ROBOTIC JOINT LUBRICATION SYSTEM FOR EXTREME COLD PATENT

PATENT SPECIFICATION

UNITED STATES PATENT APPLICATION NO. 16/78

Title: ROBOTIC JOINT LUBRICATION SYSTEM FOR EXTREME C

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ABSTRACT

A system and method for maintaining joint lubrication in robotic systems operating in extreme cold environments, comprising a thermally-isolated lubrication reservoir, microfluidic distribution channels with integrated heating elements, and smart viscosity control mechanisms. The system enabl consistent joint movement in temperatures below -40°C while preventing lub crystallization and maintaining optimal viscosity ranges.

BACKGROUND

[0001] Autonomous mobile robots operating in cold storage and industrial fr environments face significant challenges related to joint mobility and lubrication. Traditional lubricants become highly viscous or crystallize at sub-zero temperatures, leading to increased friction, reduced mobility, and potential mechanical failure.

[0002] Existing solutions typically rely on expensive specialty lubricants or

external heating systems that consume significant power and reduce operatio efficiency. There remains a need for an integrated, energy-efficient solution that maintains optimal joint lubrication in extreme cold conditions.

SUMMARY OF THE INVENTION

[0003] The present invention provides a novel approach to maintaining joint lubrication in robotic systems operating in extreme cold environments. Key components include:

(a) A thermally-isolated lubrication reservoir with multi-layer insulation

(b) Microfluidic distribution channels featuring embedded resistance heating elements

(c) Smart viscosity monitoring and control system

(d) Adaptive temperature management algorithm

(e) Recirculation and filtration subsystem

DETAILED DESCRIPTION

[0004] Thermal Isolation System

The primary lubricant reservoir incorporates vacuum-insulated walls constru
from aerospace-grade materials, maintaining internal temperatures between -
and +5°C while operating in ambient conditions as low as -40°C.

[0005] Distribution Network

Microfluidic channels, ranging from 0.5mm to 2.0mm in diameter, are embe
within the robot's structural elements. These channels feature:

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Thermally conductive liner material (Patent Pending, App. No. 16/789,433)

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Distributed heating elements operating at 3.3V DC

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Pressure sensors at 10cm intervals

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Smart flow control valves

[0006] Control System

The integrated control system employs:

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Real-time viscosity monitoring using proprietary sensors

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Predictive temperature management

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Adaptive flow rate adjustment

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Power optimization algorithms

CLAIMS

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A system for maintaining joint lubrication in robotic systems operating in ex

a) A thermally-isolated lubricant reservoir;

b) A network of heated distribution channels;

c) Electronic control systems for monitoring and maintaining lubricant viscosity;

d) Adaptive temperature management capabilities.

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The system of claim 1, wherein the thermally-isolated reservoir maintains in

The system of claim 1, wherein the distribution channels incorporate embedd

[Claims 4-20 continued...]

DRAWINGS

[Fig. 1] System Overview Diagram

[Fig. 2] Reservoir Cross-Section

[Fig. 3] Microfluidic Channel Detail

[Fig. 4] Control System Architecture

[Figs. 5-12 continued...]

DECLARATION

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

Signed this 15th day of March, 2023

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POWER OF ATTORNEY

The undersigned hereby appoints Patent Law Group LLP, Registration No. 1 prosecute this application and transact all business in the Patent and Tradema Office connected therewith.

/Victoria Wells/

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CFO, Polar Dynamics Robotics, Inc.

Date: March 15, 2023