PATENT SPECIFICATION

Arctic-Grade Power Distribution System

Patent No. US 11,847,392 B2

Filing Date: March 12, 2019

Issue Date: September 15, 2021

ABSTRACT

A system and method for distributing electrical power in extreme cold environments, specifically designed for autonomous mobile robots operating in sub-zero temperatures. The system comprises thermally-isolated power distribution modules, cold-resistant conductors, and adaptive power management circuits that maintain optimal performance in temperatures ranging from -40 C to +25 C.

BACKGROUND

[0001] Autonomous mobile robots operating in cold storage and arctic environments face significant challenges related to power distribution and management. Traditional power systems experience reduced efficiency, component failure, and battery degradation when exposed to extreme cold conditions.

[0002] Existing solutions fail to address the unique requirements of maintaining stable power distribution in sub-zero environments while supporting the high-power demands of mobile robotics systems.

SUMMARY OF THE INVENTION

[0003] The present invention provides a novel power distribution system specifically engineered for extreme cold environments. The system incorporates:

a) Thermally-isolated power distribution modules with proprietary insulation compounds

b) Temperature-compensated voltage regulation circuits

c) Cold-resistant conductor materials with optimal electrical properties at sub-zero temperatures

d) Adaptive power management algorithms that adjust distribution parameters based on environmental conditions

DETAILED DESCRIPTION

Power Distribution Modules

[0004] The primary power distribution module comprises:

- Thermal isolation chamber constructed from composite materials (40% carbon fiber, 30% glass fiber, 30% proprietary polymer blend)
- Internal heating elements maintaining critical components at -5 C 2 C
- Voltage regulation circuits with temperature compensation factors
- Redundant power routing pathways

Cold-Resistant Conductors

[0005] The system utilizes proprietary conductor materials including:

- Copper-silver alloy (Cu-Ag) with 99.99% purity
- Cross-sectional area optimized for -40 C operation
- Multi-layer insulation with self-heating capabilities
- Flexible connection points with thermal expansion compensation

Adaptive Power Management

[0006] The power management system features:

- Real-time temperature monitoring at 12 critical points
- Dynamic voltage adjustment based on environmental conditions
- Load balancing algorithms optimized for cold-weather operation
- Predictive failure prevention based on thermal stress analysis

CLAIMS

A power distribution system for autonomous mobile robots operating in extreme cold environments, comprising:

a) Thermally-isolated power distribution modules

b) Temperature-compensated voltage regulation circuits

c) Cold-resistant conductors

d) Adaptive power management algorithms

The system of claim 1, wherein the thermal isolation chamber maintains internal temperature between -7 C and -3 C while external temperatures range from -40 C to +25 C.

The system of claim 1, wherein the cold-resistant conductors comprise copper-silver alloy with thermal expansion compensation mechanisms.

DRAWINGS

[0007] Figure 1: Schematic diagram of thermal isolation chamber

[0008] Figure 2: Cross-sectional view of cold-resistant conductor assembly

[0009] Figure 3: System architecture diagram

[0010] Figure 4: Power management flow diagram

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GOVERNMENT INTERESTS

[0011] This invention was made with government support under Contract No. USAF-21C-9238 awarded by the United States Air Force. The government has certain rights in this invention.

FIELD OF INVENTION

[0012] This invention relates to power distribution systems for autonomous mobile robots, specifically systems designed to operate in extreme cold environments such as industrial freezers, cold storage facilities, and arctic environments.

The foregoing description of the preferred embodiments of the invention has been presented for the purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise form disclosed.