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**Datasheet for the decision  
of 15 May 2013**

**Case Number:** T 1328/09 - 3.5.04

**Application Number:** 04021593.1

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**IPC:** H04N9/31, G02F1/1337

**Language of the proceedings:** EN

**Title of invention:**  
Liquid crystal projector

**Applicant:**  
Sony Corporation

**Headword:**

**Relevant legal provisions:**  
EPC 1973 Art. 56

**Keyword:**  
inventive step (no - bonus effect)

**Decisions cited:**  
T 1019/99, T 0389/86, T 0055/93

**Catchword:**



**Beschwerdekammern  
Boards of Appeal  
Chambres de recours**

European Patent Office  
D-80298 MUNICH  
GERMANY  
Tel. +49 (0) 89 2399-0  
Fax +49 (0) 89 2399-4465

Case Number: T 1328/09 - 3.5.04

**D E C I S I O N**  
**of Technical Board of Appeal 3.5.04**  
**of 15 May 2013**

**Appellant:** Sony Corporation  
(Applicant) 1-7-1 Konan  
Minato-ku  
Tokyo 108-0075 (JP)

**Representative:** Müller - Hoffmann & Partner  
Patentanwälte  
Innere Wiener Strasse 17  
81667 München (DE)

**Decision under appeal:** **Decision of the Examining Division of the European Patent Office posted on 26 January 2009 refusing European patent application No. 04021593.1 pursuant to Article 97(2) EPC.**

**Composition of the Board:**

**Chairwoman:** T. Karamanli  
**Members:** M. Paci  
C. Kunzelmann

## Summary of Facts and Submissions

- I. The appeal is against the decision of the examining division refusing European patent application No. 04 021 593.1, published as EP 1 515 569 A1.
- II. The following documents were cited in the decision under appeal:  
  
D1: EP 0 303 898 A1,  
D2: M. Lu, "Nematic liquid-crystal technology for Si wafer-based reflective spatial light modulators", Journal of the Society for Information Display, Volume 10, Issue 1, pages 37-47, 2002, and  
D3: EP 1 400 837 A1
- III. The application was refused on the grounds that the subject-matter of claims 1 to 4 and 7 of the request then on file did not involve an inventive step (Article 56 EPC) in view of D3 and D1 and that the subject-matter of claims 5 and 6 of the request then on file did not involve an inventive step in view of D3, D1 and D2.
- IV. With the statement of grounds of appeal the appellant filed amended claims according to auxiliary requests I to III while maintaining as its main request the request underlying the decision under appeal.
- V. In a communication under Article 15(1) RPBA annexed to the summons to oral proceedings the board expressed the preliminary opinion that the subject-matter of claim 1 according to the main request did not involve an inventive step in view of D3 and D1 and that the subject-matter of claim 1 according to each of

auxiliary requests I to III did not involve an inventive step in view of D3, D1 and D2.

- VI. Oral proceedings were held before the board on 15 May 2013. During these oral proceedings the appellant withdrew the main request and auxiliary request I and declared that auxiliary requests II and III had become the new main and auxiliary requests.

The appellant's final requests are that the decision under appeal be set aside and that a patent be granted on the basis of the claims according to the main request (filed as auxiliary request II with the statement of grounds of appeal) or the auxiliary request (filed as auxiliary request III with the statement of grounds of appeal).

- VII. Claim 1 according to the appellant's **main request** reads as follows:

"A projection type liquid crystal display device comprising:

    a plurality of liquid crystal display panels (5R, 5B, 5G) provided correspondingly to a plurality of colored light and which modulate the colored light based on video data;

    a light synthesizing means (6) for synthesizing the colored light modulated by the liquid crystal display panels (5R, 5B, 5G), respectively, into one image; and

    a projecting means (7) for projecting the synthetic light produced by the light synthesizing means (6) onto a screen (S),

    wherein the liquid crystal display panels (5R, 5B, 5G) each include:

a transparent substrate (51) having formed on a main side thereof a transparent electrode (55) and an alignment film (65) which covers the transparent electrode (55);

a drive circuit board (52) disposed opposite to the transparent substrate (51) and having formed on a main side thereof opposite to the transparent electrode (55) a plurality of drive circuits (58) and generally-square reflective pixel electrodes (64) corresponding to pixels (61a) and an alignment film (66) which covers the plurality of reflective pixel electrodes (64); and

a liquid crystal layer (53) interposed between the alignment film (65) on the transparent substrate (51) and the alignment [sic] film (66) of the drive circuit board (52),

the liquid crystal layer (53) being a vertically-aligned liquid crystal having a negative dielectric anisotropy and in which liquid crystal molecules (200) are pretilted by the alignment film (65, 66) in a predetermined direction, wherein an alignment [sic] direction (X1, X2) of the liquid crystal display panel (5R, 5B, 5G) corresponds to the direction in which the liquid crystal molecules are pretilted and is a generally diagonal direction of the pixels (61a) forming a display area (61),

**characterized in that**

a gap between the adjacent ones of the reflective pixel electrodes is 0.7  $\mu\text{m}$  or less; and

the alignment direction (e.g. X2) of one (e.g. 5G) of the liquid crystal display panels (5R, 5B, 5G) which provides an image inverted in relation to images provided by the other liquid crystal display panels (e.g. 5R, 5B) is arranged to be inverted to the alignment directions (e.g. X1) of the other the [sic] liquid crystal display panels (e.g. 5R, 5B), so as to

be coincident with each other in an image displayed on the screen (S)."

Claims 2 to 5 according to the main request are dependent on claim 1.

- VIII. Claim 1 according to the appellant's **auxiliary request** differs from claim 1 according to the main request only in that the following text is inserted at the end of the preamble of the claim (immediately before the expression "characterized in that"):

"wherein the liquid crystal display panels (5R, 5B, 5G) are driven by a frame inversion drive which inverts the polarity of a drive voltage for each video signal frame,".

Claims 2 to 4 according to the auxiliary request are dependent on claim 1.

- IX. The examining division's reasoning in the decision under appeal can be summarised as follows:

*Inventive step*

D3, which is the closest prior art, discloses (see figure 17) a projection type liquid crystal display device according to the preamble of claim 1.

The subject-matter of **claim 1** differs from the disclosure of D3 only in that the alignment direction of one of the liquid crystal display panels (LCD panels), which provides an image inverted in relation to images provided by the other LCD panels, is arranged to be different from the alignment directions of the

other LCD panels, so as to be coincident with each other in an image displayed on the screen.

D3 is silent on the arrangement of the alignment directions of the three LCD panels with respect to each other. The skilled person would therefore be faced with the objective technical problem of "selecting an appropriate arrangement of the alignment directions of the three liquid crystal panels so as to obtain a good quality of the projected image, taking into account the related prior art and the general knowledge".

D1 discloses that picture quality can be deteriorated in a LCD projector when the elementary colours (Red, Green, Blue) of the projected light undergo different numbers of reflections, some odd, some even, within the projector. D1 attributes this deterioration to the fact that projected pixels of different colours are not fully coincident, and teaches the use of two types of mirror-inverted LCD panels to overcome this problem.

The skilled person would recognise that the diagonal alignment direction of the LCD panels in D3 is not mirror-symmetric with respect to either of the horizontal and vertical axes of the LCD panels, thus creating a potential source of image quality degradation. The skilled person would therefore want to apply the solution of D1 to this problem, and would thereby arrive without inventive step at the subject-matter of claim 1.

The technical effect mentioned in the present application is a mere bonus effect of the already obvious application of the teaching of D1 to the projector of D3 (see Guidelines C-IV, 11.9.3).

The subject-matter of dependent **claims 2 to 4 and 7** do not involve an inventive step in view of D3 and D1, because the additional features of claims 2 and 3 are known from D3 and those of claims 4 and 7 are disclosed in D1.

Regarding dependent **claim 5**, D2 discloses (see section 11 and figure 8) that frame inversion driving is most advantageous for reflective vertically-aligned liquid crystal display panels (VA-LCD panels).

Regarding dependent **claim 6**, D2 discloses (see section 11, first sentence) that the pixel gap in a reflective liquid crystal-on-silicon device (such as the panels used in D3) should be 1  $\mu\text{m}$  or less, so that the range of less than 0.7  $\mu\text{m}$  is considered as an obvious choice in view of D2.

Since the additional features of dependent claims 5 and 6 address a technical problem (i.e. avoiding fringe-field effects in vertically aligned liquid crystal-on-silicon panels) different from that addressed by the features distinguishing the subject-matter of claim 1 from the closest prior art (D3), the subject-matter of dependent claims 5 and 6 lacks an inventive step in view of a combination of D3 with D1 and D2 (solution of separate partial problems, see Guidelines C-IV, 11.7.2, last paragraph, and C-IV, 11.8, second paragraph).

X. The appellant's arguments can be summarised as follows:

*Main request*

The appellant does not dispute that D3 represents the closest prior art and that it discloses a projection



type liquid crystal display device according to the preamble of claim 1.

The examining division's definition of the objective technical problem contains a pointer to the solution and is, for this reason, an inadmissible application of hindsight knowledge of the invention. The appellant concurs with the board (see point 6 of the communication under Article 15(1) RPBA annexed to the summons to oral proceedings) that the objective technical problem should have been more broadly formulated as being "to improve the image quality of the image projected by the device on a screen".

D1 describes a projection-type colour display device utilizing three twisted nematic liquid crystal light valves (TN-LCD panels) to control red, green and blue light beams, respectively. Two of these beams are reflected an even number of times and the third beam an odd number of times before they reach their respective TN-LCD panels. As a result, the light distribution on the third TN-LCD panel is mirror-inverted compared to that on the first and second TN-LCD panels. D1 explains that two reasons cause a deterioration of the image projected on the screen, which is obtained by superimposing the three beams: **the first reason** is that the pixel electrodes on the TN-LCD panels have an asymmetric shape because of the presence of a switching transistor in the plane of the electrode (see figure 1 of D1); **the second reason** is that the luminous intensity of the light beam over the entire associated TN-LCD panel has an asymmetric distribution because the light beam is not perfectly collimated and the photoelectric characteristics of the TN-LCD panel depend on the angle of incidence of the light entering the TN-LCD panel.

First, neither D3 nor D1 (nor D2) mentions the kind of image quality deterioration, caused by colour staining due to a difference between disclinations, underlying the present invention. This underlying image quality deterioration is a local, anisotropic effect visible where oblique lines are displayed, whereas D1 concerns an isotropic image quality deterioration affecting the entire image.

Second, the skilled person would not have applied the teachings of D1 to the device of D3 for the following reasons:

(a) The **first reason** mentioned in D1 (asymmetric shape of the pixel electrodes: see *supra*) does not exist in D3 because, as illustrated in figure 12 of D3, the switching transistor is not in the plane of the pixel electrode it controls, and thus the pixel electrode can be generally square. In other words, the pixel electrode of D3, contrary to that of D1, does not have an asymmetric shape.

(b) The **second reason** mentioned in D1 (asymmetric luminous intensity distribution: see *supra*) does not apply to the device of D3 in which the light beams would have been much better collimated than in the device of D1 because D3 was filed 14 years after D1. Moreover, even if the light beams of D3 were still not perfectly collimated, the small remaining collimation imperfections would likely have resulted in a minor image quality deterioration which would not have justified the additional costs of using mirror-inverted LCD panels as suggested in D1. Furthermore, the LCD panels in D1 are twisted nematic liquid crystal light valves (TN-LCD panels) whereas those in D3 are vertically-aligned liquid crystal display panels (VA-LCD panels). It is thus doubtful that a lack of

collimation of the light beam in D3 would have caused an image degradation as described in D1.

Finally, the characterising portion of claim 1 also states that "a gap between the adjacent ones of the reflective pixel electrodes is 0.7  $\mu\text{m}$  or less". This feature was in claim 6 of the set of claims underlying the decision under appeal. Contrary to what the examining division alleged, this feature interacts with the other features of the claim because only if the gap is sufficiently narrow does the specific panel arrangement become necessary. Hence this feature should not be regarded as solving a different partial problem. The situation is similar to those decided in decisions T 389/86, OJ EPO 1988, 87, and T 55/93 of the Boards of Appeal. The jurisprudence on partial problems is thus no justification for combining the teachings of D2 with those of D3 and D1 in the present case.

*Auxiliary request*

Claim 1 according to the auxiliary request differs from claim 1 according to the main request in that it includes the additional feature in the preamble of the claim that the liquid crystal display panels are driven by a frame inversion drive which inverts the polarity of a drive voltage for each video signal frame. This feature reinforces the inventiveness of the claimed subject-matter because the skilled person would not have expected that a disclination pattern might appear at a boundary of adjacent pixels when a frame inversion drive was applied.

## **Reasons for the Decision**

1. The appeal is admissible.

### *Preliminary matter*

2. D3 is a European patent application published on 24 March 2004 in accordance with Article 158(3) EPC 1973 as an English translation of international patent application WO 2003/001285 A1 published in Japanese on 3 January 2003. Any reference to D3 in the present decision should be construed as a reference to WO 2003/001285 A1, which was published before the priority date of the present application and thus belongs to the state of the art under Article 54(2) EPC 1973.

### *Main request - inventive step (Article 56 EPC 1973)*

3. Closest prior art

The appellant does not dispute that D3 represents the closest prior art for the subject-matter of claim 1 and that it discloses (see, in particular, figure 17 and paragraphs [0017] and [0018]) a projection-type liquid crystal display device having all the features in the preamble of claim 1.

Moreover, during the oral proceedings, the board drew the appellant's attention to paragraph [0008] of D3, which states that "[i]n the vertically-aligned liquid crystal material used in the known devices, [...] the typical pixel pitch is 13.5  $\mu\text{m}$  (pixel size 13  $\mu\text{m}$ )". It follows from this sentence that the gap between adjacent pixel electrodes is equal to 0.5  $\mu\text{m}$  (pixel

pitch less pixel size). As a result, the feature in the characterising portion of claim 1 that "a gap between the adjacent ones of the reflective pixel electrodes is 0.7  $\mu\text{m}$  or less" is also known from D3. The appellant did not dispute this conclusion.

4. Distinguishing features

The device of claim 1 thus differs from the device of D3 only in that it includes the following features in the characterising portion of the claim:

"the alignment direction of one of the liquid crystal display panels which provides an image inverted in relation to images provided by the other liquid crystal display panels is arranged to be inverted to the alignment directions of the other liquid crystal display panels, so as to be coincident with each other in an image displayed on the screen".

5. Objective technical problem

The above distinguishing features are essentially the same as those identified by the examining division in the Reasons for the decision regarding claim 1 then on file (see point 1.2 of the Reasons for the decision).

The examining division defined the objective technical problem solved by the device of claim 1 over D3 as a problem of "selecting an appropriate arrangement of the alignment directions of the three liquid crystal panels so as to obtain a good quality of the projected image, taking into account the related prior art and the general knowledge" (see points 1.4 and 1.9 of the Reasons for the decision).

The appellant objected that the examining division's formulation of the objective technical problem contained pointers to the solution because it stated that the arrangement of the alignment directions contributed to improving the quality of the image.

According to the jurisprudence of the Boards of Appeal the correct procedure for formulating the objective technical problem to be used in the problem and solution approach is to choose a problem based on the technical effect of exactly those features distinguishing the claim from the prior art that is as specific as possible without containing elements or pointers to the solution (see decision T 1019/99, point 3.3 of the Reasons, and Case Law of the Boards of Appeal of the EPO, 6th edition, July 2010, section I.D. 4.3).

The distinguishing features of claim 1 of the present main request - in combination with the other features of the claim - achieve the technical effect of improving the image quality of the image projected by the device on a screen (see page 7, first full paragraph, of the application as filed).

The board concurs with the appellant that the information that this quality improvement should be achieved "by selecting an appropriate arrangement of the alignment directions of the three liquid crystal panels" may be regarded as a pointer to the solution and that it should therefore be avoided in the formulation of the objective technical problem.

In the present case, the board considers that the objective technical problem should be formulated, without pointers to the solution, as being "to improve

the image quality of the image projected by the device on a screen".

The appellant stated in the oral proceedings that it agreed with the board's formulation of the objective technical problem.

6. Obviousness

D1 discloses a projection type liquid crystal display device which aims to improve the image quality of the projected image. The technical problem described in D1 is one of image quality deterioration due to the fact that, as in the present application, some of the projected coloured light has been reflected an odd number of times whereas the remainder of the projected coloured light has been reflected an even number of times during light synthesis (see column 1, lines 21 to 28).

D1 gives two reasons why this causes a deterioration of image quality (see from column 1, line 29, to column 2, line 22). **The first reason** is that the intensity distribution of the coloured light becomes asymmetric because the optical response of the liquid crystal display panel depends on the angle of incidence of the light and the incident light is not perfectly collimated (i.e. its rays are not all parallel). **The second reason** is that the pixel reflection electrodes have a slightly asymmetric shape in order to make space for the switching transistors. For each of these reasons, the resulting asymmetry in the light beam causes an image quality deterioration because of a non-coincidence between colour images inverted an even number of times and those inverted an odd number of times.

The solution proposed in D1 to this problem is to use two types of liquid crystal display panels which are mirror-inverted with respect to each other. One type is used for coloured lights reflected an odd number of times and the other type for coloured lights reflected an even number of times.

The appellant argued that the skilled person would not have applied the teaching of D1 to the device of D3 because the above first and second reasons did not apply to the device of D3 (see points I.4, II.2.4.1 and II.2.4.2 of the statement of grounds of appeal).

The board is not convinced by the appellant's arguments, as far as the first reason is concerned, for the following reasons:

The appellant submitted that the dependency of the optical response of a display panel on the angle of the incident light in D1 was due to the use of twisted nematic liquid crystal (LCD-TN) display panels in D1, whereas this dependency did not exist in the vertically-aligned liquid crystal (LCD-VA) display panels of D3. The board is not convinced that this is correct because the vertically aligned liquid crystal material of D3 has a refractive index anisotropy (see paragraph [0008] of D3), which means that it has a different refractive index for different angles of incidence of the incoming light. Moreover, there is no indication that the numerical value of the refractive index anisotropy given in D3 differs for the corresponding value for twisted nematic liquid crystals in a manner which would support the appellant's argument.



The appellant added that the skilled person would not have applied D1 to D3 because the light is better collimated in the device of D3 (D3 was filed 14 years after D1) and enters the display panel sufficiently perpendicularly. Regarding this argument, the board agrees with the appellant that this problem would indeed not arise if the light were perfectly collimated. However, as stated in D1, column 1, lines 44 to 53, it is in practice impossible to obtain a completely collimated light.

The appellant added that even if the light beams of D3 were not perfectly collimated, the small remaining collimation imperfections would at most have resulted in minor image quality deteriorations which would not have justified the additional costs of using mirror-inverted LCD panels as suggested in D1.

The board is not convinced by this last argument which is of a commercial rather than technical nature. In any case, at least for the high-end products, the skilled person would have regarded the improvements to the image quality as worth the additional costs (which may not be high anyway).

For the above reasons, the board considers that the problem of D1 also existed, at least to some extent, in the device of D3 and that it would have been an obvious and logical course of action for the skilled person to apply the solution of D1 (mirror-inverted display panels) to the device of D3 in order to solve this problem. The skilled person would thereby have arrived at a device according to claim 1.

In the board's view, there is no need for the skilled person to have actually noticed in the device of D3 an

image quality degradation similar to that described in the present application in order to choose this course of action. By combining the teachings of D3 and D1 for the reasons given above, the skilled person would have arrived at a device which also solves this kind of image quality degradation, irrespective of whether he was aware of it. The board thus concurs with the examining division that the specific technical effect mentioned in the present application (i.e. avoidance of image deterioration caused by different disclination lines for different display panels) should be regarded as a mere "bonus" effect as defined in the jurisprudence of the Boards of Appeal (see Case Law of the Boards of Appeal of the EPO, 6th edition, July 2010, section I.D.9.8).

Finally, the appellant also cited decisions T 389/86, OJ EPO 1988, 87, and T 55/93 in support of its case that the subject-matter of claim 1 solves a single problem, not two partial problems, and that there is thus no justification for combining the teachings of three prior-art documents (D1, D2 and D3).

Since in the above reasoning as to inventive step the board relies solely on D3 and D1, but not on D2, the above two decisions are of no relevance to the present decision and thus need not be discussed.

For the above reasons, the board concludes that the subject-matter of claim 1 according to the main request does not involve an inventive step in view of D3 and D1.

7. Accordingly, the appellant's main request is not allowable.

*Auxiliary request*

8. Claim 1 according to the auxiliary request differs from claim 1 according to the main request in that it includes the additional feature **in the preamble of the claim** that the liquid crystal display panels are driven by a frame inversion drive which inverts the polarity of a drive voltage for each video signal frame.

During the oral proceedings the board drew the appellant's attention to paragraph [0006] of D3 which states that "[n]ormally the liquid crystal is driven while the voltage is inverted to be positive or negative per frame or field, [...]". In other words, the "frame inversion drive" is known from D3, which describes it as one of the two normal options (the other one being "field inversion drive") for driving the voltage of the VA-LCD panels. The board also notes that this additional feature is in the preamble of claim 1, which is regarded as an admission by the appellant that this feature was known from D3.

As to inventive step, the appellant argued that the skilled person would not have expected that a disclination pattern might appear at a boundary of adjacent pixels when a frame inversion drive was applied.

This argument, however, does not help the appellant's case because, as explained *supra* regarding claim 1 of the main request, the skilled person would have arrived at the claimed subject-matter without inventive step by applying the teaching of D1 to the device of D3, not in order to solve a problem of disclination pattern at a boundary of adjacent pixels, as described in the present application, but in order to solve another

problem, described in D1, of image quality deterioration due to an imperfectly collimated beam. The appellant has not alleged that the use of a frame inversion drive teaches away from applying the teaching of D1 to the device of D3, nor does the board think that it does.

For the above reasons, the subject-matter of claim 1 according to the auxiliary request does not involve an inventive step in view of D3 and D1.

9. Hence the appellant's auxiliary request is not allowable.

*Conclusion*

10. Since neither of the appellant's requests is allowable, the appeal must be dismissed.

**Order**

**For these reasons it is decided that:**

The appeal is dismissed.

The Registrar:

The Chair:



K. Boelicke

T. Karamanli

Decision electronically authenticated