US 20250258239A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2025/0258239 A1**

Murtezaoglu (43) **Pub. Date: Aug. 14, 2025**

(54) **STANDBY ENERGY SYSTEM**

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(21) Appl. No.: **19/050,081**

(22) Filed: **Feb. 10, 2025**

Related U.S. Application Data

(60) Provisional application No. 63/551,729, filed on Feb. 9, 2024.

Publication Classification

(51) **Int. Cl.**

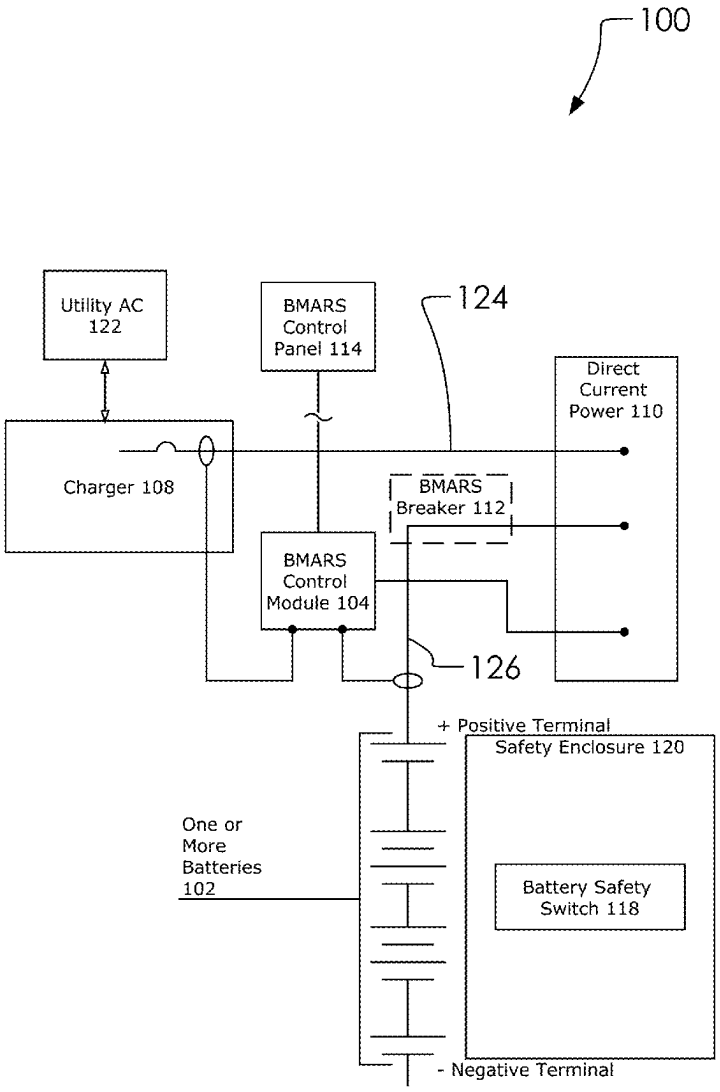
G01R 31/3842	(2019.01)
G01R 31/36	(2020.01)
G01R 31/371	(2019.01)
G01R 31/396	(2019.01)
G01R 31/40	(2020.01)

(52) **U.S. Cl.**

CPC ***G01R 31/3842*** (2019.01); ***G01R 31/3646*** (2019.01); ***G01R 31/371*** (2019.01); ***G01R 31/396*** (2019.01); ***G01R 31/40*** (2013.01)

(57) **ABSTRACT**

A BMARS system for maintaining and managing battery performance. The term BMARS stands for battery monitoring and recharge system. A BMARS control module configured to monitor, log, and manage one or more battery parameters, a charger adapted to convert AC power to DC power, a direct current power connected to the charger and adapted to supply DC power to at least one load, a breaker interposed between the direct current power and one or more batteries one or more batteries, a battery safety switch housed in a safety enclosure, one or more sensors one or more sensors configured to measure voltage, temperature, or current of the one or more batteries, and a control panel communicatively coupled to the BMARS control module.



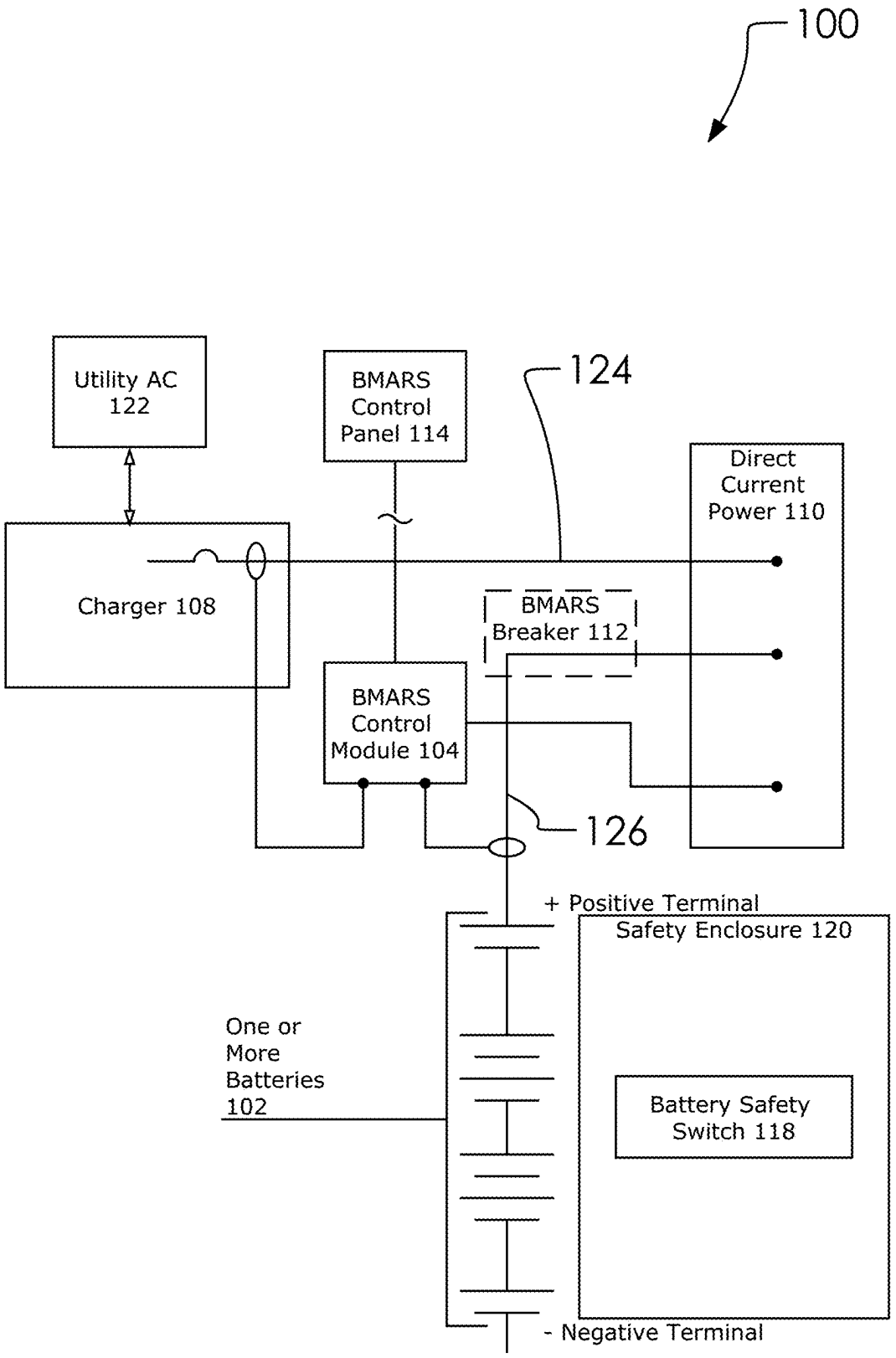

100
Utility AC 122
BMARS Control Panel 114
124
Direct Current Power 110
Charger 108
BMARS Breaker 112
BMARS Control Module 104
126
+ Positive Terminal
Safety Enclosure 120
One or More Batteries 102
Battery Safety Switch 118
- Negative Terminal

FIG. 1

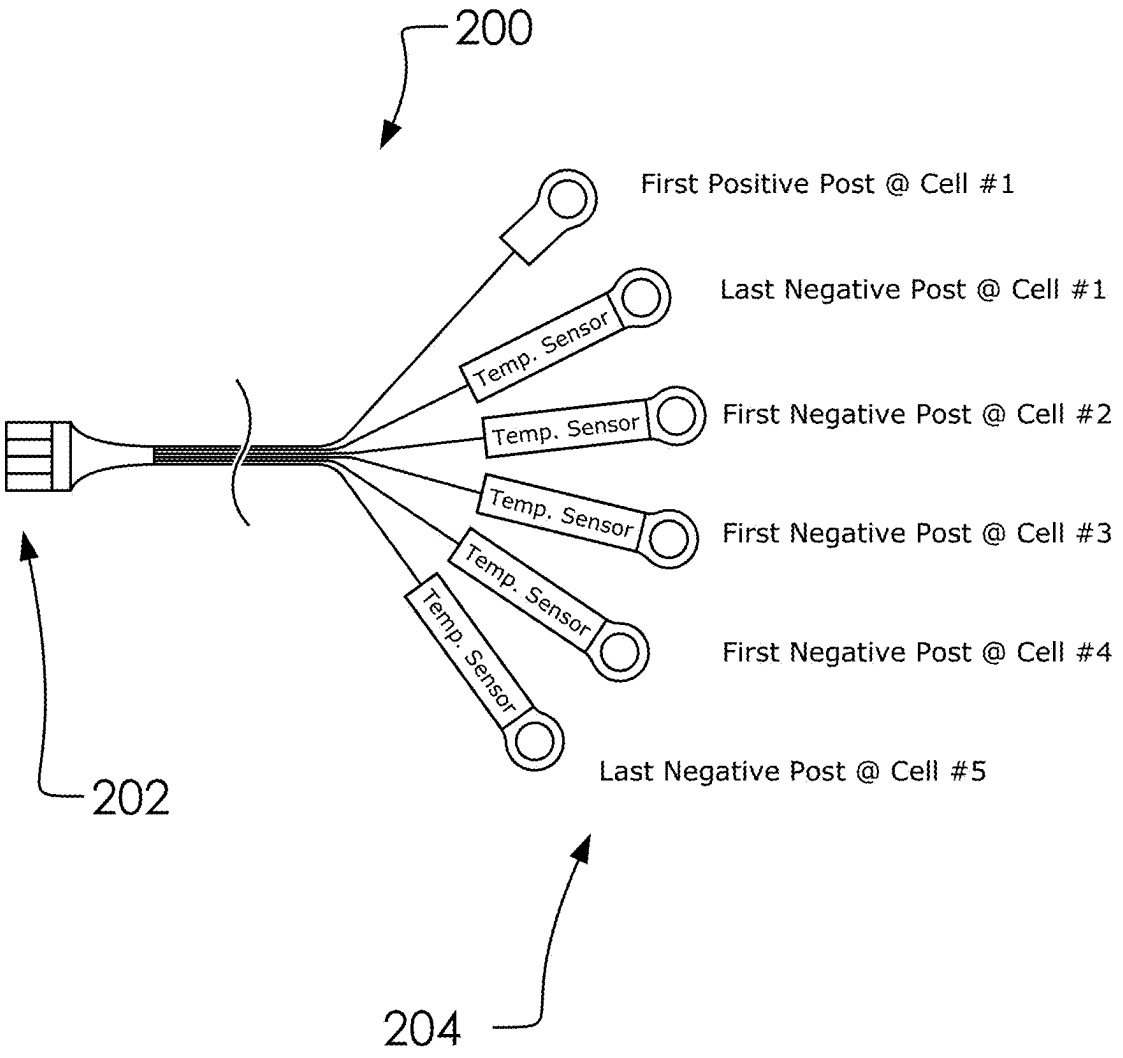

200
First Positive Post @ Cell #1
Last Negative Post @ Cell #1
Temp. Sensor
Temp. Sensor
First Negative Post @ Cell #2
Temp. Sensor
First Negative Post @ Cell #3
Temp. Sensor
First Negative Post @ Cell #4
Temp. Sensor
Last Negative Post @ Cell #5
202
204

FIG. 2

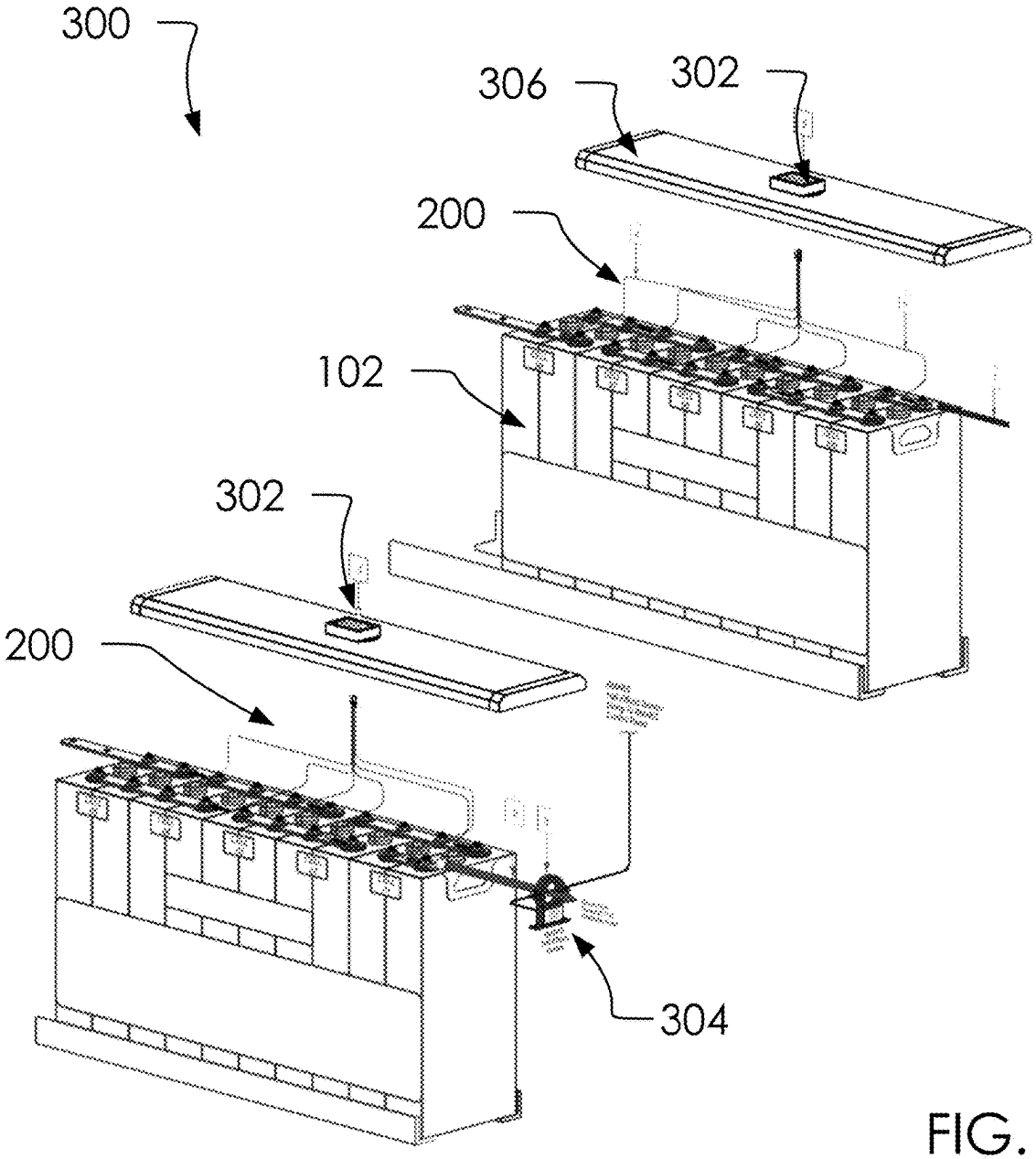


FIG. 3

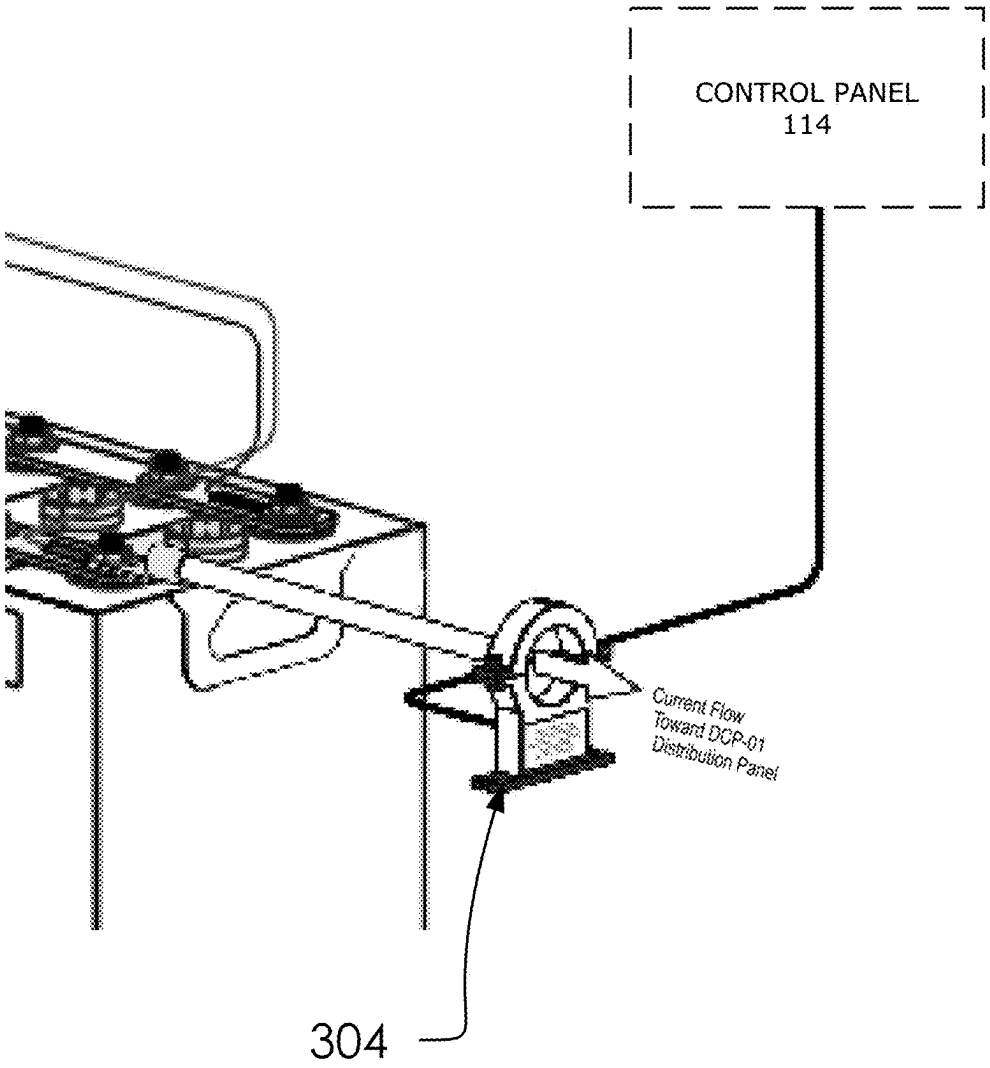

CONTROL PANEL
114
Current Flow
Toward DCP-01
Distribution Panel
304

FIG. 4

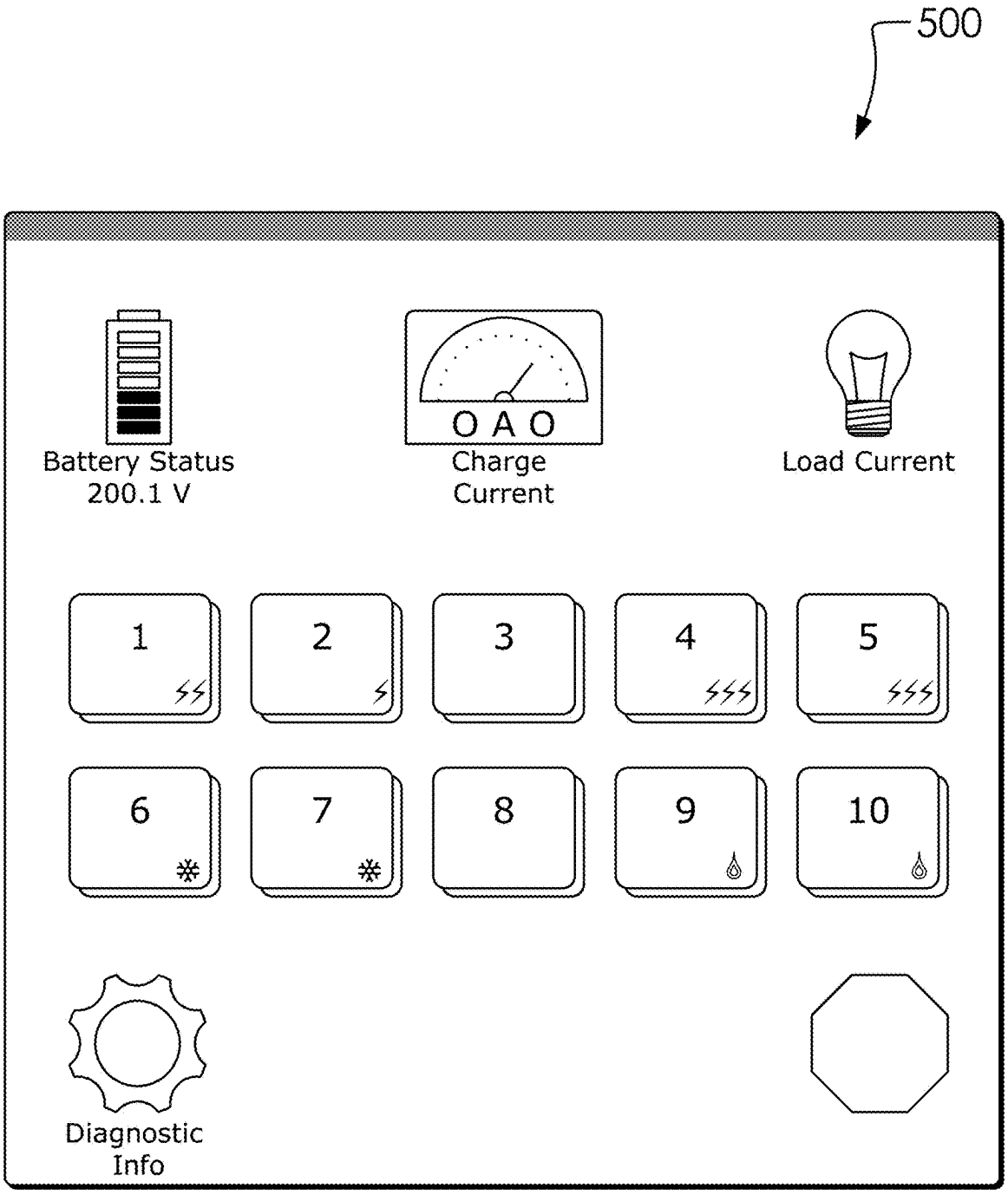

500
Battery Status
200.1 V
O A O
Charge
Current
Load Current
1
2
3
4
5
6
7
8
9
10
Diagnostic
Info

FIG. 5

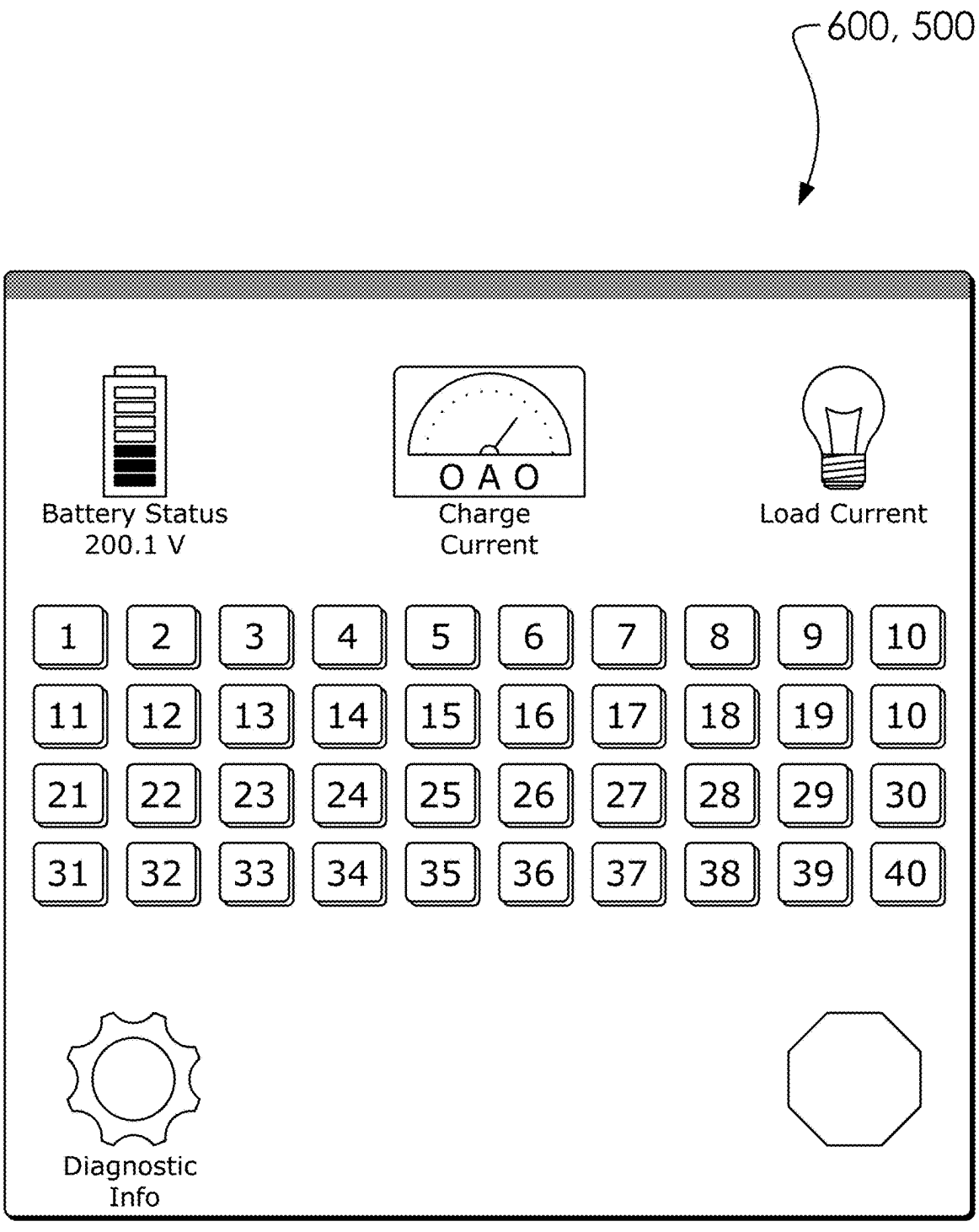

600, 500
Battery Status
200.1 V
O A O
Charge
Current
Load Current
1 2 3 4 5 6 7 8 9 10
11 12 13 14 15 16 17 18 19 10
21 22 23 24 25 26 27 28 29 30
31 32 33 34 35 36 37 38 39 40
Diagnostic
Info

FIG. 6

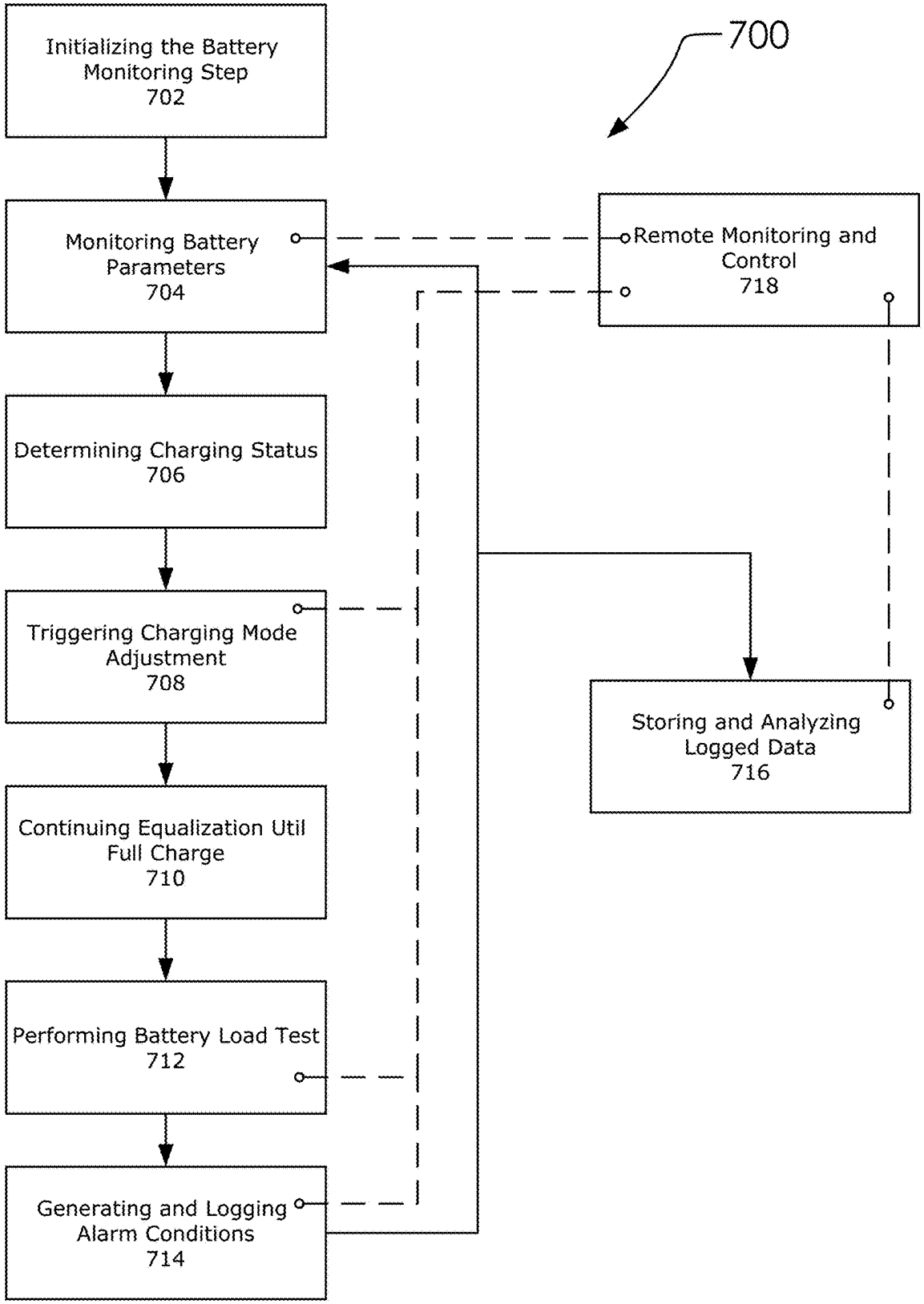

700
Initializing the Battery Monitoring Step 702
Monitoring Battery Parameters 704
Determining Charging Status 706
Triggering Charging Mode Adjustment 708
Continuing Equalization Util Full Charge 710
Performing Battery Load Test 712
Generating and Logging Alarm Conditions 714
Remote Monitoring and Control 718
Storing and Analyzing Logged Data 716

FIG. 7

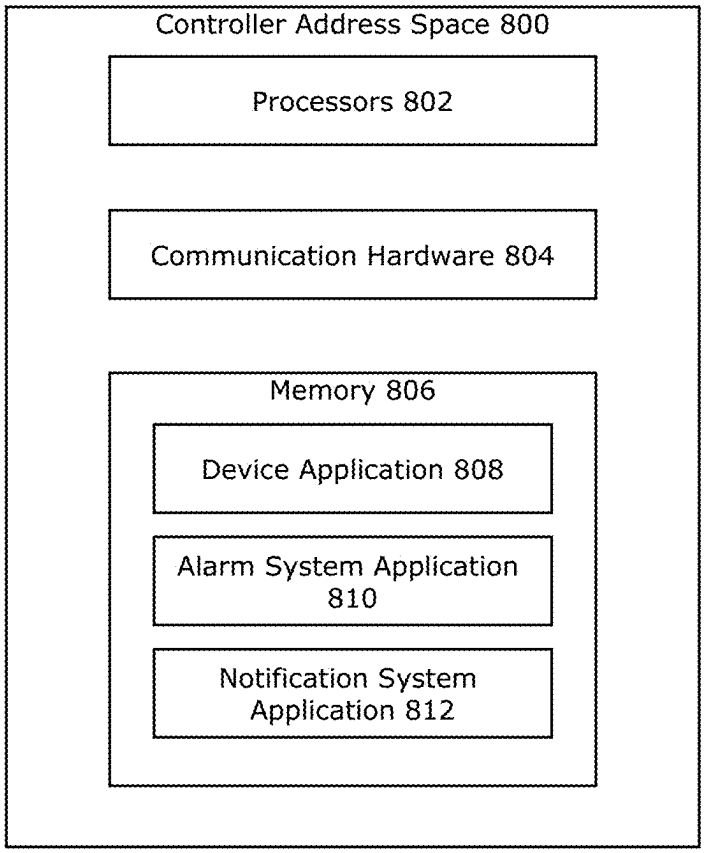
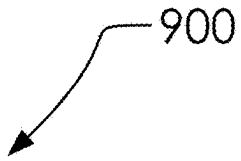

Controller Address Space 800
Processors 802
Communication Hardware 804
Memory 806
Device Application 808
Alarm System Application 810
Notification System Application 812

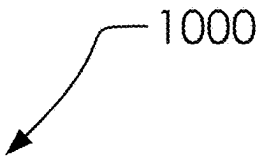
FIG. 8



Battery Discharge Test

Battery Test Date: _____
Battery Manufacturer: _____
Date of Manufacturer: _____
Date of Commissioning of Battery: _____
Battery Model: _____
Date of Battery Load Test _____
Battery Voltage Window: _____
Battery Original AH Capacity: _____
Specified Discharge Current/Time: _____
Battery AVG. Ambient Temperature: _____
Current/Temperature Logging Intervals:___A, Every ___Seconds ___Minutes
Battery Ride Through Time At This Discharge Current: _____Amps & Temperature
Test Results: ___Passed | ___Failed | ___Margin | ___Over | _____Under

FIG. 9



At any time, any operator who wants to can see or print out the Battery condition or shoot it wherever they like for consultation.

1. Date and Time of Lowest Battery Voltage
2. Date and Time of Highest Battery Voltage
3. Date and Time of Lowest Battery Input Current
4. Date and Time of Highest Battery Input Current
5. Date and Time of Lowest Battery Output Current
6. Date and Time of Highest Battery Output Current
7. Date and Time of Lowest Battery AH Capacity
8. Date and Time of Highest Battery AH Capacity
9. Date and Time of Lowest Cell Voltage
10. Date and Time of Highest Cell Voltage
1. Date and Time of Lowest Cell Temperature
12. Date and Time of Highest Cell Temperature
13. Date and Time of Lowest Average Battery Temperature
14. Date and Time of Highest Average Battery Temperature

FIG. 10

STANDBY ENERGY SYSTEM

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims benefit to and incorporates by reference, U.S. provisional patent application No. 63/551,729 filed on 2024 Feb. 9.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT (IF APPLICABLE)

[0002] Not applicable.

REFERENCE TO SEQUENCE LISTING, A TABLE, OR A COMPUTER PROGRAM LISTING COMPACT DISC APPENDIX (IF APPLICABLE)

[0003] Not applicable.

BACKGROUND OF THE INVENTION

Field of the Invention

[0004] The present invention relates to battery monitoring and management systems ("BMARS"), specifically to systems designed to continuously monitor, log, and manage battery performance to ensure optimal operation, longevity, and reliability. The system further provides real-time data and remote-control capabilities, enabling proactive battery maintenance and emergency response.

Background of the Invention

[0005] Modern electrical infrastructure relies heavily on stable and reliable power sources, with batteries serving as critical backup power supplies in industrial, commercial, and residential applications. Utility power grids face increasing complexity due to longer transmission distances, varying customer loads, power surges, electrical noise, adverse weather conditions, and unexpected equipment failures. These factors can lead to power interruptions, making reliable battery systems essential for ensuring continued operation of critical systems.

[0006] Despite the widespread use of backup batteries, traditional monitoring solutions often fail to provide real-time insights into battery health and performance. Conventional battery monitoring systems primarily alert users after a battery failure has occurred, offering little opportunity for proactive maintenance. As a result, operators are often unable to address battery degradation in advance, leading to unexpected failures and potential downtime. This limitation is particularly problematic in industries where uninterrupted power is crucial, such as telecommunications, data centers, and industrial control systems.

[0007] To address these shortcomings, the present invention introduces an advanced Battery Monitor and Recharge System (BMARS). BMARS continuously monitors individual battery cells 24/7/365, recording critical parameters such as voltage, temperature, charge/discharge currents, and overall capacity. Unlike conventional systems, BMARS does not merely indicate battery failure but provides real-time diagnostics and long-term performance tracking, allowing users to identify and resolve potential issues before a failure occurs.

[0008] The system enables remote monitoring and control via communication interfaces such as Modbus, allowing operators to adjust charging states, trigger equalization cycles, and optimize battery health from a centralized location. Additionally, BMARS integrates an automated alert system, providing immediate warnings for abnormal conditions and facilitating timely corrective actions. The system maintains a rolling three-year data log, ensuring comprehensive historical analysis and compliance with maintenance protocols.

[0009] By implementing the BMARS system, operators can extend battery lifespan, reduce maintenance costs, and prevent unexpected power failures. The invention provides a significant advancement over existing solutions by offering a proactive, intelligent approach to battery monitoring and management.

BRIEF SUMMARY OF THE INVENTION

[0010] A BMARS system for maintaining and managing battery performance. The term BMARS stands for battery monitoring and recharge system. Said BMARS system comprising a BMARS control module configured to monitor, log, and manage one or more battery parameters, a charger adapted to convert AC power to DC power, a direct current power connected to said charger and adapted to supply DC power to at least one load, a breaker interposed between said direct current power and one or more batteries one or more batteries, a battery safety switch housed in a safety enclosure, one or more sensors one or more sensors configured to measure voltage, temperature, or current of said one or more batteries, and a control panel communicatively coupled to said BMARS control module. Wherein said BMARS control module is configured to: (a) automatically track a charging state of said one or more batteries, (b) selectively switch between a Float mode and an Equalize mode for said charger, (c) record performance data for said one or more batteries at predefined time intervals, and (d) provide remote monitoring and control signals for battery maintenance. Said BMARS control module comprises an address space having: one or more processors, communication hardware, and a memory storing instructions for a device application, an alarm system application, and a notification system application. Said communication hardware is configured to exchange data with an external network, and said alarm system application is programmed to generate an alarm upon detecting abnormal battery conditions selected from the group consisting of: over-voltage, under-voltage, over-temperature, and under-temperature. Said BMARS system further comprises a hall effects sensor included among said one or more sensors, the hall effects sensor being arranged to measure both charging current flowing from said charger to said one or more batteries and load current drawn from said one or more batteries to said direct current power.

[0011] The BMARS system for maintaining and managing battery performance. The term BMARS stands for battery monitoring and recharge system. Said BMARS system comprising the BMARS control module configured to monitor, log, and manage one or more battery parameters, the charger adapted to convert AC power to DC power, the direct current power connected to said charger and adapted to supply DC power to at least one load, the breaker interposed between said direct current power and one or more batteries one or more batteries, the battery safety switch housed in the safety enclosure, one or more sensors one or more sensors config-

ured to measure voltage, temperature, or current of said one or more batteries, and the control panel communicatively coupled to said BMARS control module. Wherein said BMARS control module is configured to: (a) automatically track a charging state of said one or more batteries, (b) selectively switch between a Float mode and an Equalize mode for said charger, (c) record performance data for said one or more batteries at predefined time intervals, and (d) provide remote monitoring and control signals for battery maintenance.

[0012] A method of use for operating the BMARS system is disclosed. Comprising (a) initializing a battery monitoring step to activate real-time tracking of battery parameters for one or more batteries one or more batteries, (b) monitoring said battery parameters at a monitoring battery parameters step, the battery parameters including at least one of voltage, temperature, and current, (c) determining whether said one or more batteries require charging at a determining charging status step, (d) triggering a triggering charging mode adjustment step to place the charger in either Float mode or Equalize mode based on a condition of said one or more batteries, (e) continuing an equalization process at a continuing equalization step until said one or more batteries reach full charge, and (f) conducting a battery load test to evaluate discharge response of said one or more batteries, wherein data from steps (b) through (f) is logged at predefined time intervals and stored for subsequent analysis.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

[0013] FIG. **1** illustrates a diagram of a BMARS system **100**.

[0014] FIG. **2** illustrates a wiring harness **200**.

[0015] FIG. **3** illustrates an exemplary installation configuration **300** of said BMARS system **100**.

[0016] FIG. **4** illustrates a detailed view of said exemplary installation configuration **300**.

[0017] FIG. **5** illustrates a software interface **500** of said BMARS system **100**.

[0018] FIG. **6** illustrates a battery status screen **600** within said software interface **500**.

[0019] FIG. **7** illustrates a method of use **700** of said BMARS system **100**.

[0020] FIG. **8** illustrates a block diagram of an address space **800** within said BMARS control module **104**.

[0021] FIGS. **9** and **10** illustrate a battery discharge test **900** and a battery condition status readout **1000**, respectively.

DETAILED DESCRIPTION OF THE INVENTION

[0022] The following description is presented to enable any person skilled in the art to make and use the invention as claimed and is provided in the context of the particular examples discussed below, variations of which will be readily apparent to those skilled in the art. In the interest of clarity, not all features of an actual implementation are described in this specification. It will be appreciated that in the development of any such actual implementation (as in any development project), design decisions must be made to achieve the designers' specific goals (e.g., compliance with system-and business-related constraints), and that these goals will vary from one implementation to another. It will also be appreciated that such development effort might be complex and time-consuming, but would nevertheless be a routine undertaking for those of ordinary skill in the field of the appropriate art having the benefit of this disclosure. Accordingly, the claims appended hereto are not intended to be limited by the disclosed embodiments, but are to be accorded their widest scope consistent with the principles and features disclosed herein.

[0023] This disclosure will refer to a "Battery Monitor and Recharge System" as a "BMARS".

[0024] FIG. **1** illustrates a diagram of a BMARS system **100**.

[0025] In one embodiment, said BMARS system **100** can be configured to manage and monitor one or more batteries **102** in conjunction with a direct current power **110**, and a charger **108**.

[0026] In one embodiment, said BMARS system **100** can comprise a BMARS control module **104**, a breaker **112**, a control panel **114**, one or more sensors **116**, and a battery safety switch **118**.

[0027] Note that said direct current power **110** can also be referred to as a DCP-1 in this discussion.

[0028] In one embodiment, said battery safety switch **118** can interface with said one or more batteries **102** in a safety enclosure **120**. In some implementations, said safety enclosure **120** can correspond to a "One Safety SW Enclosure" referenced in external documentation.

[0029] In one embodiment, said BMARS system **100** can be configured to monitor battery cells with little to no downtime. Wherein said BMARS system **100** can be configured for: logging critical data multiple times per minute (such as every 10 seconds), and allowing for real-time maintenance and correction actions. This ensures prolonged battery life and serviceability from remote locations.

[0030] In one embodiment, said BMARS system **100** can be configured to work with the charger **108**, the direct current power **110**, said one or more batteries **102** and the breaker **112**. Wherein, said charger **108** can be configured for converting AC power to DC power to charge the battery. The charger operates in two modes: 'Float' for regular charging and maintaining the battery's charge level, and 'Equalize' for balancing the charge across all cells in the battery to ensure each cell is fully charged.

[0031] Said direct current power **110**, or "DCP", can comprise the DC power supply system that powers the station's loads. The DCP receives power from the charger and, in the event of a charger malfunction or utility outage, directly from the battery. Said one or more batteries **102** can store electrical energy in the form of DC power.

[0032] In one embodiment, said BMARS system **100** can monitor each cell within said one or more batteries **102** to ensure they are in good condition, charged correctly, and available to supply power whenever needed.

[0033] Said breaker **112**, or "BMARS Breaker" can act as a breaker or switch that manages the connection between the battery, charger, and loads. It can be employed for monitoring the battery's state, including its charge level and health, and controls the charging mode (Float or Equalize) based on the battery's condition.

[0034] In one embodiment, said direct current power **110** can receive an utility AC input **122**. Said direct current power **110** can be connected to said charger **108** with a DC bus **124**. Said one or more batteries **102** can be connected to said direct current power **110** through said breaker **112**. Said

DC bus **124** and a second conductor **126** can each function as a bus or common conductor for distributing DC power among said charger **108**, said BMARS control module **104**, and said one or more batteries **102**. In one embodiment, one or more hall effects sensors are looped around these bus lines to measure both charge current (flowing from said charger **108** to said one or more batteries **102**) and load current (supplying said direct current power **110**).

[0035] Said BMARS control module **104** can be configured to sense battery voltage, current, temperature, etc. In addition, said BMARS control module **104** can determine power flow direction, allowing real-time logging of both charging and discharging currents. Further said BMARS control module **104** can be configured to switch modes between Float and Equalize as described herein.

[0036] FIG. **2** illustrates a wiring harness **200**.

[0037] Said wiring harness **200** can comprise a connector **202** and one or more posts **204**.

[0038] FIG. **3** illustrates an exemplary installation configuration **300** of said BMARS system **100**.

[0039] Said BMARS system **100** can further comprise the BMARS control module **104**, a hall effects sensor **304** and a battery cover **306**, as illustrated. In one embodiment, said one or more sensors **116** can comprise at least said hall effects sensor **304**.

[0040] FIG. **4** illustrates a detailed view of said exemplary installation configuration **300**.

[0041] Said hall effects sensor **304** can be affixed around relevant DC conductors (e.g., between said charger **108** and said direct current power **110**, or between said direct current power **110** and said one or more batteries **102**) to measure current in either direction.

[0042] In one embodiment, said hall effects sensor **304** can be in data communication with the control panel **114**.

[0043] FIG. **5** illustrates a software interface **500** of said BMARS system **100**.

[0044] In one embodiment, said software interface **500** can display a series of numeric readouts (e.g., cell voltages 1-n, charge current, load current, and temperature values), along with selectable buttons for initiating an equalization cycle or a battery load test. A data-download option can generate files containing timestamped voltage, current, and temperature logs for up to three years of operation.

[0045] Said BMARS system **100** can comprise said software interface **500**; wherein said software interface **500** can comprise features include real-time displays of battery status, charge and load currents, cell states (with voltage and temperature indicators), and the ability to download logged data for analysis.

[0046] FIG. **6** illustrates a battery status screen **600** within said software interface **500**.

[0047] Battery Service and Maintenance: said BMARS system **100** can be configured to extend the service life of said one or more batteries **102** by monitoring and maintaining battery and cell health in real-time, capable of logging critical data points at frequent intervals, such as every 10 seconds.

[0048] Remote Monitoring and Control: said BMARS system **100** can be configured with said communication hardware **804** for remote monitoring and control, allowing users to manage battery charge levels remotely, especially useful in preparation for anticipated events like hurricanes.

[0049] Battery Load Test Anytime: said BMARS system **100** can be equipped with a battery load test **712** feature, enabling users to conduct battery load tests whenever needed to ensure that said one or more batteries **102** maintain their optimal condition. In some implementations, said battery load test **712** can be triggered during normal operation without requiring the entire system to shut down.

[0050] Alarm System and Data Logging: said BMARS system **100** can be configured for advanced alarm and data logging functionalities, alerting users to conditions of concern and logging detailed data with date and time stamps for easy tracking and analysis of battery health.

[0051] Utility Outage Response: said BMARS system **100** can automatically switch to supply power directly from said one or more batteries **102** to said direct current power **110** without manual intervention during a utility outage, ensuring an uninterrupted power supply.

[0052] Installation and AH Capacity Determination: said BMARS system **100** can allow operators to either input the battery's AH rating or determine it through said battery load test **712** during the initial setup, facilitating accurate monitoring and maintenance right from the beginning. FIG. **7** illustrates a method of use **700** of said BMARS system **100**.

[0053] In one embodiment, said method of use **700** can comprise initializing a battery monitoring step **702**, wherein said BMARS system **100** is activated to begin real-time monitoring of said one or more batteries **102**.

[0054] Following initialization, said BMARS system **100** proceeds to a monitoring battery parameters step **704**, wherein said one or more sensors **116** continuously track voltage, temperature, and charge/discharge currents. Data acquired during this step is transmitted for further analysis and logging.

[0055] In one embodiment, said BMARS system **100** executes a determining charging status step **706**, wherein said BMARS control module **104** evaluates whether said one or more batteries **102** require charging. If charging is required, said BMARS system **100** proceeds to a triggering charging mode adjustment step **708**, wherein said charger **108** transitions between 'Float' mode and 'Equalize' mode based on the charging requirements.

[0056] Once charging mode adjustments are triggered, said BMARS system **100** facilitates a continuing equalization step **710** until full charge. In this step, said charger **108** maintains the 'Equalize' mode to balance charge levels across all battery cells, ensuring uniform capacity retention.

[0057] After achieving full charge, said BMARS system **100** can execute the battery load test **712**, wherein said battery load test **712** is initiated to assess the discharge response and capacity of said one or more batteries **102**. Said battery load test **712** can be executed at operator discretion, even if the system remains online, to confirm battery readiness.

[0058] In the event of detected anomalies or performance degradation, said BMARS system **100** can execute generating and logging alarm conditions **714**. In this step, abnormal conditions such as excessive voltage drops, overheating, or irregular charge patterns are recorded with timestamped logs.

[0059] Said BMARS system **100** is further configured for a storing and analyzing logged data step **716**, wherein historical battery performance data is retained for predictive maintenance, compliance reporting, and troubleshooting purposes. one embodiment, about three years of rolling data

can be stored, capturing voltage, current, and temperature readings, along with event logs for each alarm or test performed.

[0060] In one embodiment, said BMARS system **100** supports a remotely monitoring and control step **718**, allowing users to access real-time battery status, issue control commands, and adjust charging parameters via a wireless or wired communication interface. Data from said remotely monitoring and control step **718** is integrated into said storing and analyzing logged data step **716** to ensure continuous performance tracking.

[0061] Said BMARS system **100** can be further configured to manage operation modes of said charger **108**, for example as between 'Float' and 'Equalize' based on the charge status of said one or more batteries **102** to ensure optimal charging and prevent potential battery damage due to overcharging or undercharging.

[0062] In one embodiment, said BMARS system **100** can further comprise AH Capacity Management; wherein, said BMARS system **100** can ensure that when a charge level of said one or more batteries **102** falls below 80%, said charger **108** is activated in 'Float' mode until reaching 80% charge, subsequently switching to 'Equalize' mode until full charge is achieved, thereafter maintaining 'Float' mode to avoid overcharging.

[0063] In one embodiment, said BMARS system **100** includes said communication hardware **804**, enabling remote monitoring and control over said one or more batteries **102**, facilitating battery load tests, and full recharging capabilities remotely in preparation for events such as hurricanes. This ensures a remote monitoring of said BMARS system **100**.

[0064] Said BMARS system **100** can further comprise critical data logging; wherein, said BMARS system **100** can be equipped with functionality for logging critical data of said one or more batteries **102** including voltage, temperature, and charge/discharge currents, every 10 seconds, thus allowing for real-time maintenance and historical data analysis.

[0065] Said BMARS system **100** can further comprise a utility outage response; wherein: during a utility outage, said BMARS system **100** can automatically transition to supply power directly from said one or more batteries **102** to said direct current power **110** without manual intervention, ensuring uninterrupted power supply.

[0066] Said BMARS system **100** can be configured for alarm and data logging; wherein said BMARS system **100** can be capable of alarming under conditions of concern and logs data with precise date and time stamps for said one or more batteries **102**, with about three years of rolling data storage, which can be downloaded for permanent record-keeping.

[0067] Said BMARS system **100** can further comprise battery load test recommendations; wherein, concurrent with conducting said battery load test **712**, said BMARS system **100** can advise switching said charger **108** to 'Equalize' mode for a designated period before returning to 'Float' mode, ensuring that said one or more batteries **102** are in optimal condition for accurate testing.

[0068] FIG. **8** illustrates a block diagram of an address space **800** within said BMARS control module **104**.

[0069] Said address space **800** can comprise one or more processors **802**, the communication hardware **804**, a memory **806** having a device application **808**, an alarm system application **810** and a notification system application **812**.

[0070] As is known in the art, programs stored in said memory **806** can be run in said one or more processors **802**. Further said communication hardware **804** can be in data communication with other computers, servers, IOT devices, or similar. Likewise, said communication hardware **804** can receive signals form said one or more sensors **116**.

[0071] FIGS. **9** and **10** illustrate a battery discharge test **900** and a battery condition status readout **1000**, respectively.

[0072] In one embodiment, said battery discharge test **900** can include displaying real-time cell voltages, discharge currents, and overall battery capacity in an on-screen or downloadable format, while said battery condition status readout **1000** can provide a historical log and present snapshot of voltages, temperatures, and alarm events over a three-year rolling period.

Parts List

[0073] BMARS system **100**,
[0074] one or more batteries **102**,
[0075] BMARS control module **104**,
[0076] charger **108**,
[0077] direct current power **110**,
[0078] breaker **112**,
[0079] control panel **114**,
[0080] one or more sensors **116**,
[0081] battery safety switch **118**,
[0082] safety enclosure **120**,
[0083] wiring harness **200**,
[0084] connector **202**,
[0085] one or more posts **204**,
[0086] exemplary installation configuration **300**,
[0087] hall effects sensor **304**,
[0088] battery cover **306**,
[0089] software interface **500**,
[0090] battery status screen **600**,
[0091] method of use **700**,
[0092] battery monitoring step **702**,
[0093] monitoring battery parameters step **704**,
[0094] determining charging status step **706**,
[0095] triggering charging mode adjustment step **708**,
[0096] continuing equalization step **710**,
[0097] battery load test **712**,
[0098] alarm conditions **714**,
[0099] storing and analyzing logged data step **716**,
[0100] remotely monitoring and control step **718**,
[0101] address space **800**,
[0102] one or more processors **802**,
[0103] communication hardware **804**,
[0104] memory **806**,
[0105] device application **808**,
[0106] alarm system application **810**,
[0107] notification system application **812**,
[0108] battery discharge test **900**, and
[0109] battery condition status readout **1000**.

[0110] The following section of the detailed description includes all embodiments from the original claims:

[0111] The BMARS system **100** for maintaining and managing battery performance. The term BMARS stands for battery monitoring and recharge system. Said BMARS system **100** comprising the BMARS control module **104** con-

figured to monitor, log, and manage one or more battery parameters, the charger **108** adapted to convert AC power to DC power, the direct current power **110** connected to said charger **108** and adapted to supply DC power to at least one load, the breaker **112** interposed between said direct current power **110** and one or more batteries one or more batteries **102**, the battery safety switch **118** housed in the safety enclosure **120**, one or more sensors one or more sensors **116** configured to measure voltage, temperature, or current of said one or more batteries **102**, and the control panel **114** communicatively coupled to said BMARS control module **104**. Wherein said BMARS control module **104** can be configured to: (a) automatically track a charging state of said one or more batteries **102**, (b) selectively switch between a Float mode and an Equalize mode for said charger **108**, (c) record performance data for said one or more batteries **102** at predefined time intervals, and (d) provide remote monitoring and control signals for battery maintenance. Said BMARS control module **104** comprises the address space **800** having: one or more processors **802**, communication hardware **804**, and the memory **806** storing instructions for the device application **808**, the alarm system application **810**, and the notification system application **812**. Said communication hardware **804** can be configured to exchange data with an external network, and said alarm system application **810** can be programmed to generate an alarm upon detecting abnormal battery conditions selected from the group consisting of: over-voltage, under-voltage, over-temperature, and under-temperature. Said BMARS system **100** further comprises the hall effects sensor **304** included among said one or more sensors **116**, the hall effects sensor **304** being arranged to measure both charging current flowing from said charger **108** to said one or more batteries **102** and load current drawn from said one or more batteries **102** to said direct current power **110**.

[0112] The BMARS system **100** for maintaining and managing battery performance. The term BMARS stands for battery monitoring and recharge system. Said BMARS system **100** comprising the BMARS control module **104** configured to monitor, log, and manage one or more battery parameters, the charger **108** adapted to convert AC power to DC power, the direct current power **110** connected to said charger **108** and adapted to supply DC power to at least one load, the breaker **112** interposed between said direct current power **110** and one or more batteries one or more batteries **102**, the battery safety switch **118** housed in the safety enclosure **120**, one or more sensors one or more sensors **116** configured to measure voltage, temperature, or current of said one or more batteries **102**, and the control panel **114** communicatively coupled to said BMARS control module **104**. Wherein said BMARS control module **104** can be configured to: (a) automatically track a charging state of said one or more batteries **102**, (b) selectively switch between a Float mode and an Equalize mode for said charger **108**, (c) record performance data for said one or more batteries **102** at predefined time intervals, and (d) provide remote monitoring and control signals for battery maintenance.

[0113] Said BMARS control module **104** comprises the address space **800** having: one or more processors **802**, communication hardware **804**, and The memory **806** storing instructions for The device application **808**, the alarm system application **810**, and The notification system application **812**. Said communication hardware **804** can be configured to exchange data with an external network, and said alarm system application **810** can be programmed to generate an alarm upon detecting abnormal battery conditions selected from the group consisting of: over-voltage, under-voltage, over-temperature, and under-temperature.

[0114] Said BMARS system **100** further comprises the software interface **500**, said software interface **500** presenting real-time graphical displays of battery status, cell voltages, cell temperatures, charge current, and load current.

[0115] Said software interface **500** includes the battery status screen **600** adapted to show a user-selectable option for initiating a battery load test and retrieving logged performance data.

[0116] Said BMARS system **100** further comprises the hall effects sensor **304** included among said one or more sensors **116**, the hall effects sensor **304** being arranged to measure both charging current flowing from said charger **108** to said one or more batteries **102** and load current drawn from said one or more batteries **102** to said direct current power **110**.

[0117] The rolling data comprising timestamped measurements of voltage, temperature, and charge or discharge current.

[0118] Said BMARS control module **104** can be configured to maintain about three years of rolling data for said one or more batteries **102**,

[0119] Said BMARS control module **104** can be configured for performing the battery load test **712** on said one or more batteries **102** at any point during normal operation, and thereby assessing the available capacity of each battery cell without interrupting power to said direct current power **110**.

[0120] Said battery safety switch **118** can be configured to isolate said one or more batteries **102** from said direct current power **110** to facilitate maintenance, and said safety enclosure **120** encloses said battery safety switch **118** to permit secure manual or remote activation of battery isolation.

[0121] Said BMARS control module **104** can be configured for performing the battery load test **712** on said one or more batteries **102** at any point during normal operation, and thereby assessing the available capacity of each battery cell without interrupting power to said direct current power **110**. Said battery safety switch **118** can be configured to isolate said one or more batteries **102** from said direct current power **110** to facilitate maintenance. And said safety enclosure **120** encloses said battery safety switch **118** to permit secure manual or remote activation of battery isolation.

[0122] The method of use **700** for operating the BMARS system **100** can comprise (a) initializing the battery monitoring step **702** to activate real-time tracking of battery parameters for one or more batteries one or more batteries **102**, (b) monitoring said battery parameters at the monitoring battery parameters step **704**, the battery parameters including at least one of voltage, temperature, and current, (c) determining whether said one or more batteries **102** require charging at the determining charging status step **706**, (d) triggering the triggering charging mode adjustment step **708** to place the charger **108** in either Float mode or Equalize mode based on a condition of said one or more batteries **102**, (e) continuing an equalization process at the continuing equalization step **710** until said one or more batteries **102** reach full charge, and (f) conducting the battery load test **712** to evaluate discharge response of said one or more batteries

102, wherein data from steps (b) through (f) can be logged at predefined time intervals and stored for subsequent analysis.

[0123] Generating and logging alarm conditions **714** when an abnormal parameter can be detected, including steps of: recording timestamped data indicating said abnormal parameter, and transmitting a notification The communication hardware **804**.

[0124] Said battery load test **712** can be performed on said one or more batteries **102** without taking them offline, thereby verifying battery capacity in real time while maintaining power to the direct current power **110**.

[0125] Said BMARS system **100** periodically checks a state of charge of said one or more batteries **102**, automatically switching from Float mode to Equalize mode whenever the state of charge can be below about 80%, and returning to Float mode upon detecting full charge. Performing said battery load test **712** includes recommending that said charger **108** be set to Equalize mode for a designated duration, followed by switching to Float mode for final stabilization of charge levels.

[0126] Remotely monitoring and controlling charging states of said charger **108** at the remotely monitoring and control step **718** through the communication hardware **804**, wherein the BMARS control module **104** logs all remote commands and resulting battery parameters in a data store accessible to the control panel **114**.

[0127] Said BMARS system **100** automatically transitions to supply power from said one or more batteries **102** to the direct current power **110** upon detecting a utility outage, and subsequently maintains continuous logging of battery discharge events to track time-stamped data for predictive maintenance.

[0128] Various changes in the details of the illustrated operational methods are possible without departing from the scope of the following claims. Some embodiments may combine the activities described herein as being separate steps. Similarly, one or more of the described steps may be omitted, depending upon the specific operational environment the method is being implemented in. It is to be understood that the above description is intended to be illustrative, and not restrictive. For example, the above-described embodiments may be used in combination with each other. Many other embodiments will be apparent to those of skill in the art upon reviewing the above description. The scope of the invention should, therefore, be determined with reference to the appended claims, along with the full scope of equivalents to which such claims are entitled. In the appended claims, the terms "including" and "in which" are used as the plain-English equivalents of the respective terms "comprising" and "wherein."

1. A BMARS system for maintaining and managing battery performance, wherein:

the term BMARS stands for battery monitoring and recharge system;

said BMARS system comprising

a BMARS control module configured to monitor, log, and manage one or more battery parameters,

a charger adapted to convert AC power to DC power,

a direct current power connected to said charger and adapted to supply DC power to at least one load,

a breaker interposed between said direct current power and

one or more batteries one or more batteries,

a battery safety switch housed in a safety enclosure,

one or more sensors one or more sensors configured to measure voltage, temperature, or current of said one or more batteries,

and a control panel communicatively coupled to said BMARS control module;

wherein said BMARS control module is configured to:

(a) automatically track a charging state of said one or more batteries,

(b) selectively switch between a Float mode and an Equalize mode for said charger,

(c) record performance data for said one or more batteries at predefined time intervals, and

(d) provide remote monitoring and control signals for battery maintenance;

said BMARS control module comprises an address space having:

one or more processors,

communication hardware, and

a memory storing instructions for

a device application,

an alarm system application, and

a notification system application;

said communication hardware is configured to exchange data with an external network, and

said alarm system application is programmed to generate an alarm upon detecting abnormal battery conditions selected from the group consisting of:

over-voltage, under-voltage, over-temperature, and under-temperature;

said BMARS system further comprises a hall effects sensor included among said one or more sensors,

the hall effects sensor being arranged to measure both charging current flowing from said charger to said one or more batteries and load current drawn from said one or more batteries to said direct current power.

2. A BMARS system for maintaining and managing battery performance, wherein:

the term BMARS stands for battery monitoring and recharge system;

said BMARS system comprising

a BMARS control module configured to monitor, log, and manage one or more battery parameters,

a charger adapted to convert AC power to DC power,

a direct current power connected to said charger and adapted to supply DC power to at least one load,

a breaker interposed between said direct current power and

one or more batteries one or more batteries,

a battery safety switch housed in a safety enclosure,

one or more sensors one or more sensors configured to measure voltage, temperature, or current of said one or more batteries,

and a control panel communicatively coupled to said BMARS control module;

wherein said BMARS control module is configured to:

(a) automatically track a charging state of said one or more batteries,

(b) selectively switch between a Float mode and an Equalize mode for said charger,

(c) record performance data for said one or more batteries at predefined time intervals, and

(d) provide remote monitoring and control signals for battery maintenance.

3. The BMARS system of claim 1, wherein
said BMARS control module comprises the address space having:
one or more processors,
communication hardware, and
The memory storing instructions for
The device application,
an alarm system application, and
The notification system application;
said communication hardware is configured to exchange data with an external network, and
said alarm system application is programmed to generate an alarm upon detecting abnormal battery conditions selected from the group consisting of:
over-voltage, under-voltage, over-temperature, and under-temperature.

4. The BMARS system of claim 3, wherein
said BMARS system further comprises a software interface,
said software interface presenting real-time graphical displays of battery status, cell voltages, cell temperatures, charge current, and load current.

5. The BMARS system of claim 4, wherein:
said software interface includes a battery status screen adapted to show a user-selectable option for initiating a battery load test and retrieving logged performance data.

6. The BMARS system of claim 1, wherein
said BMARS system further comprises the hall effects sensor included among said one or more sensors,
the hall effects sensor being arranged to measure both charging current flowing from said charger to said one or more batteries and load current drawn from said one or more batteries to said direct current power.

7. The BMARS system of claim 1, wherein
the rolling data comprising timestamped measurements of voltage, temperature, and charge or discharge current.

8. The BMARS system of claim 7, wherein
said BMARS control module is configured to maintain about three years of rolling data for said one or more batteries.

9. The BMARS system of claim 1, wherein
said BMARS control module is configured for
performing a battery load test on said one or more batteries at any point during normal operation, and
thereby assessing the available capacity of each battery cell without interrupting power to said direct current power.

10. The BMARS system of claim 1, wherein
said battery safety switch is configured to isolate said one or more batteries from said direct current power to facilitate maintenance,
and said safety enclosure encloses said battery safety switch to permit secure manual or remote activation of battery isolation.

11. The BMARS system of claim 1, wherein
said BMARS control module is configured for
performing a battery load test on said one or more batteries at any point during normal operation, and
thereby assessing the available capacity of each battery cell without interrupting power to said direct current power;
said battery safety switch is configured to isolate said one or more batteries from said direct current power to facilitate maintenance; and
and said safety enclosure encloses said battery safety switch to permit secure manual or remote activation of battery isolation.

12. A method of use for operating a BMARS system, comprising:
(a) initializing a battery monitoring step to activate real-time tracking of battery parameters for one or more batteries one or more batteries,
(b) monitoring said battery parameters at a monitoring battery parameters step, the battery parameters including at least one of voltage, temperature, and current,
(c) determining whether said one or more batteries require charging at a determining charging status step,
(d) triggering a triggering charging mode adjustment step to place a charger in either Float mode or Equalize mode based on a condition of said one or more batteries,
(e) continuing an equalization process at a continuing equalization step until said one or more batteries reach full charge, and
(f) conducting a battery load test to evaluate discharge response of said one or more batteries,
wherein data from steps (b) through (f) is logged at predefined time intervals and stored for subsequent analysis.

13. The method of use of claim 12, further comprising:
generating and logging alarm conditions when an abnormal parameter is detected, including steps of:
recording timestamped data indicating said abnormal parameter, and
transmitting a notification via communication hardware.

14. The method of use of claim 12, wherein:
said battery load test is performed on said one or more batteries without taking them offline,
thereby verifying battery capacity in real time while maintaining power to a direct current power.

15. The method of use of claim 12, wherein:
said BMARS system periodically checks a state of charge of said one or more batteries,
automatically switching from Float mode to Equalize mode whenever the state of charge is below about 80%,
and returning to Float mode upon detecting full charge.

16. The method of use of claim 12, wherein:
performing said battery load test includes recommending that said charger be set to Equalize mode for a designated duration,
followed by switching to Float mode for final stabilization of charge levels.

17. The method of use of claim 12, further comprising:
remotely monitoring and controlling charging states of said charger at a remotely monitoring and control step through a communication hardware,
wherein a BMARS control module logs all remote commands and resulting battery parameters in a data store accessible to a control panel.

18. The method of use of claim 12, wherein:
said BMARS system automatically transitions to supply power from said one or more batteries to a direct current power upon detecting a utility outage,

and subsequently maintains continuous logging of battery discharge events to track time-stamped data for predictive maintenance.

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