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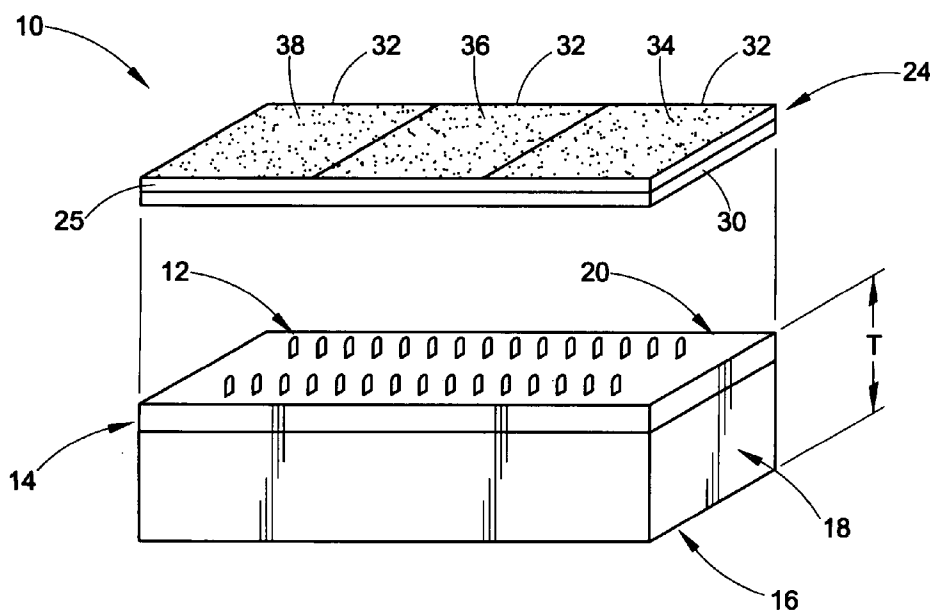
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[Continued on next page]

(54) Title: LED BACKLIGHT USING DISCRETE RGB PHOSPHORS



(57) Abstract: An LED backlight apparatus includes a plurality of radiation emitting diodes (12), each diode emits radiation having a peak wavelength of about less than 430 nm. Each diode is located on a back surface of a housing. The housing may have an opening. A screen (24) covers the opening and the screen includes a discrete pattern of phosphor coated red light emitting pixels (34), a second discrete pattern of phosphor coated green light emitting pixels (36), and a third discrete pattern of phosphor coated blue light emitting pixels (38). The emitted radiation may excite the phosphor coated pixels. The apparatus may also include a radiation regulating element (40) proximate the screen and further include a diffuser (25) proximate the diodes.

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— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

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INTERNATIONAL SEARCH REPORT

International application No
PCT/US2007/023358

A. CLASSIFICATION OF SUBJECT MATTER
INV. 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)
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, INSPEC, IBM-TDB, COMPENDEX

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|-----------|--|-------------------------|
| Y | US 2006/238671 A1 (KIM BYUNG-KI [KR] ET AL) 26 October 2006 (2006-10-26) paragraphs [0025] - [0044]; claims; figures 1,3,4,7 | 1-8, 11-21, 23,24 |
| Y | EP 1 521 235 A (LUMILEDS LIGHTING LLC [US]) 6 April 2005 (2005-04-06) paragraphs [0009], [0013], [0025], [0027], [0028]; figures 2,4-6,12A-12C | 1-8, 11-21, 23,24 |
| Y | US 2006/002141 A1 (OUDERKIRK ANDREW J [US] ET AL) 5 January 2006 (2006-01-05) paragraph [0062]; figure 12 | 1-8, 11-21, 23,24 |
| | ----- -/-- | |

☒ 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.

Z document member of the same patent family

Date of the actual completion of the international search

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|-----------|---|-----------------------|
| P,X | US 2006/279674 A1 (HSU CHIH M [TW] ET AL) 14 December 2006 (2006-12-14) paragraphs [0019] - [0022]; figures 1-5 ----- | 1,23,24 |
| A | EP 0 337 555 A (PHILIPS NV [NL]) 18 October 1989 (1989-10-18) column 3, line 4 - column 5, line 20; figures 1-4 ----- | 1,23,24 |
| A | US 2006/164858 A1 (PARK SANG-HOON [KR] ET AL) 27 July 2006 (2006-07-27) paragraphs [0028] - [0088]; figures 1-5,9 ----- | 1,23,24 |

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2007/023358

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.:

1-6, 8, 11-21, 23, 24

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: 1-6,8,11-21,23,24

The subject-matter of claims 1, 23 and 24 concerns an LED (Light Emitting Diode) backlight apparatus containing a plurality of LEDs having a peak wavelength of less than 430 nm located on the back surface of a housing. The backlight also has a screen having discrete RGB phosphor pixels which covers an opening of the housing. The backlight further has a radiation regulating element proximate the screen and a diffuser proximate the diodes.

1.1. claim: 7

The subject-matter of claim 7 concerns the backlight device having a UV filter above the screen and addresses the technical problem of removing light below 430 nm which may pass through the screen.

2. claim: 9

The subject-matter of claim concerns the backlight device having "power" LEDs and addresses the technical problem of reducing the number of UV LEDs for illumination.

3. claim: 10

The subject-matter of claim 10 concerns the backlight device having phosphor coated pixels which include one or more pigments. The inclusion of the pixels addresses the problem of "cross-talk" between pixels of different colours.

4. claim: 22

The subject-matter of claim 22 concerns the backlight device having a screen which includes a mask around the discrete pattern or red, green and blue pixels. The inclusion of the mask addresses the problem of "cross-talk" between pixels of different colours.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2007/023358

| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
|---|---------------------|--|--|
| US 2006238671 A1 | 26-10-2006 | JP 2006301632 A KR 20060110472 A | 02-11-2006 25-10-2006 |
| EP 1521235 A | 06-04-2005 | JP 2005115372 A US 2005073495 A1 | 28-04-2005 07-04-2005 |
| US 2006002141 A1 | 05-01-2006 | CN 1981218 A EP 1769274 A1 JP 2008505441 T US 2007285943 A1 WO 2006007109 A1 | 13-06-2007 04-04-2007 21-02-2008 13-12-2007 19-01-2006 |
| US 2006279674 A1 | 14-12-2006 | NONE | |
| EP 0337555 A | 18-10-1989 | JP 2012124 A JP 2747320 B2 NL 8800951 A US 5029986 A | 17-01-1990 06-05-1998 01-11-1989 09-07-1991 |
| US 2006164858 A1 | 27-07-2006 | JP 2006202753 A KR 20060085011 A | 03-08-2006 26-07-2006 |