten times greater than time period T2 for which the first switch is open and the second switch is closed. The time period T2 does not exceed substantially 0.25 seconds. The switches can be relays or solid state electronic switch arrangements.

5601937

HYDROCARBON REFORMER FOR ELECTROCHEMICAL CELLS

Isenberg Arnold O Pittsburgh, PA, UNITED STATES assigned to Westinghouse Electric Corporation

An apparatus for and a method of continuously supplying a conditioned fuel, such as CO and H₂, to an electrochemical generator such as a high temperature solid oxide electrolyte, fuel cell generator (SOFC), for electrochemical reactions and continually regenerating a hydrocarbon reformation catalyst by providing at least two iron metal/iron oxide beds. At least one bed, a reformation bed, is mainly in the iron oxide (FeO) condition and incoming hydrocarbon feed fuel gas, such as natural gas, will be reformed or conditioned at a temperature of about 600°C to 800°C on the iron oxide to CO and H₂ which represents the fuel to be fed to the fuel cells of the electrochemical generator, thereby reducing iron oxide to iron metal (Fe). While the FeO reformer bed is being reduced to Fe, the at least one other bed, an oxidation bed, which previously served as a reformer bed mainly in the iron metal condition (Fe) is oxidized at a temperature of about 600°C to 800°C to mainly FeO form with generator spent fuel gases, thereby oxidizing iron to iron oxide and also producing some additional conditioned fuel gas. The beds can be operated concurrently or sequentially, and when each bed becomes substantially exhausted, it is switched over in function to the other mode of operation.

5601938

CARBON AEROGEL ELECTRODES FOR DIRECT ENERGY CONVERSION

Mayer Steven T; Kaschmitter James L; Pekala Richard W San Leandro, CA, UNITED STATES assigned to Regents of the University of California

A direct energy conversion device, such as a fuel cell, using carbon aerogel electrodes, wherein the carbon aerogel is loaded with a noble catalyst, such as platinum or rhodium and soaked with phosphoric acid, for example. A separator is located between the electrodes, which are placed in a cylinder having plate current collectors positioned adjacent the electrodes and connected to a power supply, and a pair of gas manifolds, containing hydrogen and oxygen positioned adjacent the current collectors. Due to the high surface area and excellent electrical conductivity of carbon aerogels, the problems relative to high polarization resistance of carbon composite electrodes conventionally used in fuel cells are overcome.

5604048

ELECTRICALLY CONDUCTING CERAMIC AND FUEL CELL USING THE SAME

Nishihara Masat; Akiyama Masahid; Yamashita Shoji Kokubu, JAPAN assigned to Kyocera Corporation

The present invention is an electrically conducting ceramic having improved electrical conductivity which comprises a perovskite-type composite oxide of a composition represented by the following formula>(*See Patent for Tabular Presentation*) PS wherein A represents at least one type of atom selected from the group consisting of Sc, Y, Nd, Yb, Er, Gd, Sm and Dy, B represents at least one type of atom selected from the group consisting of Ba, Sr and Ca, and C represents at least one type of atom selected from the group consisting of Co, Fe, Ni, Ce, Zr, Mg, Al, Sb and Cr, and x, y, z, u, v and delta are the numbers that satisfy the following formulas>(*See Patent for Tabular Presentation*) PS (*See Patent for Tabular Presentation*) PS (*See Patent for Tabular Presentation*) PS (*See Patent for Tabular Presentation*) PS and at a temperature of 1000°C in the open air>(*See Patent for Tabular Presentation*) PS A tubular-type fuel cell containing an electroconductive ceramic in accordance with this invention as an air electrode does not deform during operation for long period of time and yields a stabilized output and a planar type fuel cell which is free from peeling of air electrodes or does not decrease its output by the deformation of the cell.

5605770

**SUPPLY SYSTEM FOR FUEL CELLS OF
THE S.P.E. (SOLID POLYMER
ELECTROLYTE) TYPE FOR HYBRID
VEHICLES**

Andreoli Giuseppe L; Federici Flavio Alessandria,
ITALY assigned to Finmeccanica S p A Azienda
Ansaldo

A supply system for fuel cells of the solid polymer electrolyte type for vehicles, including a primary cooling and humidifying circuit with demineralised, pressurised water with a small volumetric capacity and a secondary liquid cooling circuit with plate exchangers for cooling the demineralised water of the primary circuit and air/liquid exchangers for cooling compressed air for supply to the cells, the system further including an electric heater for heating the liquid in the secondary circuit so that the cells can be put into service quickly and means for recycling hydrogen leaving the cells to make the optimum use of the fuel.

5607786

FUEL CELL TRANSPORT FRAME

Guthrie Robin J; Corrigan Thomas J East Hartford, CT,
UNITED STATES assigned to International Fuel Cells
Corporation

The present invention discloses a transport frame for transporting and maintaining a fuel cell stack assembly in a fixed position. The fuel cell stack assembly which is under compression by a top and bottom plate held together by tie rods positioned at the corners of each plate. The top and bottom plates are then mounted to a rigid frame for transporting the fuel cell. The tie rods being attached to mounts in the base plate of the rigid frame and an insulated attachment between the top plate of the fuel cell stack frame and the rigid frame is made. The fuel cell stack assembly being electrically insulated from the rigid frame.

5612149

**FUEL CELL COLUMN HEAT
EXCHANGER MATED MODULE**

Hartvigsen Joseph; Khandkar Ashok C; Elangovan Singaravelu Kaysville, UT, UNITED STATES assigned to Ceramatec Inc

A fuel cell module with a fuel cell column, having at least one fuel cell stack, mated with the planar wall of a heat exchanger, wherein the fuel cell column and heat exchanger are mounted to a support structure, and which define an air plenum between the fuel cell column and planar wall of the heat exchanger, thereby eliminating the ductwork and insulation requirements associated with heat exchange systems while increasing the efficiency of the heat exchanger.

5614127

**HIGH-PERFORMANCE CERAMIC
INTERCONNECT FOR SOFC
APPLICATIONS**

Khandkar Ashok C; Milliken Christopher E; Elangovan S Salt Lake City, UT, UNITED STATES assigned to Gas Research Institute

An improved ceramic interconnect component for a solid oxide fuel cell having good electrical conductivity thermodynamic stability in the presence of fuel and a coefficient of thermal expansion matching closely that of zirconia electrolytes is disclosed. The interconnect is a lanthanum strontium chromate material containing minor quantities of calcia, and iron and, optionally, very minor quantities of cobalt, as dopants.

5616430

**REFORMER AND FUEL CELL SYSTEM
USING THE SAME**

Aoyama Satoshi Susono, JAPAN assigned to Toyota Jidosha Kabushiki Kaisha

While a fuel cell operates, a fuel cell system allows a carbon dioxide rich gas discharged from an anode of the

fuel cell through consumption of hydrogen to be fed into a carbon dioxide recovery element of a carbon dioxide recovery unit. The carbon dioxide recovery element is packed with a zeolite, which absorbs and retains a polar substance CO₂. When the fuel cell stops operation, a recovery element heating burner receives a supply of the hydrogen-containing carbon dioxide rich gas fed via a first exhaust conduit of the fuel cell and a supply of methanol from a methanol reservoir, and combusts hydrogen contained in the carbon dioxide rich gas as well as the supply of methanol. This keeps the zeolite packed in the carbon dioxide recovery element under a heating condition, which allows carbon dioxide previously absorbed and retained to be released from the zeolite. A reforming reaction unit of a methanol reformer and the fuel cell are filled with the released carbon dioxide fed therein.

5616431

FUEL CELL AND ITS BIPOLAR PLATE

Kusunoki Akira; Otsuki Jitsuji; Kikuoka Yasuhira; Okada Tatsunori; Matsumura Mitsue; Shinoki Toshio; Mukai Masahiro; Yagi Tetsuya Osaka, JAPAN assigned to Mitsubishi Denki Kabushiki Kaisha

A bipolar plate is designed to provide a gas seal around an electrode and gas seals around fuel gas manifolds on the same plane and to separate the gas seal and gas seals around oxidant gas manifolds with hollowed parts on an anode electrode side, and to provide the gas seal and the gas seals on a same plane and to separate the gas seal and the gas seals with hollowed parts on a cathode electrode side.

5618322

REFORMER FOR FUEL CELL SYSTEM

Mizuno Yutaka; Hanajima Toshiharu; Matsubara Hisayoshi Iwata, JAPAN assigned to Yamaha Hatsudoki Kabushiki Kaisha

A number of embodiments of reformers for reforming fuel for a fuel cell that includes an elongated catalyst bed with fuel to be reformed being delivered at one end of the bed and extracted from the other end of the bed. Heat is applied to a greater extent at the inlet end of the

catalyst bed than the outlet end to prevent the formation of carbon monoxide in the products delivered from the outlet. In all embodiments, the catalyst bed has a spiral configuration and the fuel is heated before it is delivered to the catalyst bed. In some embodiments the same heat sources are employed for heating both the fuel and the catalyst bed.

5622790

FUEL CELL AND CATALYST FOR USE THEREIN

Dicks Andrew L; Smith Thomas A; Clarke Stephen H Ashby De La Zouch, UNITED KINGDOM assigned to British Gas PLC

A molten carbonate high temperature fuel cell contains a hydrocarbon-containing fuel reforming catalyst on a support, where the catalyst is produced by reducing a catalyst precursor which is prepared by intimately mixing a defined Feitnecht compound with a non-calcined alumino-silicate clay mineral and at the same time and/or subsequently but prior to calcination with at least one added stabilizing additive for reducing silicon-species loss selected from the group consisting of alkaline earth metal compounds, rare earth metal compounds and mixtures thereof, and, optionally, an alkali metal compound, and thereafter calcining the intimate mixture, wherein the catalyst has been found to be suitable for the steam reforming of methane at the working temperature of the molten carbonate fuel cell and has been found to be substantially resistant to deactivation in the hot alkali metal carbonate environment.

5624768

GAS SHORTAGE PREVENTIVE CIRCUIT FOR A FUEL CELL POWER GENERATION SYSTEM

Tanokura Kazuo Kawasaki, JAPAN assigned to Fuji Electric Co Ltd

A gas shortage preventive circuit for use in a fuel cell power generation circuit that includes a fuel cell, an inverter, and a constant voltage controlling circuit. The

gas shortage preventive unit cooperates with an overcurrent limiting unit. The gas shortage preventive unit has an allowable overcurrent value calculating portion which calculates an allowable overcurrent value based on a fuel utilization coefficient which is higher by a certain proportion higher than a standard value and the output current of the fuel cell. The gas shortage preventive unit also has a response speed controlling portion which eliminates transient variations from the allowable overcurrent value and outputs an overcurrent value signal. The overcurrent limiting unit outputs to the constant volume controlling circuit a signal for suppressing an overcurrent when the output current of the fuel cell exceeds the preset overcurrent value.

5624769

CORROSION RESISTANT PEM FUEL CELL

Li Yan; Meng Wen-Jin; Swathirajan Swath; Harris Stephen J; Doll Gary L Troy, MI, UNITED STATES assigned to General Motors Corporation

The present invention contemplates a PEM fuel cell having electrical contact elements (including bipolar plates/septums) comprising a titanium nitride coated light weight metal (e.g., Al or Ti) core, having a passivating, protective metal layer intermediate the core and the titanium nitride. The protective layer forms a barrier to further oxidation/corrosion when exposed to the fuel cell's operating environment. Stainless steels rich in CR, Ni, and Mo are particularly effective protective interlayers.

5629102

ELECTRICAL AUTOMOBILE HAVING A FUEL CELL, AND METHOD OF POWERING AN ELECTRICAL AUTOMOBILE WITH A FUEL CELL SYSTEM

Werth John Princeton, NJ, UNITED STATES assigned to H Power Corporation

The present invention features a system and a method for operating an electrical automotive vehicle. The

system has an electrically-powered automotive vehicle with electrical drive motors. The electricity to power the drive motors is supplied onboard by a hydrogen-air fuel cell which operates by a hydrogen-oxygen reaction. The hydrogen for fueling the fuel cell is generated onboard the automobile by using a fuel storage compartment that supplies iron to a reactor bed. The reactor bed is either a fluidized bed or a catalyzed bed. The vehicle's operator obtains a fresh charge of iron for the fuel storage compartment from an iron fuel station. The iron charge is made up of pellets, sponge iron or particles of iron. The system contains a means for grinding the iron particles, or a catalyst, or both, so that their reactivity with respect to water will become enhanced. The vehicle has a tank for containing a supply of water, as well as a means for heating the water to reactive temperatures. The heated water is conveyed from the water tank to the reactor bed, where it reacts with the iron to form hydrogen and iron oxide. The hydrogen is conveyed to the hydrogen-air fuel cell, where it reacts with oxygen from the air to generate the electricity for powering the drive motors and the pumps of the vehicle, as well as provide water for resupplying the water tank, at least in part.

5629103

HIGH-TEMPERATURE FUEL CELL WITH IMPROVED SOLID-ELECTROLYTE/ELECTRODE INTERFACE AND METHOD OF PRODUCING THE INTERFACE

Wersing Wolfram; Ivers-Tiffée Elle; Landes Harald; Muml anner Rut; Numl olscher Christoph; Schmidt Harald; Schnuml oller Manfred Kirchheim, GERMANY assigned to Siemens Aktiengesellschaft

PCT No. PCT/DE94/00425 Sec. 371 Date Oct. 27, 1995 Sec. 102(e) Date Oct. 27, 1995 PCT Filed Apr. 18, 1994 PCT Pub. No. WO94/25994 PCT Pub. Date Nov. 10, 1994. To improve stability and efficiency of a high-temperature solid-electrolyte fuel cell of planar multilayer design, it is proposed to increase the effective interface between the electrolyte layer and an electrode layer. This is achieved by a suitably treated surface of the electrolyte layer or by a porous and/or rough interlayer.

5629104**MODULAR ELECTRICAL ENERGY
DEVICE**

Crawford Michael D; Wilson Curt L; Crawford Michael H; Gostek Matthew Rochester Hills, MI, UNITED STATES assigned to Detroit Center Tool

A modular energy device for combining fuel cells for use in an automotive vehicle. The modular energy device includes an end plate, a bi-plate, and compression plate. The modular energy device further includes current collectors which collect energy from an electrochemical reaction. A Membrane Electrode Assembly (MEA) or fuel cell includes a composite material, an anode and a cathode. The modular energy device uses a hydrogen based fuel and oxidant in order to create an electrical potential.

BATTERY MATERIALS**5601947****ELECTROACTIVE HIGH STORAGE
CAPACITY POLYCARBON-SULFIDE
MATERIALS AND ELECTROLYTIC
CELLS CONTAINING SAME**

Skotheim Terje A; Kovalev Igor Shoreham, NY, UNITED STATES assigned to Moltech Corporation

The present invention relates to novel electroactive energy storing polycarbon sulfide (PCS) materials of general formula $(CS_x)_n$ wherein x is greater than 2.5 to about 50, and n is equal to or greater than 2. This invention also relates to novel rechargeable electrochemical cells containing positive electrode materials comprised of said polycarbon-sulfide materials with improved storage capacity at ambient and sub-ambient temperatures. This invention also relates to novel gel type solid electrolytes useful in high energy storage batteries.

5601948**GAS PLASMA TREATMENT OF
CATHODES TO IMPROVE CELL
PERFORMANCE**

Binder Michae; Mammone Robert J; Wade William L Brooklyn, NY, UNITED STATES assigned to The United States of America as represented by the Secretary of the Army

A porous carbon black or manganese dioxide cathode, or a lithium, magnesium, calcium, zinc, or cadmium anode, is treated under vacuum with a gas plasma. The treated electrode is suitable for inclusion in a nonaqueous electrolyte cell and improves cell performance.

5603982**THIN FILM SOLID ELECTROLYTE
PRODUCTION METHOD**

Sun Luying Stoughton, MA, UNITED STATES assigned to Battery Engineering Inc

This invention is concerned with a method for producing thin film solid polymer electrolytes and more particularly to a method for producing solid thin reinforced terpolymer electrolyte films for use in the fabrication of solid state rechargeable batteries and other solid state electrochemical devices such as supercapacitors, fuel cells, sensors and the like.

5605548**MANUFACTURING METHOD FOR A
POLYMER SOLID ELECTROLYTE CELL
WHICH USES COMPOSITE POSITIVE
ELECTRODE**

Itou Tsukas; Nishioka Masato; Oda Takashi; Sonozaki Tsutomu; Kodama Yasunobu Sumoto, JAPAN assigned to Sanyo Electric Co Ltd

A quick and simple manufacturing method for a current collector single body sheet-like composite positive electrode of superior electrode performance includes a positive electrode mixture generating process mixing

non-aqueous solvent, polymer material, electrolyte salt, positive electrode active material and electrically conductive material, a positive electrode mixture pressing out process after the mixture has been applied onto the positive electrode current collector and a process for hardening the sheet-like electrode, at a same time attaching the sheet-like electrode to the positive electrode current collector using heat or ionizing radiation to polymerize the polymer material distributed in the mixture. An efficient manufacturing method for a polymer solid electrolyte cell of superior cell capacity and cell characteristics which uses said composite positive electrode additionally includes a process for arranging a polymer solid electrolyte precursor on a negative electrode, a process for arranging a current collector single body composite positive electrode on the electrolyte precursor on the surface of the negative electrode so that the positive and negative electrodes face each other with electrolyte precursor in-between, and a process for hardening the electrolyte precursor to form a polymer solid electrolyte film, at a same time attaching said film to the positive electrode by using heat or ionizing radiation to polymerize the polymer solid electrolyte precursor.

5605549

BATTERY ELECTROLYTE PAD WITH GELLING AGENTS AND METHOD

Zucker Jerry Charleston, SC, UNITED STATES assigned to Daramic Inc

A gel-type storage battery is made by preparing porous electrolyte pads having internal pockets containing a dry powdered gelling agent, and inserting the pad between adjacent battery electrodes before addition of acid. The gelling agent may include acid resistant superabsorbing polymer particles, which cause the pads to swell into intimate contact with the electrodes upon addition of the aqueous acid.

5605550

BATTERY LAMINATE WITH IMPROVED ELECTROLYTE AND ANODE OR CATHODE LAYER CHARACTERISTICS

Jensen Gert L; Chaloner-Gill Benjamin; Isaacson Mark J San Jose, CA, UNITED STATES assigned to Valence Technology Inc

In making a laminar assembly for use in the battery, a layer of battery electrode material is deposited onto a substrate surface and the battery electrode material is caused to have an uneven surface. Then an electrolyte layer is deposited onto the uneven surface of the battery electrode material. Where the method calls for first depositing the electrolyte material, then electrolyte material is deposited onto the substrate layer where the electrolyte layer is caused to have an uneven surface. Thereafter, the battery electrode material is deposited onto the uneven surface of the electrolyte material. In both cases, slippage between the battery electrode material and electrolyte material is reduced during cutting, folding and other handling process in making a laminar battery, thereby reducing the probability of shorts in the battery. In order to form the cathode or electrolyte layer, a pump is used to squeeze a viscous cathode or electrolyte material through a nozzle onto a substrate surface and the viscous material and substrate layer are passed between two pressing surfaces moving in the same direction pressing the viscous material onto the substrate layer. The two pressing surfaces are spaced apart by a predetermined distance so that the viscous material is pressed into a layer with a predetermined thickness with no pin holes therein so that the material adheres to the substrate layer.

5605774

IONICALLY PERMEABLE SEPARATOR FOR LECLANCHE CELL

Ekern Ronald; Rose Janna L; Armacanqui Miguel E Verona, WI, UNITED STATES assigned to Rayovac Corporation

An ionically permeable separator for a LeClanche cell, and methods of making and using same, are provided for in the invention. The separator comprises a Kraft paper

separator and a corrosion-inhibiting coating thereupon selected to prevent corrosion of a zinc anode of the LeClanche cell. The separator may be configured for use in round or flat LeClanche cells. The separators of the invention may be used in heavy duty batteries containing an electrolyte comprising zinc chloride as a primary component. Cells made in accordance with the invention exhibit comparable or improved capacity and other performance characteristics in respect of conventional cells.

5607785

**POLYMER ELECTROLYTE
ELECTROCHEMICAL CELL AND
PROCESS OF PREPARING SAME**

Tozawa Takesh; Toshima Nobuhito Kanagawa, JAPAN assigned to Tanaka Kikinzoku Kogyo K K; Watanabe M; Stonehart Associates

Disclosed herein are several aspects processes of preparing a polymer electrolyte electrochemical cell in which supply of a reaction gas and discharge of an obtained gas can be smoothly conducted. This can be achieved by forming through apertures in a cathode or by forming a gradient of ion exchange resin concentration of a catalyst particle cluster size.

5609795

**SOLID POLYMER ELECTROLYTE AND
METHOD OF MANUFACTURE THEREOF**

Matsumoto Morihik; Ichino Toshihiro; Nishi Shiro Tokorozawa, JAPAN assigned to Nippon Telegraph and Telephone Corporation

The present invention presents a solid polymer electrolyte consisting of a multiphase polymer matrix and an electrolyte solution. The polymer matrix consists of a highly polar polymeric (HPP) phase impregnated with the electrolyte solution to form ion conducting channels, and a less polar polymeric (LPP) phase, constituting the support structure. Further, the invented solid polymer electrolyte may also include a second ion conducting channels, forming a multiphase microstructure in which the electrolyte solution is

present around the LPP particles as a fine mesh-like network. The invention also presents two kinds of method for making such a solid polymer electrolyte. The first includes the steps of: making a multiphase polymer matrix; and impregnating the polymer matrix with an electrolyte solution. The second includes the steps of: making a multiphase polymer matrix containing an electrolyte in advance; and impregnating the multiphase polymer matrix containing the electrolyte with a solvent to dissolve the electrolyte or electrolyte solution in the polymer matrix.

5609800

**PROCESS FOR PRODUCING
HIGH-DENSITY AND HIGH-STRENGTH
CARBON ARTIFACTS SHOWING A FINE
MOSAIC TEXTURE OF OPTICAL
ANISOTROPY**

Mochida Isao; Fujiura Ryuji; Kojima Takashi; Sakamoto Hitoshi Fukuoka ken, JAPAN assigned to Mitsubishi Gas Chemical Company Inc

Self-adhesive carbonaceous grains for use in the manufacture of high-density and high-strength carbon artifacts containing 0.5-1.5 wt % of a quinoline-soluble but pyridine-insoluble component and at least 97 wt % of a quinoline-insoluble component and which are prepared by heat-treating in a nonoxidizing atmosphere a mesophase pitch that is obtained by polymerizing condensed polycyclic hydrocarbons or substances containing them in the presence of a superacid consisting of hydrogen fluoride and boron trifluoride. The carbonaceous grains are molded and the mold is baked at a sufficient temperature to achieve its carbonization, with the heating rate being not more than 20°C/h in the temperature range from 400° to 600°C In this way, high-density and high-strength carbon artifacts showing a homogeneous fine mosaic texture of optical anisotropy can be efficiently manufactured in high carbon yield.

5609844**CARBON ELECTRODE MATERIALS FOR
ELECTROCHEMICAL CELLS AND
METHOD OF MAKING SAME**

Zhang Jinshan; Anani Anaba A Duluth, GA, UNITED STATES assigned to Motorola Inc

A method for preparing an amorphous carbon material for use as an electrode, such as the anode of an electrochemical cell. The amorphous carbon is fabricated in a one heating step process from multi-functional organic monomers. Electrodes so fabricated may be incorporated into electrochemical cells as the anode thereof.

5611823**METHOD FOR FABRICATING A
BATTERY ELECTRODE**

Klein Martin Brookfield, CT, UNITED STATES assigned to Electro Energy Inc

This invention is directed to fabrication of electrodes from electrochemically active material prepared by coating non- to low-conductive particles of a metal hydroxide or metal oxide powder with nickel using an electroless nickel coating process. The cell design and electrode formulations provide for individual operation of a vented or low pressure sealed cell and/or for operation of these cells in a stacked array in an outer battery housing.

5612154**BETA-ALUMINA SOLID ELECTROLYTE**

Kajita Masaharu; Kajihara Takehiro; Totoki Takao Tajimi, JAPAN assigned to NGK Insulators Ltd

A beta-alumina solid electrolyte for use in a sodium-sulfur battery is composed of beta-alumina crystals having a degree of orientation toward the C axis thereof, of 0.2-0.4 and an aspect ratio of 4.0 or less. The beta-alumina solid electrolyte is composed of the beta-alumina crystals having a degree of orientation

toward the C axis thereof, of 0.2-0.4 and has such a particle diameter distribution that the average particle diameter is 3 μm or less, the proportion of the particles having a particle diameter of 5 μm or less is 90% or more, and the maximum particle diameter is 300 μm or less. A process for producing a beta-alumina solid electrolyte using an alumina source material, a magnesium source material and a sodium source material, uses a magnesium-aluminum spinel as the magnesium source material and subjects all materials to mixing, granulation, molding and firing to obtain a beta-alumina solid electrolyte without subjecting the materials to calcination. The beta-alumina solid electrolyte has a low electrical resistance and a large strength to internal water pressure and exhibits excellent properties when used as a diaphragm for a sodium-sulfur battery.

5616432**ELECTROCHEMICAL HYDROGEN
STORAGE ALLOYS AND BATTERIES
FABRICATED FROM MG CONTAINING
BASE ALLOYS**

Ovshinsky Stanford R; Fetcenko Michael; Reichman Benjamin; Young Kwo; Chao Benjamin; Im Jun Bloomfield Hills, MI, UNITED STATES assigned to Ovonic Battery Company Inc

A disordered multicomponent MgNi based electrochemical hydrogen storage material having a microstructure including a substantial volume fraction characterized by intermediate range order and exhibiting extraordinarily high storage capacity and methods of fabricating same.

5616435**HYDROGEN-ABSORBING ALLOY
ELECTRODE FOR METAL HYDRIDE
ALKALINE BATTERY**

Matsuura Yoshinor; Kuroda Yasushi; Higashiyama Nobuyuki; Kimoto Mamoru; Nogami Mitsuzou; Nishio Koji; Saito Toshihiko Osaka, JAPAN assigned to Sanyo Electric Co Ltd

A hydrogen-absorbing alloy electrode for metal hydride alkaline batteries is obtained by coating or filling a collector with a hydrogen-absorbing alloy powder consisting essentially of spherical particles and/or nearly spherical particles and then sintering the powder, the powder having an average particle diameter of 30 to 70 μm and containing 5 to 30% by volume of particles having a diameter of at least 2 times the average diameter and 10 to 40% by volume of particles having a diameter of not more than 1/2 of the average diameter. This electrode can give metal hydride alkaline batteries having excellent high-rate discharge characteristics and a long life.

5616436

**CARBONACEOUS ELECTRODE
MATERIAL FOR SECONDARY BATTERY
AND PROCESS FOR PRODUCTION
THEREOF**

Sonobe Naohiro; Ishikawa Minoru; Iwasaki Takao Iwaki, JAPAN assigned to Kureha Kagaku Kogyo Kabushiki Kaisha

A carbonaceous electrode having improved capacities for doping and dedoping of a cell active substance, such as lithium, and suitable for a non-aqueous solvent-type secondary battery, is constituted by a carbonaceous material having a specific microtexture. The carbonaceous material is characterized by its ability to provide an electrochemically lithium-doped product showing a main resonance peak which is shifted by 80-200 ppm to a lower magnetic field side from a resonance line of LiCl as a reference substance when subjected to ^7Li -NMR spectroscopy analysis.

5616437

**CONDUCTIVE METAL OXIDE COATED
CURRENT COLLECTOR FOR IMPROVED
ADHESION TO COMPOSITE ELECTRODE**

Gao Feng Henderson, NV, UNITED STATES assigned to Valence Technology Inc

A method of preparing an electrochemical cell wherein

the composite electrode material adheres to the current collector to create good electrical contact is provided. The electrode/current collector comprises a current collector having a layer of electrically conductive metal oxide on at least one surface of the current collector and a composite electrode selected from the group consisting of composite cathode and composite anode wherein the layer of metal oxide is positioned between the current collector and composite electrode. The composite electrode remains substantially and permanently attached to the electrically conductive metal oxide layer that has been formed on the surface(s) of the current collector during the life of the electrochemical cell or battery.

5618615

GRAPHITE LAYER MATERIAL

Inoue Takao; Ikeda Junji; Nishiki Naom HIRAKATA, JAPAN assigned to Matsushita Electric Industrial Co Ltd

The present invention provides a graphite layer material to be used as an electrode material which exhibits excellent cell characteristics when used for a secondary cell. The graphite layer material of the present invention comprises highly oriented graphite layers of which a direction of crystalline orientation is adjusted to a planar direction, and an intercalant being inserted between the graphite layers.

5622612

**METHOD OF PREPARING CURRENT
COLLECTORS FOR
ELECTROCHEMICAL CELLS**

Mihara David R; Rose Stephen J; Gustar Robert; Adamson David; Barton Paul SURREY, UNITED KINGDOM assigned to Duracell Inc

PCT No. PCT/US94/05571 Sec. 371 Date Nov. 16, 1995 Sec. 102(e) Date Nov. 16, 1995 PCT Filed May 18, 1994 PCT Pub. No. WO94/28590 PCT Pub. Date Dec. 8, 1994. A process is recited for plating elongated current collectors with indium. The current collectors have particular utility in alkaline electrochemical cells, particularly zinc/manganese dioxide alkaline cells containing zero-added mercury. The process of the

invention involves electroplating conductive wire with indium and then drawing the plated wire to a lesser diameter. The drawn plated wire may then be cut to the desired lengths, typically in the shape of a nail, for use as current collectors within the alkaline cell.

5624718

**DIAMOND-LIKE CARBON BASED
ELECTROCATALYTIC COATING FOR
FUEL CELL ELECTRODES**

Dearnaley Geoffrey San Antonio, TX, UNITED STATES assigned to Southwest Research Institute

The present invention provides a low-temperature method for producing electrocatalytic coatings for fuel cell electrodes. The electrocatalytic coating comprises a thin-film of diamond-like carbon doped with finely-dispersed catalytic agent, preferably platinum, platinum-ruthenium, or other catalytically active materials. The method may be scaled-up as a highly economical reel-to-reel process comparable to the manufacture of coated polymers for food packaging applications.

5629000

**HYDROGEN-ABSORBING ALLOY
ELECTRODE FOR METAL HYDRIDE
ALKALINE BATTERIES AND PROCESS
FOR PRODUCING THE SAME**

Matsuura Yoshinori; Nogami Mitsuzo; Kimoto Mamoru; Higashiyama Nobuyuk; Kuroda Yasushi; Yonezu Ikuo; Nishio Koji; Saito Toshihiko Osaka, JAPAN assigned to Sanyo Electric Co Ltd

A hydrogen-absorbing alloy electrode for metal hydride alkaline batteries uses as hydrogen-absorbing material a powder of a rare earth element-nickel hydrogen-absorbing alloy obtained by pulverizing thin strips of said alloy prepared by single roll process and having an average thickness of 0.08 to 0.35 mm and a minimum size of crystal grains present in the roll-surface size of at least 0.2 μm and a maximum size of crystal grains in the open-surface side of not more than 20 μm . A process for producing the above electrode is

also provided. The electrode can provide, when used as negative electrode, metal hydride alkaline batteries which are excellent in both high-rate discharge characteristics at an initial period of charge-discharge cycles and charge-discharge cycle characteristics.

LITHIUM BATTERIES

5601623

**ELECTROLYTIC CELL AND
ELECTROLYTIC PROCESS WITHIN A
CARBON DIOXIDE ENVIRONMENT**

Fauteux Denis; Massucco Arthur A Acton, MA, UNITED STATES

An electrolytic cell, such as a rechargeable lithium battery, fabricated in a carbon dioxide atmosphere, having a lithium carbonate passivating layer associated with a lithium ion source electrode and an electrolyte. Fabrication of an electrolytic cell containing an acrylic polymer paste cathode, anode and electrolyte increases the efficiency of the polymer initiator and facilitates free radical chain growth polymerizations.

5601796

**METHOD OF MAKING SPINEL $\text{Li}_2\text{Mn}_2\text{O}_4$
COMPOUND**

Frech Roger E; Huang Weiwe Norman, OK, UNITED STATES assigned to The Board of Regents of the University of Oklahoma

A method of producing spinel $\text{Li}_2\text{Mn}_2\text{O}_4$ from LiMn_2O_4 , lithium metal and graphite. A mixture of black LiMn_2O_4 , lithium metal and carbon powders is prepared at a 1:1 molar ratio of Li to LiMn_2O_4 and a 1:9 weight ratio of carbon to LiMn_2O_4 . Then, the mixture is heated at a temperature between 170°C and 200°C until spinel $\text{Li}_2\text{Mn}_2\text{O}_4$ is produced. Alternatively, Li and carbon may be reacted together to produce LiC_6 or LiC_{12} . Then the LiC_x may be mixed and heated with LiMn_2O_4 to produce spinel $\text{Li}_2\text{Mn}_2\text{O}_4$.

5601950**NON-AQUEOUS ELECTROLYTE
SECONDARY CELL**

Yamahira Takayuki; Takeuchi Yoshiaki Fukushima,
JAPAN assigned to Sony Corporation

A non-aqueous electrolyte secondary cell having a negative electrode, a positive electrode and a non-aqueous electrolytic solution, in which a carbonaceous material is used as an active negative-electrode material, is disclosed. The negative electrode is constituted by a carbon sintered mass obtained on sintering the carbonaceous material or a carbon sintered mass-current collector composite material. The secondary cell is improved in the amount of the active material packed in the negative electrode, energy density and in the charging/discharging efficiency. If the carbon sintered mass-current collector composite material is employed for the negative electrode, further improvement in the electrical conductivity and charging/discharging efficiency in the negative electrode is achieved.

5601951**RECHARGEABLE LITHIUM ION CELL**

Johnson Arden P; Schlaikjer Carl R Brookline, MA,
UNITED STATES assigned to Battery Engineering Inc

An inorganic electrolyte rechargeable electrical storage cell is shown which makes use of non-metallic electrodes in combination with an inorganic electrolyte that includes sulfur dioxide. The electrolyte can be for example a lithium and/or a calcium tetrachloroaluminate salt in sulfur dioxide. The anode of the cell is made of a carbon for example a graphite while the cathode is produced from a carbon having a relatively much higher surface area.

5601952**LITHIUM-MANGANESE OXIDE
ELECTRODE FOR A RECHARGEABLE
LITHIUM BATTERY**

Dasgupta Sankar; Jacobs James K Toronto, Ontario,
CANADA

The preparation of amorphous lithium-manganese oxide compound is described having lithium to manganese ratio between 0.4 and 1.5 and particle size less than 5 μm . The amorphous lithium-manganese oxide compound is to be utilized in a non-aqueous rechargeable lithium battery.

5604057**SECONDARY CELL HAVING A LITHIUM
INTERCOLATING MANGANESE OXIDE**

Nazri Gholam-Abbas Bloomfield Hills, MI, UNITED
STATES assigned to General Motors Corporation

A secondary lithium ion cell having an anode, a cathode and a nonaqueous electrolyte wherein the cathode comprises sub-micron-size amorphous, microporous, lithium-intercalateable manganese oxide having an internal surface area greater than about 100 m^2/g . The cathode may include an electrically conductive lithium-intercalateable polymer binder. A sol-gel process for making the amorphous quadrivalent manganese oxide is disclosed.

5604418**METHOD OF CHARGING A LITHIUM
STORAGE CELL HAVING A CARBONE
ANODE**

Andrieu Xavier; Poignant Philippe; Sonnet Antoine
Bretigny sur Orge, FRANCE assigned to Alcatel
Alsthom Compagnie Generale D'Electricite

The present invention provides a method of charging a carbon-anode lithium storage cell, which method comprises a first step in which a constant current is imposed and during which the voltage across said

storage cell is allowed to increase until it reaches a reference value, and then a second step in which said reference voltage is imposed and said current decreases. The method of the invention is characterized in that, at each instant, said reference voltage is equal to the sum of the end-of-charge voltage of the cell plus the product of the current multiplied by the ohmic resistance of the cell.

5605772

**COMPOSITE CARBON/POLYMER
ELECTRODE FOR A RECHARGEABLE
ELECTROCHEMICAL LITHIUM CELL**

Yazami Rachi; Deschamps Marc; Moreau Michel Saint Nazaire Les Eymes, FRANCE assigned to Le Carbone Lorraine

A composite carbon/polymer electrode for a rechargeable electrochemical lithium cell comprises a powder of carbonaceous material and a coating polymer rendered ionically conductive by the addition of a lithium salt, and possibly carbon black or carbon fibers. The carbonaceous material has a proportion of volatile matter between 5 and 22 wt %, and is preferably a raw coke or a semi-coke.

5605773

**LITHIUM MANGANESE OXIDE
COMPOUND AND METHOD OF
PREPARATION**

Ellgen Paul C Oklahoma City, OK, UNITED STATES assigned to Kerr-McGee Corporation

A method for manufacturing $\text{Li}_2\text{MbMn}_2\text{-bO}_4$ comprising the steps of providing $\text{LiMbMn}_2\text{-bO}_4$; providing a source of lithium; dissolving lithium from the lithium source in a liquid medium in which lithium generates solvated electrons or the reduced form of an electron-transfer catalyst; and contacting the $\text{LiMbMn}_2\text{-bO}_4$ with the liquid medium containing the dissolved lithium and the solvated electrons or the reduced form of the electron-transfer catalyst, wherein M is selected from the group Al, Ti, V, Cr, Fe, Co, Ni, and Cu.

5608305

**METHOD AND APPARATUS FOR
COMPULSORY DISCHARGING
LITHIUM-ION BATTERY TO PREVENT
QUALITY DEGRADATION**

Kokuga Toshiharu Sumoto, JAPAN assigned to Sanyo Electric Co Ltd

A method and apparatus for protecting a secondary battery initially judges whether or not the secondary battery, previously charged to a capacity more than a predetermined capacity, has been discharged to a capacity less than the predetermined capacity within a predetermined time. Then, compulsorily discharging at the secondary battery is effected until it has a capacity less than the predetermined capacity when it is judged that the secondary battery has not been discharged to a capacity less than the predetermined capacity.

5609974

**RECHARGEABLE BATTERY
POLYMERIC ELECTROLYTE**

Sun Luying Stoughton, MA, UNITED STATES assigned to Battery Engineering Inc

This invention is directed to a novel solid polymer electrolyte more particularly thin film terpolymer networks are disclosed that are highly conductive at ambient temperatures. This solid polymer electrolyte can be produced as a thin film that results from the polymerization of three selected monomers together with a lithium salt and plasticizers. The resulting solid polymer electrolyte does have excellent mechanical properties and ionic conductivity at ambient temperatures and can be used in the fabrication of a solid state battery and other solid state electrochemical devices such as supercapacitors, fuel cells, sensors, electrochromic devices or the like.

5609975

**POSITIVE ELECTRODE FOR
NON-AQUEOUS ELECTROLYTE
LITHIUM SECONDARY BATTERY AND
METHOD OF MANUFACTURING THE
SAME**

Hasegawa Masaki; Bito Yasuhiko; Ito Shuji; Murata Toshihide; Toyoguchi Yoshinori HIRAKATA, JAPAN assigned to Matsushita Electric Industrial Co Ltd

A positive electrode for a non-aqueous electrolyte lithium secondary battery comprises an active material represented by the formula $LixA1-yMyO2$ (wherein A represents at least one transition element selected from the group consisting of Mn, Co, and Ni, M represents at least one element selected from the group consisting of B, Mg, Ca, Sr, Ba, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Al, In, Nb, Mo, W, Y, and Rh, and wherein $0.05 < x < 1.1$, and $0 < y < 0.5$), a binder, a conductive agent and a current collector. The binder is selected from the group consisting of a copolymer comprising a tetrafluoroethylene unit and a hexafluoropropylene unit, a copolymer comprising a vinylidene fluoride unit, a copolymer comprising a propylene unit and a tetrafluoroethylene unit, and a polymer comprising a trifluoropropylmethylsiloxane unit.

5612152

**RECHARGEABLE LITHIUM BATTERY
FOR USE IN APPLICATIONS REQUIRING
A LOW TO HIGH POWER OUTPUT**

Bates John B Oak Ridge, TN, UNITED STATES assigned to Martin Marietta Energy Systems Inc

Rechargeable lithium batteries which employ characteristics of thin-film batteries can be used to satisfy power requirements within a relatively broad range. Thin-film battery cells utilizing a film of anode material, a film of cathode material and an electrolyte of an amorphous lithium phosphorus oxynitride can be connected in series or parallel relationship for the purpose of withdrawing electrical power simultaneously from the cells. In addition, such battery cells which employ a lithium intercalation compound as its cathode material can be connected in a manner suitable for

supplying power for the operation of an electric vehicle. Still further, by incorporating within the battery cell a relatively thick cathode of a lithium intercalation compound, a relatively thick anode of lithium and an electrolyte film of lithium phosphorus oxynitride, the battery cell is rendered capable of supplying power for any of a number of consumer products, such as a laptop computer or a cellular telephone.

5612155

LITHIUM ION SECONDARY BATTERY

Takami Norio; Ohsaki Takahisa; Asami Yoshiaki YOKOHAMA, JAPAN assigned to Kabushiki Kaisha Toshiba; Toshiba Battery Co Ltd

A lithium ion secondary battery improved in large-current discharge characteristics, discharge capacity, and cycle life is disclosed. This lithium ion secondary battery includes a positive electrode, a negative electrode comprising a collector and carbon fibers held to the collector for absorbing and desorbing lithium ions, a separator arranged between the positive electrode and the negative electrode, and a nonaqueous electrolyte. The carbon fibers have a radial orientation from an axis of the fibers, and 50 vol % or more of all carbon fibers are arranged such that an angle between an axis of each carbon fiber and a surface of the collector is 45° or less.

5614334

**MATERIAL FOR LITHIUM BATTERY
POSITIVE ELECTRODE AND
PRODUCTION THEREOF**

Kamauchi Masahiro; Takada Yoshinori AMAGASAKI, JAPAN assigned to Mitsubishi Cable Industries Ltd

PCT No. PCT/JP93/01686 Sec. 371 Date Jun. 30, 1995 Sec. 102(e) Date Jun. 30, 1995 PCT Filed Nov. 17, 1993 PCT Pub. No. WO95/12900 PCT Pub. Date May 11, 1995. The material for a lithium battery positive electrode of the present invention is characterized in that a powder of an active material comprising at least one member selected from the group consisting of lithium phosphates, lithium-cobalt phosphates, cobalt oxides and lithium-cobalt oxides, wherein lithium, cobalt and

phosphorus are contained in a proportion of more than 0.1 mole of cobalt and more than 0.2 mole of phosphorus both per mole of lithium, is formed into a sheet using a binder comprising an organic polymer, and the present invention affords a material for a lithium battery positive electrode, which is superior in practical use and production efficiency, without impairing the high electromotive force of the novel active material having the aforementioned composition. The production method of the present invention is characterized by extending a binder solution comprising a powder of the above-mentioned active material on a long support sheet, and drying, and affords a long material for a lithium battery positive electrode stably and efficiently by a continuous process.

5617002

METHOD OF AND APPARATUS FOR CHARGING NONAQUEOUS ELECTROLYTIC BATTERY

Sakamoto Yoshiak Tokyo, JAPAN assigned to Fuji Photo Film Co Ltd

A charging method of and a charging apparatus for charging a nonaqueous electrolytic battery such as a lithium primary battery including a positive pole active material, negative pole active material of a lightweight metal and nonaqueous electrolyte. The charging is carried out at a predetermined electric current per time of 2 μC -5 mC only when the residue capacity of the nonaqueous electrolytic battery is in a range of 5-95%.

5618318

METHOD FOR FORMING A FOLDED ELECTRODE CONFIGURATION FOR GALVANIC CELLS

Reddy Thomas B; Rodriquez Pedro Bronxville, NY, UNITED STATES assigned to Power Conversion Inc

A high density cell stack is provided utilizing strips of flexible cathode material and flexible anode materials folded over each other at right angles. A suitable anode material is lithium and a suitable cathode material is manganese dioxide. The disclosed cell stacks are rapidly

manufactured to provide high density cells with good mechanical stability and good stability against shorting.

5622792

ADDITIVES FOR EXTRUDING POLYMER ELECTROLYTES

Brochu Fernan; Duval Michel Longueuil, CANADA assigned to Hydro-Quebec

Preparation of an electrolyte film for lithium/polymer electrolyte batteries by extruding a powder mixture containing a polymer, a lithium salt and an additive consisting of an ultra fine powder of a metal oxide, such as silica, aluminum, or titanium oxide with a particle size between about 7 and 40 nm. The role of the additive is to prevent the formation of adhesive solid blocks in the powder mixture and to allow the introduction of this mixture in the extruder. Electrolyte compositions, electrolytes as well as electrochemical generators obtained according to the invention are also described.

5622793

METHOD FOR PREPARING NEGATIVE ELECTRODE MATERIAL FOR A LITHIUM SECONDARY CELL

Iijima Takash; Suzuki Kimihit; Sato Maki Kawasaki, JAPAN assigned to Nippon Steel Corporation

PCT No. PCT/JP93/00695 Sec. 371 Date Jan. 13, 1995 Sec. 102(e) Date Jan. 13, 1995 PCT Filed May 25, 1993 PCT Pub. No. WO93/24967 PCT Pub. Date Dec. 9, 1993. A method for preparing a negative electrode material for a lithium secondary cell comprises heat-treating pitch fibers at a first temperature of 800°-2600°C to make carbon fibers, pulverizing the carbon fibers to make carbon fiber particles, heat treating the carbon fiber particles at a second temperature greater than the first temperature thereby providing carbon fiber particles with a layer spacing between carbon layers of less than 0.338 nm and an average particle size of 5-200 μm .

5624606

**CARBONACEOUS HOST COMPOUNDS
AND USE AS ANODES IN
RECHARGEABLE BATTERIES**

Wilson Alfred; Dahn Jeffery Burnaby, CANADA
assigned to Moli Energy (1990) Limited

Carbonaceous compounds and methods for preparation are described wherein the compounds comprise a pre-graphitic carbonaceous host having organized and disorganized regions and wherein atoms of other elements are incorporated in the host without changing the structure of the organized regions. A carbonaceous insertion compound with large reversible capacity for lithium can be prepared using elements capable of alloying with lithium, such as Si, as the incorporated atoms. These insertion compounds are suitable for use as high capacity anodes in lithium ion batteries.

5624767

**ALKALI METAL CELL HAVING MAIN
AND ALTERNATE ELECTRODES**

Muffoletto Barry; Nesselbeck Neal; Stringham Rodney Alden, NY, UNITED STATES assigned to Wilson Greatbatch Ltd

An electrochemical cell including an alkali metal anode and a cathode, one of the anode or cathode being connected to a structure for making electrical connection from a load to the cell, the other of the anode or cathode having main and alternate portions, a main terminal connected to the main anode or cathode portion for making electrical connection between a load and the cell, and an alternate terminal connected to the alternate anode or cathode portion for making electrical connection between a load and the cell, so that the main anode or cathode portion first is discharged with the alternate portion held in reserve, whereupon when the main portion reaches end of life the alternate anode or cathode portion is discharged. The main and alternate anode or cathode portions are insulated from each other, and the anode preferably is of lithium. There is also provided a voltage responsive switch means in combination with the cell and connected electrically between a load and the main and alternate terminals for

connecting the main terminal initially to the load and then disconnecting the main terminal and connecting the alternate terminal to the load when the main portion reaches end of life. The cell can be provided with a casing of electrically conductive material with one of the anode or cathode being connected to the casing for making electrical connection to the load through the casing.

5628973

**LITHIUM CELL TREATING METHOD
AND LITHIUM CELL TREATING
APPARATUS**

Nishimura Katsunori; Honbo Hidetoshi; Gotoh Akihiro; Mizumoto Mamoru; Horiba Tatsuo Hitachi, JAPAN assigned to Hitachi Ltd

A treating fluid is in contact with a negative electrode containing lithium of a lithium cell under a first condition to react a surface portion of the negative electrode, and a treating fluid is in contact with lithium existing inside an article formed on the surface of the above-described negative electrode under a second condition. The cells can be effectively treated under safety condition to collect either the valuable substances, or the cell constructive components.

5629107

COIN-SHAPED LITHIUM BATTERY

Shioda Masatsugu; Miyoda Koichi Fukushima, JAPAN assigned to Sony Corporation

A coin-shaped lithium battery is disclosed. The coin-shaped lithium battery comprises a battery can containing therein an anode pellet composed of lithium or lithium alloy and a cathode pellet which are arranged to face each other with a separator provided between the pellets. At least one of the anode pellet and the cathode pellet has its central part swollen to form a curved surface. The battery can is elastically deformed to be aligned with the curved surface. In the coin-shaped lithium battery, total height of the anode pellet and the cathode pellet in outer rim part is smaller than total height in central part by 4 to 12%.

5629110

METHOD FOR PRODUCING CATHODE ACTIVE MATERIAL FOR NON-AQUEOUS ELECTROLYTE SECONDARY BATTERY

Kobayashi Shigeo; Yamaura Junichi; Okamura Kazuhiro; Okuno Hiromi Yawata, JAPAN assigned to Matsushita Electric Industrial Co Ltd

A method for producing a cathode active material for a non-aqueous electrolyte secondary battery, which comprises the step of heating a mixture of beta-Ni(OH)₂ and a lithium salt in the presence of oxygen at a temperature ranging from 600°C to 800°C to obtain LiNiO₂.

629112

STABLE FORM OF LiMnO₂ AS CATHODE IN LITHIUM CELL

Davidson Isobel J; McMillan Roderick; Murray John J Orleans, CANADA assigned to National Research Council of Canada

The invention disclosed relates to a new method of forming spinel-related λ -Li_{2-x}Mn₂O₄, wherein 0 < x < 2, solely by electrochemical means with air-stable orthorhombic LiMnO₂ as the starting material. This spinel-related material is hygroscopic, metastable and is typically made by chemical means, followed by electrochemical conversion of spinel-type LiMn₂O₄. Also disclosed are new secondary lithium ion electrochemical cells employing as initial active cathode material a compound of formula LiMnO₂, having a specific orthorhombic crystal structure.

NICKEL METAL HYDRIDE BATTERIES

5605585

METHOD FOR PRODUCING HYDROGEN STORAGE ALLOY PARTICLES AND SEALED-TYPE NICKEL-METAL HYDRIDE STORAGE BATTERY USING THE SAME

Yamamoto Osam; Komori Katsunori; Suzuki Kohei; Yamaguchi Seiji; Kimura Tadao; Ikoma Munehisa; Toyoguchi Yoshinori Hirakata, JAPAN assigned to Matsushita Electric Industrial Co Ltd

A method for manufacturing hydrogen storage alloy particles comprises steps of obtaining a melt of the hydrogen storage alloy and pulverizing the hydrogen storage alloy by water atomizing process, whereby the melt is pulverized by contacting or colliding with high-speed jetting thereto to be dispersed in the form of solidified fine particles. By employing an aqueous solution of hypophosphorous acid or an alkali aqueous solution in place of water during the water atomizing process, or by etching the oxide films once formed on the surface of the hydrogen storage alloy particles with an aqueous solution of a strong acid, the thickness of the oxide film can be made thinner, and thus a high discharge capacity of a battery configured with a negative electrode comprising the alloy particles can be realized.

5617006

RECHARGE PROFILE FOR SPACECRAFT NI/H₂ BATTERIES

Lenhart Stephen J; Hall John C; Applewhite Anthony Mountain View, CA, UNITED STATES assigned to Space Systems/Loral Inc

An improved method of charging a rechargeable nickel/hydrogen battery comprises the steps of applying a charging current to the battery resulting in a substantially full state of charge, then for a period up to approximately 60 minutes before the onset of discharging, applying a boost charging current at a rate in the range of approximately C to C/20 for a duration

up to approximately 60 minutes. The charging of the battery before applying the boost step may include the application of a taper charging current. Also, at the end of the taper charging step and immediately prior to the boost charge, a trickle charging current may be applied at a rate in the range of approximately C/80 to C/500. In another instance, when the battery has been charged to about 70% to 95% of a full state of charge, the linearly decreasing taper charge may be applied until a final desired recharge ratio is reached. Thereafter, up to a duration of approximately 60 minutes before the onset of discharging, the boost charging current may be applied at a rate in the range of approximately C to C/20 for part of or for the entire duration. The timed sequence of the initial high rate charge, the taper charge, the trickle charge, and the boost charge, in conjunction with proper control of battery temperature and recharge ratio has been found to increase overall battery capacity by approximately 10% to 30%.

5629111

NICKEL ELECTRODE ACTIVE MATERIAL; A NICKEL ELECTRODE AND A NICKEL ALKALI STORAGE CELL USING SUCH NICKEL ELECTRODE ACTIVE MATERIAL; AND PRODUCTION METHODS OF SUCH MATERIAL, ELECTRODE, AND CELL

Yamawaki Akifumi; Nakahori Shinsuke; Tadokoro Motoo; Hamamatsu Takeo; Baba Yoshitaka Itano gun, JAPAN assigned to Sanyo Electric Co Ltd

Fine-grained nickel electrode active material, each of which contributing to electrode reaction; production method of the fine-grained nickel electrode active material; and a nickel alkali storage cell of high capacity which is excellent in over discharge characteristics. In order to produce the fine-grained nickel electrode active material, fine-grained nickel hydroxide is precipitated by adding a given amount of alkali to solution in which at least a nickel compound is dissolved while the solution is stirred. Each of the fine-grained nickel hydroxide has pores with 20 vol % or more of a combined volume of the pores being composed of pores of diameter 60 #521 +0 or greater. Next, a given amount of alkali is gradually added to suspension including the fine-grained nickel hydroxide and dissolved cobalt compound so that cobalt hydroxide is precipitated on the external surface of the

fine-grained nickel hydroxide. The fine-grained nickel electrode active material is produced in the above mentioned way. Each of the fine-grained nickel electrode active material comprises a nickel hydroxide and cobalt oxide having distorted crystal structure and oxidation number higher than +30 2. The nickel hydroxide has pores whose diameters are 60 +521 +0 or greater. And the volume of such pores amounts to 20 vol % or more of the combined volume of all of the pores.+RE

COMPONENTS AND/OR CHARGERS

5601940

BATTERY HOLDER

Denecke Henry M N Hollywood, CA, UNITED STATES assigned to Denecke Inc

The battery holder enables rapid insertion and removal of a battery relative thereto. An open portion of the holder provides ready access for rapid and efficient battery insertion and removal. Biased contacts and a protruding lip portion at opposite ends of the battery holder securely retain the battery therein.

5601941

IMPROVED BATTERY ASSEMBLY

Tuttle Mark Boise, ID, UNITED STATES assigned to Micron Communications Inc

An improved battery, an improved battery contact assembly and an improved method for attaching a battery to a substrate are provided. The battery includes a housing and a cover for attachment to the housing by crimping. During the crimping process a portion of the housing is bent over a portion of the cover such that a portion of the housing is substantially co-planar with a portion of the cover. Thus the two co-planar surfaces provide the positive and negative contact surfaces of the battery on a single side of the battery. The receiving portion of the contact assembly includes a substrate having a pair of contacts formed thereon. The contacts are shaped and sized to match the contact surfaces of the

battery. The battery is attached to the substrate and traces using an electrically conducting adhesive.

5601942

**PORTABLE BATTERY PACK APPARATUS
AND METHOD OF FABRICATION
THEREOF**

Fedele Vincen Stow, MA, UNITED STATES assigned to VST Technologies Inc

A battery pack is provided for housing a plurality of flat cells for portable electronic device applications. The battery pack is sufficiently thin to preserve the desirable thin profile of the flat cells and yet exhibits surprising structural integrity considering the relatively thin polycarbonate material from which the housing and the connective sheets of the pack are fabricated. A first group of flat cells is coupled to one side of a central connective member or circuit board. A second group of flat cells is coupled to an opposite side of the central connective member. The cells of the first group are situated in side-by-side relationship and the cells of the second group are situated in side-by-side relationship. An upper connective sheet is adhesively coupled to the upper surfaces of the first group of flat cells and the upper surfaces of the second group of flat cells. A lower connective sheet is adhesively coupled to the lower surfaces of the first group of flat cells and the lower surfaces of the second group of flat cells. In this manner, a substantially I beam-like structure with significant structural integrity is formed. A main housing section of plastic sheet material is then formed around this I beam-like structure. The main housing section is adhesively coupled to both the upper connective sheet and the lower connective sheet.

5602455

**PORTABLE BATTERY CHARGER WITH
INTEGRALLY ATTACHED OUTPUT
CABLE**

Stephens Charles S; Williams David; Tran Tuan; Muranami Masahik; Bradley Terry; Brown Preston; Rose Curtis Corvallis, OR, UNITED STATES assigned to Hewlett-Packard Company

A battery charger is connected to a power source via an input cable. The battery charger has charge switching circuitry for delivering a charge to a battery under the control of a controller. The controller has state detection logic for detecting the current state of the battery, and charging logic for charging the battery by selectively enabling and disabling the charge switching circuitry based on the condition of the battery. An output cable is connected to the battery charger. The output cable delivers power from the power source to a second battery charger for charging a second battery for the electronic device. The output cable can be placed in a stowage position or a non-stowage position. The second battery charger may be external or internal to the electronic device. If the second battery charger is internal to the electronic device, two batteries can be charged at the same time the electronic device is being operated. The battery charger has the additional capability of detecting and correctly charging different battery types, and responding to error conditions detected during the charging operation.

5602459

**FUEL SAVING MULTI-BATTERY
CHARGING SYSTEM AND METHOD**

Rogers Wesley Grosse Pointe Park, MI, UNITED STATES assigned to Electronic Development Inc

A multi-battery charging system and for reduced fuel consumption and associated emissions for an automotive vehicle. The system starts the vehicle with a start battery in a fuel saving manner, removing electrical torque from alternator shaft, and allows a second (run) battery to provide all or some of the current required by the vehicle loads as fuel savings measure. The start battery is typically recharged after start using the alternator and then switched out of the system in a fully charged state for future vehicle starts. The run battery is typically recharged when its charge level drops below a predetermined level using an on-board battery charging device. The on-board battery charging device is powered from a power line source (e.g., 115 volt or 220 volt ac) external to the vehicle. The system controls the alternator field current with a voltage regulator. The voltage regulator senses the charge level of the two batteries and vehicle operating conditions and provides the proper current into the alternator rotor for maximum fuel savings. The voltage regulator may be a

non-microprocessor or a microprocessor controlled device.

5602460

**OVERCHARGE CURRENT PROTECTION
CIRCUIT AND BATTERY PACK USING
SAME**

Fernandez Jose M; Meadows Vernon; Mack Erika D;
Thandiwe Ilonga Lawrenceville, GA, UNITED
STATES assigned to Motorola Inc

A battery pack comprises cells, and is charged by a charger providing a current level. The charger is a typical nickel-cadmium battery charger providing a first charge current level in excess of an optimum charge current level. The battery pack further comprises a thermal sensing element and an overcurrent charge protection circuit having an overcurrent switch, current sense circuit, comparator circuit, and temperature signal switch. If the current level through the cells exceeds the optimum charge current level, the current sense circuit provides a signal to comparator circuit which actuates the temperature signal switch, simulating a hot battery pack. The charger then switches to a second charge current level which does not exceed the optimum charge current level. If the charger does not change current levels, a switch delay, after a brief period, accumulates enough voltage to actuate a driver switch which opens the overcurrent switch, disconnecting the cells from the charger.

5603656

**PASSIVE VENTILATION DEVICE AND
METHOD**

Baer Stephen C; Harrison David C Albuquerque, NM,
UNITED STATES assigned to Zomeworks Corporation

A passive ventilation device and method for releasing hydrogen from an enclosure housing a battery. The enclosure has an outer shell and an inner insulating layer that includes a gas permeable panel. The panel is disposed within the chamber adjacent one of the sidewalls of the enclosure. The sidewall has an inlet opening and an exhaust opening in communication

with a ventilation space for providing an upward air flow through the ventilation space to draw hydrogen through the gas permeable panel into the ventilation space. The upward air flow can be powered by the low density hydrogen and/or by heating the air within the ventilation space to a temperature greater than the ambient temperature.

5603737

**ELECTRODE STRUCTURE FOR
ELECTROCHEMICAL CELL HAVING A
RECTANGULAR HOUSING**

Marincic Nikola; Rabadjija Luka Winchester, MA,
UNITED STATES assigned to Pacesetter Inc

The electrode structure includes a cathode, anode and polymeric separator, wound into an oval configuration having a length and width equal to interior dimensions of the rectangular housing. The oval shape is achieved by winding a long, flat electrode structure around a mandrel. The length of the electrode structure is chosen based upon the size of the mandrel, the interior dimensions of the housing, and the width of the electrode structure, such that, after winding, the resulting oval structure snugly fits within the rectangular housing leaving no remaining spaces, other than in corners of the housing. A leaf spring is provided between a free end of the electrode structure and an interior wall of the housing for ensuring that the electrode structure remains tightly wound. Appropriate electrical contacts are provided to the anode and cathode of the electrode structure. The housing is flooded with a non-aqueous electrolyte, sealed, then employed for powering an implantable medical device for implantation within a human or animal.

5603782

**BATTERY CAN, SHEET FOR FORMING
BATTERY CAN, AND METHOD FOR
MANUFACTURING SHEET**

Sugikawa Hirofumi; Michibata Sachio; Hayashi Keiichi
Osaka, JAPAN assigned to Katayama Special Industries
Ltd

A steel plate having a plated layer on the upper and lower surfaces thereof to be processed into a battery can which is cylindrical and open in one end thereof by drawing and ironing processing. The plated steel plate has more than 1.2 as a Lankford value (r) which is a width deformation degree in a lengthwise direction thereof/a thickness deformation degree in the lengthwise direction thereof, a width deformation degree in a widthwise direction thereof/a thickness deformation degree in the widthwise direction thereof, a width deformation degree in an oblique direction thereof/a thickness deformation degree in the oblique direction thereof. In-plane anisotropy Deltar which is the difference among the Lankford values (r) is set to be less than ± 0.15 . In order to make the elongation coefficient of the plated steel plate constant in the three directions, a very low carbon steel plate is used. The steel plate is cold-rolled at 80-90%. The plated layer is allowed to have a granular structure by annealing it after it is plated.

5604049

BATTERY WITH TESTER LABEL AND METHOD FOR PRODUCING IT

Weiss Victor H; Anderson Jeffrey L Plantation, FL, UNITED STATES assigned to Morgan Adhesive Company

A battery encased with a label containing an integral test circuit device that is thermally insulated from the battery by an expanded material and is activated by depressing a selected area of the label whereupon a thermally sensitive material associated with the test circuit displays whether the battery has capacity. A method for producing the test circuit device is also disclosed.

5604052

STRUCTURE OF A BATTERY HOLDING SECTION INCLUDED IN A PORTABLE ELECTRONIC APPARATUS

Ikka Masahiro Shizuoka, JAPAN assigned to NEC Corporation

In a portable electronic apparatus, the positive and negative electrodes of a battery and a first and a second

terminals included in a battery holding section sequentially contact each other, thereby feeding power to electronic circuitry built in the apparatus. This successfully stabilizes the circuitry. After the battery has been fully received in the battery holding section, the negative electrode of the battery contacts a third terminal provided in the battery holding section. As a result, a voltage signal is fed from the third terminal to the circuitry, so that the circuitry is free from malfunctions.

5604055

OXIDIZED ALKALI METAL-HALOGEN CELL CASE

Brown W Richar; Smesko Sally A; Takeuchi Esther S Clarence Center, NY, UNITED STATES assigned to Wilson Greatbatch Ltd

Heat treating the inner, contact surface of an electrochemical cell casing in an oxidizing atmosphere such as air to render the inner surface thereof essentially contamination free and suitable as a current collector, is described. The casing is preferably of stainless steel and houses the alkali metal-halogen couple in a case-positive configuration. The oxidized cases are ready for cell assembly upon cooling and cell electrical performance is maintained without the need for wet chemical treatment of any kind.

5604415

BATTERY LOCKOUT CIRCUIT AND BATTERY PACK USING SAME

Vashi Dipt; Meadows Verno; Garrett Scott M Lawrenceville, GA, UNITED STATES assigned to Motorola Inc

A lockout circuit is provided in a battery pack which blocks charging by incompatible chargers while allowing charging by a compatible charger. The battery comprises a battery cell or cells, and a switch circuit. The switch circuit blocks charge current until a switch disable signal is provided to a switch disable contact. The switch circuit provides a one way bypass so that the battery may provide power to a device. To eliminate voltage drop while powering a device, a current sense circuit is provided to detect discharge current, and disable the switch circuit.

5604416**BATTERY DISCHARGE CIRCUIT WHICH PROTECTS AGAINST EXCESSIVE DISCHARGE**

Kim Byoung-ha Suwon, KOREA assigned to Samsung Electronics Co Ltd

A battery discharge circuit includes a discharge switch for turning a discharge function on and off, a triggering circuit for triggering the discharge function when the discharge switch is on, a setting circuit for setting a discharge lower limit voltage, a discharging circuit for discharging a battery to the discharge lower limit voltage by being triggered by the triggering circuit, and a display for displaying the discharge operation of the discharging circuit. The battery discharge circuit discharges a battery to a predetermined voltage in order to prolong the life of the battery.

5604419**CHARGING DEVICE FOR CHARGING RECHARGEABLE BATTERIES WITH TEMPERATURE-DEPENDENT TERMINATION OF THE CHARGING PROCESS**

Bisschop Oedilius J; Van Beek Johann R G C M; Gillissen Eduard E; Van Maaren Martinus Drachten, NETHERLANDS assigned to U S Philips Corporation

A charging device for charging a rechargeable battery including a current supplier for supplying charging current to a battery having an initial temperature at the beginning of the supply of charging current, a selector for selecting an end temperature based on a temperature range the initial temperature is in and a current terminator for terminating the supply of charging current when a battery reaches the end temperature. A rechargeable battery including a strain gauge having a temperature coefficient differing from a temperature coefficient of the battery housing is also provided.

5605769**METHOD AND APPARATUS FOR SUPPLYING ELECTRICAL ENERGY TO BATTERY POWERED EQUIPMENT**

Toms Dennis J Boulder, CO, UNITED STATES

The invention provides method and apparatus for supplying electrical energy to battery powered equipment of the type utilizing removable batteries. The method of the invention includes the steps of: placing within the battery compartment or battery holder of the equipment a rechargeable storage means for storing electrical energy to which is permanently attached and electrically connected a conversion means for converting light to electrical energy; establishing electrical connection between the rechargeable storage means and the equipment; utilizing the equipment in the normal manner until the rechargeable storage means is depleted of energy; removing the rechargeable storage means together with the attached conversion means from the battery compartment of the equipment; placing the rechargeable storage means together with the conversion means in such location and position that the conversion means is illuminated by light; conducting electrical charge from the conversion means to the rechargeable storage means; waiting until the rechargeable storage means is recharged; and reinserting the rechargeable storage means together with the conversion means in the battery compartment of the equipment. A preferred embodiment of the apparatus of the invention is characterized by a flexible member which contains the conversion means and which may be unfurled during charging so as to maximize the area of the conversion means exposed to incident light. After charging the flexible member is rolled up or wrapped around the circumference of the unit so that the entire unit will fit into the battery compartment or battery holder of the equipment to be powered.

5606114**BATTERY LEAK TESTING APPARATUS**

Palmer William Anderson, IN, UNITED STATES assigned to General Motors Corporation

Apparatus for detecting leaks in hydrogen-generating electric storage batteries including suitable enclosure for

the battery, means for overcharging the battery to generate hydrogen pressure therein, and a sensor for detecting the presence of hydrogen in the enclosure. The battery's vent will be suitably plugged or routed to divert any hydrogen escaping through the vent from contaminating the air in the enclosure. A hydrogen accumulator/seperator attached to the enclosure concentrates the hydrogen at the hydrogen sensor.

5606237

INDUCTIVE COUPLER CHARACTERISTIC SHAPE

Biasotti Mark; Abbott Russell M; Woody George San Jose, CA, UNITED STATES assigned to Delco Electronics Corporation

An inductive charging coupler for use in an inductive charging apparatus used to charge a battery. The charging coupler is insertable into a charge port that is coupled to the battery. The charge port comprises a housing, an opening into which the charging coupler is inserted, and a ferrite core surrounded by secondary windings. The charging coupler comprises a housing having a hollow disk-shaped section with substantially flat opposed surfaces and a tapered handle extending therefrom. An opening is disposed through each of the flat opposed surfaces. A center magnetic core is disposed in the opening and has opposed flat surfaces that are substantially coplanar with the substantially flat opposed surfaces of the housing. A primary winding is disposed in the hollow disk-shaped section around the center magnetic core. The coupler has the shape of a paddle and is designed to give a vehicle operator a sense of safety when transferring electric power to the battery of an electric vehicle, for example.

5606238

DISCRIMINATING BATTERY CHARGING SYSTEM

Spellman Patrick J; Megahed El-Sayed A; Anderson Karl E; Jaedike Bryan D Middleton, WI, UNITED STATES assigned to Rayovac Corporation

A battery, a battery charger, and a battery charging system are used for charging cylindrical batteries having

a certain predetermined feature. The battery charger has at least one compartment having first and second circular recesses provided at the rear wall of the at least one compartment for engaging the cathode terminals of batteries having the predetermined feature of a first and second size respectively, wherein the recesses are of such dimensions as to receive the cathode terminals of batteries having the predetermined feature, but not the cathode terminals of conventional, prior art primary and secondary batteries not having this feature. It provides a safe, easy to use, low cost battery charging system that will not charge undesired primary or secondary batteries.

5606239

COOLING DEVICE FOR ELECTRIC VEHICLE BATTERY CHARGER AND WIRING CONVERTER

Schumann Anto Munich, GERMANY assigned to Bayerische Motoren Werke AG

In a cooling device for a vehicle-internal battery charger and a transformer in electric vehicles, the battery charger and the transformer are mounted on a common cooling panel. The cooling panel is preferably liquid-cooled.

5606240

BATTERY CHARGER

Kokuga Toshiharu; Tamai Mikitaka; Okada Tetsuya Sumoto, JAPAN assigned to Sanyo Electric Co Ltd

A battery charger has a battery capacity detector for detecting the remaining battery capacity and a timer setter for controlling the timer setting that determines the battery charging time based on the results from the battery capacity detector. The battery capacity detector measures the battery voltage, the battery constant current charging time, or the battery capacity. The timer includes a protection timer to forcibly end battery charging and a constant current charging timer to establish the constant current charging interval.

5606242**SMART BATTERY ALGORITHM FOR REPORTING BATTERY PARAMETERS TO AN EXTERNAL DEVICE**

Hull Matthew P; Taylor Alwyn H; Hruska Louis W; Friel Daniel D Jamestown, RI, UNITED STATES assigned to Duracell Inc

A smart battery which provides electrical power and which reports predefined battery parameters to an external device having a power management system, includes: at least one rechargeable cell connected to a pair of terminals to provide electrical power to an external device during a discharge mode and to receive electrical power during a charge mode, as provided or determined by the remote device; a data bus for reporting predefined battery identification and charge parameters to the external device; analog devices for generating analog signals representative of battery voltage and current at said terminals, and an analog signal representative of battery temperature at said cell; a hybrid integrated circuit (IC) having a microprocessor for receiving the analog signals and converting them to digital signals representative of battery voltage, current and temperature, and calculating actual charge parameters over time from the digital signals, the calculations including one calculation according to the following algorithm;(*See Patent for Tabular Presentation*) PS wherein ϵ is a function of battery current and temperature; and I_s is a function of battery temperature and CAPFC. Superimposed on this equation is reset logic, that self corrects the value of CAPFC with a capacity calculation at each full charge (EOC) and each end of full discharge.

5606243**BATTERY STATE JUDGING APPARATUS**

Sakai Shoj; Asa Hironori; Inagaki Mitsuo Toyota, JAPAN assigned to Nippon Soken Inc

A battery state judging apparatus comprising a voltage detector detecting a voltage at a terminal of a battery, a current detector detecting a charge/discharge current of the battery and an arithmetic operation circuit calculating a residual capacity index of the battery relating to a value obtained by subtracting a quantity of

electric charge from a reference capacity value of the battery and calculating a power consumption of the battery from the detected terminal voltage and charge/discharge current. The arithmetic operation circuit estimates a charge/discharge current as a function of the battery residual capacity index and battery power consumption and successively estimates a charge/discharge current in a predetermined power consumption pattern to successively calculate a battery residual capacity index from the estimated charge/discharge current. A battery operable threshold is judged when a battery discharge current, estimated on the basis of an updated battery residual capacity index exceeds a threshold current at that power consumption, and a result is displayed via a display circuit.

5606481**OVERVOLTAGE PROTECTION FOR BATTERY POWERED EQUIPMENT**

Heep Jerry J; Curtis Douglas R Weatherford, TX, UNITED STATES assigned to Tandy Corporation

An overvoltage protection circuit for a CMOS electronic multimeter circuit uses a pair of complementary field-effect protection transistors connected to each input line of the meter circuit. The gate electrodes of the protection transistors are connected to bias voltage sources which provide bias voltages with magnitudes slightly less than the meter power supply voltages. The protection transistors go into conduction when an overvoltage condition causes the voltage on the input to exceed the bias voltages and the conducting protection transistors clamp the input voltage to substantially the bias voltage. Current caused by an overvoltage condition is shunted to ground thereby avoiding a charging condition in the power supplies.

5607789**LIGHT TRANSPARENT MULTILAYER MOISTURE BARRIER FOR ELECTROCHEMICAL CELL TESTER AND CELL EMPLOYING SAME**

Treger Jack; Lagos Bryan C; Fenn John; Gibbard H Fran; Wei Guang Quincy, MA, UNITED STATES assigned to Duracell Inc

A light transparent moisture barrier useful for preventing moisture from destroying the effectiveness of a moisture sensitive cell condition tester on an electrochemical cell comprises a plurality of very thin, alternating layers of an inorganic material and an organic material on a flexible, polymeric substrate. The layers are not laminated, but are formed on the substrate by a deposition or coating process and the thickness of any layer is less than 5 microns. The organic material is a hydrophobic polymer and the inorganic material is a metal oxide, nitride, a glass or silicon.

5607790

**ELECTROCHEMICAL CELL LABEL
WITH INTEGRATED TESTER**

Hughen John; Ferguson Scott; Garris Michael
Cucamonga, CA, UNITED STATES assigned to
Duracell Inc

A label for an electrochemical cell with a condition tester for the cell integrated with the label to form a label/tester composite is disclosed. The label/tester composite has a thermochromic material in thermal contact with an electrically conductive material. A substructure containing a cured conductive material and preferably also a thermochromic material is formed on a releasable web and transferred from the releasable web to the inside surface of the heat shrinkable base film. A partition coating may be applied over the transferred conductive material. Preferably, a sheet of paper or plastic film having a large window opening therein for entrapping air is applied over the partition coating and aligned over the heat generating portion of the conductive material. The label/tester composite is applied to the cell housing with the insulating paper or plastic film with window opening against the cell housing. The tester may be activated by depressing one or two regions on its surface thereby connecting the conductive material to the terminals of the cell, whereupon the conductive material becomes heated causing a change in appearance of the thermochromic material to indicate the condition of the cell.

5608275

**FAULT TOLERANT ISOLATION
BETWEEN DEVICES POWERED BY
SEPARATE POWER SOURCES**

Khosrowpour Farzad Austin, TX, UNITED STATES
assigned to Dell USA L P

A fault tolerant isolation system providing fault tolerant electrical isolation between different components receiving power from separate power sources regardless of which of the power sources fails. One power source provides operating voltage to an isolation device, which is a transceiver, buffer, quick switch, etc. The other power source activates a transistor switch coupled to the output enable input of the isolation device, and a current limit device is provided between the output enable and power inputs of the isolation device. In this manner, failure of either power source disables the isolation device and therefore provides fault tolerant isolation between the devices on either side. In the preferred embodiment, the isolation device acts as a high impedance open switch if its power is removed thereby isolating the devices on either side. The transistor switch is implemented using a field-effect transistor (FET), which is deactivated when the other source fails, where the output enable is pulled high by the first power source thereby disabling the outputs of the isolation device. Voltage drop devices such as diodes may be used to lower the voltage of either source to the appropriate operating voltage of the isolation device, if necessary.

5608304

**BATTERY PROTECTION CIRCUIT AND
BATTERY PACK AND APPARATUS
USING THE BATTERY PACK**

Okumura Masafumi Kawasaki, JAPAN assigned to
Fujitsu Limited

A battery protection circuit for protecting a battery is proposed. The circuit includes a detecting circuit for detecting a battery condition and producing a detected voltage in relation to the battery condition, a comparator comparing the detected voltage with a given voltage, and a switching circuit controlling a connection between the battery and electrical elements. In the battery protection

circuit, when the comparator determines that the battery needs to be protected from the battery condition, the switching circuit turns off to disconnect the battery from the electrical elements.

5608307

**APPARATUS FOR CONTROLLING
EXCESS RECHARGE CURRENT APPLIED
TO A BATTERY**

Garrett Scott; Desai Venus D; Meadows Vernon; Fernandez Jose Lawrenceville, GA, UNITED STATES assigned to Motorola Inc

A battery recharge current source 12 provides a recharge current 14 to battery cells 16. Recharge current 14 is in excess of an optimum recharge current level for battery cells 16 and is divided into currents 26 and 28 by variable shunt load 24 as controlled by charge current control circuit 18. Charge current control circuit 18 is comprised of current sense circuit 20 and load control circuit 22. Current sense circuit 20 produces a current sense signal in response to current through battery cells 16. Load control circuit 22 is responsive to the current sense signal and controls variable shunt load 24 as needed to conduct excess current away from the battery cells.

5608324

**APPARATUS FOR DETECTING A
REMAINING CAPACITY OF A BATTERY
IN A PORTABLE DATA
TRANSMISSION/RECEPTION DEVICE**

Yoshida Toshio Tokyo, JAPAN assigned to NEC Corporation

A controller of a card radio modem connectable to a data terminal measures two kinds of a battery voltage under a different load condition of the card radio modem. The controller determines the kind of battery and detects the remaining time of accuracy, based on the kind of the battery. In addition, the controller calculates an available capacity of a file data to be transmitted and received during the remaining time. When the available capacity is smaller than a capacity which is necessary to transmit

and receive, the controller generates an alarm to inform an operator. The controller displays the available capacity or remaining time on a display.

5608325

**METHOD OF RECALIBRATING A
BATTERY ENERGY MANAGEMENT
PROCESSOR**

Chabbert Philipp; Chatenay Alain; Menard Christian; Meux Dominique Rueil Malmaison, FRANCE assigned to Thomson-CSF

PCT No. PCT/FR94/00933 Sec. 371 Date Apr. 6, 1995 Sec. 102(e) Date Apr. 6, 1995 PCT Filed Jul. 26, 1994 PCT Pub. No. WO95/04937 PCT Pub. Date Feb. 16, 1995. The method of recalibrating an energy management processor of a battery of accumulators consists, at the end of a defined period of time, in initiating a process of recalibration of evaluation of the quantity of electrical energy contained in the battery, in completely recharging the battery, in detecting the end of the complete recharge of the battery, in performing a partial discharge of the battery, in measuring the quantity of electricity extracted during this discharge, in leaving the battery to rest for a defined time, in totally discharging the battery at a low current while measuring the quantity of electricity thus extracted from the battery, in adding the said two quantities of electricity measured in order to obtain the value of the maximum capacity of the battery at the moment of the recalibration.

5610495

**CIRCUIT AND METHOD OF
MONITORING BATTERY CELLS**

Yee Renwin J; Stockstad Troy L; Petty Thomas Chandler, AZ, UNITED STATES assigned to Motorola Inc

A battery monitoring circuit sequentially samples individual voltages across a string of serially coupled battery cells. A control circuit controls first and second multiplexers to sample each battery voltage for an over-voltage condition. A comparator detects an over-voltage condition by comparing a divided down

battery voltage against a reference. The conduction path through the battery cells is disabled upon detecting a fault condition by a transistor in the battery cell conduction path. The battery cells are further sequentially sampled for an under-voltage fault. The comparator detects an under-voltage condition by comparing a second divided down battery voltage against the reference. The conduction path through the battery cells is disabled upon detecting a fault condition by a transistor in the battery cell conduction path.

5610498

**CIRCUIT AND METHOD FOR
CONTROLLING CHARGING OF A
BATTERY**

Oh Byung K Seoul, KOREA assigned to Goldstar Co Ltd

A circuit for controlling the charging of a battery and a method thereof, which are capable of discriminating residual voltage and charged voltage of a respective battery and an adapter by means of a central processing unit. Such circuit for controlling the charging of a battery requires less hardware compared to conventional circuitry, so that the net cost for the product is reduced and power is conserved. Also malfunctions thereof are advantageously prevented, thereby enhancing product reliability.

5610511

**TEMPERATURE RESPONSIVE BATTERY
TESTER**

Parker Robert Alamo, CA, UNITED STATES assigned to Avery Dennison Corporation

A device for measuring the voltage of a voltage source includes a number of temperature responsive displays and a circuit including a number of heating circuits, each heating circuit for heating one of the temperature responsive displays when a threshold voltage of the heating circuit is exceeded, and a printed resistor, each heating circuit being connected to a length of the printed resistor such that the voltage of the voltage source at which each heating circuit heats a temperature

responsive display is a function of the ratio of the lengths of the printed resistor to which the heating circuits are connected.

5610525

BATTERY CAPACITY DETECTOR

Yoshida Toshio; Kanno Yukihiro Tokyo, JAPAN assigned to NEC Corporation

In communication equipment which uses a battery as the power supply, when a controller increases the transmission power at a transmitter corresponding to a drop in the electric field intensity, the controller lowers, accompanying that operation, a reference voltage from a reference voltage source which is used for comparison with the battery voltage for the purpose of detecting a drop in the battery capacity. Therefore, even when the battery voltage is dropped due to an increase in the transmission output, the reference voltage is also lowered correspondingly, so that there will not occur an erroneous detection of drop in the battery capacity due to the drop in the battery voltage.

5612151

**ELECTROCHEMICAL CELL LABEL
WITH INTEGRATED TESTER**

Hughen John F Rancho Cucamonga, CA, UNITED STATES assigned to Duracell Inc

A label for an electrochemical cell with a condition tester for the cell integrated with the label to form a label/tester composite is disclosed. The label/tester composite comprises a thermochromic coating in thermal contact with an electrically conductive coating. The label/tester composite is preferably constructed by applying an adhesive to the inside surface of a heat shrinkable base film forming part of the label. A substructure containing a cured conductive coating and preferably also a thermochromic coating is formed on a releasable web. The substructure is transferred from the releasable web to the inside surface of the heat shrinkable base film and in contact with a portion of the adhesive on the base film. A patterned partition insulating coating is then applied over the transferred conductive coating. The label/tester composite is applied

to the cell housing. The integrated tester may be manually activated by depressing one or two regions on the surface of the composite. The conductive coating becomes heated and the generated heat causes changes along the thermochromic coating to indicate the condition of the cell.

5612606

**BATTERY EXCHANGE SYSTEM FOR
ELECTRIC VEHICLES**

Guimarin David C; Janik Wayne M San Jose, CA,
UNITED STATES assigned to Guimarin David C

An integrated electric vehicle service station system for managing the exchange of heavy and bulky battery assemblies in electric vehicles. The battery exchange system includes a battery platform for supporting an assembly of batteries for the vehicle, a vehicle platform support structure within an electric vehicle for receiving and supporting the battery platform, and a mechanized vehicle service station facility for exchanging recharged battery platforms with spent platforms mounted on-board electric vehicles. The battery platform is of a simple modular shape that may be used with the large variety of sizes and shapes of electric vehicles that may be expected in the future. The battery platform support structure is a correspondingly simple structure that may readily be included in electric vehicles of widely differing designs. The service station facility includes two general service substations—an exchange substation where the spent battery platform is removed from the vehicles and replaced with a fully charged platform, and a staging substation where the battery platforms are stored, re-charged, serviced, and staged for insertion into a waiting vehicle at the exchange substation. The exchange substation is such that the exchange of a battery platform for an electric vehicle positioned at the exchange substation is able to proceed automatically and rapidly with a minimum of operator assistance so as to minimize the inconvenience to the vehicle operator.

5612607

**METHOD FOR THE FAST CHARGING OF
A BATTERY AND INTEGRATED CIRCUIT
FOR THE IMPLEMENTATION OF THIS
METHOD**

Nicolai Jean Chateaneuf le Rouge, FRANCE assigned
to SGS-Thomson Microelectronics S A

To carry out a fast charging of a battery, a high current is injected into this battery while, at the same time, the terminals of this battery are monitored. This injection is stopped when this voltage undergoes an inflection of its variation. It is shown that, given the security of the system, it is possible to charge nickel-cadmium or nickel-metal-hydride type batteries with currents that are even higher than in prior systems.

5612608

**APPARATUS FOR DISPLAYING
RESIDUAL CAPACITY OF BATTERY FOR
USE ON ELECTRIC VEHICLE**

Ishiguro Kazunari; Kayano Morio Wako, JAPAN
assigned to Honda Giken Kogyo Kabushiki Kaisha

An apparatus for displaying the residual capacity of a battery includes a temperature indicator composed of a linear array of spaced light-emitting elements for displaying the temperature of the battery by way of light emitted from a succession of those of the light-emitting elements which correspond to the temperature of the battery detected by a temperature detector, a fully charged capacity indicator composed of a linear array of spaced light-emitting elements for displaying the fully charged capacity of the battery in association with the displayed temperature of the battery by way of light emitted from one of the light-emitting elements which is in a position corresponding to the fully charged capacity obtained based on the temperature of the battery, and a residual capacity indicator composed of a linear array of spaced light-emitting elements for displaying the residual capacity of the battery in association with the fully charged capacity by way of light emitted from a succession of those of the light-emitting elements which correspond to the residual capacity calculated by an electronic control unit.

5614331**MEDIUM AND HIGH DISCHARGE RATE COMBINATION BATTERY AND METHOD**

Takeuchi Esther S; Walsh Karen East Amherst, NY, UNITED STATES assigned to Wilson Greatbatch Ltd

A combination battery comprising a medium rate cell portion intended to be discharged under a substantially constant drain and a high rate cell portion intended to be pulse discharged, is described. Both cell portions are housed in the same casing and activated with the same electrolyte. The respective cells are capable of both independent and simultaneous discharge.

5614332**METHOD AND APPARATUS FOR INCREASING CHARGING AND DISCHARGING EFFICIENCY IN BATTERIES**

Pavelle Richard; Latanision Ronald M; Burstein Paul Winchester, MA, UNITED STATES

A method and apparatus for increasing charging and discharging efficiency of a battery. A battery is provided having electrodes and an electrolyte. The electrodes are connected to a charging or discharging circuit and at least one electrode is mechanically manipulated during the charging or discharging.

5614804**METHOD OF DETECTING RESIDUAL CAPACITY OF BATTERY FOR USE ON ELECTRIC VEHICLE**

Kayano Morio; Watanabe Kazunori Wako, JAPAN assigned to Honda Giken Kogyo Kabushiki Kaisha

Based on the difference between a battery voltage immediately after the battery is left to stand and the battery voltage upon elapse of the period of time after the battery has been left to stand, it is determined whether the battery has been in a charge mode or a

discharge mode immediately before the battery is left to stand. If the battery has been in the charge mode, then a residual capacity is determined from the battery voltage at a predetermined time. When the battery is being discharged, then a maximum battery output is calculated based on a discharge current. If the residual capacity of the battery is determined as being virtually zero based on the maximum output, then the residual capacity is corrected with a corrective capacity for correcting for a change in the residual capacity due to a degradation of the battery, thus determining the residual capacity of the required charge quantity is calculated from the detected residual capacity and a stored rated capacity of the battery, and a temperature corrective coefficient for correcting the required charge quantity is determined. The residual capacity of the battery is determined based on an actual charge quantity indicative of an integrated average charging current at predetermined periods and the charging efficiency based on battery voltage during charging.

5614805**METHOD AND APPARATUS FOR CHARGING A SECONDARY BATTERY BY SUPPLYING PULSED CURRENT AS CHARGING CURRENT**

Momotani Hiroshi; Otsuki Etsuo; Hasebe Akio; Takeuchi Tamiko Sendai, JAPAN assigned to Tokin Corporation

In a method for charging a secondary battery having a positive electrode, a negative electrode, and an electrolyte, a pulsed current is supplied to the secondary battery to make the pulsed current flow between the positive electrode and the negative electrode through the electrolyte to thereby charge the secondary battery. The pulsed current comprises positive pulse current which has a positive pulse amplitude corresponding to a first current density of 1 $\mu\text{A}/\text{cm}^2$ to 100 mA/cm^2 in the positive electrode. However, the pulsed current may include a negative pulse current following after each positive pulse and having a negative amplitude corresponding to a second current density not greater than a quarter of the first current density.

5614806**BATTERY CHARGER**

Wilson Nathaniel B; McLaren Elbert A San Diego,
CA, UNITED STATES

The battery charging system of the present invention charges the battery of a portable, multiple mode radiotelephone while the radiotelephone is operating. The radiotelephone generates a clock signal having varying on/off times dependent on the radiotelephone's mode. This mode can include an analog cellular mode or a digital cellular mode. The battery charger detects the clock signal's on/off times and changes the average charge current to compensate for one mode requiring a larger charge current.

5614807**BATTERY CHARGE INDICATOR**

Duley Raymond Buda, TX, UNITED STATES
assigned to Advanced Micro Devices Inc

A low-cost battery charge indicator is provided which is capable of indicating a quantity of charge upon a battery or battery pack. The charge indicator includes positive and negative battery terminals and a charge gauge circuit mounted within a battery pack or a battery-powered electronic device. The positive and negative terminals are adapted to receive a battery and to test the battery charge within the battery during times in which the charge gauge circuit is active. Activation of the charge gauge circuit occurs by depressing a momentary switch coupled between the charge gauge circuit and the battery terminals. Upon activation of the switch, one of three LEDs will emit light informing the user of the state of charge upon the battery or battery pack. The switch remains normally open to avoid current draw from the battery during non-test times.

5614808**ELECTRIC VEHICLE CHARGING
CONNECTOR, CONNECTOR ASSEMBLY
AND ELECTRIC VEHICLE CHARGING
SYSTEM**

Konoya Hisashi; Kuki Heiji Mie Pref, JAPAN
assigned to Sumitomo Wiring Systems Ltd

An electric vehicle charging connector used for charging a power battery of an electric vehicle includes connector holder and a display section mounted in an upper portion of the connector holder. The display section includes red and green light-emitting diodes and a seven-segment two-digit numeric display including light-emitting diodes. The red light-emitting diode is turned on while the power battery is being charged. The green light-emitting diode is turned on instead of the red light-emitting diode when charging has been completed. Either the time elapsed after the charging operation has been initiated or the remaining capacity of the power battery is displayed by the numeric display.

5614809**ELECTRIC GENERATION CONTROL
SYSTEM FOR HYBRID VEHICLE**

Kiuchi Takeo; Taguchi Satosh; Nakaya Katsunor; Fueta Shigekazu; Fukuda Kenji Wako, JAPAN assigned to
Honda Giken Kogyo Kabushiki Kaisha

When the remaining capacity of a battery on a hybrid vehicle is smaller than a threshold value or the battery is unable to output the amount of electric energy required to propel the hybrid vehicle with a propulsive electric motor, the engine is started by a generator which operates in a motor mode. After the engine has been warmed up, the generator operates in a generator mode to generate electric energy which is supplied to the battery and the propulsive electric motor. The threshold value for the remaining capacity of the battery is greater as the atmospheric pressure is lower. Therefore, if the hybrid vehicle is running under a low atmospheric pressure such as on a highland, the electric energy is supplied from the generator to the battery and the propulsive electric motor at an early stage where the capacity of the battery is relatively high. The generator

also starts to generate electric energy when the battery is unable to output an amount of electric energy sufficient enough to propel the hybrid vehicle.

5614829

**STATE-OF-CHARGE MEASURING
METHOD USING MULTILEVEL
PEUKERT'S EQUATION**

Song Sung-ku Sunnam, KOREA assigned to Y P Lee & Associates

The method of measuring the state-of-charge of a battery by using multilevel Peukert's equation which is different from conventional Peukert's equation in such a way that the conventional Peukert's equation uses only two reference points to obtain Peukert's constants whereas the multilevel Peukert's equation uses a third reference point to obtain two sets of Peukert's constants. By doing so, the state-of-charge of a battery can be measured more precisely and the reliability of a battery powered product can be enhanced.

5616433

**ELECTRICAL CONNECTOR FOR
STORAGE BATTERIES**

Kau Pui K Alameda, CA, UNITED STATES assigned to Asian International Trades Company

An electrical connector for connecting a battery post to a wire is described. The electrical connector comprises a U-shaped clamp having (i) a concave portion sized to hold the battery post; and (ii) opposing first and second legs extending from the concave portion. The first leg has a first hole therethrough, and the second leg has a second hole that is substantially aligned with the first hole. Unitary compression means extending through the first and second holes of the U-shaped clamp, is provided for (i) compressing a wire against the U-shaped clamp, and (ii) compression fitting the U-shaped clamp about the battery post. In a preferred configuration, the unitary compression means comprises a wire holding compression stud extending through the first hole and second hole, and fastening means for tightening the stud on the U-shaped clamp.

5616434

**BATTERY PLATE SEPARATOR
ENVELOPE AND METHOD OF FORMING
BATTERY PLATE ASSEMBLIES
INCLUDING THE SAME**

Redden Galen; Luzader Rex E Gypsum, KS, UNITED STATES assigned to Exide Corporation

Battery plate envelopes include a sheet of porous film material having a folded widthwise bottom edge and overlapped lateral edges to thereby form a pocket for receiving a battery plate therein. The overlapped lateral edges are joined to one another by a lengthwise extending series of discontinuous joining regions with adjacent ones of the discontinuous joining regions being separated by respective unsealed regions. These unsealed regions thereby establish respective lateral channels through which fluid (e.g., electrolyte employed in a wet storage battery) may pass to the interior pocket, and hence to the battery plate. The discontinuous joining regions are most preferably formed by passing the sheet material through the nip between opposed joining rings, each of which is provided with a series of triangularly-shaped teeth with smooth land areas formed between adjacent teeth series.

5617003

**METHOD AND APPARATUS FOR
CHARGING A BATTERY OF AN
ELECTRIC VEHICLE**

Odachi Yasuharu; Minoshima Norimoto Aichi ken, JAPAN assigned to Kabushiki Kaisha Toyoda Jidoshokki Seisakusho

Method and apparatus of charging a battery of an electric vehicle through inductive coupling between a primary inductive device having a core and a primary coil connected to a power source and a secondary inductive device having a core and a secondary coil connected to the battery are disclosed. The primary inductive device is provided on a movable arm of a ground charger unit and the secondary inductive device is mounted on the bottom of the vehicle adjacent its rear end. The power source supplies to the primary coil selectively a charging current and a check current. When the check current is supplied to the primary coil, an

electromotive force is induced in the secondary coil which varies with a change of the relative position between the primary and secondary inductive devices. The variation in the induced electromotive force causes a change of the check current flowing in the primary coil. The position where the primary inductive device should be placed with respect to the secondary inductive device just before coupling thereof is determined on the basis of the change of the check current which is monitored while moving the primary inductive device relative to the secondary inductive device.

5617004

BATTERY CHARGING APPARATUS FOR SERIES BATTERY

Kaneko Akira Shirakawa, JAPAN assigned to Integran Inc

A plurality of battery charging modules C, equal in number to a plurality of batteries B connected in series, are connected in series form a column of battery charging modules 6. Output terminals 7, 8 of this column 6 serve as the connecting terminals for a beginning terminal 2 and an ending terminal 3 of the series-connected column of batteries 1. A connecting point between consecutive batteries B connects to a junction point between consecutive battery charging modules C. This configuration enables the column of battery charging modules 6 to be connected with the column of batteries 1 and results in a set of parallel connections between the battery charging modules C and the corresponding batteries B. This enables current to flow at the same time from the battery charging modules C to each battery B connected in series therewith to charge batteries, and after the battery B with the largest balance of residual capacity is charged fully, the battery with the second largest balance of residual capacity is charged by the corresponding charging module C, and thereafter batteries are charged in the order of importance of residual capacity balance.

5617007

BATTERY CHARGING METHOD AND APPARATUS USING CURRENT CONTROL

Keidl Steven D; Rotter Jeffrey; Steele Steven Rochester, MN, UNITED STATES assigned to International Business Machines Corporation

A battery charging apparatus and method are provided for charging a battery using current control with a switching power supply charging circuit coupled to the battery. During a first charging phase, a predetermined constant charging current is applied to the battery. The battery voltage is monitored and a second charging phase is started when the battery voltage reaches a predetermined threshold voltage. During a second charging phase, a sequence of stepwise decreasing-amplitude current pulses are applied to the battery. The envelope for the decreasing current pulses is exponential which is characteristic of the current for voltage controlled charging methods. The battery voltage is maintained at a temperature compensated target with a 1% tolerance. The charging current is compared to a predetermined minimum amplitude value and a third charging phase is started when the sequential charging current pulse equals the predetermined minimum amplitude value. During a third charging phase, predetermined charging current pulses having the predetermined minimum amplitude value are applied to the battery. The battery voltage is maintained at a temperature compensated target with a 1% tolerance.

5617008

METHOD, APPARATUS, AND COMMUNICATION DEVICE FOR CHARGING A CHARGE STORAGE DEVICE WHICH IS MOMENTARILY CONNECTED TO A FIXED LOAD

Eastmond Bruce; Alameh Rachid Downers Grove, IL, UNITED STATES assigned to Motorola Inc

The present invention provides a method, an apparatus, and a communication device for automatically maintaining a state of full charge in a charge storage device, such as a secondary battery, to which a fixed

load is momentarily connected. Since the load is fixed, a predetermined amount of charge is removed from the charge storage device each time the load is connected. A counter is incremented while the load is connected. From the count, the amount of charge that must be replaced can be determined. As the charge is replaced the count is decremented.

5617009

**RECHARGEABLE BATTERY CHARGING
CIRCUIT WHICH SETS SUPPLEMENTAL
CHARGING CAPACITY ACCORDING TO
AMBIENT TEMPERATURE**

Takao Mitsunori; Kokuga Toshihar; Matsumoto Takana; Sakurai Hiroaki Sumoto, JAPAN assigned to Sanyo Electric Co Ltd

A battery charging circuit performs rapid charging without over-charging followed by supplementary charging to insure a fully charged rechargeable battery. The amount of supplementary charging is increased at low ambient temperatures and decreased at high temperatures. A primary charging circuit means for rapid charging and a supplementary charging circuit means for supplementary charging are provided. A temperature sensing means measures ambient temperature during rapid charging to establish the amount of supplementary charging required.

5617324

**REMAINING BATTERY CAPACITY
MEASURING METHOD AND APPARATUS**

Arai Youichi Shizuoka ken, JAPAN assigned to Yazaki Corporation

A remaining battery capacity measuring apparatus comprises: a voltage-current change trend calculating section for detecting dispersive terminal voltages and discharge currents of a battery; a voltage-current approximate linear function calculating section for calculating an approximate linear function indicative of a trend of the detected dispersive terminal voltages and discharge currents; a correlation coefficient calculating section for calculating a correlation coefficient between

the detected dispersive terminal voltages and discharge currents; a correlation coefficient deciding section for deciding whether the calculated correlation coefficient less than a negative reference value can be calculated continuously or not, and for enabling the voltage-current approximate linear function calculating section to output the calculated approximate linear function, only when the correlation coefficient less than the negative reference value can be calculated continuously, and a remaining battery capacity calculating section for calculating a remaining battery capacity on the basis of a terminal voltage corresponding to a reference discharge current along the outputted approximate linear function.

5619076

**METHOD AND APPARATUS FOR
CONNECTION AND DISCONNECTION OF
BATTERIES TO UNINTERRUPTIBLE
POWER SYSTEMS AND THE LIKE**

Layden David L; Cane Michael J; Bishop Rober New Lisbon, WI, UNITED STATES assigned to General Signal Power Systems Inc

Connection of batteries to the DC bus lines across which capacitors are connected in power systems, such as uninterruptible power systems, is carried out using an auxiliary switch which is controlled to connect the batteries to a DC bus line through a precharge resistor momentarily before connection is made through a main connector. The preconnection of the batteries through the precharge resistor provides a controlled rate of charge of the capacitors before closing of the main connector to thereby avoid excessive surge currents. When the main connector is opened, as when the power system is prepared for transportation or long term storage, the auxiliary switch interrupts the current path from the battery through the precharge resistor and provides a current path from the DC bus line through a discharge resistor to ground to bleed down the charge on the capacitors to a desired level within a selected period of time.

5619107**SYSTEM FOR CONTROLLING ELECTRIC VEHICLE MOTOR**

Shinohara Sadao; Hosoda Masaharu Wako, JAPAN assigned to Honda Giken Kogyo Kabushiki Kaisha

A device for controlling an electric vehicle motor that optimally discharges a smoothing capacitor, connected to the input terminals of an inverter in accordance with the condition of an electric vehicle. The device includes a motor drive means, the smoothing capacitor connected in parallel with the motor drive means, switching means operating in connection with an operation switch operated by the vehicle operator, discharging means for discharging the smoothing capacitor, draw detecting means, and discharge restricting means. The system opens the switching means to shut off output from the battery and to discharge the smoothing capacitor when the switching means is open, but restricts discharging during a towing or drawing condition of the electric vehicle.

5619116**UNIVERSAL BATTERY CHARGER CHARGEABLE WITH RELEVANT CURRENT DEPENDENT ON CELL NUMBER**

Takano Nobuhiro; Shinohara Shigeru; Ogura Mitsuo Hitachinaka, JAPAN assigned to Hitachi Koki Co Ltd

To charge a battery having a different number of cells connected in series with a relevant charge current, the number of cells of the battery is firstly determined and a current level corresponding to the number of cells is determined in view of the potential of the charger. The charge current having a level substantially equal to the thus determined current level is flowed in the battery.

5619117**BATTERY PACK HAVING MEMORY**

Koenck Steven E Cedar Rapids, IA, UNITED STATES assigned to Norand Corporation

In an exemplary embodiment, a battery conditioning system monitors battery conditioning and includes a memory for storing data based thereon; for example, data may be stored representative of available battery capacity as measured during a deep discharge cycle. With a microprocessor monitoring battery operation of a portable unit, a measure of remaining battery capacity can be calculated and displayed. Where the microprocessor and battery conditioning system memory are permanently secured to the battery so as to receive operating power therefrom during storage and handling, the performance of a given battery in actual use can be accurately judged since the battery system can itself maintain a count of accumulated hours of use and other relevant parameters. In the case of a non-portable conditioning system, two-way communication may be established with a memory associated with the portable unit so that the portable unit can transmit to the conditioning system information concerning battery parameters (e.g. rated battery capacity) and/or battery usage (e.g. numbers of shallow discharge and recharge cycles), and after a conditioning operation, the conditioning system can transmit to the portable unit a measured value of battery capacity, for example. A battery pack having memory stores battery history and identifying data to be retrieved by a portable battery powered device. Battery status information may be utilized in conjunction with characteristic battery history data in order to optimize charging and discharging functions and to maximize the useful life of a battery pack.

5619118**METHOD AND AN APPARATUS FOR CHARGING A RECHARGEABLE BATTERY**

Reipur John; Juul-Hansen Ebbe Klampenborg, DENMARK assigned to Chartec Laboratories A/S

PCT No. PCT/DK92/00047 Sec. 371 Date Sep. 16, 1993 Sec. 102(e) Date Sep. 16, 1993 PCT Filed Feb. 14, 1992 PCT Pub. No. WO92/15142 PCT Pub. Date Sep. 3, 1992. A rechargeable battery is charged by connecting the terminals of the battery to an electrical power source. In order to avoid overcharging and undue temperature increase in the battery cell, the course of a least one charging parameter, such as the increase rate of voltage, is surveyed during at least part of the process of charging the battery. This charging parameter surveyed is

compared with a number of reference parameter courses representing idealistic or desirable processes of charging the battery for different starting states of charge of the battery. Such comparisons may for example be made by means of a microprocessor, which may also select the reference course with a starting state of charge similar to the actual starting state of charge of the battery. Thereafter the process of charging the battery may be controlled so as to approximate the course of said charging parameter to the selected reference course. The charging voltage may be limited to a maximum value (V_{max}). When such value has been reached the charging process may be terminated after a certain predetermined time period being one of the reference values.

5619417

**BATTERY MONITORING SYSTEM FOR
AN ELECTRIC VEHICLE**

Kendall Jeffrey M Southfield, MI, UNITED STATES
assigned to Chrysler Corporation

A battery monitoring system for an electric vehicle is provided in which an individual battery monitor is physically touching and electrically connected to each one of the battery modules in the string of series or parallel connected battery modules. The battery monitors are themselves connected in a series loop with a central computer via optical communication links such that when the central computer issues a command to force instantaneous battery parameter readings, data from a battery monitor upstream in the series loop is transmitted via an optical communication link to the next battery monitor downstream and ultimately back to the central computer. The central computer utilizes the battery parameter data thus collected to determine various battery charge and fault conditions.

5622789

**BATTERY CELL HAVING AN INTERNAL
CIRCUIT FOR CONTROLLING ITS
OPERATION**

Young Steven J Milpitas, CA, UNITED STATES
assigned to Apple Computer Inc

A battery cell having a positive terminal, a negative terminal and a power producing core section (e.g., electrolyte) for systems, such as computer systems, cellular phones, etc. The battery cell also includes an internal circuit to monitor the state of the battery cell. The state that is monitored may include the temperature, charge level of the battery core section, the discharge/charge rate. The circuit may control the battery cell (e.g., cause charging of the battery cell). This internal circuit may be an integrated circuit, such as a microprocessor.

5623193

**APPARATUS FOR CONTROLLING
BATTERY DISCHARGE**

Lang Gerhard; Wolf Juml urgen Altweilnau,
GERMANY assigned to Braun Aktiengesellschaft

The invention is directed to an electrical device in which an electrical load is powered by a battery via an electronic switching device. A display means serves the function of indicating the charge status of the battery, and a time measurement means determines the connection time of the load to the battery. Following expiration of a predetermined connection time of the load to the battery, when the display means indicates the charge status zero, the time measurement means will disconnect the electrical load from the battery by means of the electronic switching device.

5623194

**APPARATUS FOR MONITORING AND
CONTROLLING CHARGING OF A
BATTERY FOR A HYBRID OR ELECTRIC
VEHICLE**

Boll Wolf; Knuml orzer Guml unther; Mikulic Leopold
Weinstadt, GERMANY assigned to Mercedes-Benz AG

The invention relates to a charge information system to support the operator of an electric vehicle or hybrid vehicle, including the input of desired parameters for charging and operating the vehicle. The charge information system according to the invention comprises an input unit for putting the desired parameters into a

computing unit which determines the required remaining charging time and displays it. Defining quantities are, among others, the charging efficiency or the desired range.

5623195

APPARATUS AND METHOD FOR CONTROLLING A CHARGING VOLTAGE OF A BATTERY BASED ON BATTERY TEMPERATURE

Bullock Norma K; Fent Douglas G; Nguyen Trung V
Rockwall, TX, UNITED STATES assigned to Lucent Technologies Inc

A battery charging system controls and modifies the output voltage of the charging rectifier in response to differing temperature ranges of the battery. At a low range of temperatures starting at a low temperature (e.g. within a range of 0 to 25°C to about 53°C) the rectifier voltage decreases as the temperature increases to prevent charging current from rising as the battery temperature increases. This change is performed in accord with a linear graphical slope relating the change of charging voltage to temperature. A suitable charging voltage decrease rate may be 3 mV/°C/cell with a range of 1.5 mV/°C/cell to 5 mV/°C/cell being acceptable. Reduction of the charging voltage within this range reduces the aging effect of high temperature operation of the battery. The charging voltage applied to the battery is held at a constant value over a subsequent range of temperatures (e.g. 53°C to 75°C) in order to prevent accelerated grid corrosion within the battery, which normally occurs as the voltage approaches the fully charged open circuit voltage level of the battery. At attainment of a high threshold temperature at the high end of the second temperature range (e.g. 75°C) the charging voltage level is dropped as a step function to a level below the fully charged open circuit voltage threshold of the battery to arrest the thermal runaway situation. At this level the battery is maintained at partial, but not full, state of charge by the rectifiers, and an alarm signal is generated to alert the maintenance staff to this situation.

5623196

APPARATUS AND METHOD OF SIMULATING HIGH BATTERY TEMPERATURE IN A RECHARGEABLE BATTERY

Fernandez Josacu Meadows Verno; Desai Venus; Garrett Scott M; Lam Dao N; Kamke James; Patino Josep Sunrise, FL, UNITED STATES assigned to Motorola Inc

A device for simulating a high battery temperature used in charging a rechargeable cell. The device takes advantage of a control signal generated by a voltage control circuit used to disconnect a rechargeable cell from a charging system when a predetermined voltage is reached. The device is generally used with cells having a lithium based chemistry and requiring a different charging regime than nickel chemistry cells. The device is activated by the control signal from control circuit which detects a predetermined voltage from rechargeable cell enabling thermistor to change its state. This change is detected by the charging system which alters its mode of operation from a rapid charging rate to a slower charging rate. The device is retrofitable to existing rechargeable batteries allowing them to be charged using existing charging systems alien to the rechargeable battery.

5623197

ACTIVE CONTROL OF BATTERY CHARGING PROFILE BY GENERATOR CONTROL UNIT

Roseman Ronald W; Rice Kevin Walton Hills, OH, UNITED STATES assigned to Lucas Aerospace Power Equipment Corporation

A system for actively controlling the charging profile of a battery uses a software-based generator control unit to control the charging voltage. The voltage may be initially reduced following battery discharge to prevent large current inrush transients. The voltage may then be raised above a normal charging level to increase the battery charging rate. The control system provides better control over battery charging prevent overheating of the battery and generator and allows the battery to be recharged more quickly.

5623210**CURRENT DETECTOR FOR DETECTING
BATTERY CHARGE REMAINING**

Sakamoto Norinob Ora gun, JAPAN assigned to Sanyo Electric Co Ltd

A current-voltage convertor respectively generates positive and negative voltages when a battery is being charged and discharged. A voltage synthesizer adds a prescribed positive voltage to the voltage, and always generates a positive sample voltage. This sample voltage and prescribed reference voltages are compared by means of two differential amplifiers to obtain signals for the currents being charged and discharged. Then, these signals are supplied to a microcomputer.

5624003**BATTERY TEMPERATURE-RAISING
DEVICE FOR ELECTRIC VEHICLE**

Matsuki Tsutom; Matsuno Takayosh Aichi ken, JAPAN assigned to Toyota Jidosha Kabushiki Kaisha

The present invention relates to a battery heating device for an electric vehicle, which includes: a combustion heater for heating an interior of the electric vehicle; batteries which are a driving source of the electric vehicle, the batteries being disposed about the combustion heater; and a transfer device for transferring exhaust heat from the combustion heater, which is in operation, to the batteries. When the combustion heater is actuated, the battery temperature is raised by the exhaust heat from the combustion heater.

5625271**BATTERY CHARGER ADAPTER AND
METHOD THEREFOR**

Shapiro Steven C; Fay Eugene; McMurray Charles R Lake Worth, FL, UNITED STATES assigned to Motorola Inc

A battery charger adapter has a housing receptacle formed as a battery for a cellular telephone. The housing

receptacle has a recessed portion formed in a base surface of the housing receptacle for receiving a battery pack to be charged, at least one holding clip for securing the battery pack in the recessed portion, an electrical coupler for coupling the battery pack to the housing receptacle and an access port, coupled to the electrical coupler, for electrically coupling the housing receptacle to a charger for enabling the battery pack to be charged in the battery charger adapter.

5625272**BATTERY CHARGE/DISCHARGE
CONTROL METHOD FOR ELECTRIC
VEHICLE**

Takahashi Tsutom Oota, JAPAN assigned to Fuji Jukogyo Kabushiki Kaisha

A method of controlling charge or discharge of a battery for an electric vehicle comprises the steps of, dividing a battery into a plurality of blocks each composed of a plurality of cells for constituting the battery in all, detecting terminal voltages (V_n) of the divided blocks, respectively to obtain a difference ($V_{max}-V_{min}$) in voltage between a maximum value and a minimum value from among the detected terminal voltages of the respective divided blocks, and controlling the charge or discharge of the battery on the basis of the obtained difference in voltage between the maximum and minimum values of the terminal voltages of the divided blocks. In practice, when the voltage difference ($V_{max}-V_{min}$) between the maximum value and the minimum value is equal to or higher than a specified value (V_{Kc} , V_{Kd}), the battery is stopped from being further charged or discharged; the charge or discharge current is limited; or the charge or discharge current is decreased stepwise at each control start period, to prevent the low-performance cells from being overcharged or over-discharged, that is, for prevention of the partial cells from being deteriorated due to a performance difference between the respective cells.

5625273**BATTERY SAFETY DEVICE**

Fehling John R; Meierdierck Charles; Fagon Donald F New Hyde Park, NY, UNITED STATES assigned to Bren-Tronics Inc

A battery safety device and circuit which prevents detrimental effect from the three most common battery faults generally encountered, excessive heat generation, voltage reversal and short circuit problems. The device includes fast acting circuits which latch the battery in the off state until reset by removal of the load, thereby preventing continued cycling of the battery between on and off states. The safety device includes a gating transistor such as a MOSFET (metal-oxide semiconductor field-effect transistor) switch, a latching timer (RC circuit) and a latching circuit having a transistor which turns on when a charge is 0.5 volts or greater. The safety device further comprises one or more sensor switches triggered by predetermined thermal, pressure, etc., conditions, with the switches being outside the circuit (and not affected by circuit conditions) and adapted to provide a latching voltage to the gating transistor under a detected untoward condition.

5625274

METHOD FOR FAST CHARGING OF DIFFERENT TYPES OF BATTERIES

Naskali Matt Yliskulma, FINLAND assigned to Nokia Mobile Phones Limited

The invention relates to a method for terminating the charging of a battery, in which a certain decrease in the battery voltage is detected when the battery is fully charged and the charge begins to decrease. With the invention it is possible to prevent battery overcharge reliably and efficiently. The solution can be applied to the charging of both Ni-Cd and Ni-MH batteries with a same charger and/or same charge control program.

5628825

BATTERY LUG HEATING APPARATUS

Hopwood Robert T Cheltenham, UNITED KINGDOM assigned to TBS Engineering Limited

PCT No. PCT/GB95/00323 Sec. 371 Date Sep. 19, 1995 Sec. 102(e) Date Sep. 19, 1995 PCT Filed Feb. 16, 1995 PCT Pub. No. WO95/22845 PCT Pub. Date Aug. 24, 1995. This invention relates to apparatus for heating the lugs of battery plates. The apparatus includes a hot air duct which communicates with a nozzle having a

head that defines a pair of opposite facing nozzles. Each nozzle has an outlet from which extends a generally flat and divergent plate. The plate entrains hot air passing through the outlet into a generally flat stream so that the hot air impinges on lugs, but not of the rest of the group of plates and separators.

5629106

CONNECTION STRUCTURE AND CONNECTION FITTING FOR AN ELECTRODE POST OF A BATTERY

Yamada Satosh; Kuboshima Hidehik Haibara gun, JAPAN assigned to Yazaki Corporation

An electrode post connection structure for connecting a connection conductor to an electrode post of a battery through a connection fitting, which includes a lock stage portion formed on a circumference of the electrode post, a tapered portion formed at a top portion of the electrode post, a lock spring inserted in the connection fitting so as to engage with the lock stage portion to thereby lock the electrode post and the connection fitting with each other, and a hollow elastic body accommodated in the connection fitting so as to press the connection conductor to thereby connect the electrode post and the connection conductor to each other. Thus, work for connecting a connection conductor to an electrode post of a battery is simplified, and the electric characteristic and reliability of the connection are improved greatly.

5629599

RECHARGEABLE BATTERY-POWERED COMMUNICATION DEVICE HAVING INTEGRAL VIBRATING MEANS

Malaspina Francis P; Thomas George Plantation, FL, UNITED STATES assigned to Motorola Inc

A system for charging a battery including a power supply and a vibration device to enhance charging. The vibration device may be the speaker of an electronic communication device.

5629605**PULSEWIDTH MODULATED VISUAL INDICATOR FOR BATTERY STATUS**

Lavan Thomas J; Gandre Jerry D Austin, TX, UNITED STATES assigned to Dell USA L P

A battery status indication circuit and a method of indicating battery status. The battery status indication circuit comprises: (1) an indicator having an inactive state and an active state and (2) an indicator modulation circuit adapted to receive a charge level signal indicating a charge level of a battery and transmit, in response thereto, a pulsewidth modulated indicator signal to the indicator, a duty cycle of the indicator signal being a function of the charge level, the indicator thereby toggling between the inactive and active states to provide an indication of the charge level. A single indicator having only two states can therefore be employed to indicate multiple grades of battery charge level.

5629606**BATTERY CHARGING DEVICE FOR VEHICLE**

Asada Tadatoshi Anjo, JAPAN assigned to Nippondenso Co Ltd

A generator for vehicle is connected to an end of a transmitting wire through a generator-side signal transmitting and receiving circuit which has a transistor and a comparator. An ECU is connected to the other end of the transmitting wire through a vehicle-side signal transmitting and receiving circuit which has a switching transistor and a comparator. The comparator receives frequency signals from the transistor, and the comparator receives a voltage signal from the transistor. Thus, the generator control signal and the generator condition signal are transmitted by the same transmitting wire.

OTHER BATTERIES**5601943****MODULE FOR AN AQUEOUS BATTERY SYSTEM**

Eidler Phillip A; Loppnow Eric Muskego, WI, UNITED STATES assigned to ZBB Technologies Inc

A module for liquid electrolyte, electric energy storing devices. The module includes a double-walled container having an innerwall and an outerwall and a rim. The container includes a first well for holding liquid electrolyte electric energy storing devices and which is defined by the inner wall. The container also includes a first electrolyte reservoir having a shelf and a lid for covering the first reservoir. The innerwall and outerwall define a second electrolyte reservoir which surrounds the first electrolyte reservoir so that the first and second reservoirs are in nested relationship. The reservoirs are designed so that a physical puncture of the module will cause the electrolyte from the first reservoir to mix with the electrolyte from the second before it leaks from the module.

5601944**BUTTON TYPE ALKALINE BATTERY**

Yamaguchi Norishige; Hosoda Kiyoshi Fukushima, JAPAN assigned to Sony Corporation

There can be provided a button type alkaline battery in which resistance to leakage of the electrolysis solution is improved. A button type alkaline battery includes a positive electrode can a negative electrode cup and a gasket. The negative electrode cup has a cuff portion. The cuff portion is inclined toward a center of a battery at an angle ranging from 5 ° to 20 °.

5601946

**RECTANGULAR SEALED ALKALINE
STORAGE BATTERY AND MODULE
BATTERY THEREOF**

Hattori Yohei; Morishita Nobuyasu; Matsuda Hiromu; Ikoma Munehisa Kadoma, JAPAN assigned to Matsushita Electric Industrial Co Ltd

A relatively large rectangular sealed alkaline storage battery used for electric cars, etc. is disclosed. The battery has such an inner construction as to inhibit deformation of the electrode group caused by charging and discharging so as to improve the life characteristics. The electrode group comprises positive electrode plates alternating with negative electrode plates in a planar direction and separators between the adjacent electrode plates. The electrode group and an alkali electrolyte are inserted in a container, which is sealed by a cover provided with a safety vent and the position of the electrode group in the container is controlled by fixing poles to the cover. The amount of the alkali electrolyte is 1.5-2.5 cm³/battery capacity 1 Ah. Especially, for a module battery, a given distance is provided between the shorter side face of the electrode group and the inner wall of the container, and the outer longer side faces of the container are constrained by a metallic plate.

5601949

**ION CONDUCTIVE MATERIAL FOR
SECONDARY BATTERY**

Fujimoto Masahisa; Nishio Koji; Saitoh Toshihiko Osaka, JAPAN assigned to Sanyo Electric Co Ltd

A secondary battery is comprised of a positive electrode having a material intercalating alkali earth metal ions reversibly, a negative electrode having a carbon composition intercalating those ions reversibly and an electrolyte having an organic solvent and a solute. The solute includes an alkali earth metal salt. The organic solvent is selected from a group comprising ethylene carbonate (EC), dimethyl carbonate (DMC) and vinylene carbonate (VC). The carbon composition is selected from a group comprising coke, refined coke with 99% or more purity, organic compound produced by calcined cellulose, graphite and glassy carbon.

5602328

BATTERY LEAK TESTING METHOD

Palmer William P Anderson, IN, UNITED STATES assigned to General Motors Corporation

Method for detecting leaks in hydrogen-generating electric storage batteries including placing the battery in a suitable enclosure, overcharging the battery to generate hydrogen and analyzing the gas in the enclosure for hydrogen. The battery's vent will be suitably plugged or routed to divert any hydrogen escaping through the vent from contaminating the air in the enclosure. A hydrogen accumulator/separator concentrates the hydrogen at the hydrogen sensor.

5603157

**METHODS OF PRODUCING
BUTTON-TYPE BATTERIES AND A
PLURALITY OF BATTERY TERMINAL
HOUSING MEMBERS**

Lake Rickie; Blonsky Peter Boise, ID, UNITED STATES assigned to Micron Communications Inc

A method of forming a button-type battery includes: a) providing an electrically conductive sheet having an exposed surface which is divisible into a plurality of areas; b) depositing an uncured electrically insulative gasket material onto the conductive sheet into a plurality of the areas, the gasket material being deposited to define at least one discrete pattern within the respective deposited areas, the respective discrete patterns covering less than a total of their respective areas; c) curing the deposited gasket material; d) cutting and forming a plurality of discrete first terminal housing members from the areas of the conductive sheet, the respective first terminal housing members comprising at least a portion of one of the discrete patterns of gasket material; d) providing a discrete electrically conductive second terminal housing member in facing juxtaposition to one of the first terminal housing members; e) providing an anode and a cathode having a separator and electrolyte positioned therebetween; the anode, cathode, separator and electrolyte being positioned intermediate the juxtaposed first and second terminal housing members; the anode being positioned to electrically connect with

one of the first or second terminal housing members and the cathode being positioned to electrically connect with the other of the first or second terminal housing members; and f) crimping the first and second terminal housing members together into an enclosed battery housing with the gasket material being interposed between the first and second terminal housing members to provide a fluid-tight seal and to provide electrical insulation therebetween.

5604051

HIGH TEMPERATURE RECHARGEABLE CELL DESIGN

Pulley Christopher; Specht Steven J; Barlow Geoffrey
Shaker Hts, OH, UNITED STATES

There is described an lithium-alloy/molten salt/metal sulfide electrochemical cell which eliminates the use of perforated baskets to restrain active materials and uses simple mechanical seal made from ceramic material. It also uses high melting point salt as the electrical insulator between the electrodes and the cell can. In the cell, the positive current collector is made from flexible graphite and a corrosion resistant metal. The cell is assembled in a low carbon steel case with side closure.

5604053

ELECTROCHEMICAL CELL

Coetzer Johan; Vlok Isak L Pretoria, SOUTH AFRICA
assigned to Electro Chemical Holdings Societe
Anonyme

The invention provides an electrochemical cell, a cathode therefor and methods of making them. The cell is of the high temperature alkali metal/transition metal halide type, having a molten sodium anode, a nickel/nickel chloride cathode, an essentially sodium aluminium chloride molten salt electrolyte and a solid electrolyte sodium ion conducting separator which separates the sodium from the molten salt electrolyte. The nickel/nickel chloride is dispersed in solid form in a porous electronically conductive electrolyte-permeable matrix which is impregnated by the molten salt electrolyte, and antimony in finely divided solid form is mixed with the nickel/nickel chloride in the matrix. The

mass ratio of antimony to the nickel in the nickel chloride in the cell in its fully charged state is 2:100-130:100.

5604054

REDUCED ENVIRONMENTAL HAZARD LECLANCHE CELL HAVING IMPROVED PERFORMANCE IONICALLY PERMEABLE SEPARATOR

Ekern Ronald J; Armacanqui Miguel; Rose Janna L
Verona, WI, UNITED STATES assigned to Rayovac
Corporation

An ionically permeable separator for a LeClanche cell, and methods of making and using same, are provided for in the invention. The separator comprises a Kraft paper separator and a corrosion-inhibiting coating thereupon selected to prevent corrosion of a zinc anode of the LeClanche cell. The separator may be configured for use in round or flat LeClanche cells. The separators of the invention may be used in heavy duty batteries containing an electrolyte comprising zinc chloride as a primary component. Cells made in accordance with the invention exhibit comparable or improved capacity and other performance characteristics in respect of conventional cells.

5604056

ELECTROLYTIC CELL AND PROCESS FOR TREATING AN ALKALI METAL ELECTRODE

Fauteux Denis; Van Buren Marti; Shi Jie Acton, MA,
UNITED STATES

An electrolytic cell and process for treating an alkali metal electrode, wherein an additive is applied to the electrode so as to result in a predominately additive interface between the electrode and an electrolyte. The additive interface is ionically conductive yet non-ionic. In addition, the additive interface is substantially inert when in contact with the electrode, while being substantially insoluble in the electrolyte.

5604660

**ELECTROCHEMICAL CELL HAVING
SOLID POLYMER ELECTROLYTE AND
ASYMMETRIC INORGANIC
ELECTRODES**

Bai Lijun; Nerz John E; Li Changming Vernon Hills, IL, UNITED STATES assigned to Motorola Inc

An electrochemical cell is made with two asymmetric electrodes and a solid polymer electrolyte. The anode is made from materials such metal hydrides, metals, metal hydroxides or metal oxides. The cathode is made from metal hydrides, metals, metal hydroxides or metal oxides. A solid polymer electrolyte is in intimate contact with and situated between the anode and the cathode. The solid polymer electrolyte is made from a polymeric binder such as polyethylene oxide, polyvinylalcohol, polyvinyl acetate, polyacrylamide, poly(vinylpyrrolidone), poly(2-vinylpyridine), poly(4-vinylpyridine) and polyethyleneimine. The polymeric binder has H₂SO₄ or H₃PO₄ dispersed within it.

5607485

**METHOD OF MAKING POLYMERIC
ELECTROLYTIC CELL SEPARATOR
MEMBRANE**

Gozdz Antoni S; Schmutz Caroline; Tarascon Jean-Mari; Warren Paul C Tinton Falls, NJ, UNITED STATES assigned to Bell Communications Research Inc

A flexible polymeric film useful as an interelectrode separator or electrolyte member in electrolytic devices, such as rechargeable batteries, comprises a copolymer of vinylidene fluoride with 8 to 25% hexafluoropropylene. The film may be cast or formed as a self-supporting layer retaining about 20% to 70% of a high-boiling solvent plasticizer or plasticizer mixture comprising such solvents as ethylene carbonate, propylene carbonate, dimethyl carbonate, and dibutyl phthalate. The film may be used in such form or after extracting of the retained plasticizer with a film-inert low-boiling solvent to provide a separator member into which a solution of electrolytic salt is subsequently imbibed to displace retained plasticizer or replace plasticizer previously extracted from the polymeric matrix.

5607787

**HIGH TEMPERATURE STORAGE
BATTERY**

Wedlake Roger; Bones Roger J; Segal David L Mulbarton, SOUTH AFRICA assigned to Programme 3 Patent Holdings

A high temperature storage battery comprises a plurality of panels forming a housing defining a cell storage cavity, heat insulating material in or adjacent the panels, and a non-aqueous high temperature electrochemical cell within the cell storage cavity. It also includes holding means for holding a dispersible protective substance. The holding means is adapted to discharge protective substance into the cavity on the temperature in the cavity exceeding a predetermined temperature, and/or on rupturing thereof.

5607788

**ZINC-BROMINE BATTERY WITH
CIRCULATING ELECTROLYTES**

Tomazic Ger Murzzuschiag, AUSTRIA assigned to Elin Energieanwendung GmbH

PCT No. PCT/AT93/00134 Sec. 371 Date Apr. 24, 1995 Sec. 102(e) Date Apr. 24, 1995 PCT Filed Aug. 30, 1993 PCT Pub. No. WO94/06167 PCT Pub. Date Mar. 17, 1994. Zinc-bromine battery with circulating electrolytes, motor-driven pumps with pump chambers, containers for the electrolytes, dipolar electrodes and separators of synthetic material fitted between them, in which the edges of the separators and the electrodes are welded together, and electrolyte inlet and outlet lines allocated to the electrode chambers thus formed, and possibly heat exchangers for the electrolytes. One gas and liquid-proof chamber unit with at least one container, catholyte inlet and outlet lines, a pump chamber and cathode chambers is formed which is connected to another gas and liquid-proof chamber unit consisting of another container, anolyte inlet and outlet lines, another pump chamber and anode chambers, especially solely via separators.

5607796**RECHARGEABLE ALKALINE
ELECTROCHEMICAL CELL**

Jacus Robert J; Rose Janna Madison, WI, UNITED STATES assigned to Rayovac Corporation

This invention pertains to rechargeable zinc alkaline electrochemical cells. In cells of the invention, the anode current collector comprises copper, and from about 0.5% by weight to about 11% silicon. Preferred compositions for the anode current collector comprise from about 1% by weight silicon to about 6% by weight silicon. Cells embodying anode current collectors of the invention exhibit reduced current flow under anode polarization in alkaline conditions, and reduced cell expansion under abusive electrical drain conditions. The cells are less susceptible to oxidation of the anode current collector, which is typically irreversible, than known brass anode current collectors. In general, cells of the invention are less susceptible to, and generally do not exhibit as much, irreversible chemical reaction activity, as conventional current collectors, especially oxidation of copper at the anode current collector.

5608181**ELECTRIC POWER GENERATING
ELEMENT**

Yasuda Shigeyuki Kibuki cho kita, Kasugai shi, Aichi ken, JAPAN

In an electric power generating element, either positive or negative electrode includes a composition containing an organic compound as a main agent and the positive electrode has an electrically conductive substance so that relatively low-temperature thermal energy is efficiently converted to electric energy. Polyethylene glycol is employed as the organic compound and graphite or a graphite composition is employed as the conductive substance. Salt providing ionic conductivity may be added to the organic compound or polyethylene glycol, and the negative electrode may be formed of a metal having an ionization tendency as large as or larger than copper or a composition of the metal.

5609973**REDUCED ENVIRONMENTAL HAZARD
LECLANCHE CELL HAVING IMPROVED
PERFORMANCE**

Ekern Ronald; Messing Terry G Verona, WI, UNITED STATES assigned to Rayovac Corporation

A low iron zinc anode for a LeClanche cell, and methods of making and using same, are provided for in the invention. The zinc anode contains at least 95% zinc and no more than about 12 ppm iron, and may be configured for use in round or flat LeClanche cells. The zinc anodes of the invention may be used in general purpose and heavy duty batteries containing an electrolyte comprising zinc chloride as a primary component. Cells made in accordance with the invention exhibit improved capacity and other performance characteristics in respect of conventional cells.

5609976**ALKALINE STORAGE BATTERY**

Ueda Takao; Takizawa Yoshihisa Itano gun, JAPAN assigned to Sanyo Electric Co Ltd

The alkaline storage battery comprises a positive electrode, a negative electrode, a separator, and alkaline electrolyte. The separator is a single layer of synthetic fiber non-woven fabric. Treating the separator to increase either the amount of fiber interconnection at the surface or the amount the fibers are broken apart at the surface or both improves separator strength without sacrificing permeability. This prevents internal short circuits, reduces internal pressure, and significantly improves battery lifetime.

5612148**PROCESS FOR ENERGY STORAGE
AND/OR POWER DELIVERY WITH
MEANS FOR RESTORING
ELECTROLYTE BALANCE**

Zito Ralph Chapel Hill, NC, UNITED STATES assigned to National Power PLC

An electrochemical apparatus for energy storage and/or power delivery comprises multi-compartment cells with the +ve chamber and the -ve chamber of each cell being separated by at least one buffer chamber through which an idler electrolyte circulates, the electrolyte circulating through the -ve chamber during power delivery containing sulfide and the apparatus comprising means for restoring the electrolyte balance of the -ve electrolyte by the oxidation of any S²⁻ and/or HS⁻ ions contained in the idler electrolyte to form sulfur, means for the collection of precipitated sulfur and means for the reintroduction of the precipitated sulfur into the -ve electrolyte.

5612150

**METHOD AND APPARATUS FOR
TREATMENT OF A BATTERY
CONTAINING ALKALI METAL**

Nishimura Katsunori; Honbo Hidetoshi; Gotoh Akihiro; Mizumoto Mamoru; Horiba Tatsuo Hitachi, JAPAN assigned to Hitachi Ltd

A safe and controllable method of treating a secondary battery having at least one component containing alkali metal, comprises the steps of opening the battery casing, and introducing a gas containing at least one of water vapor and alcohol vapor into a closed chamber containing the battery thereby to form alkali metal hydroxide. To control hydrogen concentration, the rate of introduction of water and/or alcohol vapor may be varied. Apparatus for carrying out this method is also described.

5616429

**ALKALI METAL ELECTROCHEMICAL
CELL EXHIBITING REDUCED VOLTAGE
DELAY AND METHOD OF
MANUFACTURE**

Klementowski Thomas W Amherst, NY, UNITED STATES assigned to Wilson Greatbatch Ltd

An alkali metal electrochemical cell capable of delivering high current pulses without exhibiting voltage delay, rapidly recovering its open circuit voltage and having high current capacity, is described. The stated

benefits are realized by conditioning the cell heated at an elevated temperature for an extended period of time.

5618640

NONAQUEOUS SECONDARY BATTERY

Idota Yoshio; Mishima Masayuki; Miyaki Yukio; Kubota Tadahiko; Miyasaka Tsutomu Kanagawa, JAPAN assigned to Fuji Photo Film Co Ltd

A nonaqueous secondary battery comprising a positive electrode active material, a negative electrode active material, and a lithium salt is disclosed, in which the negative electrode active material contains (1) a compound capable of intercalating and deintercalating lithium comprising an atom of the group IIIB, IVB or VB of the periodic table, (2) an amorphous compound containing at least two atoms selected from the elements of the groups IIIB, IVB, and VB of the periodic table, (3) a compound capable of intercalating and deintercalating lithium containing at least one of the atoms of the group IIIB, IVB, and VB of the periodic table and fluorine, or (4) a compound of the metal of the group IIIB, IVB or VB of the periodic table, Zn, or Mg which is capable of intercalating and deintercalating lithium. The nonaqueous secondary battery of the invention exhibits improved charge and discharge characteristics and improved safety.

5624468

**METHOD FOR FABRICATING A
LEADLESS BATTERY EMPLOYING AN
ALKALI METAL ANODE AND POLYMER
FILM INKS**

Lake Rickie Boise, ID, UNITED STATES assigned to Micron Technology Inc

A package and method for fabricating a battery is disclosed. According to the method a first base, preferably comprising a polyester, is provided and a first slot is made thereon. Next, a first conductive thick film ink is printed superjacent the first base which is subsequently cured to form a first conductive layer. Subsequently, a cathode layer is formed superjacent the first conductive layer and the combination is

subsequently cured. An electrolyte layer is then formed superjacent the cathode layer, which is subsequently cured to complete the first base. A second base, preferably comprising a polyester, is then provided and a second slot is made thereon. Subsequently, a second conductive thick film ink is printed superjacent the second base which is then cured to form a second conductive layer. Next, a molten alkali metal is fused to the second conductive layer and allowed to solidify and cool. This completes fabrication of the second base. Once both first and second bases are completed, they are properly aligned such that the first pad is exposed through the second slot, and the second pad is exposed through the first slot. Thus, direct electrical contact can be made to both the first and second conductive layers by means of both pads through both slots.

5624771

NON-AQUEOUS ELECTROLYTE CELL

Sano Akihiro; Nishino Shuich; Daio Fumio; Oguro Shusuke; Kondo Masatsug Hirakata, JAPAN assigned to Matsushita Electric Industrial Co Ltd

The present invention provides a general purpose non-aqueous electrolyte cell of high performance, capable of long-term use and/or storage even in high-temperature environments by separating the positive and the negative electrodes with a separator. The separator is made of glass-fiber non-woven cloth having a defined fiber diameter, fiber weight per unit area, and average pore size. The present invention also provides a gasket made of polyphenylene sulfide resin only or substantially of polyphenylene sulfide on which a sealant layer made substantially of blown asphalt is disposed.

5629109

NON-AQUEOUS ELECTROLYTE SECONDARY BATTERY AND METHOD FOR PRODUCING ANODE THEREFOR

Ito Shuji; Murata Toshihide; Hasegawa Masaki; Bito Yasuhiko; Toyoguchi Yoshinori Akashi, JAPAN assigned to Matsushita Electric Industrial Co Ltd

A non-aqueous electrolyte secondary battery is disclosed which has an anode comprising a carbon material. The carbon material contains at least one of 7-35 wt % sulfur, 6.5-25 wt % oxygen and 10.5-18.3 wt % nitrogen, provided that if the carbon material contains at least two of these elements, the total amount of the elements does not exceed 35 wt %.

5629108

METHOD OF FORMING A BATTERY AND BATTERY

Lake Rickie C Eagle, ID, UNITED STATES assigned to Micron Communications Inc

A button-type battery includes, a) an anode; b) a cathode positioned adjacent to the anode; c) an electrolyte between the anode and the cathode; d) a conductive first terminal housing member in electrical contact with one of the anode or the cathode; the first terminal housing member having a periphery; e) a conductive second terminal housing member in electrical contact with the other of the anode or the cathode; the second terminal housing member having a periphery; f) the first and second terminal housing members forming an enclosed housing which holds and protects the anode, the cathode and the electrolyte; and g) the first and second terminal housing member peripheries being configured together to form an electrically insulative seal which seals the anode, the electrolyte and the cathode within the housing formed by the first and second terminal housing members, the electrically insulative seal comprising cross-linked butyl rubber. The seal can include a gasket which constitutes the cross-linked butyl rubber or other material. The seal can comprise an uncured precursor to butyl rubber. Methods of forming such button-type batteries include in situ curing or forming butyl rubber in place on one of the battery terminals. Alternately, a butyl rubber precursor can be applied to one or both of the battery terminals.



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