PATENT APPLICATION

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SELF-HEATING COMPONENT ASSEMBLY FOR SU

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ABSTRACT

A self-heating component assembly for autonomous mobile robots op
sub-zero environments, comprising an integrated thermal manageme
active heating elements and smart temperature regulation. The assem
a multi-layer insulation structure, embedded resistance heating eleme
microprocessor-controlled thermal distribution network that maintains
operating temperatures for critical robotic components in environment
from 0 C to -40 C.

BACKGROUND OF THE INVENTION

[0001] Autonomous mobile robots operating in cold storage and indus
environments face significant challenges related to component reliabil
performance degradation. Conventional heating solutions fail to provid
thermal management for precise robotic operations in sustained sub-z
conditions.

[0002] Existing solutions typically employ basic resistance heating or p
insulation, which prove insufficient for maintaining consistent compon
temperatures across varied operational states and environmental con

SUMMARY OF THE INVENTION

[0003] The present invention provides a comprehensive thermal mana
solution for robotic components operating in extreme cold environmen
system comprises:

a) A multi-layer composite insulation structure incorporating:

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Vacuum-sealed aerogel core layer

-

Carbon fiber reinforced outer shell

- Thermally conductive intermediate layer

b) Distributed heating elements featuring:

- Precision-controlled resistance heaters
- Phase-change material thermal buffers
- Temperature-sensitive semiconductor elements

c) Smart control system including:

- Real-time temperature monitoring array
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Predictive thermal management algorithms

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Power optimization protocols

DETAILED DESCRIPTION

[0004] The self-heating component assembly utilizes a proprietary Blu thermal management architecture to maintain optimal operating temp robotic components in extreme cold environments.

[0005] The primary thermal management unit comprises:

Thermal Sensing Array

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Multiple distributed temperature sensors

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Thermal imaging capabilities

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Environmental condition monitoring

Heating Element Network

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Variable-resistance heating elements

-

Zoned heating control

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Redundant heating circuits

Control System

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Microprocessor-based thermal regulation

Machine learning optimization

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Power consumption management

[0006] The assembly maintains component temperatures within 2 C o operating conditions while consuming less than 150W of power during operation.

CLAIMS

A self-heating component assembly for autonomous mobile robots co

a) A multi-layer insulation structure

b) Distributed heating elements

c) Microprocessor-controlled thermal management system

d) Power optimization system

The assembly of claim 1, wherein the multi-layer insulation structure c

a) Vacuum-sealed aerogel core

b) Carbon fiber reinforced outer shell

c) Thermally conductive intermediate layer

The assembly of claim 1, wherein the thermal management system m

DRAWINGS

[0007] FIG. 1 illustrates the layered construction of the thermal manag assembly.

[0008] FIG. 2 shows the distributed heating element network configura

[0009] FIG. 3 depicts the control system architecture.

TECHNICAL FIELD

[0010] The invention relates to thermal management systems for robo
components, specifically addressing the challenges of maintaining op
operating temperatures in extreme cold environments.

INDUSTRIAL APPLICABILITY

[0011] This invention has direct application in:

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Cold storage warehouses

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Frozen food manufacturing facilities

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Pharmaceutical cold chain operations

Industrial freezer environments

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Arctic research applications

DECLARATION

I hereby declare that all statements made herein of my own knowledg
and that all statements made on information and belief are believed to
and further that these statements were made with the knowledge that
false statements and the like so made are punishable by fine or impris
both, under Section 1001 of Title 18 of the United States Code.

Executed on: March 15, 2023

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