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Licensing Opportunity

TTO – Technology Transfer Offic

High sensitivity and wide dynamic range compliant load cell with adjustable stiffness

Implementation of the tunable stiffness load cell composed of a three-flexure suspension coupled to a frame and a lever linkage. A first setting modifies the stiffness, and another setting varies the offset of the measurement.

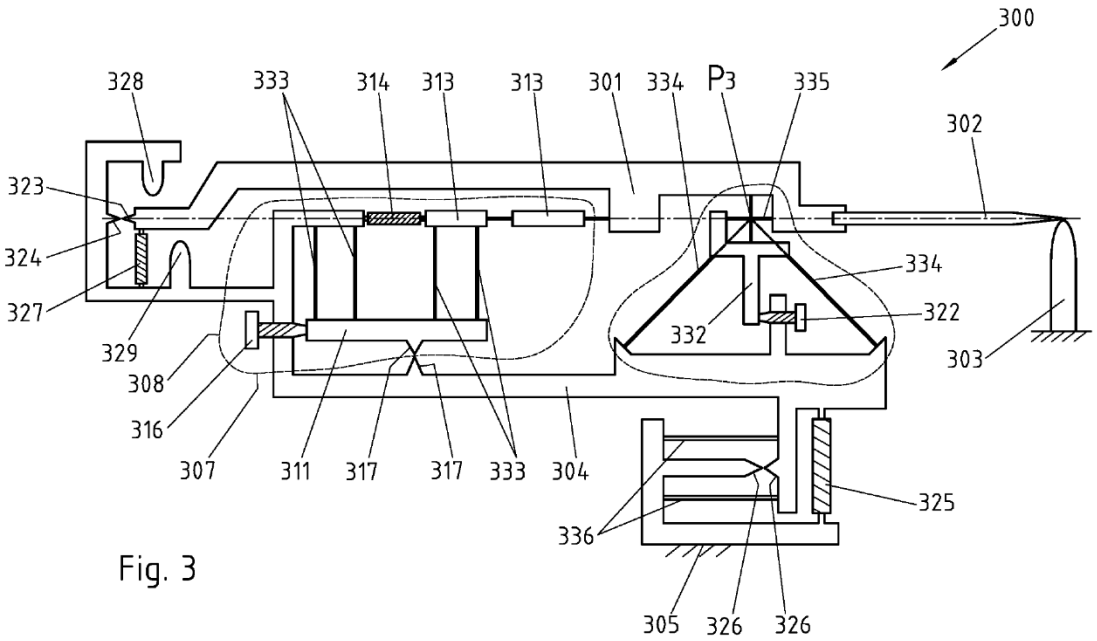

Fig. 3

Ref. Nr

6.1936 & 6.2130

Keywords

Compliant mechanism,
Load cell,
Adjustable stiffness,
Precise force sensing,
Zero stiffness.

Intellectual Property

WO2020/207911

WO2022/122629

Publications

Design of a compliant load cell with adjustable stiffness, M. Smreczak et al., in J. of Precision Engineering, https://doi.org/10.1016/j.precisioneng.2021.04.016

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Description

At macroscale, flexure systems are widely used in precision sensing applications like force or torque measurement, threshold sensing, and programmable memory. Scaling these mechanisms down presents challenges in space, fabrication, complexity, and achieving stable and tunable stiffness. This invention introduces a compact flexure pivot system where a rigid frame and a lever are linked by a three-flexure suspension. Two flexures guide the rotation of the load cell, while the third transmits a preload force generated by a dedicated preloading mechanism. This enables fine control of stiffness, even to bistable states, supporting highly sensitive force, torque, or acceleration measurements. By adjusting the preloading, stiffness can range from its initial value down to near-zero and bistable states, making this system highly adaptable to applications requiring minimal interference yet precise response. Its design is particularly suited for micro- and nanoscale applications, such as biomedical sensors and MEMS devices, achieving high sensitivity and usability without complex adjustments and offering force measurements down to nanonewton scale.

Advantages

This load cell system provides high sensitivity and stability with a simple and compact design. Its adjustable stiffness and offset features enables precise sensing in an extremely broad range of forces. The design minimizes the influence of gravity, enhancing accuracy. The setup is versatile, suitable for force, torque, or acceleration sensing, reducing complexity and providing a large range of motion with limited mechanical stress.

Applications

- Metrology and sensing: tunable sensitivity through stiffness.
- MedTech: Flexure-based surgical tools with force limitation feature.
- Robotics: Low-stiffness bearing with integrated angular position sensor.
- Aerospace and astrophysics: Low-stiffness guiding mechanisms (which can be actuated by low-power actuators).

- MEMS: Micro-mechanisms requiring a low stiffness or bistable behaviors.