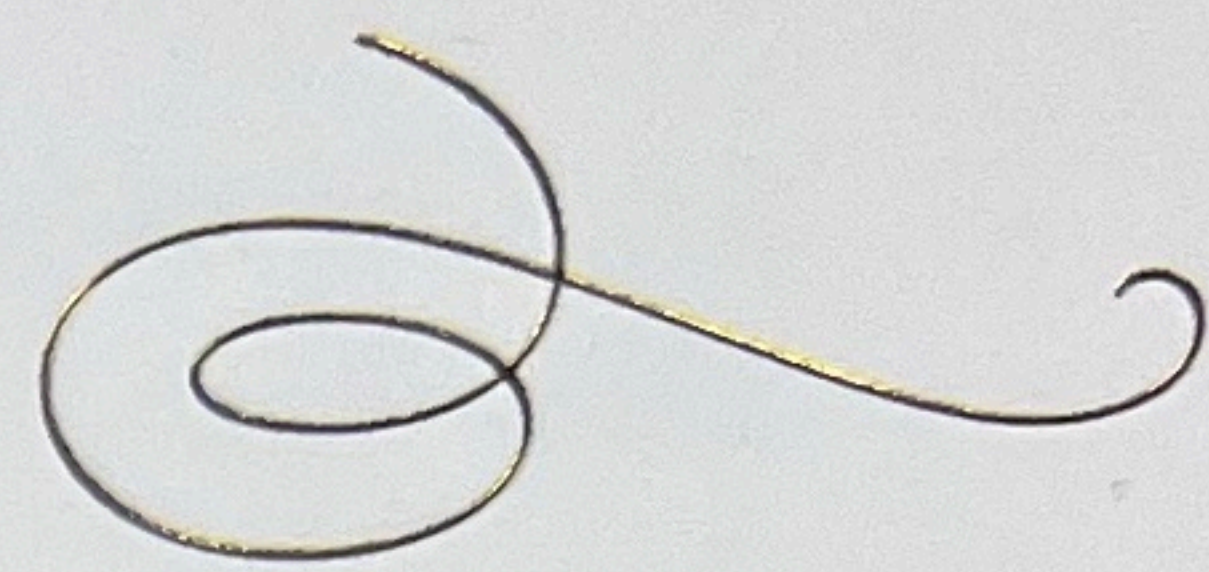
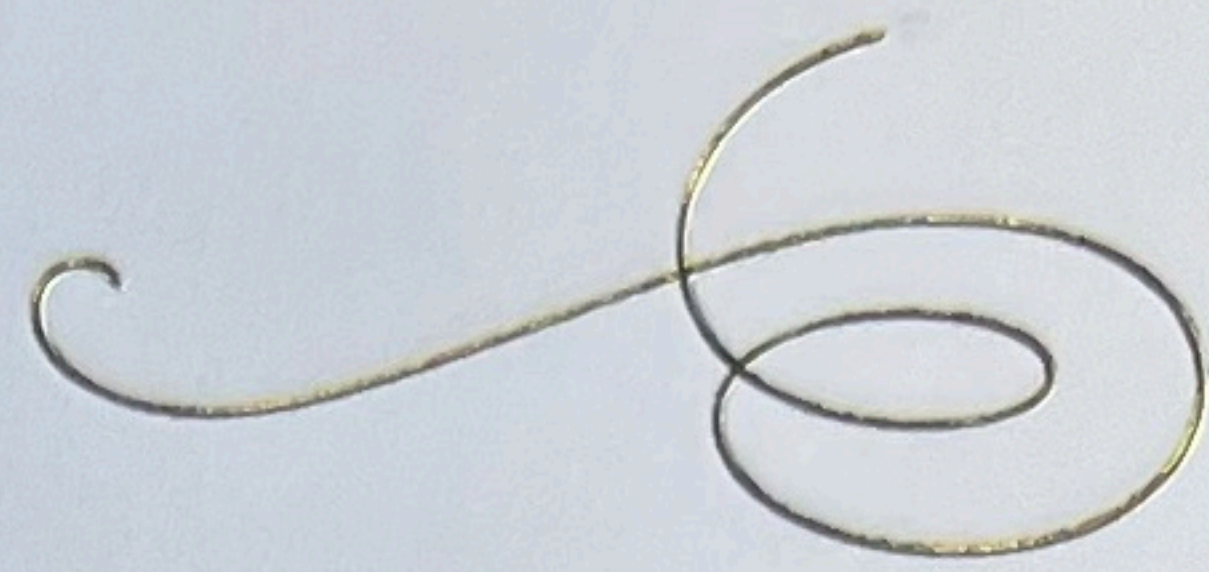


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The Director

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



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

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(54) **WELL PUMP DIAGNOSTICS USING MULTI-PHYSICS SENSOR DATA**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 114 days.

(21) Appl. No.: **16/898,639**

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Related U.S. Application Data

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(51) **Int. Cl.**
E21B 47/009 (2012.01)
E21B 47/06 (2012.01)
E21B 47/007 (2012.01)
E21B 47/18 (2012.01)

(52) **U.S. Cl.**
CPC **E21B 47/009** (2020.05); **E21B 47/007** (2020.05); **E21B 47/06** (2013.01); **E21B 47/18** (2013.01)

(58) **Field of Classification Search**

CPC E21B 47/009; E21B 47/007; E21B 47/06; E21B 47/12; E21B 47/18

See application file for complete search history.

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(57) **ABSTRACT**

A method includes receiving acoustic signals from one or more acoustic sensors that are coupled to a beam pump unit. The method also includes identifying a frequency of the beam pump unit in the acoustic signals. The method also includes detecting an outlier in the acoustic signals based at least partially upon the identified frequency. The outlier represents an operational issue with the beam pump unit.

15 Claims, 14 Drawing Sheets

