PATENT SPECIFICATION

Arctic-Grade Cable and Connector System

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ABSTRACT

A system and method for ultra-low temperature resistant cable and connector assemblies specifically designed for robotic applications in extreme cold environments. The invention comprises a novel combination of thermally-optimized materials, geometric configurations, and connection mechanisms that maintain reliable electrical and data transmission in temperatures ranging from -60 C to +25 C while preserving flexibility and durability.

BACKGROUND OF THE INVENTION

[0001] Autonomous mobile robots operating in cold storage and industrial freezer environments face significant challenges related to cable and connector reliability. Traditional cable assemblies become brittle and prone to failure at extremely low temperatures, while standard connectors can experience thermal contraction that compromises connection integrity.

[0002] Existing solutions have failed to adequately address the combined challenges of maintaining cable flexibility, preventing connector separation, and ensuring consistent signal transmission in arctic-grade industrial environments.

SUMMARY OF THE INVENTION

[0003] The present invention provides a novel cable and connector system comprising:

- A multi-layer cable jacket utilizing proprietary polymer blends optimized for extreme cold flexibility
- An internal heating element integrated within the cable structure
- A self-adjusting connector mechanism that compensates for thermal contraction
- Redundant contact points with gold-plated surfaces
- An automated connection verification system

DETAILED DESCRIPTION

Cable Assembly

[0004] The cable assembly comprises:

(a) An inner conductor bundle featuring:

- 24 AWG copper conductors
- Triple-redundant signal paths
- Proprietary insulation compound (PDR-775)

[0005] The middle layer includes:

(b) Thermal management components:

- Resistive heating elements
- Temperature sensors at 30cm intervals
- Thermal distribution mesh

[0006] The outer jacket consists of:

(c) Three-layer protection system:

- Inner: Modified fluoropolymer blend
- Middle: Aramid fiber reinforcement
- Outer: Proprietary cold-resistant elastomer (PDR-890)

Connector System

[0007] The connector assembly features:

(a) Floating contact design allowing for:

- 0.5mm thermal movement
- Self-aligning contact points
- Spring-loaded engagement mechanism

[0008] Environmental sealing through:

(b) Triple-barrier system:

- Primary O-ring (modified EPDM)
- Secondary labyrinth seal
- Tertiary compression gasket

CLAIMS

A cable assembly for extreme cold environments comprising:

(a) A multi-conductor core featuring redundant signal paths

(b) An integrated heating element system

(c) A three-layer jacket system utilizing proprietary polymer blends

A connector system for extreme cold environments comprising:

(a) Self-adjusting contact mechanisms

(b) Triple-barrier environmental sealing

(c) Automated connection verification

The combination of claims 1 and 2 wherein:

(a) Operating temperature range is -60 C to +25 C

(b) Maintains flexibility at specified temperatures

(c) Provides consistent electrical characteristics throughout range

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GOVERNMENT RIGHTS

[0009] This invention was made with government support under Contract No. NSF-SBIR-1945372 awarded by the National Science Foundation. The government has certain rights in the invention.

CERTIFICATION

I hereby certify that this patent document and all statements made herein of my own knowledge are true, that all statements made on information and belief are believed to be true, and that these statements were made with the knowledge that willful false statements are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

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