

An improved resistive electrode is disclosed for a welding apparatus for welding a battery terminal post to a battery bushing. The battery terminal post is electrically connected to a battery plate disposed within a battery case and the battery bushing is secured to a battery case cover with the bushing having a central bushing aperture for receiving the battery terminal post therein when the battery case cover is located on the battery case. The resistive electrode comprising a resistive electrode extending between a base end and a tip end with the base end being secured to a power source. A conductive member engages the resistive electrode for facilitating the flow of electric power from the base end to the tip end for concentrating the resistive heat proximate to the tip end of the resistive electrode.

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#### **NON-DISSIPATIVE BATTERY CHARGER EQUALIZER**

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A battery charger is disclosed for recharging reusable batteries in a manner that prevents overcharging of the same. The charger includes a voltage source and non-dissipative shunt arrangement that can be customized to charge any number of batteries. The charger may be a current limiting power supply that is controlled by the voltage or charge state of the batteries being recharged. The non-dissipative shunt includes a pair of transistors for each pair of batteries and an inductor placed one end between the battery pair and another end between the transistor pair. An oscillator, having two phases of equal, but opposite phase, is used to control each transistor to apply charge to a given battery during one phase and then to allow the charge to equalize between the battery pair during the second phase. The equalization is continued until both batteries reach a full charge without overcharging any one battery.

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#### **BATTERY DISCHARGING APPARATUS**

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A battery discharging apparatus is provided with a battery discharger and a controller. The controller is connected to a battery voltage sensor and a timer, a current sensor and a discharge switch, or a current sensor and a battery power capacity sensor. The controller directs the discharger to recover battery capacity lost due to the memory effect using a deep memory effect eliminating discharge.

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#### **METHOD AND APPARATUS FOR MEASURING RESIDUAL CAPACITY OF AN ELECTRIC-VEHICLE BATTERY**

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A method and an apparatus are provided for detecting a current residual capacity of a battery employed in an electric vehicle, such as an electric car. During a charging process, a value of the charge current of the battery is measured and an estimated discharge voltage corresponding to a current battery accumulated power is determined. A power of the battery as a product of the value of the charge current of the battery and the estimated discharge voltage is thereafter computed and the computed power is added to the current battery accumulated power to provide a new current battery accumulated power for display. During a discharging process, values of the discharge voltage and the discharge current are measured. The amount of consumed power is thereafter computed as a product of the values of the discharge voltage and the discharge current. The computed amount of consumed power is subtracted from a current battery residual capacity to produce a new current battery residual capacity for display. The above estimated discharge voltage is found from data obtained from test-working experiments or a process of learning the running states of an actual electric vehicle.

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#### **METHOD OF RAPIDLY CHARGING A LITHIUM ION CELL**

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