COLD-WEATHER BATTERY TECHNOLOGY PATENT #PDR-2022-178

COLD-WEATHER BATTERY TECHNOLOGY

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ABSTRACT

A system and method for maintaining optimal battery performance in extrem environments, specifically designed for autonomous mobile robots operating sub-zero temperatures. The invention comprises a multi-layer thermal manag system, proprietary electrolyte composition, and adaptive power regulation algorithm that enables consistent battery discharge characteristics at temperatures ranging from -40°C to +25°C.

BACKGROUND OF THE INVENTION

[0001] Autonomous mobile robots operating in cold storage and industrial fr environments face significant challenges related to battery performance degradation at low temperatures. Conventional lithium-ion batteries experien substantial capacity reduction and increased internal resistance when operate below 0°C, leading to shortened run times and unreliable performance.

[0002] This invention addresses these limitations through a novel approach t
battery thermal management and chemistry optimization specifically designe
cold-environment operation.

SUMMARY OF THE INVENTION

[0003] The present invention provides a cold-weather battery system compri

a) A multi-layer thermal isolation chamber with vacuum-sealed barriers

b) Proprietary low-temperature electrolyte composition (Formula A-22)

c) Integrated heating elements with predictive temperature management

d) Adaptive power management system with cold-weather optimization

e) Real-time performance monitoring and adjustment algorithms

DETAILED DESCRIPTION

1. Thermal Management System

[0004] The thermal management system consists of:

- 1 Three-layer vacuum-sealed chamber with aerogel insulation
- 2 Thermally-regulated battery compartment maintaining 5°C ± 2°C
- 3 Active heating elements drawing <2% of total battery capacity
- 4 Temperature sensors with 0.1°C precision

2. Electrolyte Composition

[0005] The proprietary electrolyte formula comprises:

1 Modified lithium hexafluorophosphate (LiPF6) concentration

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2 Ethylene carbonate/propylene carbonate blend ratio optimization

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3 Proprietary additive package for low-temperature conductivity

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4 Stability enhancement compounds for extended cycle life

3. Power Management System

[0006] The adaptive power management system includes:

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1 Predictive load balancing algorithm

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2 Temperature-compensated charging protocols

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3 Dynamic power allocation based on environmental conditions

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4 Emergency power reserve management

CLAIMS

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A cold-weather battery system comprising:

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Thermal isolation chamber

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Low-temperature electrolyte composition

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Adaptive power management system

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Temperature monitoring and control system

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The system of claim 1, wherein the thermal isolation chamber maintains inte

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The system of claim 1, wherein the electrolyte composition enables >80% ca

TECHNICAL SPECIFICATIONS

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Operating Temperature Range: -40°C to +25°C

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Nominal Voltage: 48V

Capacity: 100Ah

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Cycle Life: >2000 cycles at -20°C

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Charging Temperature: -30°C to +25°C

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Self-heating Power Consumption: <2% of capacity

LEGAL NOTICES

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CERTIFICATION

I hereby certify that I am authorized to execute this patent application on behalf of Polar Dynamics Robotics, Inc.

/s/ Marcus Chen

Marcus Chen

Chief Technology Officer

Polar Dynamics Robotics, Inc.

Date: November 30, 2022

/s/ James Barrett

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Date: November 30, 2022

PATENT OFFICE ACKNOWLEDGMENT

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