



(12) **United States Patent**
Isobe

(10) **Patent No.:** **US 9,411,128 B2**
(45) **Date of Patent:** **Aug. 9, 2016**

(54) **AUTOMATIC FOCUSING APPARATUS WITH CYCLIC PATTERN DETERMINATION**

250/201.4, 201.6, 201.7; 352/139, 140; 359/696, 698; 382/255

See application file for complete search history.

(71) Applicant: **CANON KABUSHIKI KAISHA**,
Tokyo (JP)

(56) **References Cited**

(72) Inventor: **Shingo Isobe**, Saitama (JP)

U.S. PATENT DOCUMENTS

(73) Assignee: **Canon Kabushiki Kaisha**, Tokyo (JP)

4,591,919 A * 5/1986 Kaneda et al. 348/348
5,597,999 A * 1/1997 Kinba et al. 250/201.7

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 1 day.

(Continued)

FOREIGN PATENT DOCUMENTS

(21) Appl. No.: **14/452,691**

CN 101241222 A 8/2008
JP 63-262611 A 10/1988

(22) Filed: **Aug. 6, 2014**

(Continued)

(65) **Prior Publication Data**

US 2014/0340564 A1 Nov. 20, 2014

OTHER PUBLICATIONS

Search Report dated Apr. 11, 2014, in European Application No. 11734787.2.

(Continued)

Related U.S. Application Data

(62) Division of application No. 13/510,978, filed as application No. PCT/JP2011/051152 on Jan. 18, 2011, now Pat. No. 8,860,872.

Primary Examiner — Dennis Hogue

(74) *Attorney, Agent, or Firm* — Fitzpatrick, Cella, Harper & Scinto

(30) **Foreign Application Priority Data**

Jan. 22, 2010 (JP) 2010-012093

(57) **ABSTRACT**

(51) **Int. Cl.**
G02B 7/28 (2006.01)
G02B 7/34 (2006.01)
(Continued)

An automatic focusing apparatus includes a position detecting unit for a focus unit, a driving unit for the focus unit, a focus detecting unit using a phase difference method, a contrast acquiring unit for picking up an image of object, and a focusing determining unit based on a contrast, a cyclic pattern determining unit for an object based on focus information obtained by the focusing detecting unit, a target position setting unit for driving of the focus unit, and a focusing direction determining unit, and, when the object has a cyclic pattern, the apparatus determines a direction of an in-focus point, sets a target position in the determined direction of the in-focus point, drives the focus unit toward the target position, and determines whether or not in-focus state is achieved by using the focusing determining unit.

(52) **U.S. Cl.**
CPC **G02B 7/282** (2013.01); **G02B 7/343** (2013.01); **G03B 13/36** (2013.01); **H04N 5/23212** (2013.01)

9 Claims, 22 Drawing Sheets

(58) **Field of Classification Search**
CPC . G02B 7/282; G02B 7/343; G02B 7/34-7/38; G03B 13/36; H04N 5/23212; H04N 5/3696
USPC 348/207.99, 222.1, 345-357; 396/63-70, 80, 104, 133, 213-262;

