

PATENT: COLD-RESISTANT SERVO MOTOR DESIGN

PATENT APPLICATION

COLD-RESISTANT SERVO MOTOR DESIGN

United States Patent Application No. 16/789,432

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Assignee: Polar Dynamics Robotics, Inc.

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ABSTRACT

A cold-resistant servo motor system designed for reliable operation in sub-zero environments, comprising a thermally insulated housing, specialized lubricant delivery system, and temperature-compensating control algorithms. The invention enables consistent torque delivery and precise positional control in ambient temperatures ranging from -40°C to +25°C.

BACKGROUND OF INVENTION

[0001] Conventional servo motors experience significant performance degradation in cold environments due to increased mechanical resistance, lubricant viscosity changes, and thermal contraction of components. This invention addresses the critical need for reliable servo motor operation in cold-chain automation applications.

[0002] Prior art solutions have failed to adequately address the combined challenges of thermal management, lubrication, and precise control in sub-zero

conditions.

SUMMARY OF INVENTION

[0003] The present invention provides a servo motor system specifically engineered for cold environment operation, featuring:

- a) A multi-layer thermally insulated housing with vacuum-sealed chambers
- b) Temperature-regulated lubricant circulation system
- c) Adaptive control algorithms compensating for temperature-induced mechanical variations
- d) Self-heating elements triggered by performance monitoring
- e) Cold-resistant electrical components and connections

DETAILED DESCRIPTION

Housing Design

[0004] The servo motor housing comprises:

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Outer shell: Aircraft-grade aluminum alloy (6061-T6)

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Middle layer: Aerogel-based thermal insulation (2-5mm thickness)

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Inner chamber: Vacuum-sealed space with radiation barriers

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Sealed bearings with specialized cold-resistant gaskets

Lubrication System

[0005] The invention incorporates:

- - 4 -

Proprietary low-temperature synthetic lubricant (viscosity index >180)

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Heated lubricant reservoir maintaining $15^{\circ}\text{C} \pm 2^{\circ}\text{C}$

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Micropump circulation system with pressure monitoring

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Temperature-dependent flow rate adjustment

Control System

[0006] The control architecture features:

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Real-time temperature monitoring at 12 critical points

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Predictive compensation for mechanical resistance variations

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Adaptive PID control parameters based on thermal conditions

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Emergency shutdown protocols for thermal anomalies

CLAIMS

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A cold-resistant servo motor system comprising:

a) A thermally insulated housing;

b) Temperature-regulated lubrication system;

c) Adaptive control algorithms;

d) Self-heating elements;

wherein said system maintains operational specifications at temperatures between -40°C and +25°C.

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The system of claim 1, wherein the housing comprises multiple thermal isolation layers.

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The system of claim 1, wherein the lubrication system automatically adjusts flow rate based on temperature.

[Claims 4-20 continued...]

DRAWINGS

[0007] Figure 1: Cross-sectional view of insulated housing

[0008] Figure 2: Lubrication system schematic

[0009] Figure 3: Control system architecture

[0010] Figure 4: Performance data at various temperatures

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 which

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I have reviewed and understand the contents of this application;

-

I acknowledge the duty to disclose information material to patentability as de

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[Additional standard USPTO filing documentation follows...]

