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(54) Title: STRUCTURED LIGHT PROJECTION AND IMAGING

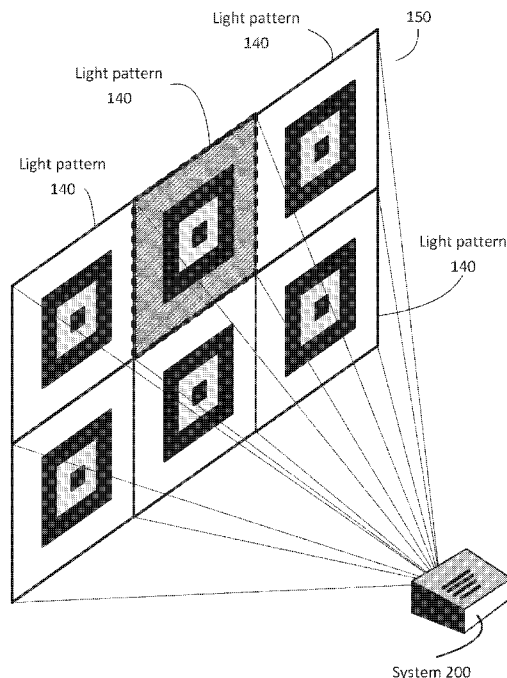


FIG. 4A

(57) Abstract: An optical system, including: (a) an emitter array including a plurality of individual emitters, wherein each emitter in the emitter array is operable to emit a light beam which is characterized by a native beam width; (b) an optical subunit, operable to transform a plurality of light beams emitted by the emitter array, wherein each of the transformed light beams is characterized by an expanded beam width that is wider than the native beam width of the corresponding light beam and is wider than a facilitating beam width; and (c) a diffractive optical element that is capable of diffracting the transformed light beams to provide light patterns whose angular resolution meets a light pattern target angular resolution criteria.



— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

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## INTERNATIONAL SEARCH REPORT

International application No.

PCT/IB2015/056074

A. CLASSIFICATION OF SUBJECT MATTER IPC(8) - G01B 11/30 (2016.01) CPC - G01B 11/25 (2016.01) 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) IPC(8) - F21V 3/00; G01B 11/24, 11/30 (2016.01) CPC - G01B 11/25, 11/2513, 11/2536 (2016.01)		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched USPC- 356/603, 610, 612; 362/235, 236, 244, 311.06 (keyword delimited)		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) Orbit, Google Patents, ProQuest Search terms used: emitter array, diffractive optical, telecentric, expanding beams, width, facilitating, grating, periods, patterns, transform, expander		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2013/0038881 A1 (PESACH et al) 14 February 2013 (14.02.2013) entire document	1-20, 84-102
Y	US 2005/0047472 A1 (GRUHLKE) 03 March 2005 (03.03.2005) entire document	1-20, 84-102
Y	US 2012/0243100 A1 (KESSLER DAVID et al) 27 September 2012 (27.09.2012) entire document	3, 4, 9, 89
Y	US 2008/0291954 A1 (APHEK et al) 27 November 2008 (27.11.2008) entire document	5, 6, 86, 87
Y	US 2002/0167751 A1 (LEE et al) 14 November 2002 (14.11.2002) entire document	12-17, 19, 92-97, 99
Y	US 2013/0242053 A1 (ABSOLUTE IMAGING LLC) 19 September 2013 (19.09.2013) entire document	15, 16, 95, 96
Y	US 2013/0182226 A1 (SILVERSTEIN) 18 July 2013 (18.07.2013) entire document	17, 97
Y	US 2009/0207342 A1 (YAMAGUCHI et al) 20 August 2009 (20.08.2009) entire document	101
Y	US 2013/0135588 A1 (POPOVICH et al) 30 May 2013 (30.05.2013) entire document	102
A	US 2011/0181704 A1 (GORDON et al) 28 July 2011 (28.07.2011) entire document	1-20, 84-102
<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> 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 application or patent 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 24 March 2016	Date of mailing of the international search report <b>08 APR 2016</b>	
Name and mailing address of the ISA/ Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, VA 22313-1450 Facsimile No. 571-273-8300	Authorized officer Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774	

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/IB2015/056074

**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 supplemental page

1.  As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2.  As all searchable claims could be searched without effort justifying 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 report covers 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.:  
1-20, 84-102

**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.

Continued from Box No. III Observations where unity of invention is lacking

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I, claims 1-20,84-102, drawn to optical projection.

Group II, claims 21-38,103-122, drawn to optical projection of first and second beams.

Group III, claims 39-69,123-137, drawn to directing a plurality of transformed light beams onto the diffractive optical element.

Group IV, claims 70-83, drawn to an optical system.

Group V, claims 138-139, drawn to a method comprising: obtaining optical characteristics.

The inventions listed as Groups I, II, III, IV, or V do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons: the special technical feature of the Group I invention: an expanded beam width that is wider than the native beam width of the corresponding light beam and is wider than a facilitating beam width as claimed therein is not present in the invention of Groups II, III, IV, or V. The special technical feature of the Group II invention: wherein each of the transformed light beams is characterized by a second beam divergence that is smaller than the first beam divergence of the corresponding light beam as claimed therein is not present in the invention of Groups I, III, IV, or V. The special technical feature of the Group III invention: direct the plurality of transformed light beams onto the diffractive optical element at different angles of incidence as claimed therein is not present in the invention of Groups I, II, IV, or V. The special technical feature of the Group IV invention: wherein a combination of the optical subunit and the diffractive optical element is characterized by a distortion function; wherein the plurality of individual emitters are arranged in a non-uniform configuration whose relation to a predefined uniform grid is an inverse function of the distortion function as claimed therein is not present in the invention of Groups I, II, III, or V. The special technical feature of the Group V invention: obtaining a target emission layout; determining an emitters layout based on the target emission layout and based on the provisional light beams emission layout as claimed therein is not present in the invention of Groups I, II, III, or IV.

Groups I, II, III, IV, and V lack unity of invention because even though the inventions of these groups require the technical feature of an emitter array comprising a plurality of individual emitters, wherein each emitter in the emitter array is operable to emit a light beam; an optical subunit, operable to transform a plurality of light beams emitted by the emitter array, wherein the transformation includes expansion and/or collimation of the plurality of light beams; a diffractive optical element that is capable of diffracting the transformed light beams to provide light pattern, this technical feature is not a special technical feature as it does not make a contribution over the prior art.

Specifically, US 2011/0181704 A1 (GORDON et al) 28 July 2011 (28.07.2011) teaches an emitter array comprising a plurality of individual emitters, wherein each emitter in the emitter array is operable to emit a light beam (a predefined array of a finite set of identifiable feature types in the form of spatial formations of varying intensity light beams, Para. 95 and Fig. 1); an optical subunit, operable to transform a plurality of light beams emitted by the emitter array (Para. 101), wherein the transformation includes expansion and/or collimation of the plurality of light beams (beam shaping, Para. 98); a diffractive optical element that is capable of diffracting the transformed light beams to provide light pattern (Paras. 51 and 129).

Since none of the special technical features of the Group I, II, III, IV or V inventions are found in more than one of the inventions, unity of invention is lacking.