

CHASSIS WEATHERPROOFING TECHNOLOGY PATENT

PATENT SPECIFICATION

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CHASSIS WEATHERPROOFING TECHNOLOGY FOR

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ABSTRACT

A system and method for weatherproofing autonomous mobile robot chassis for sustained operation in extreme cold environments. The invention comprises a multi-layer thermal isolation system, integrated heating elements, and moisture-resistant sealing technology that enables reliable robot operation in sub-zero temperatures down to -40°C while protecting critical internal components.

BACKGROUND OF THE INVENTION

[0001] Autonomous mobile robots (AMRs) operating in cold storage and industrial freezer environments face significant challenges related to component degradation, battery performance reduction, and mechanical stress due to extreme temperatures. Conventional weatherproofing methods fail to provide adequate protection for sustained operation below -10°C .

[0002] This invention addresses the limitations of existing solutions through an innovative approach to thermal management and moisture control specifically designed for mobile robotics applications.

SUMMARY OF THE INVENTION

[0003] The present invention provides a weatherproofing system for AMR comprising:

- A triple-layer thermal isolation barrier
- Active thermal management subsystem
- Condensation prevention system
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Flexible joint sealing technology

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Smart thermal monitoring and regulation

DETAILED DESCRIPTION

Thermal Isolation System

[0004] The chassis weatherproofing system utilizes a proprietary three-layer approach:

(a) Outer Layer: High-density polyethylene (HDPE) shell with titanium dioxide thermal reflective coating

(b) Middle Layer: Vacuum-sealed aerogel insulation matrix

(c) Inner Layer: Carbon fiber composite with embedded heating elements

[0005] The layers are bonded using a proprietary cold-resistant adhesive compound (Formula PDR-372) that maintains flexibility at extreme temperatures.

Active Thermal Management

[0006] The system incorporates strategically placed heating elements:

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Primary heaters: 24V DC resistance heating strips

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Secondary heaters: Ceramic PTC elements

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Thermal distribution channels: Aluminum heat pipes

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Temperature sensors: PT100 platinum RTDs

[0007] Power consumption is optimized through predictive thermal modeling.

zone-based activation.

Moisture Control System

[0008] Condensation is prevented through:

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Positive pressure maintenance

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Desiccant-based moisture absorption

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Active dehumidification cycles

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Hydrophobic surface treatments

Joint Sealing Technology

[0009] Critical joints and access panels are protected by:

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Silicone-based compression gaskets

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Expanding foam seals

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Interlocking labyrinth channels

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Redundant O-ring systems

CLAIMS

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A weatherproofing system for autonomous mobile robot chassis comprising:

a) A multi-layer thermal isolation barrier

- b) Active heating elements
- c) Moisture control mechanisms
- d) Environmental monitoring sensors
- e) Smart control system

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The system of claim 1, wherein the thermal isolation barrier comprises three

- a) An outer HDPE shell
- b) A middle aerogel layer
- c) An inner composite layer

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The system of claim 1, wherein the active heating elements maintain internal

[Claims 4-20 continued...]

DRAWINGS

[Figure references and detailed technical drawings omitted for brevity]

TECHNICAL FIELD

This invention relates to environmental protection systems for autonomous mobile robots, specifically addressing thermal management and moisture control in extreme cold environments.

INDUSTRIAL APPLICABILITY

The invention enables reliable autonomous robot operation in cold storage facilities, frozen food warehouses, and other sub-zero industrial environments requiring consistent performance and component protection.

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