



US009410426B2

(12) **United States Patent**  
**Beeler**

(10) **Patent No.:** **US 9,410,426 B2**  
(45) **Date of Patent:** **Aug. 9, 2016**

(54) **BOUNDARY LAYER DISK TURBINE SYSTEMS FOR HYDROCARBON RECOVERY**

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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 443 days.

(21) Appl. No.: **13/617,167**

(22) Filed: **Sep. 14, 2012**

(65) **Prior Publication Data**

US 2013/0068314 A1 Mar. 21, 2013

**Related U.S. Application Data**

(60) Provisional application No. 61/535,173, filed on Sep. 15, 2011.

(51) **Int. Cl.**  
**F01D 1/36** (2006.01)  
**F04D 17/16** (2006.01)

(52) **U.S. Cl.**  
CPC ..... **F01D 1/36** (2013.01); **F04D 17/161** (2013.01); **F05D 2220/62** (2013.01); **Y10T 137/0396** (2015.04)

(58) **Field of Classification Search**  
CPC ..... E21B 43/16; F01D 1/36; F04D 17/161  
USPC ..... 407/53, 223, 319, 313, 375, 379, 405; 166/75.12, 267  
See application file for complete search history.

(56) **References Cited**

**U.S. PATENT DOCUMENTS**

1,061,206 A \* 5/1913 Tesla ..... 415/90  
2,309,075 A \* 1/1943 Hill ..... 166/266

3,007,311 A 11/1961 Amero  
3,526,276 A \* 9/1970 Haberthur et al. .... 166/52  
4,505,333 A \* 3/1985 Ricks, Sr. .... 166/267  
5,819,524 A 10/1998 Bosley et al.  
6,174,127 B1 1/2001 Conrad et al.  
6,779,964 B2 8/2004 Dial

(Continued)

**FOREIGN PATENT DOCUMENTS**

GB 1099479 1/1968  
WO WO2009131477 10/2009

(Continued)

**OTHER PUBLICATIONS**

International Search Report and Written Opinion for PCT/US12/55388 issued Jan. 4, 2013.

(Continued)

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(57) **ABSTRACT**

Provided are various devices and processes that harness the inherent kinetic energy of a flowing pressurized fluid to drive a compressor to compress a fluid without any need for electrical or chemical energy. The flowing fluid flows over a boundary layer disk turbine, or Tesla turbine, which is mechanically coupled to a compressor that compresses a fluid. The flowing fluid may be a natural gas from a hydrocarbon recovery operation. The compressed fluid may be a vapor gas from a hydrocarbon production, processing, or storage facility. Harnessing the kinetic energy of the flowing fluid increases economic efficiency of the process, while also avoiding unwanted emissions adverse to the environment and public health.

**35 Claims, 4 Drawing Sheets**

