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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

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Andrei Iancu

DIRECTOR OF THE UNITED STATES PATENT AND TRADEMARK OFFICE

US010564259B2

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

(10) **Patent No.: US 10,564,259 B2**
(45) **Date of Patent: Feb. 18, 2020**

(54) **METHOD AND SYSTEM FOR DETECTING, CHARACTERIZING AND ASSESSING THE QUALITY OF A SPRAY**

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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 145 days.

(21) Appl. No.: **15/712,188**

(22) Filed: **Sep. 22, 2017**

(65) **Prior Publication Data**

US 2019/0049559 A1 Feb. 14, 2019

(30) **Foreign Application Priority Data**

Aug. 10, 2017 (EP) 17185736

(51) **Int. Cl.**

G01S 7/41	(2006.01)
B05B 12/00	(2018.01)
G01S 13/88	(2006.01)
G01S 13/58	(2006.01)
B05B 1/14	(2006.01)
G01S 7/35	(2006.01)

(52) **U.S. Cl.**

CPC ***G01S 7/412*** (2013.01); ***B05B 1/14*** (2013.01); ***B05B 12/004*** (2013.01); ***B05B 12/008*** (2013.01); ***G01S 7/352*** (2013.01); ***G01S 7/417*** (2013.01); ***G01S 13/583*** (2013.01); ***G01S 13/88*** (2013.01); *G01S 2007/356* (2013.01)

(58) **Field of Classification Search**

CPC ... B05B 12/004; B05B 12/006; B05B 12/008; G01S 7/412; G01S 2007/356; G01S 13/583; G01S 13/88

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2,824,284 A *	2/1958	Johnson	.....	G01P 3/665 324/642
4,467,961 A *	8/1984	Coffee	.....	A01M 7/0089 239/1

(Continued)

FOREIGN PATENT DOCUMENTS

EP 2756745 A1 * 7/2014 ..... A01C 17/001

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(57) **ABSTRACT**

The present disclosure relates to a method for the detection, characterization and assessment of the quality of a spray which is produced by atomizing liquids with nozzles of different designs and constructional forms. The spray may have an application-specific droplet size distribution ranging from fine to very coarse droplets which move at different speeds. A radar signal is directed into and reflected by the spray. The reflected radar signal is subject to a Doppler shift caused by the movement of the droplets in the spray. The transmitted and received radar signals are mixed to create a low-frequency Doppler oscillation signal which is sampled at a predetermined rate with an analog-digital converter, the output of which is stored in a data array and transformed from the time domain into the frequency domain for further processing.

12 Claims, 3 Drawing Sheets