



US009410867B2

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

(10) **Patent No.:** **US 9,410,867 B2**  
(45) **Date of Patent:** **Aug. 9, 2016**

(54) **LASER SYSTEM FOR MEASURING INTERNAL CYLINDER PRESSURE**

(56) **References Cited**

- (71) Applicant: **Caterpillar Inc.**, Peoria, IL (US)
- (72) Inventors: **Martin Leo Willi**, Dunlap, IL (US);  
**Marion Billingsley Grant**, Princeville, IL (US)
- (73) Assignee: **Caterpillar Inc.**, Peoria, IL (US)
- (\* ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 72 days.

U.S. PATENT DOCUMENTS

4,620,093 A	10/1986	Barkhoudarian et al.	
5,351,547 A	10/1994	Grudzien et al.	
5,400,648 A *	3/1995	Mahr .....	G01M 15/08 73/114.16
5,452,087 A	9/1995	Taylor et al.	
5,852,245 A	12/1998	Wesling et al.	
6,188,952 B1 *	2/2001	Serra .....	F02B 77/08 123/406.24
6,941,813 B2	9/2005	Boukhny et al.	
2011/0007153 A1 *	1/2011	Webster .....	F15B 15/2876 348/135
2015/0136049 A1 *	5/2015	Stoppel .....	F01P 3/16 123/41.32

(21) Appl. No.: **14/565,061**

\* cited by examiner

(22) Filed: **Dec. 9, 2014**

*Primary Examiner* — Marguerite McMahon

(65) **Prior Publication Data**

(74) *Attorney, Agent, or Firm* — Finnegan, Henderson, Farabow, Garrett & Dunner, LLP

US 2016/0161368 A1 Jun. 9, 2016

- (51) **Int. Cl.**  
**G01M 15/00** (2006.01)  
**G01M 15/08** (2006.01)  
**F02F 1/24** (2006.01)  
**F02F 7/00** (2006.01)

(57) **ABSTRACT**

A system is disclosed for measuring internal cylinder pressure of a combustion chamber at least partially formed by a cylinder head. The system may include an emitter configured to generate and emit a wavelength of energy along a surface of the cylinder head, and a target inline with the emitter and configured to receive the wavelength of energy. The system may also include a controller in communication with the emitter and/or target. The controller may be configured to correlate a distortion of the wavelength of energy to the internal pressure.

- (52) **U.S. Cl.**  
CPC ..... **G01M 15/08** (2013.01); **F02F 1/24** (2013.01); **F02F 7/0021** (2013.01)

- (58) **Field of Classification Search**  
CPC ..... G01M 15/08; F02F 7/0021; F02F 1/24  
USPC ..... 123/657  
See application file for complete search history.

**20 Claims, 2 Drawing Sheets**

