



US010845565B2

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

(10) **Patent No.:** **US 10,845,565 B2**  
(45) **Date of Patent:** **Nov. 24, 2020**

(54) **LINEAR BALL GUIDED VOICE COIL MOTOR FOR FOLDED OPTIC**

(71) Applicant: **Corephotonics Ltd.**, Tel-Aviv (IL)

(72) Inventors: **Gil Bachar**, Tel-Aviv (IL); **Itay Yedid**, Karme Yosef (IL); **Gal Shabtay**, Tel-Aviv (IL); **Ephraim Goldenberg**, Ashdod (IL); **Gal Avivi**, Haifa (IL); **Itay Jerbi**, Netanya (IL)

(73) Assignee: **Corephotonics Ltd.**, Tel Aviv (IL)

(\* ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **15/738,951**

(22) PCT Filed: **Jul. 6, 2017**

(86) PCT No.: **PCT/IB2017/054088**

§ 371 (c)(1),  
(2) Date: **Dec. 21, 2017**

(87) PCT Pub. No.: **WO2018/007981**

PCT Pub. Date: **Jan. 11, 2018**

(65) **Prior Publication Data**

US 2019/0377155 A1 Dec. 12, 2019

**Related U.S. Application Data**

(60) Provisional application No. 62/359,222, filed on Jul. 7, 2016.

(51) **Int. Cl.**

**G02B 7/09** (2006.01)

**G02B 27/64** (2006.01)

**H04N 5/225** (2006.01)

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

CPC ..... **G02B 7/09** (2013.01); **G02B 27/64** (2013.01); **H04N 5/2253** (2013.01); **H04N 5/2254** (2013.01)

(58) **Field of Classification Search**

CPC ..... G02B 27/646; B02B 7/08; B02B 7/09; H04N 4/2253; H04N 5/2254

See application file for complete search history.

(56) **References Cited**

**U.S. PATENT DOCUMENTS**

4,199,785 A 4/1980 McCullough et al.

5,005,083 A 4/1991 Grage et al.

(Continued)

**FOREIGN PATENT DOCUMENTS**

CN 101276415 A 10/2008

CN 102739949 A 10/2012

(Continued)

**OTHER PUBLICATIONS**

Statistical Modeling and Performance Characterization of a Real-Time Dual Camera Surveillance System, Greienhagen et al., Publisher: IEEE, 2000, 8 pages.

(Continued)

*Primary Examiner* — Jorge L Carrasquillo

*Assistant Examiner* — Zoheb S Imtiaz

(74) *Attorney, Agent, or Firm* — Nathan & Associates; Menachem Nathan

(57) **ABSTRACT**

Actuators for carrying and actuating a lens having a first optical axis, the lens receiving light folded from a second optical axis substantially perpendicular to the first optical axis, comprising first and second VCM engines coupled to the lens and first and second linear ball-guided rails operative to create movement of the lens in two substantially orthogonal directions upon actuation by respective VCM engines.

**20 Claims, 11 Drawing Sheets**

