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(54) STORAGE BATTERY AND BATTERY TESTER

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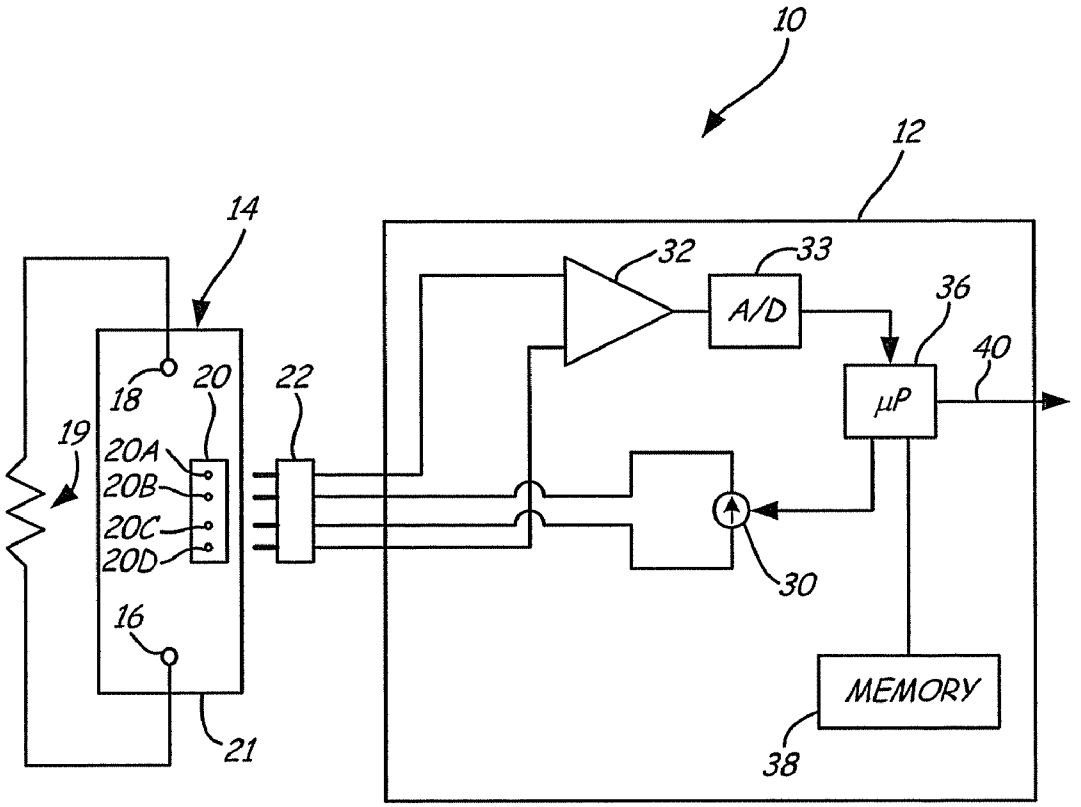
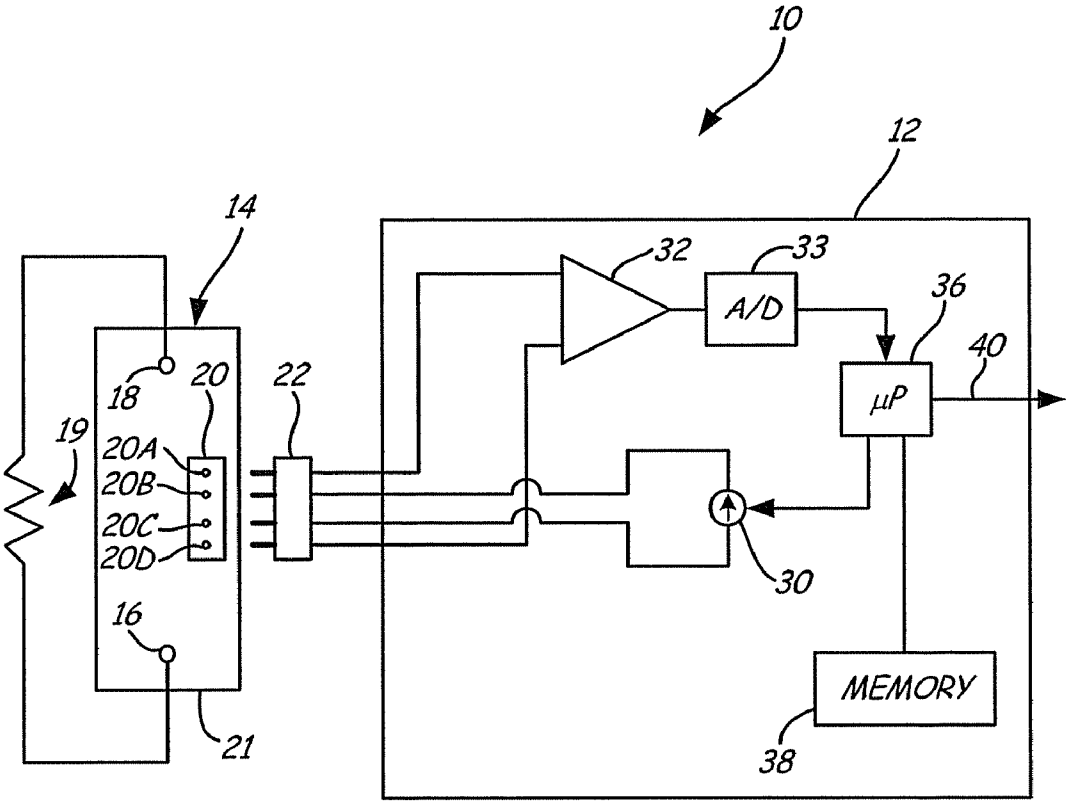
(57) **ABSTRACT**

A storage battery is provided which has a first and second post for electrically coupling to an electrical system. A test plug is provided for use in coupling the storage battery to an electronic battery tester. In another aspect, a battery tester is provided having a plug configured to couple to a test plug of a storage battery for use in performing an electronic battery test on the storage battery.




10
12
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A/D
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20A
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MEMORY
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38

FIG. 1

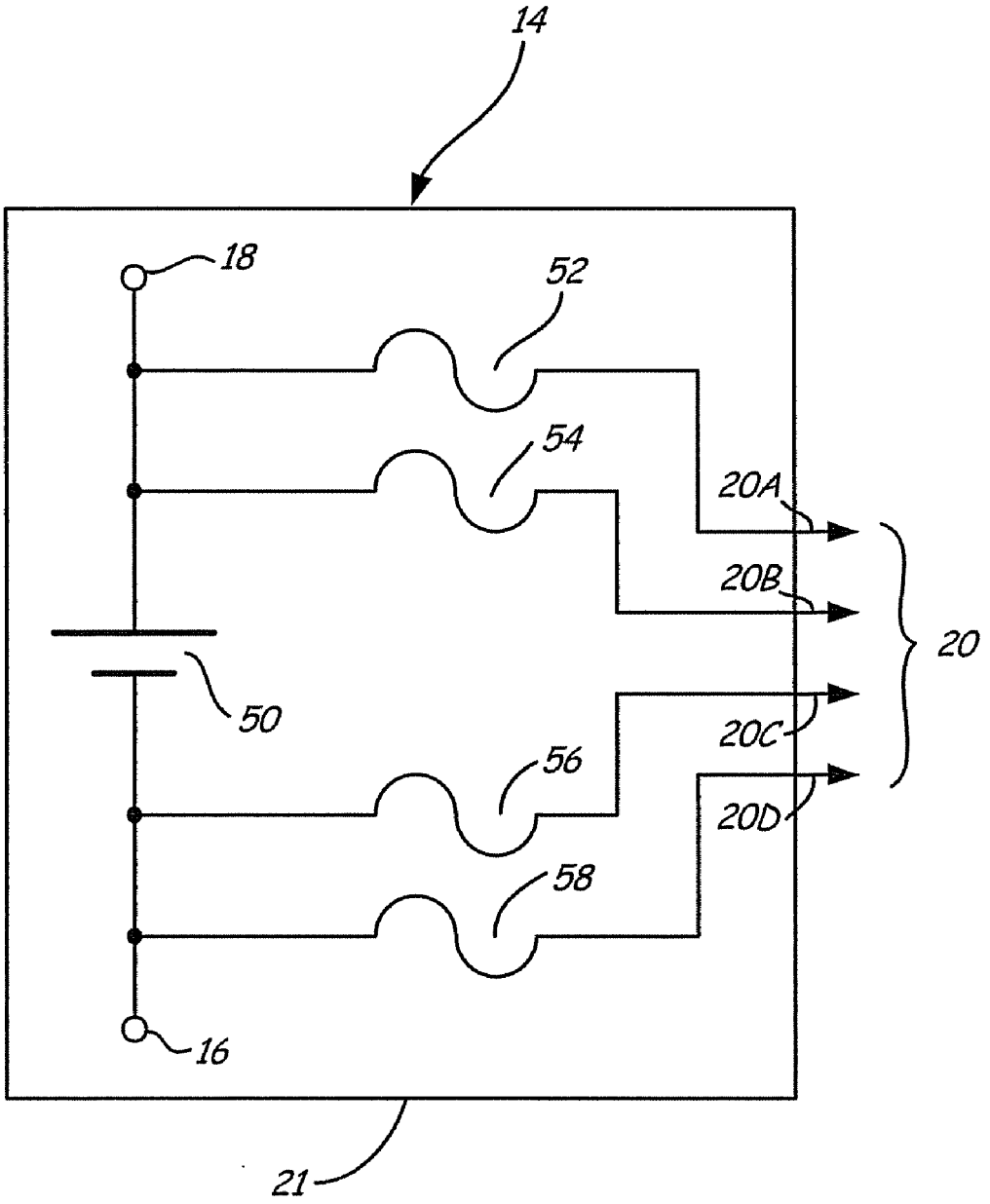

FIG. 2

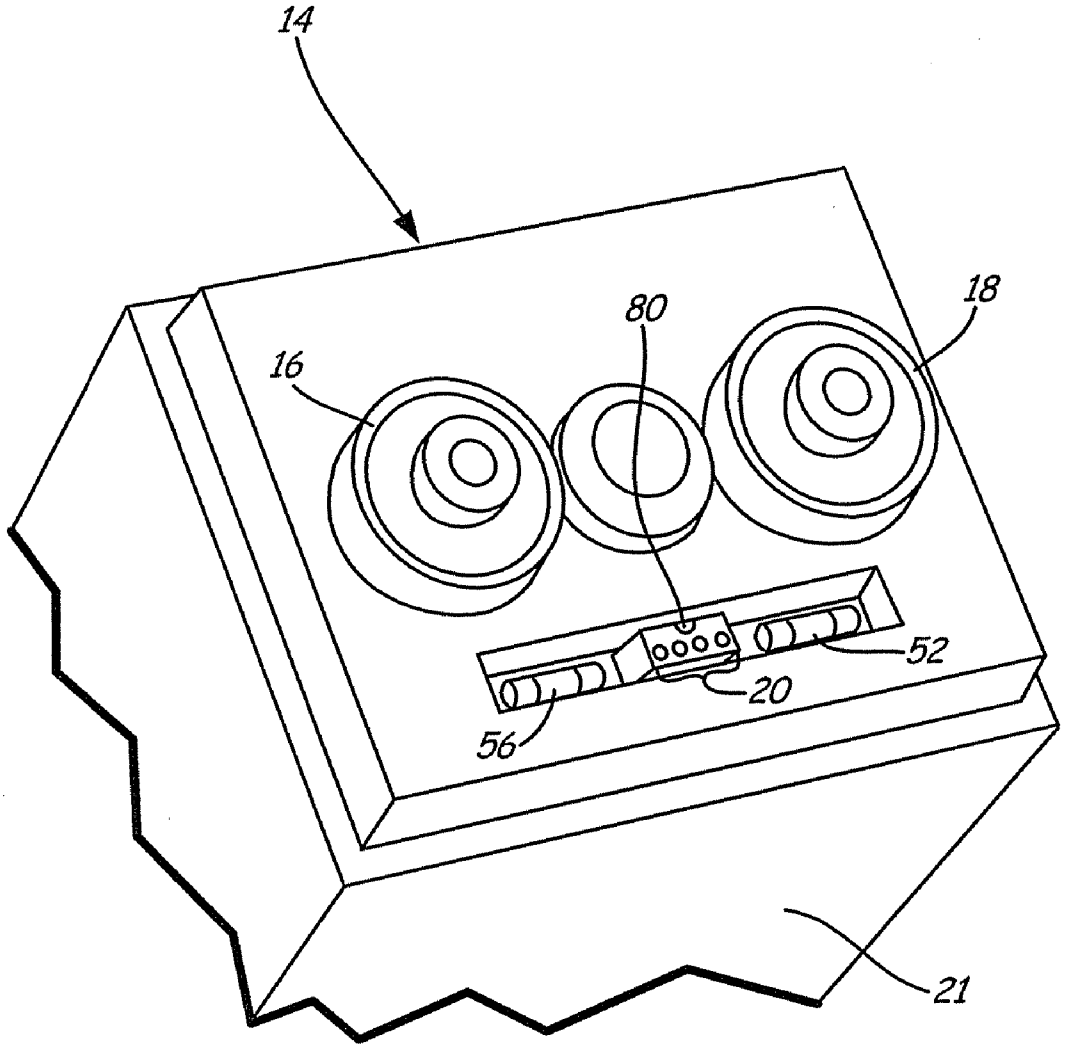

FIG. 3

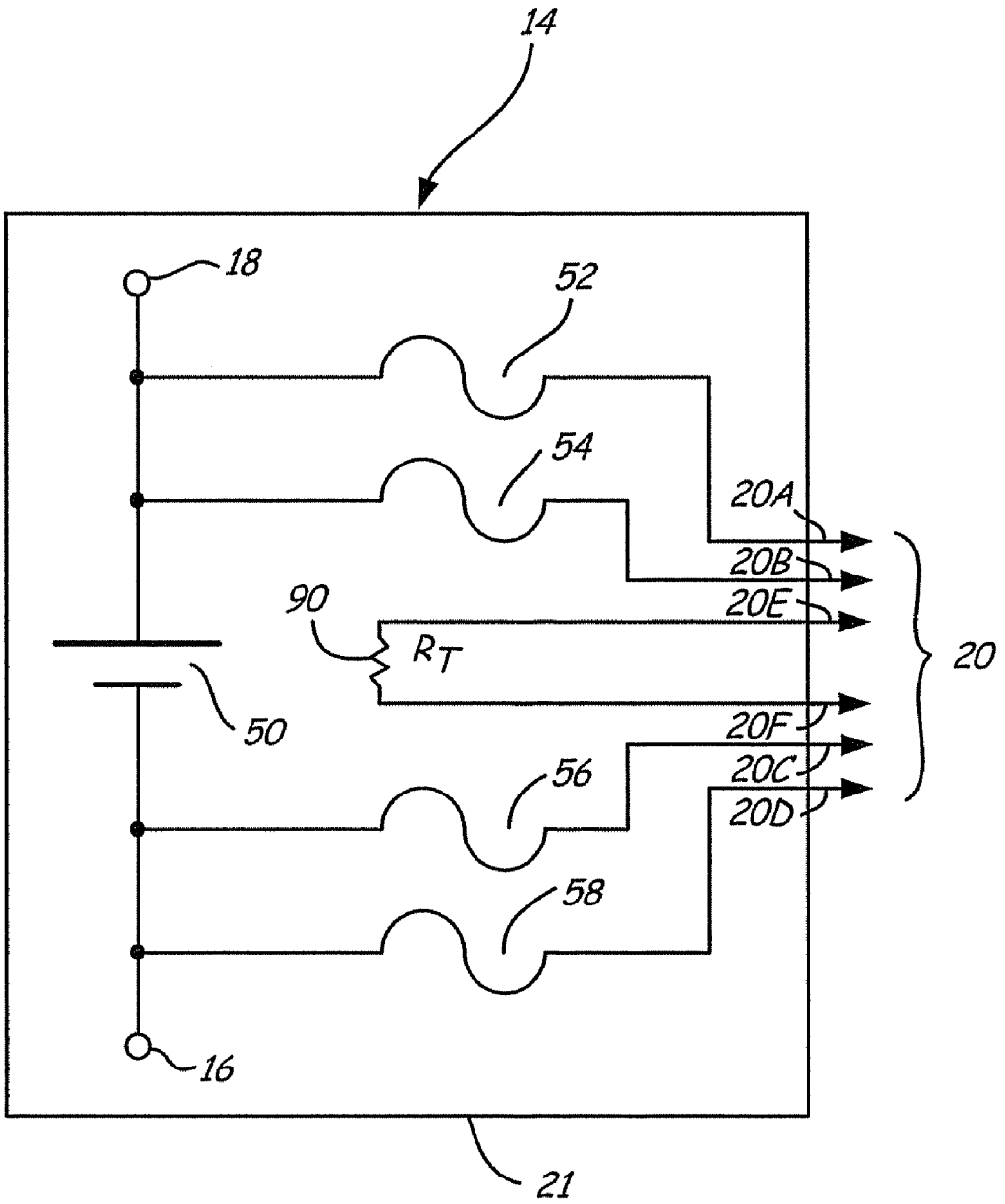

FIG. 4

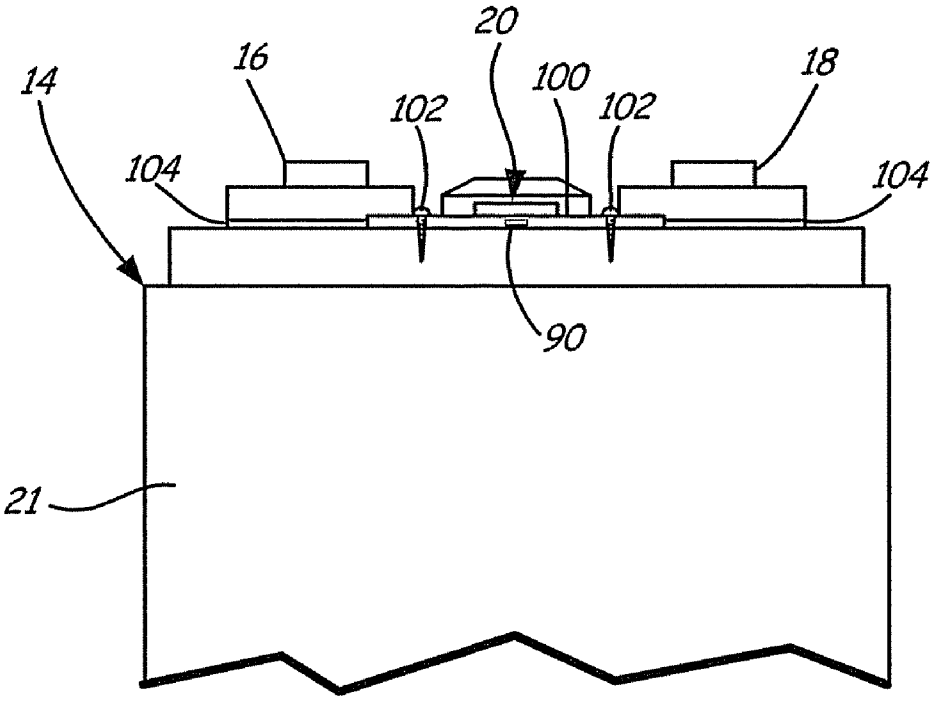

FIG. 5

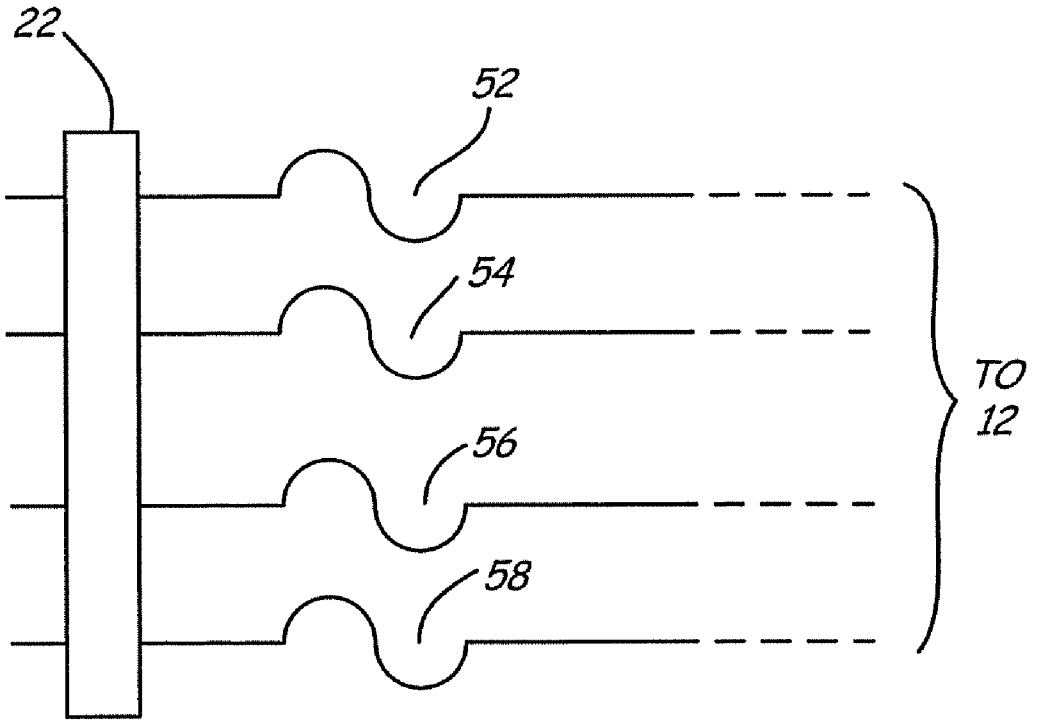

FIG. 6

STORAGE BATTERY AND BATTERY TESTER

[0001] The present application is based on and claims the benefit of U.S. provisional patent application Ser. No. 60/992,798, filed Dec. 6, 2007, the content of which is hereby incorporated by reference in its entirety.

BACKGROUND OF THE INVENTION

[0002] The present invention relates to storage batteries and electronic battery testers used to test such storage batteries.

[0003] Storage batteries, of the type used in automotive vehicles, as backup power sources, etc., typically comprise a plurality of battery plates which form a series of single cells batteries, coupled together to form the storage battery. Various chemistries are used in such batteries.

[0004] Storage batteries typically have a limited life span and must be replaced and periodically recharged. Various techniques are known to monitor the condition of such batteries to determine if replacement or recharging is necessary. Midtronics, Inc. of Willowbrook, Ill. and Dr. Keith S. Champlin have pioneered techniques for monitoring such storage batteries. Examples of such techniques are shown and described in U.S. Pat. No. 3,873,911, issued Mar. 25, 1975, to Champlin; U.S. Pat. No. 3,909,708, issued Sep. 30, 1975, to Champlin; U.S. Pat. No. 4,816,768, issued Mar. 28, 1989, to Champlin; U.S. Pat. No. 4,825,170, issued Apr. 25, 1989, to Champlin; U.S. Pat. No. 4,881,038, issued Nov. 14, 1989, to Champlin; U.S. Pat. No. 4,912,416, issued Mar. 27, 1990, to Champlin; U.S. Pat. No. 5,140,269, issued Aug. 18, 1992, to Champlin; U.S. Pat. No. 5,343,380, issued Aug. 30, 1994; U.S. Pat. No. 5,572,136, issued Nov. 5, 1996; U.S. Pat. No. 5,574,355, issued Nov. 12, 1996; U.S. Pat. No. 5,583,416, issued Dec. 10, 1996; U.S. Pat. No. 5,585,728, issued Dec. 17, 1996; U.S. Pat. No. 5,589,757, issued Dec. 31, 1996; U.S. Pat. No. 5,592,093, issued Jan. 7, 1997; U.S. Pat. No. 5,598,098, issued Jan. 28, 1997; U.S. Pat. No. 5,656,920, issued Aug. 12, 1997; U.S. Pat. No. 5,757,192, issued May 26, 1998; U.S. Pat. No. 5,821,756, issued Oct. 13, 1998; U.S. Pat. No. 5,831,435, issued Nov. 3, 1998; U.S. Pat. No. 5,871,858, issued Feb. 16, 1999; U.S. Pat. No. 5,914,605, issued Jun. 22, 1999; U.S. Pat. No. 5,945,829, issued Aug. 31, 1999; U.S. Pat. No. 6,002,238, issued Dec. 14, 1999; U.S. Pat. No. 6,037,751, issued Mar. 14, 2000; U.S. Pat. No. 6,037,777, issued Mar. 14, 2000; U.S. Pat. No. 6,051,976, issued Apr. 18, 2000; U.S. Pat. No. 6,081,098, issued Jun. 27, 2000; U.S. Pat. No. 6,091,245, issued Jul. 18, 2000; U.S. Pat. No. 6,104,167, issued Aug. 15, 2000; U.S. Pat. No. 6,137,269, issued Oct. 24, 2000; U.S. Pat. No. 6,163,156, issued Dec. 19, 2000; U.S. Pat. No. 6,172,483, issued Jan. 9, 2001; U.S. Pat. No. 6,172,505, issued Jan. 9, 2001; U.S. Pat. No. 6,222,369, issued Apr. 24, 2001; U.S. Pat. No. 6,225,808, issued May 1, 2001; U.S. Pat. No. 6,249,124, issued Jun. 19, 2001; U.S. Pat. No. 6,259,254, issued Jul. 10, 2001; U.S. Pat. No. 6,262,563, issued Jul. 17, 2001; U.S. Pat. No. 6,294,896, issued Sep. 25, 2001; U.S. Pat. No. 6,294,897, issued Sep. 25, 2001; U.S. Pat. No. 6,304,087, issued Oct. 16, 2001; U.S. Pat. No. 6,310,481, issued Oct. 30, 2001; U.S. Pat. No. 6,313,607, issued Nov. 6, 2001; U.S. Pat. No. 6,313,608, issued Nov. 6, 2001; U.S. Pat. No. 6,316,914, issued Nov. 13, 2001; U.S. Pat. No. 6,323,650, issued Nov. 27, 2001; U.S. Pat. No. 6,329,793, issued Dec. 11, 2001; U.S. Pat. No. 6,331,762, issued Dec. 18, 2001; U.S. Pat. No. 6,332,113, issued Dec. 18, 2001; U.S. Pat. No. 6,351,102, issued Feb. 26, 2002; U.S. Pat. No. 6,359,441, issued Mar. 19, 2002; U.S. Pat. No. 6,363,303, issued Mar. 26, 2002; U.S. Pat. No. 6,377,031, issued Apr. 23, 2002; U.S. Pat. No. 6,392,414, issued May 21, 2002; U.S. Pat. No. 6,417,669, issued Jul. 9, 2002; U.S. Pat. No. 6,424,158, issued Jul. 23, 2002; U.S. Pat. No. 6,441,585, issued Aug. 17, 2002; U.S. Pat. No. 6,437,957, issued Aug. 20, 2002; U.S. Pat. No. 6,445,158, issued Sep. 3, 2002; U.S. Pat. No. 6,456,045; U.S. Pat. No. 6,466,025, issued Oct. 15, 2002; U.S. Pat. No. 6,465,908, issued Oct. 15, 2002; U.S. Pat. No. 6,466,026, issued Oct. 15, 2002; U.S. Pat. No. 6,469,511, issued Nov. 22, 2002; U.S. Pat. No. 6,495,990, issued Dec. 17, 2002; U.S. Pat. No. 6,497,209, issued Dec. 24, 2002; U.S. Pat. No. 6,507,196, issued Jan. 14, 2003; U.S. Pat. No. 6,534,993; issued Mar. 18, 2003; U.S. Pat. No. 6,544,078, issued Apr. 8, 2003; U.S. Pat. No. 6,556,019, issued Apr. 29, 2003; U.S. Pat. No. 6,566,883, issued May 20, 2003; U.S. Pat. No. 6,586,941, issued Jul. 1, 2003; U.S. Pat. No. 6,597,150, issued Jul. 22, 2003; U.S. Pat. No. 6,621,272, issued Sep. 16, 2003; U.S. Pat. No. 6,623,314, issued Sep. 23, 2003; U.S. Pat. No. 6,633,165, issued Oct. 14, 2003; U.S. Pat. No. 6,635,974, issued Oct. 21, 2003; U.S. Pat. No. 6,707,303, issued Mar. 16, 2004; U.S. Pat. No. 6,737,831, issued May 18, 2004; U.S. Pat. No. 6,744,149, issued Jun. 1, 2004; U.S. Pat. No. 6,759,849, issued Jul. 6, 2004; U.S. Pat. No. 6,781,382, issued Aug. 24, 2004; U.S. Pat. No. 6,788,025, filed Sep. 7, 2004; U.S. Pat. No. 6,795,782, issued Sep. 21, 2004; U.S. Pat. No. 6,805,090, filed Oct. 19, 2004; U.S. Pat. No. 6,806,716, filed Oct. 19, 2004; U.S. Pat. No. 6,850,037, filed Feb. 1, 2005; U.S. Pat. No. 6,850,037, issued Feb. 1, 2005; U.S. Pat. No. 6,871,151, issued march 22, 2005; U.S. Pat. No. 6,885,195, issued Apr. 26, 2005; U.S. Pat. No. 6,888,468, issued May 3, 2005; U.S. Pat. No. 6,891,378, issued May 10, 2005; U.S. Pat. No. 6,906,522, issued Jun. 14, 2005; U.S. Pat. No. 6,906,523, issued Jun. 14, 2005; U.S. Pat. No. 6,909,287, issued Jun. 21, 2005; U.S. Pat. No. 6,914,413, issued Jul. 5, 2005; U.S. Pat. No. 6,913,483, issued Jul. 5, 2005; U.S. Pat. No. 6,930,485, issued Aug. 16, 2005; U.S. Pat. No. 6,933,727, issued Aug. 23, 200; U.S. Pat. No. 6,941,234, filed Sep. 6, 2005; U.S. Pat. No. 6,967,484, issued Nov. 22, 2005; U.S. Pat. No. 6,998,847, issued Feb. 14, 2006; U.S. Pat. No. 7,003,410, issued Feb. 21, 2006; U.S. Pat. No. 7,003,411, issued Feb. 21, 2006; U.S. Pat. No. 7,012,433, issued Mar. 14, 2006; U.S. Pat. No. 7,015,674, issued Mar. 21, 2006; U.S. Pat. No. 7,034,541, issued Apr. 25, 2006; U.S. Pat. No. 7,039,533, issued May 2, 2006; U.S. Pat. No. 7,058,525, issued Jun. 6, 2006; U.S. Pat. No. 7,081,755, issued Jul. 25, 2006; U.S. Pat. No. 7,106,070, issued Sep. 12, 2006; U.S. Pat. No. 7,116,109, issued Oct. 3, 2006; U.S. Pat. No. 7,119,686, issued Oct. 10, 2006; and U.S. Pat. No. 7,126,341, issued Oct. 24, 2006; U.S. Pat. No. 7,154,276, issued Dec. 26, 2006; U.S. Pat. No. 7,198,510, issued Apr. 3, 2007; U.S. Pat. No. 7,363,175, issued Apr. 22, 2008; U.S. Pat. No. 7,208,914, issued Apr. 24, 2007; U.S. Pat. No. 7,246,015, issued Jul. 17, 2007; U.S. Pat. No. 7,295,936, issued Nov. 13, 2007; U.S. Pat. No. 7,319,304, issued Jan. 15, 2008; U.S. Pat. No. 7,363,175, issued Apr. 22, 2008; U.S. Pat. No. 7,398,176, issued Jul. 8, 2008; U.S. Pat. No. 7,408,358, issued Aug. 5, 2008; U.S. Pat. No. 7,425,833, issued Sep. 16, 2008; U.S. Pat. No. 7,446,536, issued Nov. 4, 2008; U.S. Ser. No. 09/780,146, filed Feb. 9, 2001, entitled STORAGE BATTERY WITH INTEGRAL BATTERY TESTER; U.S. Ser. No. 09/756,638, filed Jan. 8, 2001, entitled METHOD AND APPARATUS FOR DETERMINING BATTERY PROPERTIES FROM COMPLEX IMPEDANCE/ADMITTANCE; U.S. Ser. No. 09/862,783, filed May 21, 2001, entitled METHOD AND APPARATUS FOR

TESTING CELLS AND BATTERIES EMBEDDED IN SERIES/PARALLEL SYSTEMS; U.S. Ser. No. 09/880,473, filed Jun. 13, 2001; entitled BATTERY TEST MODULE; U.S. Ser. No. 10/042,451, filed Jan. 8, 2002, entitled BATTERY CHARGE CONTROL DEVICE; U.S. Ser. No. 10/109,734, filed Mar. 28, 2002, entitled APPARATUS AND METHOD FOR COUNTERACTING SELF DISCHARGE IN A STORAGE BATTERY; U.S. Ser. No. 10/112,998, filed Mar. 29, 2002, entitled BATTERY TESTER WITH BATTERY REPLACEMENT OUTPUT; U.S. Ser. No. 10/263,473, filed Oct. 2, 2002, entitled ELECTRONIC BATTERY TESTER WITH RELATIVE TEST OUTPUT; U.S. Ser. No. 10/310,385, filed Dec. 5, 2002, entitled BATTERY TEST MODULE; U.S. Ser. No. 10/653,342, filed Sep. 2, 2003, entitled ELECTRONIC BATTERY TESTER CONFIGURED TO PREDICT A LOAD TEST RESULT; U.S. Ser. No. 10/441,271, filed May 19, 2003, entitled ELECTRONIC BATTERY TESTER; U.S. Ser. No. 09/653,963, filed Sep. 1, 2000, entitled SYSTEM AND METHOD FOR CONTROLLING POWER GENERATION AND STORAGE; U.S. Ser. No. 10/174,110, filed Jun. 18, 2002, entitled DAYTIME RUNNING LIGHT CONTROL USING AN INTELLIGENT POWER MANAGEMENT SYSTEM; U.S. Ser. No. 10/258,441, filed Apr. 9, 2003, entitled CURRENT MEASURING CIRCUIT SUITED FOR BATTERIES; U.S. Ser. No. 10/681,666, filed Oct. 8, 2003, entitled ELECTRONIC BATTERY TESTER WITH PROBE LIGHT; U.S. Ser. No. 10/783,682, filed Feb. 20, 2004, entitled REPLACEABLE CLAMP FOR ELECTRONIC BATTERY TESTER; U.S. Ser. No. 10/791,141, filed Mar. 2, 2004, entitled METHOD AND APPARATUS FOR AUDITING A BATTERY TEST; U.S. Ser. No. 10/867,385, filed Jun. 14, 2004, entitled ENERGY MANAGEMENT SYSTEM FOR AUTOMOTIVE VEHICLE; U.S. Ser. No. 10/896,834, filed Jul. 22, 2004, entitled ELECTRONIC BATTERY TESTER; U.S. Ser. No. 10/958,821, filed Oct. 5, 2004, entitled IN-VEHICLE BATTERY MONITOR; U.S. Ser. No. 10/958,812, filed Oct. 5, 2004, entitled SCAN TOOL FOR ELECTRONIC BATTERY TESTER; U.S. Ser. No. 11/008,456, filed Dec. 9, 2004, entitled APPARATUS AND METHOD FOR PREDICTING BATTERY CAPACITY AND FITNESS FOR SERVICE FROM A BATTERY DYNAMIC PARAMETER AND A RECOVERY VOLTAGE DIFFERENTIAL, U.S. Ser. No. 60/587,232, filed Dec. 14, 2004, entitled CELLTRON ULTRA, U.S. Ser. No. 11/018,785, filed Dec. 21, 2004, entitled WIRELESS BATTERY MONITOR; U.S. Ser. No. 60/653,537, filed Feb. 16, 2005, entitled CUSTOMER MANAGED WARRANTY CODE; U.S. Ser. No. 11/063,247, filed Feb. 22, 2005, entitled ELECTRONIC BATTERY TESTER OR CHARGER WITH DATABUS CONNECTION; U.S. Ser. No. 60/665,070, filed Mar. 24, 2005, entitled OHMMETER PROTECTION CIRCUIT; U.S. Ser. No. 11/141,234, filed May 31, 2005, entitled BATTERY TESTER CAPABLE OF IDENTIFYING FAULTY BATTERY POST ADAPTERS; U.S. Ser. No. 11/143,828, filed Jun. 2, 2005, entitled BATTERY TEST MODULE; U.S. Ser. No. 11/146,608, filed Jun. 7, 2005, entitled SCAN TOOL FOR ELECTRONIC BATTERY TESTER; U.S. Ser. No. 60,694,199, filed Jun. 27, 2005, entitled GEL BATTERY CONDUCTANCE COMPENSATION; U.S. Ser. No. 11/178,550, filed Jul. 11, 2005, entitled WIRELESS BATTERY TESTER/CHARGER; U.S. Ser. No. 60/705,389, filed Aug. 4, 2005, entitled PORTABLE TOOL THEFT PREVENTION SYSTEM, U.S. Ser. No. 11/207,419, filed Aug. 19, 2005, entitled SYSTEM FOR AUTOMATICALLY GATHERING BATTERY INFORMATION FOR USE DURING BATTERY TESTER/CHARGING, U.S. Ser. No. 60/712,322, filed Aug. 29, 2005, entitled AUTOMOTIVE VEHICLE ELECTRICAL SYSTEM DIAGNOSTIC DEVICE, U.S. Ser. No. 60/713,168, filed Aug. 31, 2005, entitled LOAD TESTER SIMULATION WITH DISCHARGE COMPENSATION, U.S. Ser. No. 60/731,881, filed Oct. 31, 2005, entitled PLUG-IN FEATURES FOR BATTERY TESTERS; U.S. Ser. No. 60/731,887, filed Oct. 31, 2005, entitled AUTOMOTIVE VEHICLE ELECTRICAL SYSTEM DIAGNOSTIC DEVICE; U.S. Ser. No. 11/304,004, filed Dec. 14, 2005, entitled BATTERY TESTER THAT CALCULATES ITS OWN REFERENCE VALUES; U.S. Ser. No. 60/751,853, filed Dec. 20, 2005, entitled BATTERY MONITORING SYSTEM; U.S. Ser. No. 11/304,004, filed Dec. 14, 2005, entitled BATTERY TESTER WITH CALCULATES ITS OWN REFERENCE VALUES; U.S. Ser. No. 60/751,853, filed Dec. 20, 2005, entitled BATTERY MONITORING SYSTEM; U.S. Ser. No. 11/356,299, filed Feb. 16, 2006, entitled CENTRALLY MONITORED SALES OF STORAGE BATTERIES; U.S. Ser. No. 11/356,443, filed Feb. 16, 2006, entitled ELECTRONIC BATTERY TESTER WITH NETWORK COMMUNICATION; U.S. Ser. No. 11/498,703, filed Aug. 3, 2006, entitled THEFT PREVENTION DEVICE FOR AUTOMOTIVE VEHICLE SERVICE CENTERS; U.S. Ser. No. 11/507,157, filed Aug. 21, 2006, entitled APPARATUS AND METHOD FOR SIMULATING A BATTERY TESTER WITH A FIXED RESISTANCE LOAD; U.S. Ser. No. 11/511,872, filed Aug. 29, 2006, entitled AUTOMOTIVE VEHICLE ELECTRICAL SYSTEM DIAGNOSTIC DEVICE; U.S. Ser. No. 11/519,481, filed Sep. 12, 2006, entitled BROAD-BAND LOW-CONDUCTANCE CABLES FOR MAKING KELVIN CONNECTIONS TO ELECTROCHEMICAL CELLS AND BATTERIES; U.S. Ser. No. 60/847,064, filed Sep. 25, 2006, entitled STATIONARY BATTERY MONITORING ALGORITHMS; U.S. Ser. No. 11/638,771, filed Dec. 14, 2006, entitled BATTERY MONITORING SYSTEM; U.S. Ser. No. 11/641,594, filed Dec. 19, 2006, entitled METHOD AND APPARATUS FOR MEASURING A PARAMETER OF A VEHICLE ELECTRONIC SYSTEM; U.S. Ser. No. 11/711,356, filed Feb. 27, 2007, entitled BATTERY TESTER WITH PROMOTION FEATURE; U.S. Ser. No. 11/811,528, filed Jun. 11, 2007, entitled ALTERNATOR TESTER; U.S. Ser. No. 60/950,182, filed Jul. 17, 2007, entitled BATTERY TESTER FOR HYBRID VEHICLE; U.S. Ser. No. 60/973,879, filed Sep. 20, 2007, entitled ELECTRONIC BATTERY TESTER FOR TESTING STATIONARY BATTERIES; U.S. Ser. No. 11/931,907, filed Oct. 31, 2007, entitled BATTERY MAINTENANCE WITH PROBE LIGHT; U.S. Ser. No. 60/992,798, filed Dec. 6, 2007,entitled STORAGE BATTERY AND BATTERY TESTER; U.S. Ser. No. 12/099,826, filed Apr. 9, 2008, entitled BATTERY RUN DOWN INDICATOR; U.S. Ser. No. 61/061,848, filed Jun. 16, 2008, entitled KELVIN CLAMP FOR ELECTRONICALLY COUPLING TO A BATTERY CONTACT; U.S. Ser. No. 12/168,264, filed Jul. 7, 2008, entitled BATTERY TESTERS WITH SECONDARY FUNCTIONALITY; U.S. Ser. No. 12/174,894, filed Jul. 17, 2008, entitled BATTERY TESTER FOR ELECTRIC VEHICLE; U.S. Ser. No. 12/204,141, filed Sep. 4, 2008, entitled ELECTRONIC BATTERY TESTER OR CHARGER WITH DATABUS CONNECTION; which are incorporated herein in their entirety.

[0005] There is an ongoing need for improved methods and techniques for testing and monitoring storage batteries.

SUMMARY OF THE INVENTION

[0006] A storage battery is provided which has a first and second post for electrically coupling to an electrical system. A test receptacle is provided for use in coupling the storage battery to an electronic battery tester. In another aspect, a battery tester is provided having a plug configured to couple to a test receptacle of a storage battery for use in performing an electronic battery test on the storage battery.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] FIG. **1** is a simplified block diagram showing a battery and battery tester in accordance with the present invention.

[0008] FIG. **2** is a simplified schematic diagram of the battery of FIG. **1**.

[0009] FIG. **3** is a perspective view of the battery of FIG. **1**.

[0010] FIG. **4** is a schematic diagram showing a battery in accordance with another embodiment of the present invention having a temperature sensor.

[0011] FIG. **5** is a side view of a battery including a test receptacle mount.

[0012] FIG. **6** is a schematic diagram showing a test plug including fuse elements or the like.

DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

[0013] Various types of storage batteries are known in the art and are used for many purposes including, for example, automotive vehicles, backup power sources, etc. As discussed in the background section, various techniques are used for testing such batteries. The present invention provides a storage battery having a test receptacle which is adapted to couple to an electronic battery tester. Further, the present invention includes an electronic battery tester having a test plug adapted to couple to the test receptacle of the storage battery for use in performing an electronic battery test on the storage battery.

[0014] In one specific example, a storage battery is provided having a test receptacle built into the battery housing. The receptacle has 2 or more connections (1-2 to each pole) connected in a standard or Kelvin configuration.

[0015] The four connection configuration enables consistent connection of conductance/impedance testing instruments for periodic testing with a handheld device. One problem with portable testers now is that the operator is not consistent in placement of the clamps/probes are placed, resulting in considerable variability for any ohmic test method. A standardized connector would guarantee a consistent and reliable connection.

[0016] The 2 or 4 pole configurations provide a simple and quick way to connect a monitoring system. When battery monitoring systems are presently connected, the battery straps must be disconnected in order to attach ring terminals, etc., to the battery in order to make the connections. In this way, the electrical system must be taken off line. With the present invention, the batteries themselves make the system "monitor ready", and cables can be simply plugged in while the battery system remains live. It further eliminates the possibility of incorrect wiring. The 2 pole version can still be used with ohmic measurement methods The 2 poles may be for the sensing function, and a forcing function may be applied across multiple series connected cells.

[0017] For monitoring applications, 2 or 4 fuses (number depending on whether a 2 or 4 wire cable is connected) are provided to limit current should the wires become pinched or shorted against a frame rail. In one example, the fuses have a rating of 4 amperes, which is considerably more than either the force current or the sense current, yet significantly smaller than the fusing current of the connection wire (typically 18 gauge). An alternative embodiment is to provide fuses of the automatic reset (PTC, i.e., Positive Temperature Coefficient) type, or standard circuit breakers.

[0018] FIG. **1** is a simplified diagram **10** of a electronic battery tester **12** coupled to a storage battery **14** in accordance with one example embodiment of the present invention. Storage battery **14** includes terminals (or posts) **16** and **18** which are used to couple to an electrical system (illustrated as a resistance) **19**, for example of an automotive vehicle, backup power source (such as those used to power cellular telephone sites, power substations, etc), or other device. A test receptacle **20** is provided in a housing **21** of battery **14**.

[0019] Although FIG. **1** shows a test receptacle having four electrical connections, any number of electrical connections may be employed. A battery tester test plug **22** is provided of battery tester **12** and is configured to plug into test plug **20** and also has four electrical connections. However, any number of connections can be used and they do not need to be the same number as provided by receptacle **20**.

[0020] Battery tester **12** includes some type of a forcing function generator **30** which provides a time varying signal and a sense amplifier **32**. This can be an active or a passive forcing function. In this configuration, the battery tester **12** is configured to perform a test using a Kelvin connection in which a forcing function signal is applied by forcing function generator **30** between cells of the battery **14** and the resultant response the cell is measured by sense amplifier **32**. Analog to digital converter **33** receives output from the amplifier **32** and provides a digitized value to a microprocessor **36**. The microprocessor **36** operates in accordance with instructions stored in memory **38** and, for example, can determine conductance of the battery **14** using appropriate technique, or perform other tests, including but not limited to those described in the background section. In one configuration, a Kelvin connection is not used and instead a single connection is provided to the battery **14**. This can be used, for example, to measure standard resistance, as opposed to a dynamic parameter. Microprocessor **36** provides an output **40** related to the condition of battery **14**.

[0021] FIG. **1** also illustrates the individual connections **20**A, **20**B, **20**C and **20**D of receptacle **20**. These are configured to receive individual pins or connectors on plug **22** which couple to connectors or wiring **22**A, **22**B, **22**C and **22**D, respectively.

[0022] FIG. **2** is a simplified electrical schematic diagram of battery **14** which shows the electrical connections between test plug **20** and the internal cell or cells **50** of battery **14**. Further, as discussed above, fuses **52** **54**, **56** and **58** are provided which electrically couple plug **20** to the cell or cells **50**. These elements may be fuses, automatically resettable fuses (i.e., such as a PTC), circuit breakers or the like. As illustrated in FIG. **2**, the plug **20** can be coupled to the battery tester **12** without disturbing the electrical connections to terminals **16** and **18**. Although battery **14** illustrated in FIG. **2** shows only a single cell **50**, any number of cells **50** may be included. The

electrical connection between receptacle **20** and the cell or cells **50** may be configured as desired. For example, the connection can be to individual cells within the battery **14** or may provide a connection across all of the cells **50** within battery **14**. Thus, if desired, configurations can be provided which allow testing of individual cells within a battery as opposed to testing all of the cells simultaneously.

[0023] FIG. **3** is a perspective view of battery **14** showing posts **16** and **18** and plug **20**. In this example, two fuses **52** and **56** are provided and are accessible to an operator. Note that receptacle **20** has a notch or slot **80** formed therein to polarize the receptacle. This provides a polarizing key for use with plug **22**. This can be used to ensure that test plug **22** from battery tester **12** is connected with a desired polarity to battery **14**.

[0024] FIG. **4** is a simplified schematic diagram of storage battery **14** in accordance with another example configuration. In FIG. **4**, a temperature sensor **90** is provided. In this example, temperature sensor **90** comprises a thermistor which has a resistance which changes as a function of temperature. In such a configuration, additional connections can be provided through receptacle **20**. For example, connectors connections **20**E and **20**F are provided for coupling to temperature sensor **90**. In such a configuration, the temperature of the battery, such as the internal battery temperature, can be directly measured by battery tester **12**. Referring back to FIG. **1**, in this configuration battery tester **12** includes two additional connections to test plug **22** allowing temperature to be measured. The measurement can be made, for example, by applying a current with source **30** through temperature sensor **90** and measuring the resultant voltage drop using amplifier **32**.

[0025] FIG. **4** is a simplified schematic diagram of another configuration of battery **14**. Similar elements have retained their numbering for consistency. In the embodiment of FIG. **4**, battery **14** also includes a temperature sensor **90** illustrated as RT. This can comprise, for example, a resistance based temperature sensor in which the resistance of element **90** changes as a function of temperature. The resistance can be measured using any appropriate technique, for example, using forcing function generator **30** and amplifier **32**.

[0026] In various configurations, the test plug **22** of battery tester **12** may not include a connector for each of the connectors in test receptacle **20**. In such a configuration, the battery tester **12** may have access to some of the connections, for example the sense connections and/or the temperature connections, while not having access to other connections. This can be used in combination with slot **80** to provide a polarized connection between plug **22** and test receptacle **20**.

[0027] Although the receptacle **20** is shown as being positioned on the top of battery **14**, the receptacle **20** can be positioned as appropriate, for example, on one of the sides or bottom of the battery **14**.

[0028] FIG. **5** is a side view of battery **16** showing a receptacle mount **100** in accordance with another example configuration. Mount **100** includes post connectors **104** which are configured to electrically couple to battery post **16** and **18**. Electrical connections are provided between post connectors **104** and test receptacle **20** as illustrated schematically, for example, in FIG. **2**. Attachment mechanisms **102**, for example, screws or bolts, are provided to physically couple receptacle mount **100** to the battery housing **16**. In one configuration, the temperature sensor **90** is positioned within mount **100**. Fuses, PTC elements or circuit breakers **52**, **54**, **56** and **58** (not shown in FIG. **5**) can also be positioned in mount **100**. Such a configuration allows the present invention to be easily retrofit with existing batteries, or with existing battery designs, without having to retool the battery manufacturing facilities.

[0029] FIG. **6** shows another example configuration of plug **22** in which fuses **52**, **54**, **56** and **58** are associated with the plug **22** and the battery tester **12**. In such a configuration, the fuses **52-58** do not need to be placed in or on the battery **14** thereby reducing the individual costs associated with each battery. As discussed above, elements **52-58** can comprise any appropriate component for preventing a short circuit such as a circuit breaker or PTC element.

[0030] Although the present invention has been described with reference to preferred embodiments, workers skilled in the art will recognize that changes may be made in form and detail without departing from the spirit and scope of the invention. Although specific battery configurations, plug configurations and battery tester configurations are shown, the present invention is not limited to these. Further, the plug **20** may include a latch, clip or other mechanism to selectively lock test plug **20** with battery tester plug **22**. In one example, element **19** shown in FIG. **1** comprises any automotive vehicle electrical system. Tester **12** can measure a dynamic parameter of battery **14**, or some other parameter as desired.

What is claimed is:

1. A storage battery, comprising:

at least one battery cell;

first and second terminals configured to couple the at least one battery cell to an electrical system;

a test receptacle electrically coupled to the at least one cell for use in coupling the at least one battery cell to a battery tester.

2. The apparatus of claim **1** wherein the test receptacle provides a first connection coupled to the first terminal and a second connection coupled to the second terminal.

3. The apparatus of claim **2** wherein the test receptacle includes a third connection coupled to the first terminal and a fourth connection coupled to the second terminal.

4. The apparatus of claim **1** including at least one fuse electrically coupled between the first terminal and the test receptacle.

5. An electronic battery tester including a battery tester plug configured to connect to the test receptacle of the battery of claim **1**.

6. The apparatus of claim **5** wherein the battery tester includes a forcing function and a sense amplifier.

7. The apparatus of claim **6** wherein the battery tester is configured to measure a dynamic parameter of the storage battery through the test receptacle.

8. The apparatus of claim **5** including a analog to digital converter which is configured to digitize a voltage measured across connectors of the test receptacle.

9. The apparatus of claim **5** wherein the battery tester is further configured to couple to a temperature sensor through the test receptacle.

10. The apparatus of claim **9** wherein the temperature sensor is mounted to the storage battery.

11. The apparatus of claim **5** wherein the battery tester plug and the test receptacle include four connections.

12. The apparatus of claim **5** wherein the battery tester plug and the test receptacle include six connections.

13. The apparatus of claim **1** including at least one circuit breaker electrically coupled between the first terminal and the test receptacle.

14. The apparatus of claim **1** including at least one PTC element connected between the first terminal and the test receptacle.

15. The apparatus of claim **1** wherein the test receptacle include a polarity key.

16. The apparatus of claim **5** including at least one fuse electrically coupled between circuitry of the battery tester and the battery tester plug.

17. The apparatus of claim **5** including at least one circuit breaker electrically coupled between circuitry of the battery tester and the battery tester plug.

18. The apparatus of claim **5** including at least one PTC element electrically coupled between circuitry of the battery tester and the battery tester plug.

19. The apparatus of claim **1** wherein the test receptacle is attached to a test receptacle mount, the test receptacle mount electrically coupled to the first and second terminals.

20. The apparatus of claim **19** wherein the test receptacle mount is attached to a housing of the battery.

21. The apparatus of claim **19** wherein the test receptacle mount includes a temperature sensor.

22. The apparatus of claim **1** wherein the electrical system comprises an automotive vehicle electrical system.

23. The apparatus of claim **1** wherein the electrical system comprises a backup power source electrical system.

24. A method of testing a storage battery of the type which couples to an electric system, comprising:

electrically coupling a test receptacle to at least one storage cell of the storage battery, the at least one storage cell further electrically coupled to first and second terminals of the battery which couple to the electrical system;

electrically connecting a test plug of a battery tester to the test receptacle, the test plug and the test receptacle providing at least four electrical connections, wherein two of the electrical connections are electrically coupled to the first terminal of the battery and two the electrical connections are electrically coupled to the second terminal of the battery thereby providing Kelvin connections to the first and second terminals;

applying a forcing function with the battery tester to the battery through the test plug and the test receptacle, the forcing function applied between the first and second terminals of the battery using a first pair of the electrical connections;

sensing, in the battery tester through the test plug and the test receptacle, a response to the applied forcing function using a second pair of the electrical connections;

determining a battery condition based upon the sensed response.

25. The method of claim **24** wherein the test receptacle provides a first connection coupled to the first post and a second connection coupled to the second post.

26. The method of claim **24** including at least one fuse electrically coupled between the first terminal and the test receptacle.

27. The method of claim **24** wherein the battery tester is configured to measure a dynamic parameter of the storage battery.

28. The method of claim **24** including coupling a temperature sensor in the storage battery to the battery tester.

29. The method of claim **28** wherein the temperature sensor is mounted to the storage battery.

30. The method of claim **24** wherein the test receptacle is attached to a test receptacle mount, the test receptacle mount electrically coupled to the first and second terminals.

31. The method of claim **30** wherein the test receptacle mount is attached to a housing of the battery.

32. The method of claim **30** wherein the test receptacle mount includes a temperature sensor.

33. The method of claim **24** wherein the electrical system comprises an automotive vehicle electrical system.

34. The method of claim **24** wherein the electrical system comprises a backup power source electrical system.

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