



US011048060B2

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

(10) **Patent No.:** **US 11,048,060 B2**

(45) **Date of Patent:** **Jun. 29, 2021**

(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 Jerby, 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.: **16/863,239**

(22) Filed: **Apr. 30, 2020**

(65) **Prior Publication Data**

US 2020/0264403 A1 Aug. 20, 2020

Related U.S. Application Data

(63) Continuation of application No. 15/738,951, filed as
application No. PCT/IB2017/054088 on Jul. 6, 2017,
now Pat. No. 10,845,565.

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

(51) **Int. Cl.**
G02B 7/09 (2021.01)
G02B 27/64 (2006.01)
H04N 5/225 (2006.01)

(52) **U.S. Cl.**
CPC **G02B 7/09** (2013.01); **G02B 27/646**
(2013.01); **H04N 5/2253** (2013.01); **H04N**
5/2254 (2013.01)

(58) **Field of Classification Search**

CPC G02B 7/09; G02B 27/646; H04N 5/2253;
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.
5,032,917 A 7/1991 Aschwanden
5,041,852 A 8/1991 Misawa et al.
5,051,830 A 9/1991 von Hoessle
5,099,263 A 3/1992 Matsumoto et al.

(Continued)

FOREIGN PATENT DOCUMENTS

CN 101276415 A 10/2008
CN 201514511 U 6/2010

(Continued)

OTHER PUBLICATIONS

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

(Continued)

Primary Examiner — Zoheb S Imtiaz

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

(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 opera-
tive to create movement of the lens in two substantially
orthogonal directions upon actuation by respective VCM
engines.

14 Claims, 11 Drawing Sheets

