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Declarations under Rule 4.17:

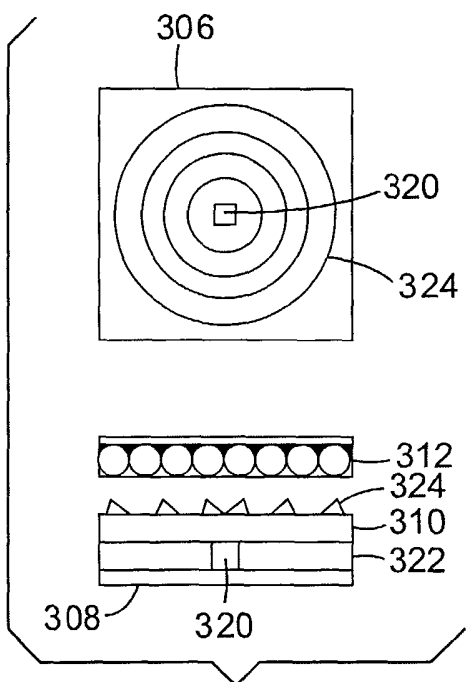
- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii)) for all designations
- as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii)) for all designations

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

[Continued on next page]

(54) Title: LED ARRAY SYSTEMS



(57) Abstract: A light emitting diode (LED) array comprises an array of LEDs mounted to a substrate. The LEDs emit light in a direction generally perpendicular to the substrate (308). An optical sheet is disposed over the LEDs (320). At least a portion of light entering one side of the optical sheet from the LEDs is guided within the optical sheet in a direction generally parallel to the substrate. Light extraction features (324) direct light from the optical sheet in a generally forward direction. Such an array is useful for several applications, including space lighting, direct information display and backlighting of liquid crystal displays. The light spreading effect of the optical sheet reduces the amount of black space between LED pixels.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

INTERNATIONAL SEARCH REPORT

National Application No
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A. CLASSIFICATION OF SUBJECT MATTER G02B6/00 G09F9/33 G02F1/13357		
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 G09F G02F		
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, WPI Data		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	US 4 679 044 A (KNOLL ET AL) 7 July 1987 (1987-07-07) abstract; figure 1 column 2, line 57 - column 3, line 25	1,2 3-60
X A	WO 2004/008233 A (DIEHL AKO STIFTUNG & CO. KG; MOERSCH, NORBERT) 22 January 2004 (2004-01-22) abstract; figures 1,2 page 2, line 15 - page 3, line 1 page 6, lines 5-12	1,2 3-60
X A	US 2004/056989 A1 (BETZ ALEXANDER C ET AL) 25 March 2004 (2004-03-25) abstract; figures 1-3 paragraph '0024!	1,2 3-60
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<input checked="" type="checkbox"/> Further documents are listed in the continuation of box C. <input checked="" type="checkbox"/> Patent family members are listed in 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 16 November 2005		Date of mailing of the international search report 27. 12. 2005
Name and mailing address of the ISA 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		Authorized officer Elflein, W

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2005/017851

Box 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 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 all searchable claims.
2. As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
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.:

Remark on Protest

- The additional search fees were accompanied by the applicant's protest.
- 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: 1-60

An optical assembly for emitting light, comprising:
an array of inorganic light emitting diodes (LEDs) mounted to a substrate, the LEDs emitting light in a direction generally perpendicular to the substrate; and
an optical sheet disposed over the LEDs, at least a portion of light entering one side of the optical sheet from the LEDs being guided within the optical sheet in a direction generally parallel to the substrate,
wherein the optical sheet comprises a first side facing towards the substrate and a second side facing away from the substrate, at least one light extraction feature being provided with the optical sheet to extract light, that has been guided along the optical sheet from the LEDs, through one of the first and second sides,
wherein the light extraction feature comprises one or more light extraction prisms having prism bases disposed on the second side of the optical sheet (i.e. the features of claims 1,2 and 3).

2. claims: 61-89

A light emitting system having a plurality of individually illuminated light emitting elements, the system comprising:
an array of inorganic light emitting diodes (LEDs) emitting light generally in a light emission direction;
light spreading means for laterally spreading light in a direction across the array of the LEDs; and
light directing means for directing light from the light spreading means in a desired illumination direction.
(i.e. the features of claim 76).

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US2005/017851

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 005 108 A (PRISTASH ET AL) 2 April 1991 (1991-04-02) abstract; figures 711,12 -----	1-60
A	EP 0 426 411 A (MINNESOTA MINING AND MANUFACTURING COMPANY) 8 May 1991 (1991-05-08) abstract; figures 1-4 -----	1-60
A	US 2003/123247 A1 (PARKER JEFFERY R ET AL) 3 July 2003 (2003-07-03) abstract; figures 22,40 -----	1-60
X	US 5 678 335 A (GOMI ET AL) 21 October 1997 (1997-10-21) abstract; figure 6 -----	61,76
A		62-75, 77-89
X	US 4 274 217 A (OHSHIMA ET AL) 23 June 1981 (1981-06-23) abstract; figures 3-5 -----	76,77
A		61-75, 78-89

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
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Patent document cited in search report	A	Publication date	Patent family member(s)	Publication date
US 4679044	A	07-07-1987	DE 3331724 A1	21-03-1985
WO 2004008233	A	22-01-2004	AU 2003263169 A1 CN 1656411 A DE 10242589 A1 DE 20210707 U1 EP 1521994 A1 US 2005073628 A1	02-02-2004 17-08-2005 29-01-2004 20-11-2003 13-04-2005 07-04-2005
US 2004056989	A1	25-03-2004	EP 1403688 A2	31-03-2004
US 5005108	A	02-04-1991	US 5136480 A	04-08-1992
EP 0426411	A	08-05-1991	AU 644816 B2 AU 6481090 A CA 2026834 A1 DE 69033501 D1 DE 69033501 T2 JP 3185404 A JP 3224387 B2 JP 3303868 B2 JP 2000147216 A JP 3555890 B2 JP 2002267819 A JP 2004070369 A JP 3644951 B2 JP 2004038200 A JP 2005072018 A KR 150456 B1 US 5040883 A	23-12-1993 02-05-1991 01-05-1991 11-05-2000 21-12-2000 13-08-1991 29-10-2001 22-07-2002 26-05-2000 18-08-2004 18-09-2002 04-03-2004 11-05-2005 05-02-2004 17-03-2005 15-10-1998 20-08-1991
US 2003123247	A1	03-07-2003	US 2003007344 A1 US 2003123245 A1 US 2003123246 A1 US 2005072032 A1 US 2004012946 A1 US 2004080927 A1 US 2004135273 A1 US 2004165372 A1	09-01-2003 03-07-2003 03-07-2003 07-04-2005 22-01-2004 29-04-2004 15-07-2004 26-08-2004
US 5678335	A	21-10-1997	NONE	
US 4274217	A	23-06-1981	DE 2929809 A1	07-02-1980