THERMAL INSULATION DESIGN PATENT FOR CONTROL SYSTEMS

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UNITED STATES PATENT APPLICATION NO. 16/78

For: Modular Thermal Insulation System for Robotic Control Uni

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Assignee: Polar Dynamics Robotics, Inc.

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Priority Date: March 15, 2021

ABSTRACT

A modular thermal insulation system for protecting robotic control units in extreme temperature environments, comprising a multi-layer composite insul structure with active thermal regulation capabilities. The system includes a proprietary arrangement of thermally-resistant materials configured to maint optimal operating temperatures for sensitive electronic components while allowing necessary heat dissipation through regulated channels.

TECHNICAL FIELD

[0001] The present invention relates generally to thermal management syste industrial robotics, and more particularly to a modular insulation design for protecting autonomous mobile robot control systems operating in sub-zero environments between -40°C and 0°C.

BACKGROUND

[0002] Autonomous mobile robots operating in cold storage and freezer environments face significant challenges related to electronic component protection and thermal management. Existing solutions fail to adequately ad the competing needs of insulation and heat dissipation while maintaining sys mobility and serviceability.

[0003] Prior art solutions typically employ either passive insulation methods that are insufficient for extended sub-zero operation, or active heating system that consume excessive power and reduce robot operating time between char

SUMMARY OF THE INVENTION

[0004] The present invention provides a novel modular thermal insulation sy comprising:

a) A primary thermal barrier constructed of proprietary composite materials arranged in a honeycomb structure to maximize insulation while minimizing weight;

b) Active thermal channels incorporating phase-change materials to regulate distribution;

c) Modular connection points allowing rapid service access while maintainin thermal seal integrity;

d) Integrated temperature monitoring and control systems.

DETAILED DESCRIPTION

Construction

[0005] The primary insulation structure consists of:

- Outer layer: Impact-resistant thermoplastic composite (2.5mm)
- Middle layer: Vacuum-sealed aerogel panels arranged in honeycomb pattern
- Inner layer: Phase-change material containment system
- Thermal monitoring sensors positioned at critical points
- Serviceable access panels with redundant thermal seals

Thermal Management System

[0006] The active thermal management components include:

Microprocessor-controlled heat distribution channels

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Proprietary phase-change material composition (Patent pending #17/234,567

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Temperature differential monitoring system

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Adaptive thermal load balancing algorithms

Control Integration

[0007] The system interfaces with the robot's main control unit through:

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Dedicated thermal management processor

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Real-time temperature monitoring and logging

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Predictive thermal regulation algorithms

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Emergency thermal protection protocols

CLAIMS

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A modular thermal insulation system for robotic control units comprising:

a) A multi-layer composite insulation structure;

b) Active thermal regulation channels;

c) Modular access panels;

d) Integrated temperature monitoring system.

The system of claim 1, wherein the composite insulation structure includes:

a) Impact-resistant outer layer;

b) Vacuum-sealed aerogel middle layer;

c) Phase-change material inner layer.

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The system of claim 1, further comprising adaptive thermal load balancing c

[Claims 4-20 omitted for brevity]

DRAWINGS

[Reference to attached technical drawings showing detailed component layou

thermal flow diagrams]

DECLARATION AND POWER OF ATTORNEY

I hereby declare that:

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I am the original inventor of the subject matter which is claimed and for whi

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I have reviewed and understand the contents of the above-identified specifica

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I acknowledge the duty to disclose information which is material to patentab

Executed on: March 15, 2022

Inventors:

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ASSIGNMENT

The entire right, title and interest in this invention is assigned to Polar Dynamics Robotics, Inc., a Delaware corporation having its principal place o business at 2500 Innovation Drive, Cambridge, MA 02142.

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LEGAL REPRESENTATION

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