(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
15 November 2007 (15.11.2007)

PCT

(10) International Publication Number
WO 2007/130299 A3

(51) International Patent Classification:
G02B 13/22 (2006.01) *G02B 27/00* (2006.01)

(21) International Application Number:
PCT/US2007/010044

(22) International Filing Date: 26 April 2007 (26.04.2007)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/746,566 5 May 2006 (05.05.2006) US

(71) Applicant *(for all designated States except US)*: **CORNING INCORPORATED** [US/US]; 1 Riverfront Plaza, Corning, New York 14831 (US).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: **WEBB, James E** [US/US]; 10 Potter Place, Fairport, New York 14450 (US).

(74) Agent: **SCHAEBERLE, Timothy M**; Corning Incorporated, Sp-ti-3-1, Corning, New York 14831 (US).

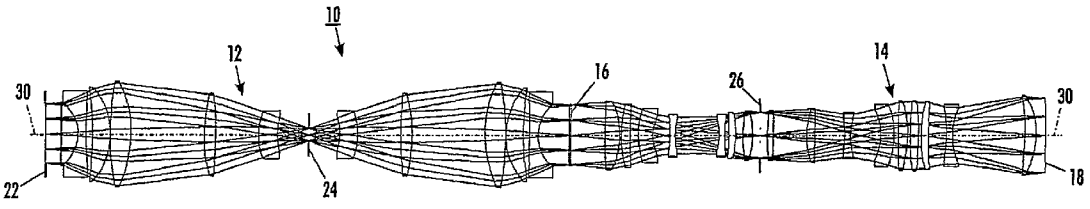
(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*
— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

(88) Date of publication of the international search report:
10 April 2008

(54) Title: DISTORTION TUNING OF A QUASI-TELECENTRIC IMAGING LENS



(57) Abstract: The application relates to the correction of distortion in a telecentric imaging system by shifting the object plane along the optical axis. The goal is to correct distortion errors caused by environmental influences like changes in temperature or pressure. The design of the imaging system remains sufficiently telecentric so that changes in working distance do not significantly alter magnification. Distortions accompanying magnification corrections can also be corrected.

WO 2007/130299 A3

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2007/010044

A. CLASSIFICATION OF SUBJECT MATTER
INV. G02B13/22 G02B27/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G02B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2002/149756 A1 (TOKUDA NORIAKI [JP] ET AL) 17 October 2002 (2002-10-17)	1-7
A	paragraphs [0042], [0058]; figures 1,4	8

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
17 December 2007	29/02/2008

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Michel, Alain

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2007/010044

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers allsearchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search reportcovers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

see annex

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-8,23

Claim 8 relates to an optical imaging system comprising a quasi-telecentric lens assembly having an object plane and an optical axis according to claims 1 and 7, the latter appearing to be either known or obvious over the disclosure of pblication US 2002/149756 A1 (D1) which seriously puts into question the novelty of the subject-matter of claims 1 and 23 of the present application: This document discloses an optical imaging system comprising a quasi-telecentric lens assembly (see figure 1 (14)) and a stage (see figure 4 (45)) for relatively translating the object (reticle 6) with respect to said quasi-telecentric lens assembly (14) along the optical axis to compensate for distortion otherwise apparent in the image plane of said quasi-telecentric lens assembly (see paragraph 42, first sentence, paragraph 58, sentence bridging columns 4 and 5). Independent method claim 23 appears to correspond to apparatus claim 1.
The underlying problem to be solved is how to correct for distortion errors caused by environmental influences like changes in temperature or pressure.
The special feature is a stage for translating the object with respect to the quasi-telecentric imaging system along its optical axis, said translation having, in opposite directions, minimal non orthogonal effects with respect to other aberrations in the image plane.

---

2. claims: 1,9-15,23,29

Claim 9, or 10, relates to an optical imaging system comprising a quasi-telecentric lens assembly having an object plane and an optical axis according to claim 1, the latter appearing to be known over the disclosure of D1 (see below). Claims 11-15 are dependent upon claim 10. Claim 29 is dependent upon claim 23, the latter appearing to be known over the disclosure of D1, and appears to relate to the same problem.
The underlying problem to be solved is how to monitor errors caused by environmental influences.
The special feature is the environmental monitor.

---

3. claims: 1,16-20,23-28

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Claim 16 relates to an optical imaging system comprising a quasi-telecentric lens assembly having an object plane and an optical axis according to claim 1, the latter appearing to be known over the disclosure of D1 (see below). Claims 17-20 are dependent upon claim 16. Claims 24-28 are dependent upon claim 23, the latter appearing to be known over the disclosure of D1, and appear to relate to the same problem.
The underlying problem to be solved is how to vary the magnification in the image plane.
The special feature is a second stage translating a component of the quasi-telecentric lens assembly.

---

4. claims: 1,21-23,30-37

Independent claim 31 relates to an optical projection system comprising a quasi-telecentric illumination system and a quasi-telecentric projection lens. Claims 32-37 are dependent upon claim 31. Claims 21 and 22, both depending on claim 1, appear to relate to the same system and problem. Claim 30 depends on claim 23 and appears to also relate to the same system and problem.
The underlying problem to be solved is how to optimise the imaging of the quasi-telecentric projection lens.
The special feature is the pupil matching of the quasi-telecentric illumination system with the quasi-telecentric projection lens.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2007/010044

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2002149756 A1	17-10-2002	NONE	