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Datasheet for the decision of 21 March 2012

Case Number: T 0216/09 - 3.4.02

Application Number: 06012749.5

Publication Number: 1739474

IPC: G02F1/1339

Language of the proceedings: EN

Title of invention:
Liquid crystal display device and method for manufacturing the same

Applicant:
LG Display Co., Ltd.

Relevant legal provisions:
EPC Art. 123(2), 56

Keyword:
Added subject-matter (no)
Inventive step (yes)

Case Number: T0216/09 - 3.4.02

D E C I S I O N
of the Technical Board of Appeal 3.4.02
of 21 March 2012

Appellant: (Applicant)	LG Display Co., Ltd. 20, Yoido-dong, Youngdungpo-gu, Seoul (REPUBLIQUE DE COREE)
Representative:	TER MEER - STEINMEISTER & PARTNER GbR Patentanwälte Mauerkircherstrasse 45 81679 München (ALLEMAGNE)
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted 4 August 2008 refusing European patent application No. 06012749.5 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman: A. G. Klein
Members: F. J. Narganes-Quijano
D. Rogers

Summary of Facts and Submissions

I. The appellant (applicant) lodged an appeal against the decision of the examining division refusing European patent application No. 06012749.5 (publication No. 1739474).

In its decision the examining division referred to documents

D1: JP-A-10039318 and the corresponding abstract published in "Patent Abstracts of Japan"
D2: JP-A-2004301933 and the corresponding abstract published in "Patent Abstracts of Japan"
D4: US-B1-6501527

and held with regard to the set of claims then on file that the subject-matter of dependent claim 3 did not comply with the requirements of Article 123(2) EPC and that the subject-matter of independent claims 1 and 9 did not involve an inventive step in view of the disclosure of documents D1 and D4 (Article 56 EPC).

II. With the statement setting out the grounds of appeal the appellant submitted an amended set of claims 1 to 13 and amended pages 2, 7 to 10, 13 and 31 of the description and requested that the decision under appeal be set aside and a patent be granted. The appellant also submitted a machine-assisted translation (document D1') of the Japanese document referred to under document D1.

III. The wording of independent claims 1 and 9 and of dependent claim 3 dependent on claim 1 by reference to dependent claim 2 reads as follows:

"1. An LCD device comprising:
- first and second substrates (100, 200) opposing each other;
- gate and data lines crossing each other on the first substrate to define pixel regions;
- thin film transistors formed at crossing portions of the gate lines and the data lines;
- a column spacer (210) formed of a first organic material on a predetermined portion of the second substrate (200);
- a protrusion (110) formed of a second organic material on the first substrate (100), the protrusion (110) including a ball spacer formed on a fixed position of the first substrate (100) to oppose the column spacer (210), wherein the contact area between the protrusion (110) and the opposite surface of the column spacer (210) is smaller than the area of such opposite surface; and
- a liquid crystal layer filled between the first and second substrates (100, 200)."

"3. The LCD device as claimed in claim 2, wherein the first organic material is the same as the second organic material."

"9. A method for manufacturing an LCD device comprising:
- preparing first and second substrates (100, 200) opposing each other;

- forming a thin film transistor array on the first substrate (100) and a color filter array (202) on the second substrate (200);
- forming a column spacer (210) of a first organic material on a predetermined portion of the second substrate (200);
- forming a protrusion (110) formed of a second organic material on the first substrate (100), the protrusion (110) including a ball spacer formed on a fixed position of the first substrate (100) to oppose the column spacer (210), wherein the contact area between the protrusion and the opposite surface of the column spacer (210) is smaller than the area of such opposite surface;
- dropping liquid crystals onto any one of the first substrate (100) and the second substrate (200); and
- bonding the first and second substrates (100, 200) to each other so that the protrusion (110) on the first substrate (100) opposes the column spacer (210) on the second substrate (200)."

Claims 2 and 4 to 8 and claims 10 to 13, not listed above, are dependent claims directed to particular embodiments of the subject-matter of independent claims 1 and 9, respectively.

IV. The arguments submitted by the appellant in support of its requests are essentially the following:

The subject-mater of dependent claim 3 is based on the passage of the description of the application specifying that the organic material of the column spacer is the same as the organic material of the protrusion (paragraph [0028]) together with the

subsequent passage specifying that the protrusion includes a ball spacer (paragraph [0029]).

The invention is directed to the touch defects present in conventional LCD devices (Figures 2 to 4 and the corresponding description in the application), and this problem is also present in the device disclosed in document D1, even if the document is silent about it. The objective problem underlying the claimed invention is therefore the reduction of touch defects, i.e. the improvement of the capability of the device to restore its shape after having been deformed by touching the display with a finger. With the claimed arrangement the frictional forces between the spacers and the opposing substrate are reduced and when an external force is applied the load is uniformly dispersed into the protrusions and the column spacers, thus preventing plastic deformation of the spacers and avoiding imprinting defects due to the deformations caused when touching the display.

Bead or ball spacers are known from document D4, but the document is completely silent about touch defects and there is no indication in the document that the replacement of the projecting members or protrusions shown in document D1 by ball spacers could help to avoid touch defects. On the contrary, in document D4 the contact area of the spacer with the substrate is enlarged by flattening the top of the spacer by abrading so that when bonding the substrates together the pressure can be applied uniformly and the cell gap between the two substrates can be controlled with high accuracy. Thus, document D4 points in a completely different direction from that of the present invention.

The examining division's formulation of the objective problem in terms of the reduction of the contact area between protrusions and column spacers in the device of document D1 is not the problem, but an essential part of the claimed solution. In addition, the problem of display unevenness considered in document D1 occurs at the stage of bonding the substrates together when the spacers do not transfer the bonding force in the same manner all over the whole area of the display, thus causing unevenness that remains after the bonding process, and the document proposes a spacer arrangement in which all spacers are able to receive and transfer the same force and the problem of unevenness of the display is supposed to be already overcome by the device of document D1. Thus, there is no need in document D1 to further reduce the contact area between the projecting members and the spacers because the relatively small contact area required in the document already provides a reliable force transfer.

Reasons for the Decision

1. The appeal is admissible.

2. *Article 123(2) EPC*

2.1 The subject-matter of the set of claims amended according to the present request of the appellant is essentially the same as that of the set of claims underlying the decision under appeal.

The board is satisfied that the application documents as amended according to the present request of the

appellant comply with the requirements of Article 123(2) EPC. In particular,

- claim 1 is based on original claims 1, 4 and 7 together with paragraph [0063] of the application as filed,
- independent claim 9 is based on original independent claim 12 together with amendments corresponding to those made to present claim 1, and
- dependent claims 2, 4, 5, 7, 8 and 10 to 13 are based on original claims 2, 5, 6, 10, 11, 13, 14, 16 and 17, respectively, and dependent claim 6 is based on page 23, lines 1 and 2 of the description.

2.2 As regards dependent claim 3, its wording is identical to that of original dependent claim 3 and in its decision the examining division held that the subject-matter of the claim contravened the requirements of Article 123(2) EPC because original dependent claim 3 depended on the original claim 2, which in turn depended on the original claim 1, and none of these three claims recited the feature of a protrusion including a ball spacer made of the same organic material as the column spacer as required by the reference in claim 3 to present claim 1 which in its amended version specifies that the protrusion includes a ball spacer.

The Board concurs with the examining division that in the set of claims as originally filed the provision of a protrusion including a ball spacer is defined in dependent claim 4 which depended on claim 1 only and that the formal dependency of claims 2 to 4 on claim 1 did not include a combination of the features defined in dependent claim 4 with those defined in dependent

claim 3. However, as submitted by the appellant with reference to the statements of the invention disclosed in paragraphs [0026], [0028] and [0029] of the description of the application as originally filed, the essential features of the subject-matter of original claim 1 and including the definition of the column spacer formed of a first organic material and the protrusion formed of a second organic material are defined in paragraph [0026] and this paragraph is followed by paragraph [0028] according to which the first and the second organic materials are the same and by paragraph [0029] according to which the protrusion includes a ball spacer. In the Board's opinion, the skilled reader would understand in the context of the technical disclosure of these paragraphs that the feature according to which the column spacer and the protrusion are made of the same organic material and the feature according to which the protrusion includes a ball spacer are directed to two complementary aspects of the spacer-protrusion arrangement and that, in the absence of any teaching or indication to the contrary, these two features can be implemented concurrently in the mentioned arrangement. This conclusion is further supported by paragraphs [00120] *et seq*. of the description of the application as filed; these paragraphs follow the disclosure of the manufacture of the LCD device of the invention involving protrusions including a ball spacer (Figure 7 and paragraphs [00113] to [00115]) and in the discussion of the advantages of the resulting device (paragraph [00120]) reference is made to the protrusions being formed "of an organic material the same as or similar to that of the column spacer" (paragraph [00122]).

Having regard to the above, the amendments to present claim 1 do no result in dependent claim 3 defining

subject-matter going beyond the content of the application as originally filed.

2.3 As regards the description, its text has been revised and brought into conformity with the invention as defined in the claims as presently amended, and the pertinent prior art has been appropriately acknowledged in the introductory part of the description (Article 84, second sentence together with Rule 42(1), paragraphs (b) and (c) EPC).

3. *Inventive step*

3.1 The Board agrees with the examining division that the closest state of the art is represented by the LCD device disclosed in document D1 comprising a liquid crystal layer between a first and a second substrate (substrates 2 and 1 in the main figure of the English abstract), the first substrate comprising thin film transistors at crossing portions of gate and data lines (Figures 3 to 6 of the Japanese document).

The LCD device disclosed in document D1 also comprises an array of column spacers (spacers 4, 4' in the main figure of the abstract) formed on the second substrate and an array of protrusions (protrusions 5) formed on the first substrate, each of the protrusions being arranged to oppose a respective one of the column spacers so that the contact area between each of the protrusions and the opposite surface of the corresponding column spacer is smaller than the minimum value of the cross-sectional area of the column spacers (see abstract) and therefore smaller than the area of the mentioned opposite surface.

In addition, it has been undisputed by the appellant that, as concluded by the examining division on the basis of its own translation of the relevant passages of the Japanese document D1 and in accordance with the machine-assisted translation (document D1'), the column spacers and the protrusions are formed of organic material (*cf.* document D1', paragraphs [0029] and [0044]).

3.1.1 As concluded by the examining division in its decision, the LCD device defined in claim 1 differs from the LCD device disclosed in document D1 in that each of the protrusions include a ball spacer formed on the first substrate, whereas in document D1 the protrusions have a columnar shape.

3.1.2 According to the line of argument followed by the examining division in its decision, when starting with the device disclosed in document D1 as the closest state of the art the objective problem solved by the claimed distinguishing feature identified above is the reduction of the contact area between protrusions and column spacers in order to further reduce display unevenness.

The Board, however, considers that the examining division has incorrectly formulated the objective problem to be solved for the following reasons:

The disclosure of the English abstract of document D1 is as follows: By making the contact area between each of the protrusions and the opposite surface of the corresponding column spacer smaller than the area of said opposite surface (point 3.1 above, second paragraph) the two following effects are achieved: first, the effect of misalignments and/or non-

uniformities in the shape of the column spacers on the distribution of the load supported by the arrangement when bonding together the two substrates is compensated for and, second, the load is evenly distributed over the whole display during the sealing of the LCD device. The result of this technical feature is to provide a uniform gap between the substrates over the whole display area and to improve the uniform display characteristics of the device (first paragraph of the abstract; see also paragraphs [0020] and [0037] of document D1').

On the basis of these technical considerations the examining division concluded that the skilled person would have considered further reducing the area of contact between the protrusions and the respective column spacers in order to further improve the uniform display characteristics of the device. However, as submitted by the appellant, there is no hint in document D1 towards a further reduction of the contact area between the protrusions and the column spacers beyond that disclosed in document D1. In particular, the problem of counterbalancing the effects of the column spacers on the display characteristics is already solved in document D1 by means of the protrusions having a relatively small contact area with the column spacers. There appears to be no teaching or indication in document D1 - nor any guidance in the prior art on file - that better display characteristics, in particular a more uniform display, would be achieved by further reducing the value of the contact area between the protrusions and the column spacers.

In these circumstances, there appears to be no objective technical basis for the problem formulated by

the examining division. Rather, the idea of further reducing the area of contact between the protrusions and the respective column spacers appears to result from inadmissible hindsight knowledge of the claimed invention. According to the disclosure of the present application the invention is primarily directed to the so-called "touch defect" in conventional LCD devices. This is the problem of the generation of unwanted spots in LCD devices provided with column spacers when the display panel is touched with a finger or other object (Figures 2 to 4 and paragraphs [0018] to [0022] and [0063] to [0070] of the application). This is caused by frictional forces induced by the contact area between the column spacers and the opposing substrate under the action of the external force (paragraphs [0019] and [0055]). According to the application this problem is solved by the provision of a protrusion including a ball spacer between the substrate and each of the column spacers, the resulting arrangement reducing the frictional area and therefore the frictional forces referred to above (paragraphs [0063] and [00121]). Thus, the claimed invention improves the capability of the device deformed under the action of a finger or other object to restore its original shape and results in a reduction of the display unevenness and the imprinting defects shown in the display when the applied external force is removed. As is apparent from this analysis, the technical improvements achieved by the present invention are different from those considered in document D1 and the underlying technical mechanisms are also different. In addition, when compared with the disclosure of document D1, the claimed invention, by requiring the use of protrusions in the form of ball spacers, inherently results in an arrangement with a reduced area of contact between the protrusions and the respective column spacers. However,

as already noted above, this technical measure is not apparent to the skilled person when reading document D1 and cannot be incorporated into the formulation of the objective problem. To do so would involve including part of the solution offered by the invention in the statement of the problem.

3.1.3 The problem solved by the claimed invention over the closest prior art is formulated by assessing the technical results (or effects) achieved by the claimed invention when compared with the closest state of the art and then defining the technical problem to be solved as the object of the invention to achieve these results. In the present case the objective problem can be seen in the avoidance or reduction of the touch defect mentioned above, it being noted that - as submitted by the appellant - this problem is also present in the LCD device of document D1. Such a problem would be apparent to the skilled person operating the device of document D1.

3.1.4 According to the decision under appeal, the teaching of document D4, in combination of document D1, rendered obvious the claimed solution to the objective problem formulated by the examining division. Since, as concluded above, the examining division's formulation of the objective problem cannot be accepted, the question arises whether document D4, in combination with document D1, renders obvious the claimed subject-matter in view of the reformulated objective problem in point 3.1.3 above.

Document D4 discloses an LCD device of the type disclosed in document D1, i.e. a device comprising an arrangement of spacers between two substrates enclosing a liquid crystal compound (abstract). The document

addresses in particular the problem of the formation of the spacers having a predetermined spacing length - and therefore the formation of the device with an accurate value of the cell gap - and the influence of the same on the display quality of the device (column 1, lines 38 to 45 together with column 2, line 20 *et seq*.). Document D4 proposes the formation of spacers by repeated ejection of a curable material so as to form multilayered spacers the diameter and the form of which can be controlled by the ejection process and subsequently flattening the upper surface of the spacers (Figures 1 to 11 and the corresponding disclosure, in particular column 5, lines 43 to 53 and column 6, lines 21 to 33). As an alternative, document D4 also discloses the formation of ball-like spacers by application of a curable adhesive having beads of an organic material dispersed therein (column 9, line 31 to column 10, line 12 together with Figure 12 and column 13, lines 21 to 25, and example 4).

According to the disclosure of document D4, the techniques disclosed in connection with the two alternatives mentioned above counteract the influence of the spacers on the display pixel portions and improve the display quality of the device (column 1, lines 38 to 45, column 2, lines 20 to 26 and column 17, lines 29 to 33). However, document D4 is silent as to the touch defect referred to above or any technical consideration that might have an impact on this defect or on its underlying mechanism. More particularly, document D4 focuses on the effect on the display quality of possible inaccuracies in the alignment and the dimensions of the spacers. Document D4, however, is silent as to any effect of the structure of the spacers on the touch defect mentioned above or on other

functional characteristic indicative of a possible solution to the problem of the touch defect.

Having regard to the above analysis, the teaching of document D4 does not identify the problem of the touch defect in the LCD device disclosed in document D1. Thus document D4 clearly contains no disclosure of the provision of protrusions including a ball spacer opposing a column spacer as claimed, or of the replacement in document D1 of the columnar protrusions connected to the column spacers by beads or ball spacers. Neither does document D4 contain any hint to apply such teaching to the disclosure of document D1. In view of the two alternatives disclosed in document D4, document D4 would, at the most, suggest replacing the arrangement of protrusions and column spacers in document D1 by an arrangement of ball spacers, but not replacing the columnar protrusions by ball spacers while keeping the column spacers.

3.1.5 It follows from the considerations above that, contrary to the examining division's finding, the subject-matter of claim 1 does not result in an obvious way from the disclosure of documents D1 and D4.

The remaining documents on file are less pertinent and do not affect the conclusion above. In particular, document D2 - relied on by the examining division in the assessment of inventive step of the dependent claims - discusses the effect of the spacers on the display quality of an LCD device of the type under consideration (abstract and Figures 1 and 2) and discloses the use of either ball or column spacers (Figures 3 and 4 of the Japanese document), and no teaching can be identified in the document towards the

claimed arrangement of ball spacers each opposing a column spacer.

The Board concludes that the available prior art does not render obvious the subject-matter of claim 1 within the meaning of Article 56 EPC.

3.2 Independent claim 9 is directed to a method of manufacture of an LCD device having the column and ball spacer arrangement of the LCD device defined in claim 1. Accordingly, the method defined in claim 9 involves an inventive step for reasons analogous to those put forward in point 3.1 above with regard to claim 1. The same conclusion applies to dependent claims 2 to 8 and 10 to 13 by virtue of their dependence on claims 1 and 9.

4. The Board is also satisfied that the application documents as presently amended and the invention to which they relate meet the remaining requirements of the EPC within the meaning of Article 97(1) EPC.

In view of the above conclusions and considerations, the Board concludes that the decision under appeal is to be set aside and a patent be granted on the basis of the application documents amended according to the present request of the appellant.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the department of first instance with the order to grant a patent on the basis of the following application documents:
   - description: pages 2, 7 to 10, 13 and 31 filed with the statement setting out the grounds of appeal dated 5 December 2008 and pages 3 to 6, 11, 12 and 14 to 30 of the application as originally filed,
   - claims: claims 1 to 13 filed with the statement setting out the grounds of appeal dated 5 December 2008, and
   - drawings: sheets 1/9 to 9/9 of the application as originally filed.

The Registrar: The Chairman:

M. Kiehl A. G. Klein

Decision electronically authenticated