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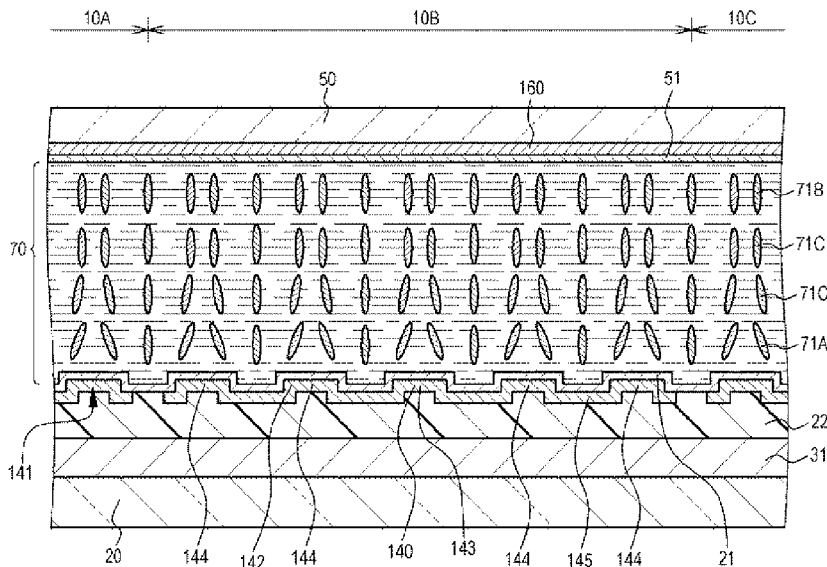
AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

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Published:  
— with international search report (Art. 21(3))  
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(88) Date of publication of the international search report:  
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(54) Title: LIQUID CRYSTAL DISPLAY DEVICE

FIG. 1



(57) Abstract: There is provided a liquid crystal display device comprising: a first substrate (20); a second substrate (50); a first electrode (140) formed on a first surface of the first substrate (20), the first surface facing the second substrate (50), the first electrode (140) including a plurality of convex and concave portions (141); a first oriented film (21) formed on the first surface of the first substrate (20); a second electrode (160) formed on a second surface of a second substrate (50), the second surface facing the first substrate (20); and a liquid crystal layer (70) provided between the first substrate (20) and the second substrate (50), wherein at least one of the convex portions (143, 144) includes a plurality of stepped portions. There is also provided a method of manufacturing a liquid crystal display device.



WO 2013/161209 A3

**INTERNATIONAL SEARCH REPORT**

International application No  
PCT/JP2013/002498

A. CLASSIFICATION OF SUBJECT MATTER  
INV. G02F1/1337 G02F1/1343  
ADD.  
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 practicable, 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.
A	US 2011/317104 A1 (NAKAMURA MASAHIKO [JP] ET AL) 29 December 2011 (2011-12-29) paragraphs [0011], [0077], [0081] - [0084], [0088] paragraphs [0093], [0105] - [0106], [0113] paragraphs [0122] - [0123], [0127] - [0131] paragraphs [0137], [0184] - [0185]; figures 2-5,9,17-20,22-28,36 & JP 2011 232736 A (SONY CORP) 17 November 2011 (2011-11-17) cited in the application ----- -/--	1-8

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 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 <b>25 July 2013</b>	Date of mailing of the international search report <b>13/02/2014</b>
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Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer <b>Wahl, Martin</b>
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## INTERNATIONAL SEARCH REPORT

International application No  
PCT/JP2013/002498

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2008/074599 A1 (YAMAGUCHI MINORU [JP] ET AL) 27 March 2008 (2008-03-27)	1
A	column 1, line 49 - column 2, line 51 column 4, lines 1-18 column 6, line 63 - column 7, line 9; figures 1,5,6,19	2-8
X	----- US 6 710 837 B1 (SONG JANG-KUN [KR] ET AL) 23 March 2004 (2004-03-23)	1
A	paragraphs [0007] - [0031], [0050], [0057], [0058], [0061] paragraphs [0083], [0084]; figures 1-16 -----	2-8

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/JP2013/002498

## 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 all searchable 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 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.:

1-8

### 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.

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/JP2013/002498

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2011317104	A1	29-12-2011	JP 2011232736 A
			TW 201142445 A
			US 2011317104 A1
-----			
US 2008074599	A1	27-03-2008	JP 2008083389 A
			US 2008074599 A1
-----			
US 6710837	B1	23-03-2004	JP 4130274 B2
			JP 4336730 B2
			JP 5326074 B2
			JP H11352489 A
			JP 2008158550 A
			JP 2009075607 A
			JP 2012177932 A
			JP 2012177933 A
			TW 584779 B
			US 6710837 B1
			US 2004080697 A1
			US 2005140887 A1
			US 2008079886 A1
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**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

A liquid crystal display comprising a first substrate, a first electrode including a plurality of convex and concave portions, a first orientation layer, a liquid crystal layer, a second orientation layer, a second electrode and a second substrate, wherein at least one of the convex portions includes a plurality of stepped portions.

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## 2. claims: 9-17

A liquid crystal display comprising a first substrate, a first electrode including a plurality of convex and concave portion,, a first orientation layer, a liquid crystal layer, a second orientation layer, a second electrode and a second substrate, wherein the convex portion is specified by its contour/shape, e.g. forming a circumferential portion around the pixels, as defined in claims 9-11 or 15-17, or comprising convex stem portions formed in cross shape in the pixel center portion and branched portions extend toward a circumferential portion of the pixels, and wherein a orientation regulation structure is formed on the second electrode opposite to the stem portions, as defined in claims 12-14.

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## 3. claims: 18, 19

Method of manufacturing a liquid crystal display comprising a first substrate, a first electrode, a first orientation layer, a liquid crystal layer, a second orientation layer, a second electrode and a second substrate, wherein after assembly of the display, the orientation layers are UV-irradiated while applying a voltage.

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