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(12) **United States Patent**
Bertness

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(54) **ELECTRONIC BATTERY TESTER WITH NETWORK COMMUNICATION**

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This patent is subject to a terminal disclaimer.

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CPC ***G01R 31/3627*** (2013.01)
USPC **702/63**

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See application file for complete search history.

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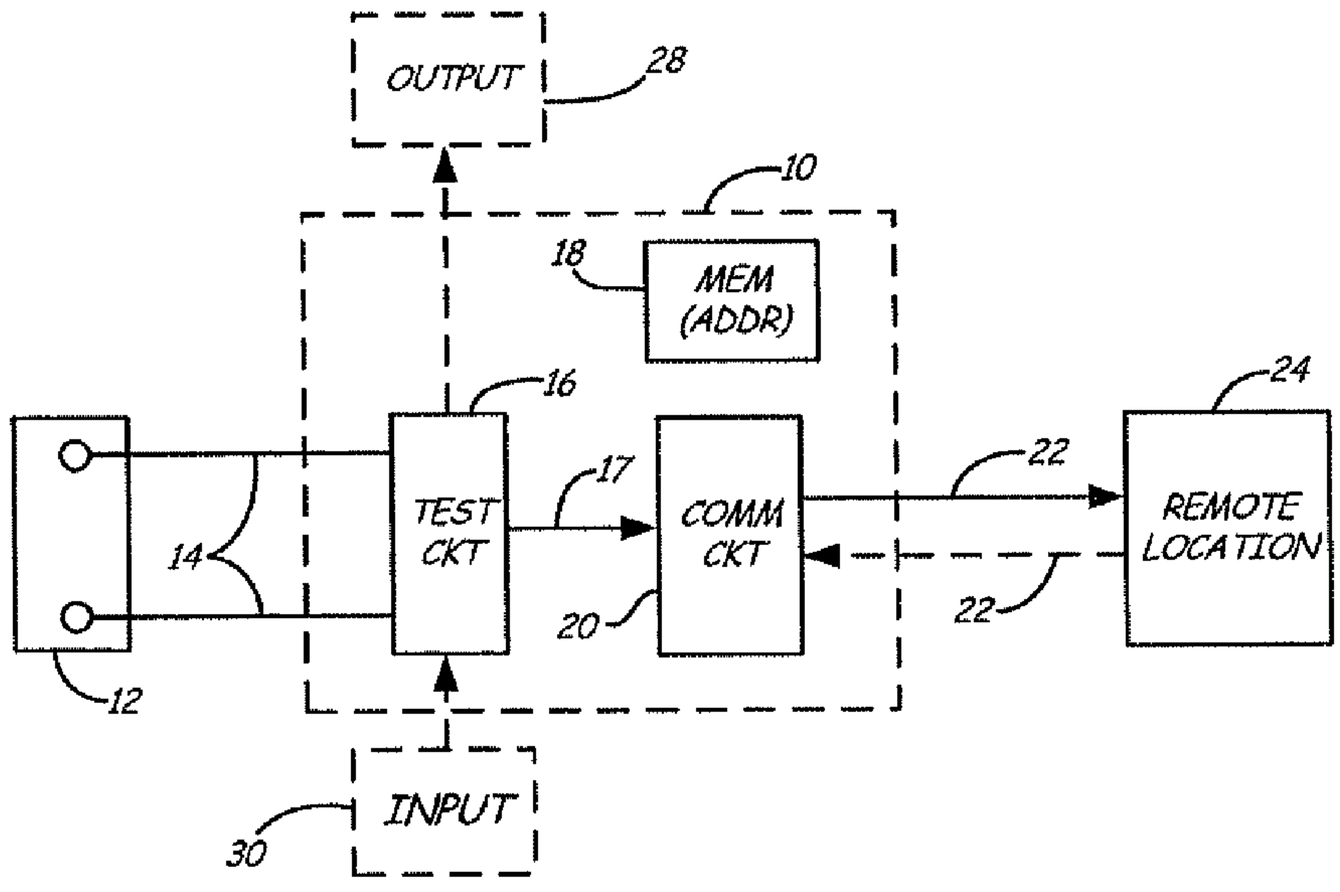
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(57) **ABSTRACT**

An electronic battery tester for testing a storage battery includes test circuitry configured to provide a battery test output related to a condition of the battery. A memory stores a battery tester address of the battery tester, and communication circuitry transmits the battery test output formatted with the battery tester address on a communication link to a remote location.

74 Claims, 3 Drawing Sheets



Related U.S. Application Data

division of application No. 10/093,853, filed on Mar. 7, 2002, now Pat. No. 6,871,151, which is a continuation-in-part of application No. 10/046,659, filed on Oct. 29, 2001, now Pat. No. 6,909,287, which is a division of application No. 09/564,740, filed on May 4, 2000, now Pat. No. 6,331,762, said application No. 10/046,659 is a continuation-in-part of application No. 09/575,627, filed on May 22, 2000, now Pat. No. 6,313,608, which is a continuation-in-part of application No. 08/962,754, filed on Nov. 3, 1997, now Pat. No. 6,081,098.

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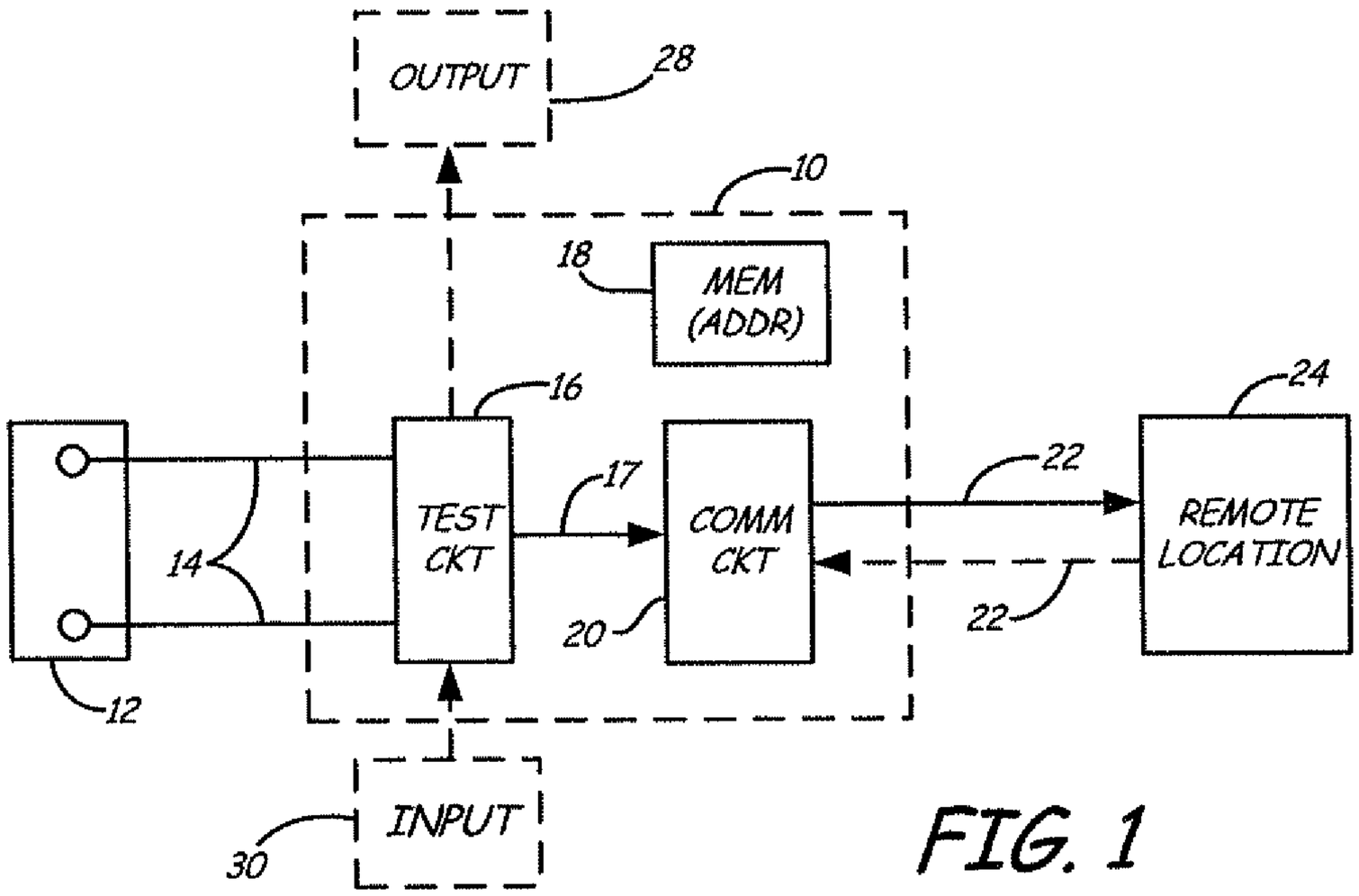

OUTPUT
28
10
18
MEM
(ADDR)
16
24
22
17
TEST
CKT
COMM
CKT
REMOTE
LOCATION
14
20
22
12
INPUT
30

FIG. 1

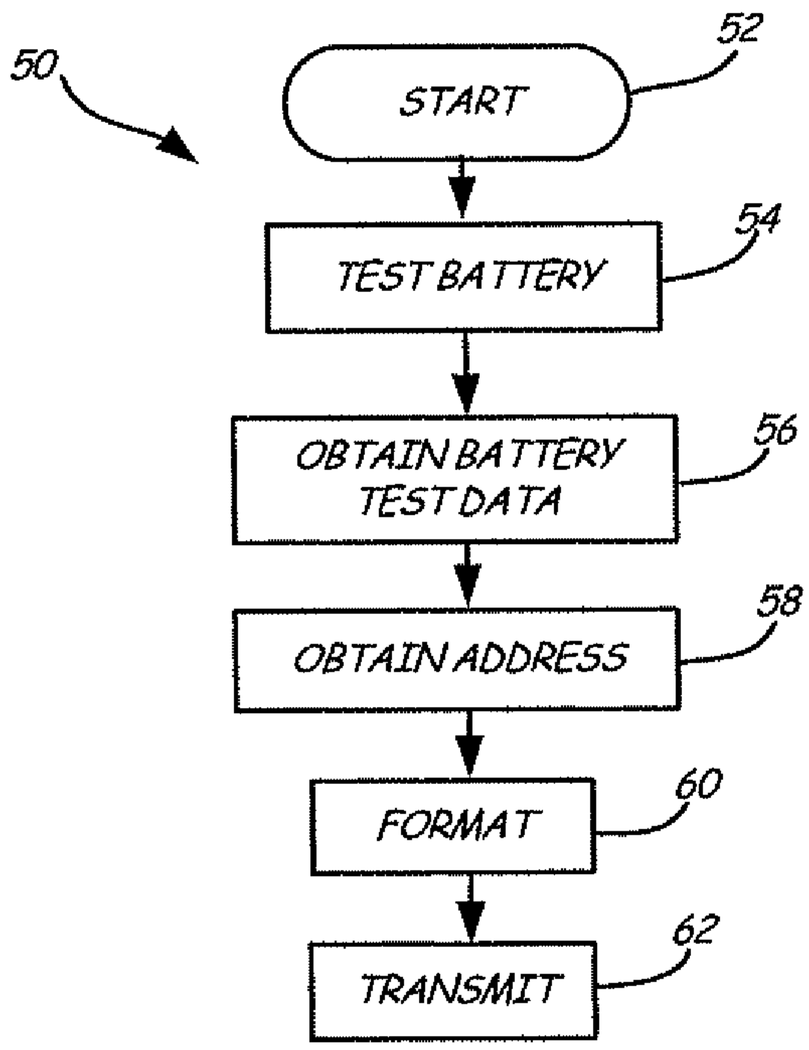

50
52
START
TEST BATTERY
54
OBTAIN BATTERY
TEST DATA
56
OBTAIN ADDRESS
58
FORMAT
60
TRANSMIT
62

FIG. 2

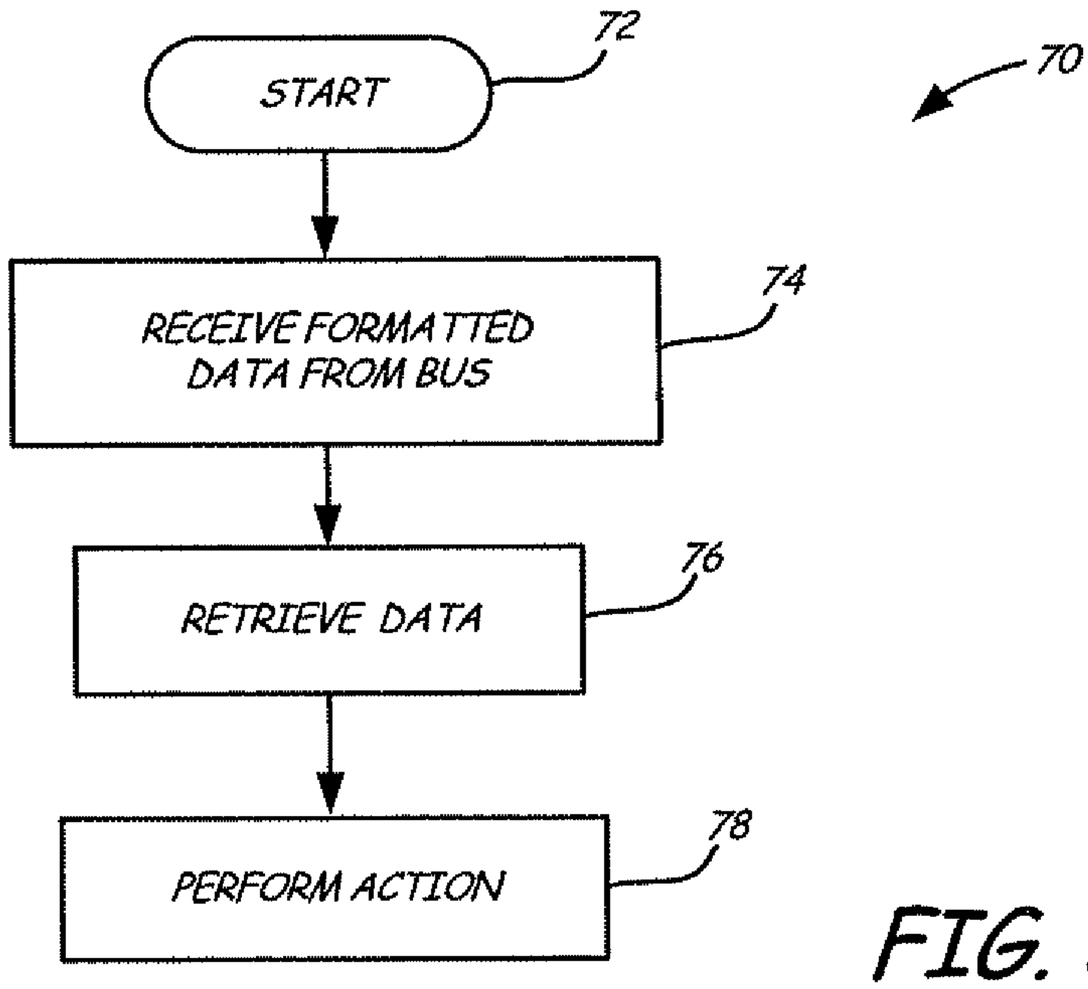

START
72
70
RECEIVE FORMATTED DATA FROM BUS
74
RETRIEVE DATA
76
PERFORM ACTION
78

FIG. 3

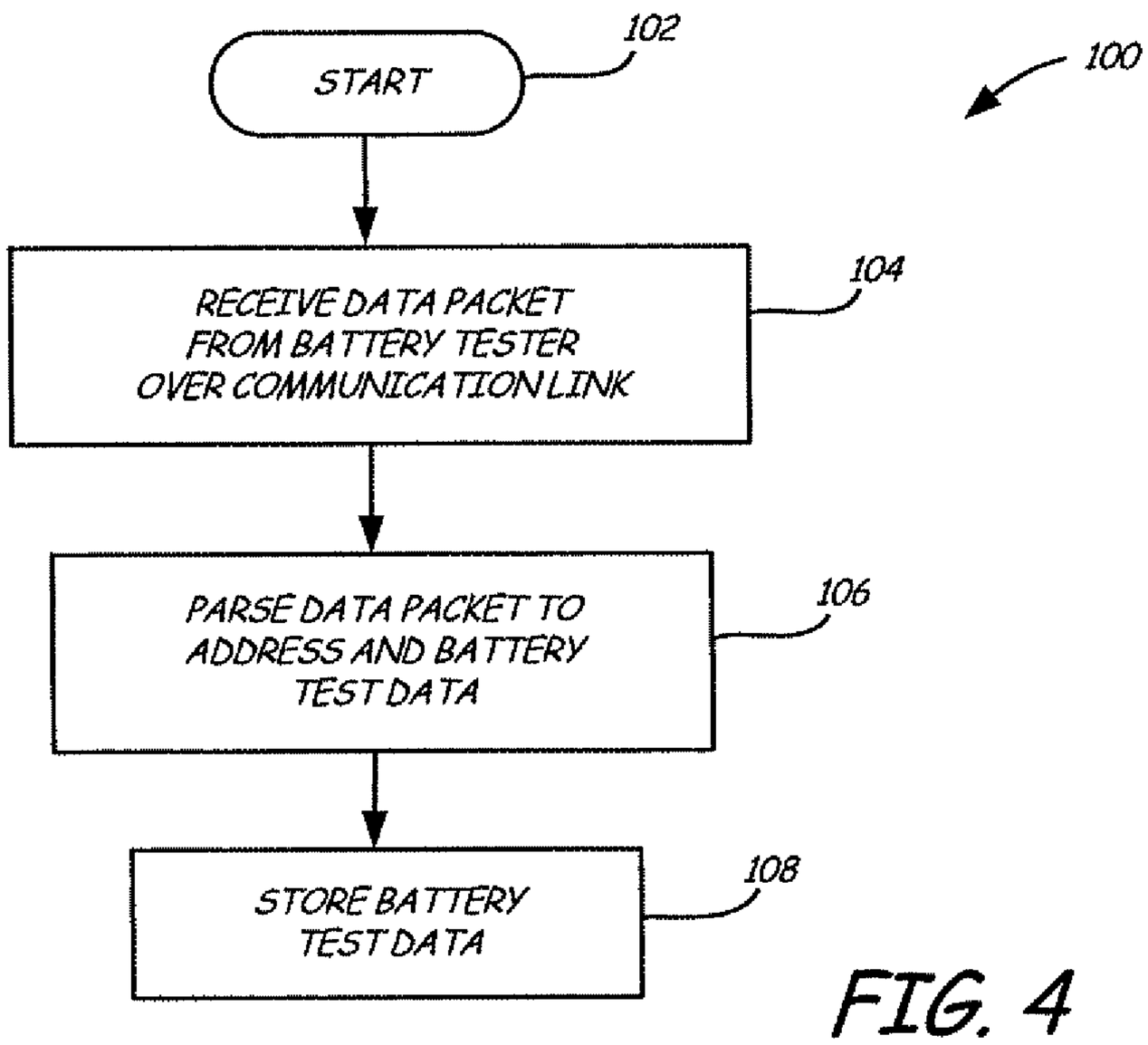

START
102
100
RECEIVE DATA PACKET FROM BATTERY TESTER OVER COMMUNICATION LINK
104
PARSE DATA PACKET TO ADDRESS AND BATTERY TEST DATA
106
STORE BATTERY TEST DATA
108

FIG. 4

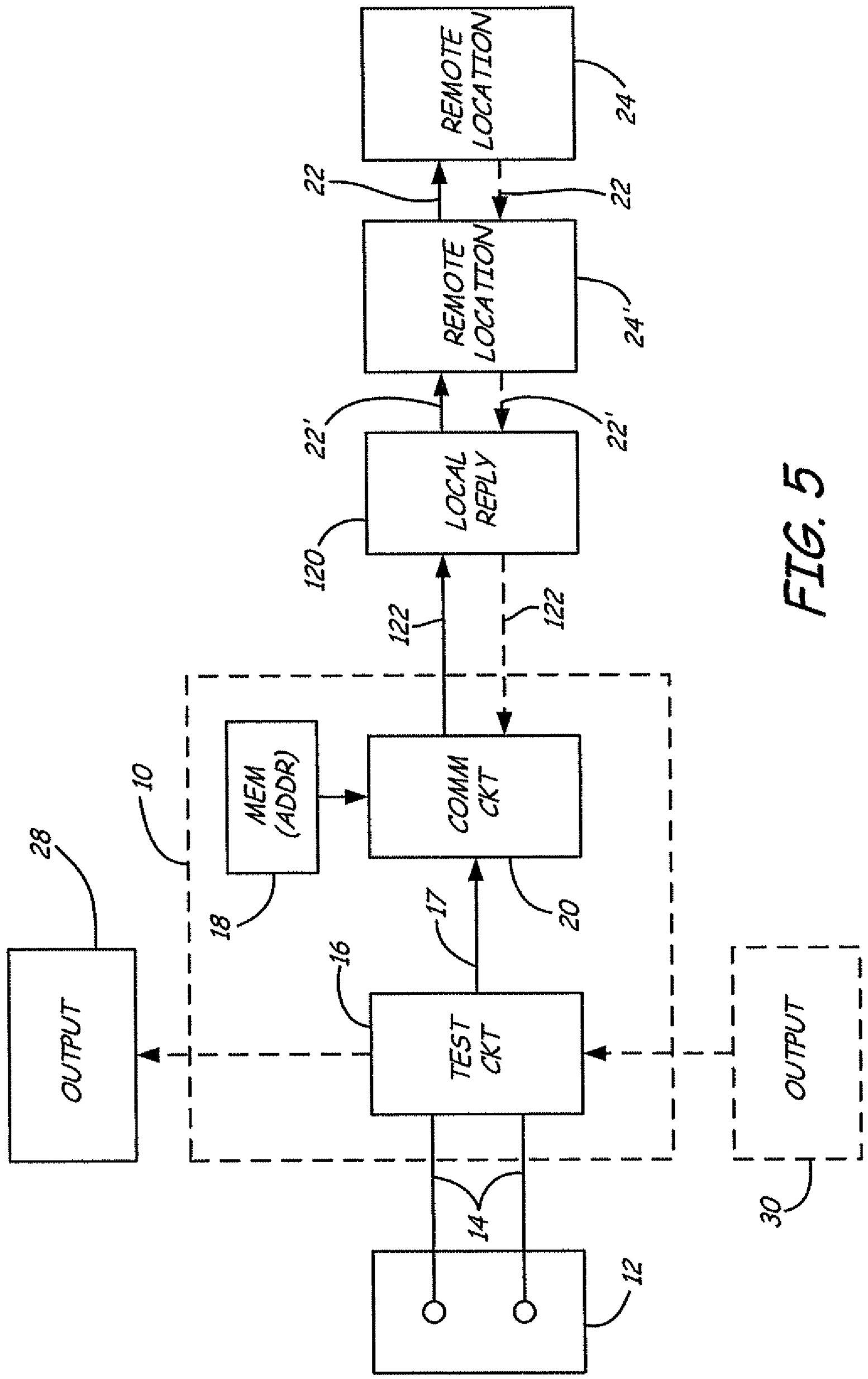

REMOTE LOCATION
24
22
22
REMOTE LOCATION
24'
22'
22'
LOCAL REPLY
120
122
122
10
MEM (ADDR)
COMM CKT
18
17
20
28
OUTPUT
16
TEST CKT
OUTPUT
30
14
12

FIG. 5

ELECTRONIC BATTERY TESTER WITH NETWORK COMMUNICATION

The present application is a Continuation-In-Part of Ser. No. 11/356,443, filed Feb. 16, 2006, which is a Continuation of U.S. Ser. No. 10/914,304, filed Aug. 9, 2004, now U.S. Pat. No. 7,003,411, which is a Divisional of U.S. Ser. No. 10/093,853, filed Mar. 7, 2002, now U.S. Pat. No. 6,871,151, which is a of U.S. Ser. No. 10/046,659, filed Oct. 29, 2001, now U.S. Pat. No. 6,909,287, which is a Divisional of Ser. No. 09/564,740, filed May 4, 2000, now U.S. Pat. No. 6,331,762, which claims priority to Provisional Application Ser. No. 60/132,622, filed May 5, 1999, U.S. Provisional Application No. 60/165,208, filed Nov. 12, 1999, and Provisional Application Ser. No. 60/175,762, filed Jan. 12, 2000, application Ser. No. 10/046,659 is also a Continuation-In-Part of application Ser. No. 09/575,627, filed May 22, 2000, now U.S. Pat. No. 6,313,608, which is a Continuation-In-Part of application Ser. No. 08/962,754, filed Nov. 3, 1997, now U.S. Pat. No. 6,081,098, the contents of which are hereby incorporated by reference in their entirety.

BACKGROUND OF THE INVENTION

The present invention relates to electronic battery testers of the type used to perform tests on storage batteries.

Electronic battery testers are used to test and determine the condition of storage batteries. Examples of electronic battery testers and related technologies are shown 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 Mar. 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. Pat. No. 7,479,763, issued Jan. 20, 2009; U.S. Pat. No. 7,498,767, issued Mar. 3, 2009; U.S. Pat. No. 7,501,795, issued Mar. 10, 2009; U.S. Pat. No. 7,505,856, issued Mar. 17, 2009; U.S. Pat. No. 7,545,146, issued Jun. 9, 2009; U.S. Pat. No. 7,557,586, issued Jul. 7, 2009; U.S. Pat. No. 7,595,643, issued Sep. 29, 2009; U.S. Pat. No. 7,598,699, issued Oct. 6, 2009; U.S. Pat. No. 7,598,744, issued Oct. 6, 2009; U.S. Pat. No. 7,598,743, issued Oct. 6, 2009; U.S. Pat. No.

7,619,417, issued Nov. 17, 2009; U.S. Pat. No. 7,642,786, issued Jan. 5, 2010; U.S. Pat. No. 7,642,787, issued Jan. 5, 2010; U.S. Pat. No. 7,656,162, issued Feb. 2, 2010; 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. 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. 10/791,141, 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. 10/958,812, filed Oct. 5, 2004, entitled SCAN TOOL FOR ELECTRONIC BATTERY TESTER; 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. 60/665,070, filed Mar. 24, 2005, entitled OHMMETER PROTECTION CIRCUIT; 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. 11/356,443, 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. 11/511,872, 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. 11/641,594, 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; U.S. Ser. No. 12/328,022, filed Dec. 4, 2008, entitled STORAGE BATTERY AND BATTERY TESTER; U.S. Ser. No. 12/416,457, filed Apr. 1, 2009, entitled SYSTEM FOR AUTOMATICALLY GATHERING BATTERY INFORMATION; U.S. Ser. No. 12/416,453, filed Apr. 1, 2009, entitled INTEGRATED TAG READER AND ENVIRONMENT SENSOR; U.S. Ser. No. 12/416,445, filed Apr. 1, 2009, entitled SIMPLIFICATION OF INVENTORY MANAGEMENT; U.S. Ser. No. 12/485,459, filed Jun. 16, 2009, entitled CLAMP FOR ELECTRONICALLY COUPLING TO A BATTERY CONTACT; U.S. Ser. No. 12/498,642, filed Jul. 7, 2009, entitled ELECTRONIC BATTERY TESTER; U.S. Ser. No. 12/697,485, filed Feb. 1, 2010, entitled ELECTRONIC BATTERY TESTER; U.S. Ser. No. 12/698,375, filed Feb. 2, 2010, entitled ELECTRONIC BATTERY TESTER; U.S. Ser. No. 12/712,456, filed Feb. 25, 2010, entitled METHOD AND APPARATUS FOR DETECTING CELL DETERIORATION IN AN ELECTROCHEMICAL CELL OR BATTERY; U.S. Ser. No. 61/311,485, filed Mar. 8, 2010, entitled BATTERY TESTER WITH DATABUS FOR COMMUNICATING WITH VEHICLE ELECTRICAL SYSTEM U.S. Ser. No. 61/313,893, filed Mar. 15, 2010, entitled USE OF BATTERY MANUFACTURE/SELL DATE IN DIAGNOSIS AND RECOVERY OF DISCHARGED BATTERIES; which are incorporated herein in their entirety.

As storage batteries have found increasing use in various industries, the use of electronic battery testers to test those batteries has expanded. Example uses include batteries for vehicles (with or without internal combustion engines) and batteries for back up power supplies such as those used in telecommunication installations.

To address this increased use, various diagnostic and testing techniques and systems for use with storage batteries have advanced in recent times. However, a typical electronic battery tester simply provides an output which is viewed by a user or technician. The data is used to make a determination regarding the condition and possible need for replacement of a storage battery. Once that determination is made, the output from the battery tester is typically discarded when the battery tester is disconnected.

The increasing use of electronic battery testers has resulted in an increasing number of battery tests which are performed and consequently resulted in an increased amount of data related to storage batteries. However, advantages from this increased amount of data has been largely unrecognized.

SUMMARY OF THE INVENTION

An electronic battery tester for testing a storage battery includes test circuitry configured to couple to the storage battery and provide a battery test output related to a condition of the battery. A memory is configured to store a battery tester address of the battery tester. Communication circuitry transmits the battery test output formatted with the battery tester address on a communication link to a remote location.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a simplified block diagram of a battery tester in accordance with one example embodiment of the present invention.

FIG. **2** is a simplified flow chart showing steps in accordance with one example embodiment of the invention.

FIG. **3** is a simplified block diagram showing steps associated with retrieving data in accordance with one example embodiment of the invention.

FIG. **4** is a simplified block diagram showing steps in accordance with receiving battery test data.

FIG. **5** is a simplified block diagram showing another configuration for communicating information to a remote location.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention includes the recognition that the output from electronic battery testers can provide useful diagnostic or other information for analysis to a remote location. In one aspect, the present invention includes providing an electronic battery tester with a battery tester address and transmitting the result of a battery test, data recovered the test during or from the battery, or related to the battery test, to a remote location in a manner in which the battery tester address is formatted (i.e., in some way combined or associated with) with the battery test data. This information is transmitted to a remote location for subsequent review or processing. Similarly, the battery tester can receive information when the information is associated with the battery tester address.

FIG. **1** is a simplified block diagram showing an electronic battery tester **10** in accordance with one example embodiment of the present invention. Electronic battery tester **10** couples to storage battery **12** through electrical connections **14**. In one embodiment, connections **14** are Kelvin connections. However, the invention is not limited to such a configuration. The connection can be any type of connection including non-physical connections and can comprise any number of connections. Electronic battery tester **10** includes test circuitry **16** which is configured to perform a test on battery **12** using any type of known or yet to be discovered battery test and provide a battery test result (or output) **17**.

A memory **18** contains a battery tester address associated with the battery tester **10**. In some embodiments, the address is not unique. Communication circuitry **20** couples to the test circuitry **16** and the memory **18** and is configured to format information related to the battery test (battery test data) along with the battery tester address on a communication link **22**. Link **22** can, for example, couple to a remote location **24**. The communication link **22** can operate bi-directionally or in a single direction, carrying data between tester **10** and remote location **24**. The link **22** can be a network, such as a computer network. Example network implementations include ethernet, token ring, PPP (point to point protocol), SLIP, or other protocols including proprietary protocols.

FIG. **1** also illustrates an optional output **28** which can be used to provide an output related to the battery test. Similarly, an optional input **30** can be used to input data. For example, the data can relate to the type of battery **12** or be used in the determination of a relative condition of battery **12**, for example by receiving a battery rating. The output **28** and the input **30** can be for use by an operator, such as a display and a manual input, or it can be coupled to other equipment. The input **30** and output **28** can be over physical or non-physical connections. The various components of battery tester **10** including output **28** and input **30**, can be implemented using any number of components and FIG. **1** is provided to illustrate a simplified block diagram. With microprocessor based circuitry, the various blocks illustrated in FIG. **1** may be implemented in shared components and their physical implementation may not break down into the discrete blocks illustrated in the Figure. The various components can be implemented in hardware, software or their combination.

FIG. **2** is a simplified block diagram **50** showing example steps in accordance with the present invention. The various steps shown in FIG. **2** may be implemented in any order, or wholly or partially in parallel, and are not limited to the particular implementation shown in the Figure. At block **52**, the process starts and control is passed to block **54** where the storage battery **12** is tested. At optional block **56**, battery test data is obtained. This can be any data which is related to the battery test and may or may not include the battery test result obtained at block **54**. At block **58**, the address of the battery tester **10** is obtained from memory **18**. At block **60**, tester **10** formats the battery test data with the battery tester address. The formatted data is transmitted over communication link **22** at block **62**.

The battery test performed at block **54** by test circuitry **16** can be any known or yet to be discovered battery test. In one aspect, the battery test is based upon a dynamic measurement, that is a measurement in which a time varying signal is used in performing the battery test. In another example aspect, electrical connections **14** comprise Kelvin connections.

The battery test output **17** can be any type of output from a battery test including a qualitative or a quantitative output. The optional battery test related data can be any type of data related to the battery test including various measurements used in obtaining the battery test output (such as voltages, currents, information related to timing, time periods, signals and waveforms, etc.) or other types of data including tem-

perature (either ambient or some other temperature such as the temperature of battery **12**), battery serial number, model number, vehicle identification or serial number, geographic related information, time and/or date information, data which identifies the operator, the steps performed by the operator or the battery test, the vehicle VIN number, data obtained from the vehicle computer or computer system, data related to the architecture of a backup or auxiliary battery site including the equipment, number of battery strings and types of batteries, maintenance related data, etc. The data can be obtained from existing or yet to be implemented vehicle communication bus structures including the CAN bus, J1939, J1850, etc. Other types of data includes bar code information, dealer information, codes such as warranty codes, count information related to how many times or when a particular battery tester was used, information relating to promotions or sales, etc. Additionally, data can be a compilation of data collected over a period of time, either raw data or data which has been analyzed or otherwise used by the battery tester.

FIG. **3** is a simplified block diagram **70** showing steps associated with the receiving of data by electronic battery tester **10** over communication link **22**. The procedure starts at **72** and at block **74** the formatted data is received from bus **22**. This formatted data is of a similar format to that discussed in connection with FIG. **2** and contains information along with the address of the electronic battery tester **10**. The formatted data is extracted and retrieved at step **76** and some type of action is performed at step **78**. The particular type of action can be any type of action including actions in which the retrieved data is acted upon as a function of the retrieved data, stored in memory **18** for future use, immediately displayed or otherwise utilized by battery tester **10**, etc.

Communication link **22** is any type of physical or non-physical communication link, or a combination. Examples include electrical wiring, infrared, Radio Frequency (RF), etc. The data carried on communication link **22** can be uni-directional or bi-directional and can be in accordance with any communication protocol. The data carried on communication link can be in an encrypted format in accordance with any encryption technique. In various aspects, the address of battery tester **10** can be a shared address, a locally unique address or a globally unique address.

One example protocol for data on link **22** is the TCP/IP protocol. In such an embodiment, the address of battery tester **10** can be an IP (Internet Protocol) address. For example, RFC791 promulgated by the Internet Engineering Taskforce in September 1981 defines such an address. In one specific example, the address consists of at least four groups of data, each group comprises at least 8 bits.

Data can be sent in response to an event at battery tester **10**, at particular times, or in response to polling from remote location **24**. If a two-way communication link **22** is used, data and/or programming instructions in tester **10** can be updated as desired and tester **10** can be controlled from a remote location.

Remote location **24** can collect data from one or more battery testers. The data can be placed into a database format for subsequent analysis. For example, statistics of the data can be calculated and used in order to diagnose or research battery failures, sales trends, usage, or other aspects related to battery tests, installation, use and ultimate failure. Additionally, data can be correlated with vehicles, geographical areas, dealers, etc., including how battery testers are being used.

When retrieving data, various types of information can be retrieved by electronic battery tester **10**. For example, battery test parameters or test criteria can be automatically updated as can tables or battery ratings. The battery tester software can be updated as desired as new releases become available. Service bulletins related to a particular test, or particular type of battery, particular vehicle or problem associate with a battery or battery test can be provided to the operated or stored in the memory for future use. The test procedures for unusual cars, or tests which are difficult to perform, can be looked up on a remove database. An authorization can be received in which the operator receives an authorization to replace a battery, for example a battery which is under warranty. The authorizations can be a function of data contained at a remote location, for example if a particular location has an unusually high rate of warranty returns, a request for authorization to return a battery could be denied, or otherwise identified for subsequent auditing. The battery tester **10** can also take advantage of increased computing power which might be available at a remove location. Data available over the interne can be retrieved for use during the test. For example, weather information or statistics can be obtained for a particular area such that the battery test is modified as function of the current or predicted weather. If a cold period is imminent, for example, a harsher test can be employed. If a battery is replaced, an inventory list can be updated such that a inventory is reordered, for example, by sending an e-mail or other communication to a distributor. If the battery itself has a unique identification, for example a serial number, this information can be used to monitor the battery from "cradle to grave". For example, various tests performed throughout the life of the battery can be utilized to observe trends in the battery test. Further, service alerts or other information can be linked to a battery.

FIG. **4** is a simplified block diagram **100** showing steps performed in accordance with receiving data from an electronic battery tester in accordance with the present invention. The receiving can be, for example, at a remote manufacturing or management site. At block **102** the procedure starts and control is passed to block **104** where a data pack is received from the electronic battery tester over the communication link. At block **106**, the data packet is parsed into the address which identifies the electronic battery tester and the battery test data contained within the data packet. At block **108**, the battery test data is stored or otherwise operated upon. Various examples of such operations are discussed above.

Any appropriate type of wireless communication may be used in accordance with the present invention. One specific example is cellular based wireless communication technologies. These include, for example, PCS, GSM, CDMA, AMPS, NAMPS, FDMA, TDMA technologies or others such as "3G" and "4G" and "EDGE". Other communication can comprise analog or digital communication techniques and may be unidirectional or bidirectional including full or half duplex communication. In such a configuration, the address of the battery tester can comprise a numerical representation which identifies a cellular phone on a cellular phone network. Examples include the International Mobile Equipment Identifier (IMEAI) or the Electronic Serial Number (ESN), or a telephone number, etc. This information is stored in a memory which, for example, a NAM (Number Assignment Module), ICCID (Integrated Circuit Card ID), IMSI (International Mobile Subscriber Identifier) or others. The cellular communication can occur between a single or multiple cellular tower antenna contained on a cellular tower, and/or single or multiple antennas carried in orbit on satellites.

FIG. **5** is a simplified block diagram similar to FIG. **1** showing a configuration where the communication circuitry communicates with a remote location in which the communication pathway includes an intermediary link. In the configuration of FIG. **5**, the communication circuitry **20** commu-

nicates with a local relay **120** over an optionally bidirectional communication link **122**. Local relay **122** communicates with an optional intermediary remote location **24'** over an optionally bidirectional communication link **22'**. The communication reaches a final remote location destination **24** over optionally bidirectional communication link **22**. Elements **120** and **24'** operate as intermediary relays and communicates information with remote location **24**. Although only two intermediary relays are shown, any number may be employed.

In one specific example embodiment, local relay **120** comprises, for example, a cellular telephone or other cellular based communication device. In such a configuration, the communication link **122** with battery tester **10** can be in accordance with a local communication technology such as a hardwire connection, for example, USB or the like, or a wireless technology such as BlueTooth® communication technology, WIFI or other. The local relay **120** can then communicate, with for example a cellular telephone site **24'** using cellular technology as described above. In one example, the intermediary remote location **24'** comprises a cellular tower at a cellular communication site. The remote location **24'** can then communicate with an ultimate destination remote location **24** using standard national and international data communication networks such as cellular telephone networks, land line or other hardwire networks, digital communication network, etc.

The local relay **120** can comprise, for example, a "smart phone" which provides additional processing capabilities and is configured to relay information to the remote location **24**. In addition to conveying information, the local relay **120** can be used to monitor or control operation of battery tester **10**.

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.

What is claimed is:

1. An electronic battery tester for testing a storage battery, comprising:

test circuitry configured to couple to the storage battery and provide a battery test output related to a condition of the battery;

a memory containing a battery tester address associated with the battery tester which identifies the battery tester;

a local communication link configured to provide communication between the test circuitry and a local relay;

a remote communication link configured to provide communication between the local relay and a remote location;

wherein data sent to the remote location includes battery test data and the battery tester address.

2. The apparatus of claim **1** wherein the local relay comprises a cellular telephone.

3. The apparatus of claim **1** wherein the local communication link is in accordance with wireless technology.

4. The apparatus of claim **3** wherein the wireless technology comprises Bluetooth® wireless communication technology.

5. The apparatus of claim **3** wherein the wireless communication comprises WIFI.

6. The apparatus of claim **1** wherein the local communication comprises a hardwired link.

7. The apparatus of claim **6** wherein the hardwired link comprises an Ethernet connection.

8. The apparatus of claim **1** wherein the local relay is configured to communicate with an intermediary remote location.

9. The apparatus of claim **8** wherein the intermediary remote location comprises a cellular telephone tower.

10. The apparatus of claim **1** wherein the battery tester address information comprises an IP address.

11. The apparatus of claim **1** wherein the battery tester address comprises an address in accordance with cellular telephone communication protocols.

12. The apparatus of claim **1** wherein the remote communication link is in accordance with cellular telephone communication protocol.

13. The apparatus of claim **1** wherein the local communication link is bi-directional.

14. The apparatus of claim **13** wherein the battery tester retrieves test parameter updates from the local relay.

15. The apparatus of claim **13** wherein the battery tester receives software updates from the local relay.

16. The apparatus of claim **13** wherein the battery tester receives service bulletins from the local relay.

17. The apparatus of claim **13** wherein the battery tester receives test procedures from the local relay.

18. The apparatus of claim **13** wherein the battery tester receives battery replacement authorization from the local relay.

19. The apparatus of claim **13** wherein the battery tester receives weather related information from the local relay.

20. The apparatus of claim **13** wherein the battery tester receives information related to the specific battery under test.

21. The apparatus of claim **1** wherein the test circuitry including a Kelvin connection configured to couple the test circuitry to the battery.

22. The apparatus of claim **1** wherein the test circuitry'measures a dynamic parameter of the battery.

23. The apparatus of claim **1** including a user input.

24. The apparatus of claim **23** wherein the battery test data includes data received through the user input.

25. The apparatus of claim **24** wherein the data received through the user input comprises a battery rating.

26. The apparatus of claim **24** wherein the data received through the user input comprises a battery type.

27. The apparatus of claim **1** including a display configured to provide an output related to the condition of the battery.

28. The apparatus of claim **1** wherein the battery test data includes the output related to the condition of the battery.

29. The apparatus of claim **1** wherein the battery test data includes data used by the test circuitry to determine the condition of the battery.

30. The apparatus of claim **1** wherein the battery test data includes data received through a bar code.

31. The apparatus of claim **1** wherein the battery test data includes data which identifies a dealer.

32. The apparatus of claim **1** wherein the battery test data includes a warranty code.

33. The apparatus of claim **1** wherein the battery test data includes count information.

34. The apparatus of claim **1** wherein the battery test data includes information related to a promotion.

35. The apparatus of claim **1** wherein the battery test data includes a compilation of data.

36. The apparatus of claim **1** wherein the battery test data is encrypted.

37. The apparatus of claim **1** wherein the battery test data is transmitted on the local or remote communication link at predetermined times.

38. The apparatus of claim **1** wherein the battery test data is transmitted on the local or remote communication link in response to polling of the battery tester.

39. The apparatus of claim 1 wherein the battery test data includes a vehicle identification number (VIN).

40. The apparatus of claim 1 wherein the battery test data includes data retrieved from a data bus of a vehicle.

41. A method for testing a storage battery with a battery tester, comprising:

coupling the battery tester to the storage battery and providing a battery test output from the battery tester related to a condition of the battery;

a battery tester address associated with the battery tester which identifies the battery tester;

transmitting battery test data formatted with the battery tester address on a local communication link to a local relay; and

transmitting the battery test data from the local relay to a remote location over a remote communication link.

42. The method of claim 41 wherein the local communication link comprises a physical connection.

43. The method of claim 41 wherein the local communication link comprises a non-physical connection.

44. The method of claim 41 wherein the local communication link is in accordance with TCP/IP.

45. The method of claim 41 wherein the battery tester address comprises an IP address.

46. The method of claim 45 wherein the IP address comprises four groups of eight bits each.

47. The method of claim 46 wherein the battery test data includes the user input.

48. The method of claim 47 wherein the user input comprises a battery rating.

49. The method of claim 47 wherein the user input comprises a battery type.

50. The method of claim 41 wherein the battery tester address comprises a unique address.

51. The method of claim 41 wherein the communication link is bi-directional.

52. The method of claim 41 wherein the coupling comprises coupling with a Kelvin connection to the battery.

53. The method of claim 41 including measuring a dynamic parameter of the battery.

54. The method of claim 41 including receiving a user input.

55. The method of claim 41 including displaying an output related to the condition of the battery.

56. The method of claim 41 wherein the battery test data includes data used by the test circuitry to determine the condition of the battery.

57. The method of claim 41 wherein the battery test data includes data received through a bar code.

58. The method of claim 41 wherein the battery test data includes data which identifies a dealer.

59. The method of claim 41 wherein the battery test data includes a warranty code.

60. The method of claim 41 wherein the battery test data includes count information.

61. The method of claim 41 wherein the battery test data includes information related to a promotion.

62. The method of claim 41 wherein the battery test data includes a compilation of data.

63. The method of claim 41 including encrypting the battery test data.

64. The method of claim 41 including transmitting battery test data on the communication link at predetermined times.

65. The method of claim 41 wherein the battery test data is transmitted on the communication link in response to polling of the battery tester.

66. The method of claim 41 wherein the battery test data includes a vehicle identification number (VIN).

67. The method of claim 41 including retrieving the battery test data from a data bus of a vehicle.

68. The method of claim 41 including retrieving test parameter updates on the link.

69. The method of claim 41 including receiving software updates on the link.

70. The method of claim 41 including receiving service bulletins on the link.

71. The method of claim 41 including receiving test procedures on the link.

72. The method of claim 41 including receiving battery replacement authorization on the link.

73. The method of claim 41 including receiving weather related information on the link.

74. The method of claim 41 including receiving information related to the specific battery under test on the link.

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