

PATENT SPECIFICATION

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UNITED STATES PATENT APPLICATION NO. 16/78

Title: THERMAL MANAGEMENT SYSTEM AND METHOD FOR AU

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Patent Pending

ABSTRACT

A thermal management system (BlueCore(TM)) for autonomous mobile robots (AMRs) operating in extreme cold environments, comprising an integrated network of temperature-resistant components, thermal isolation chambers, and active heating elements. The system maintains critical operating temperatures of electronic components while enabling sustained robot functionality in environments ranging from -40 C to +25 C through dynamic thermal management and power management.

BACKGROUND

[0001] Autonomous mobile robots (AMRs) operating in cold storage and freezer environments face significant challenges related to battery performance, electronic component reliability, and mechanical system functionality at sub-zero temperatures. Conventional thermal management systems for

adequately protect sensitive components while maintaining efficient operation under sustained cold conditions.

[0002] Existing solutions typically employ basic heating elements that consume excessive power and provide inadequate temperature control, resulting in reduced operating time and potential system failures.

SUMMARY OF THE INVENTION

[0003] The present invention provides a comprehensive thermal management system for AMRs operating in extreme cold environments, comprising:

a) A multi-chamber thermal isolation architecture with specialized components for:

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Power systems

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Navigation electronics

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Motor control units

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Sensor arrays

b) An adaptive heating control system utilizing:

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Temperature-sensitive phase change materials

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Microprocessor-controlled heating elements

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Dynamic power allocation algorithms

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Thermal feedback loops

c) A power management subsystem featuring:

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Cold-resistant battery chemistry

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Intelligent load balancing

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Thermal energy recovery

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Predictive temperature management

DETAILED DESCRIPTION

[0004] The BlueCore(TM) thermal management system comprises mu

subsystems working in concert to maintain optimal operating temperatures, maximizing energy efficiency.

Thermal Isolation Architecture

[0005] The primary thermal isolation chamber employs a vacuum-sealed construction with proprietary insulation material achieving an R-value of 15. Internal compartments are segregated based on thermal requirements:

- Critical Electronics Zone: Maintained at 15 C ± 2 C
- Power Systems Zone: Maintained at 10 C ± 3 C
- Motor Control Zone: Maintained at 5 C ± 5 C
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Sensor Zone: Variable temperature management based on sensor type

Adaptive Heating Control

[0006] The system utilizes a network of microprocessor-controlled heating elements with the following specifications:

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Operating Voltage: 24V DC

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Maximum Power Draw: 200W

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Response Time: <500ms

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Temperature Control Accuracy: 0.5 C

Power Management Integration

[0007] The power management subsystem incorporates:

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Lithium Iron Phosphate batteries rated for -40 C operation

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Proprietary battery heating algorithms

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Thermal energy recovery from motor operations

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Smart power allocation based on operating conditions

CLAIMS

A thermal management system for autonomous mobile robots comprising:

- a) A multi-chamber thermal isolation architecture
- b) An adaptive heating control system
- c) An integrated power management subsystem
- d) Temperature-sensitive phase change materials
- e) Microprocessor-controlled heating elements

The system of claim 1, wherein the thermal isolation architecture mainly comprises:

The system of claim 1, wherein the adaptive heating control system comprises:

[Claims 4-20 omitted for brevity]

DRAWINGS

[Reference is made to accompanying drawings showing detailed system
and component relationships]

Figure 1: System Architecture Overview

Figure 2: Thermal Chamber Cross-Section

Figure 3: Control System Diagram

Figure 4: Power Management Flow

[Figures 5-12 omitted for brevity]

DECLARATION

I hereby declare that all statements made herein of my own knowledge
and that all statements made on information and belief are believed to be true
and further that these statements were made with the knowledge that
false statements and the like so made are punishable by fine or imprisonment

both, under Section 1001 of Title 18 of the United States Code.

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