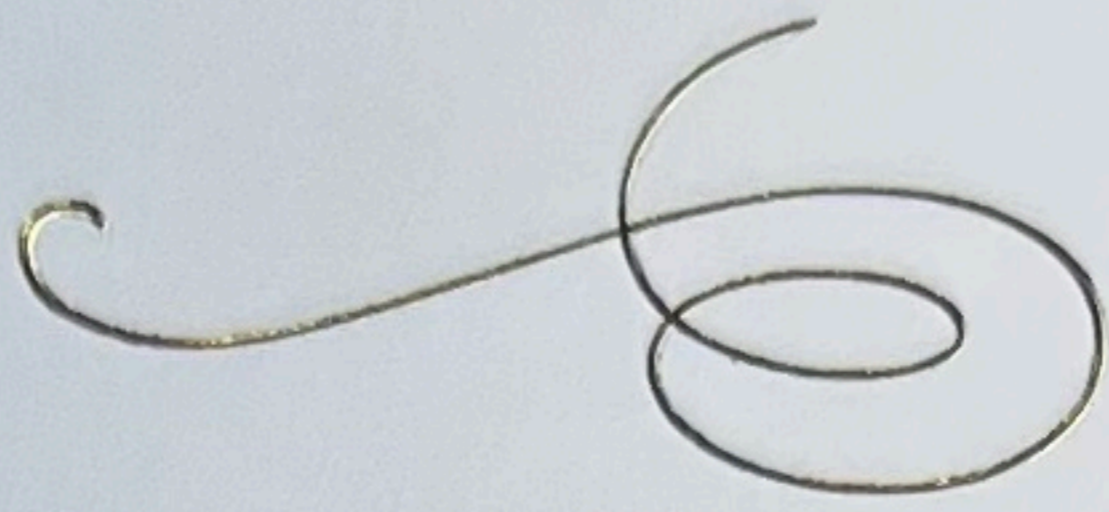
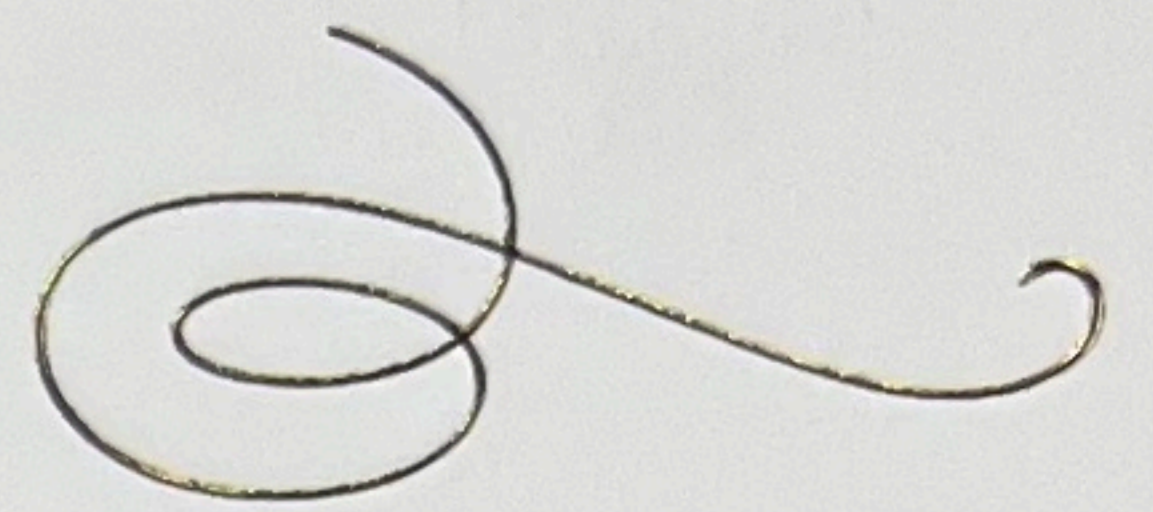


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The Director

of the United States Patent and Trademark Office has received an application for a patent for a new and useful invention. The title and description of the invention are enclosed. The requirements of law have been complied with, and it has been determined that a patent on the invention shall be granted under the law.

Therefore, this United States

Patent

grants to the person(s) having title to this patent the right to exclude others from making, using, offering for sale, or selling the invention throughout the United States of America or importing the invention into the United States of America, and if the invention is a process, of the right to exclude others from using, offering for sale or selling throughout the United States of America, products made by that process, for the term set forth in 35 U.S.C. 154(a)(2) or (c)(1), subject to the payment of maintenance fees as provided by 35 U.S.C. 41(b). See the Maintenance Fee Notice on the inside of the cover.

Katherine Kelly Vidal

DIRECTOR OF THE UNITED STATES PATENT AND TRADEMARK OFFICE



US011572770B2

(12) **United States Patent**
Sengul et al.

(10) **Patent No.:** **US 11,572,770 B2**
(45) **Date of Patent:** **Feb. 7, 2023**

(54) **SYSTEM AND METHOD FOR DETERMINING LOAD AND DISPLACEMENT OF A POLISHED ROD**

(71) Applicant: **Noven, Inc.**, Houston, TX (US)

(72) Inventors: **Mahmut Sengul**, Houston, TX (US);
Mario Ruscev, Houston, TX (US)

(73) Assignee: **NOVEN, INC.**, Houston, TX (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 206 days.

(21) Appl. No.: **16/898,050**

(22) Filed: **Jun. 10, 2020**

(65) **Prior Publication Data**

US 2020/0392822 A1 Dec. 17, 2020

Related U.S. Application Data

(60) Provisional application No. 62/859,958, filed on Jun. 11, 2019.

(51) **Int. Cl.**
F04B 47/02 (2006.01)
E21B 43/12 (2006.01)
F04B 49/06 (2006.01)

(52) **U.S. Cl.**
CPC *E21B 43/12* (2013.01); *F04B 47/026* (2013.01); *F04B 49/06* (2013.01); *F04B 2201/121* (2013.01)

(58) **Field of Classification Search**
CPC *E21B 43/12*; *F04B 47/026*; *F04B 49/06*; *F04B 2201/121*

See application file for complete search history.

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Primary Examiner — Taras P Bemko

(74) Attorney, Agent, or Firm — MH2 Technology Law Group LLP

(57) **ABSTRACT**

An apparatus includes a body. The body includes first and second clamping mechanisms that are configured to grip a tubular member of a beam pump unit at first and second axially-offset locations along the tubular member, respectively. The body also includes a base positioned at least partially between the first and second clamping mechanisms. The apparatus also includes a strain gauge coupled to the base and configured to measure a strain on the tubular member as the tubular member moves. The apparatus also includes a gyroscope configured to measure an orientation, an angular velocity, or both of the beam pump unit as the beam pump unit operates. The apparatus also includes an accelerometer configured to measure an acceleration of the beam pump unit as the beam pump unit operates.

20 Claims, 5 Drawing Sheets

