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D E C I S I O N
of 30 March 2000

Case Number: T 0359/98 - 3.4.2

Application Number: 89308374.1

Publication Number: 0355064

IPC: G02F 1/1335

Language of the proceedings: EN

Title of invention:

Back lighting device for a liquid crystal panel

Applicant:

Tosoh Corporation, et al

Opponent:

TA TRIUMPH-ADLER AG Patente & Warenzeichen

Headword:

-

Relevant legal provisions:

EPC Art. 56

Keyword:

"Inventive step (yes)"

Decisions cited:

-

Catchword:

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Boards of Appeal

Chambres de recours

Case Number: T 0359/98 - 3.4.2

D E C I S I O N
of the Technical Board of Appeal 3.4.2
of 30 March 2000

Appellants: Tosoh Corporation
(Proprietors of the patent) 4560, Kaisei-cho
Shinnanyo-shi
Yamaguchi-ken
746-8501 (JP)

Representative: Kearney, Kevin David Nicholas
KILBURN & STRODE
20 Red Lion Street
London WC1R 4PJ (GB)

Respondent(s): TA TRIUMPH-ADLER AG Patente & Warenzeichen
(Opponent) Südwestpark 23
D-90449 Nürnberg (DE)

Representative: Schneck, Herbert, Dipl.-Phys., Dr.
Rau, Schneck & Hübner
Patentanwälte
Königstrasse 2
D-90402 Nürnberg (DE)

Decision under appeal: Decision of the Opposition Division of the
European Patent Office posted 16 February 1998
revoking European patent No. 0 355 064 pursuant
to Article 102(1) EPC.

Composition of the Board:

Chairman: E. Turrini
Members: A. G. Klein
B. J. Schachenmann

Summary of Facts and Submissions

I. An opposition was filed against European patent No. 0 355 064 (application No. 89 308 374.1) on the ground that its subject-matter lacked an inventive step within the meaning of Article 56 EPC in view of the following documents:

A1: DE-A-3 223 706,

A2: "Optik und Atomphysik", Pohl, Springer-Verlag, 1963, page 55,

A3: US-A-4 714 983,

A4: GB-A-2 164 138,

A5: DE-C-3 625 767, and

A6: DE-A-3 634 493.

II. The patent was revoked by decision of the Opposition Division.

The Opposition Division held in its decision that the closest prior art back light device as disclosed in document A1 was distinguished from the claimed device in that the document did not contain an explicit reference to the refractive index of the light scattering material being higher than that of the transmissive material of the light-conductive plate, nor to the mathematical expression of the coating rate. Since however the refractive indexes had to be different from each other for the device to function

physically, using a higher index for the light scattering material was just one of two obvious possibilities. The mathematical expression of the coating rate as set out in claim 1 was disclosed in document A5 which was concerned with the same type of device, although in conjunction with non-reflecting patterns, having a dimming function to reduce too bright areas. The claimed device did not therefore involve an inventive step within the meaning of Article 56 EPC (see points 3.1 to 3.5 of the Reasons).

III. The appellants (proprietors of the patent) lodged an appeal against this decision, requesting that it be set aside and that the patent be maintained on the basis as main request of amended claims 1 and 2, of which the only independent claim, filed with the statement of the grounds of appeal, reads as follows:

"1. A back light device for a liquid crystal panel comprising:

 a transparent plate (2) made of a light transmissive material;

 a light source provided close to at least one side end portion of the said transparent plate;

 characterised in that the light source (7) is a linear light source extending along the full length of the side end portion of the plate at which it is located,

 a first surface of the said transparent plate is partially coated with light scattering material (5) having a refractive index higher than the said transmissive material of the said light-conductive plate;

 the light scattering material being in the form of

dots, each dot having a size selected within a range of from 0.2 mm to 3 mm in order to provide uniform luminance;

a light reflecting plate (4) covers the said first surface of the said light-conductive plate which is partially coated with the said light scattering material;

a light scattering plate (3) is provided on the other or second surface that is the light emitting surface of the said light-conductive plate (2), and in that the said light transmitting plate or member is partially coated with the said light scattering material on the said first surface so that the coating rate thereof is increased in proportion to x^n , where x is the distance from the light source, and n is a number from 1.7 to 3."

The respondent (opponent) withdrew his opposition upon receipt of the appellants' statement of the grounds of appeal, without further comments.

IV. In support of their request, the appellants who after the withdrawal of the opposition by the opponent stay as the only party in the appeal procedure, stressed that document A1 disclosed a device having a very complex light intensity distribution. The device indeed comprised several lamps disposed in respective cut-outs at the periphery of the plate, the light-refracting surface structures being constituted by line grids or grooves disposed in the form of concentric rings or circles.

The document did not disclose any light source extending along the full edge of one of the sides,

which in accordance with the invention simplified light distribution into a linear model, the intensity distribution being constant along directions parallel to the light source.

Neither document A1, nor any of the other citations suggested the claimed provision of light scattering dots having a size precisely selected within a range from 0.2 mm to 3 mm in combination with a coating rate increasing in proportion to x^n , with x being the distance from the linear light source and n a value from 1.7 to 3. It was only after very careful and lengthy research that the appellants arrived at the conclusion that this specific combination of ranges achieved excellent uniformity of the luminance throughout the surface of the transparent plate.

Reasons for the Decision

1. The appeal is admissible.
2. *Amendments*

Claim 1 corresponds in substance to a combination of independent claim 2 and dependent claim 3 as granted, with the further limitations that the size of each dot is selected within a range of 0.2 mm to 3 mm, as was disclosed on page 4, lines 23 to 25 of the description as originally filed, and that the linear light source extends along the full length of the side end portion of the plate at which it is located.

The latter feature was not expressly set out in the

application documents as originally filed. Original Figures 1 and 3 however clearly show a linear light source extending along the whole length of an edge of the transparent plate, and the skilled person in the Board's view immediately understands that the illustrated arrangement of the light scattering dots such that the coating rate is constant in a direction parallel to the edge provided with the linear light source could not achieve the uniform luminance of the back light device stressed throughout the description if the light source extended only over part of the edge of the plate.

The amendments brought to independent claim 2 as granted so as to achieve present claim 1 also clearly limit its scope.

Dependent claim 2 corresponds to dependent claim 4 as granted.

Accordingly, the amendments brought to the patent are not objectionable under Article 123(2) and (3) EPC.

3. *Patentability*

3.1 The opponent did not raise any objection against the allowability of independent claim 1, filed with the appellants' statement of the grounds of appeal, and his withdrawal of the opposition leaves the appellants as the sole party in the procedure.

The Board having scrutinized the citations on the file found that novelty and inventive step of the claimed subject-matter were not called in question by the

presently available prior art, for the following reasons.

- 3.2 The back light device set out in claim 1 comprises a combination of a plurality of features which closely cooperate with each other so as to achieve a common result, namely a flat and compact lighting device which is capable of providing uniform illumination to a transmissive liquid crystal panel irradiated from the rear (see column 1, lines 7 to 9, 20 to 25 and 39 to 47).

The claimed combination in particular involves a transparent light transmissive plate, a linear light source extending along the full length of the side end portion of the plate at which it is located, dots of a light scattering material formed on a first or back surface of the transparent plate, which itself is covered by a light reflecting plate, and a light scattering plate provided on the other i.e. front surface of the transparent plate. In addition, the scattering material of the dots, their size and their coating rate meet specific requirements also set out in claim 1.

The Board notices that the claimed dots of a **light scattering** material form a thin luminance uniforming structure which absorbs incident light and re-emits it in a broad range of directions, independently of the angle of incidence. Since this structure is provided on the back surface of the transparent plate, its distance from the further light scattering plate at the front light emitting side of the device is sufficient to permit proper mixing of the light rays issued from the

dots and to avoid bright spots being formed on the front side, despite a very thin sandwiched arrangement of the transparent plate between the front light scattering plate and the back light reflecting plate.

- 3.3 The claimed combination of features in the Board's view is neither known from, nor suggested by the prior art citations on the file.

Document A1 in particular discloses a back light device with a transparent plate having light refracting structures on its front surface. Light is emitted from the transparent plate at these refracting structures only, in a dosed manner (see claim 1 and the sentence bridging pages 2 and 3 of the description in accordance with the typewritten numbering, and the light rays shown in Figure 2). These **light refracting** surface structures thus do not form **light scattering** dots in the above sense and the fact that they are formed on the front surface of the transparent plate calls for the overlying light scattering plate being spaced from the front surface of the transparent plate so as to achieve sufficient mixing of the light and to avoid hot spots (see page 3 of the description, second sentence). In contrast the present invention allows for a more compact structure in which the light scattering plate can be provided directly on the front surface of the transparent plate.

Document A1 in a single passage states that the light refracting structures may be provided either at the front surface or at the back surface of the transparent plate (see page 2 of the description, lines 14 and 15: "die Plattenoberseite **oder Unterseite**"), but the

document does not show how the device should be adapted to allow for the refracting structure being provided at the back surface. Claim 1, the only independent claim in this document, the abstract and the specific disclosure of the embodiment described, all explicitly require that the refracting structures be provided on the front surface of the transparent plate.

Document A2 is an excerpt from a text book on physics, which simply shows that the energy of the radiation emitted by a punctual light source into the 3-dimensional space as received by a detector is inversely proportional to the square of the distance between the source and the detector.

Document A3 is the sole citation on the file to show a back light device for a liquid crystal display with a transparent plate having a back surface for the scattering of light. However, light scattering on the back surface is obtained by providing a uniformly frosted surface, obtained by conventional milling techniques, rather than by arranging dots of light scattering material at a varying coating rate as in the invention (see the abstract, Figure 3 and column 6, lines 30 to 32 of the description). This device does not comprise any front light scattering plate and the light sources are constituted by incandescent lamps disposed in cavities formed in the back surface of the transparent plate.

Document A4 discloses a back light device comprising a transparent plate, which in the embodiments described in conjunction with Figures 9 to 11 also comprises means to improve uniformity of luminance. These means

comprise light diffusing areas formed onto the front surface of a transparent plate. The light diffusing material, in contrast with the light scattering material of the dots of the invention, exhibits a refractive index which is lower than the refractive index of the transparent plate and light is emitted from the front face of the device only through the light diffusing areas (see page 3, lines 76 to 85). Uniform illumination is obtained by varying either the thickness (Figure 9) or the density (Figures 10 and 11) of the diffusing areas in relation to the distance from the light source. The device neither comprises any front scattering plate nor any linear light source.

Document A5 is the sole citation on the file to show a back light device having a light scattering plate disposed directly on the front surface of a transparent plate (see Figure 2). Uniformity of the luminance is controlled by areas or dots of a non-reflecting material comprising e.g. a black or a grey paint coated onto the back surface of the transparent plate, which in contrast with the present invention results in substantial loss of light energy by absorption. The device is illuminated through small electrical lamps provided in holes formed at the periphery of the transparent plate, rather than by a linear light source extending along the full length of a side end portion of it, as is set out in present claim 1. The document states that the light absorbing areas are disposed on the back surface of the transparent plate in such a way that their surface decreases in proportion to the square of the distance from the light source (see column 3, lines 63 to 66).

Document A6 is the sole citation on the file to show a back light device having a linear light source extending along the full length of the side end portion of the transparent plate 2 at which it is located (see Figure 1). Uniformity of the luminance at the light emitting side of the device is obtained by providing on the front surface of the transparent plate, a light scattering layer 3, which is separated from the light transmissive transparent plate by a layer 4 of an intermediate light transmissivity, a light reflecting film 7 and a front light scattering plate 6. The light reflecting film is expressly said to be in contact neither with the underlying light scattering layer 3, nor with the front light scattering plate, and it comprises light reflecting dots which reflect light back into the transparent plate. The size, shape and coating rate of the light reflecting areas is selected so as to achieve uniform luminance of the light which passes through the film (see the abstract, Figures 1 and 2, column 4, lines 61 to 67 and column 7, lines 25 to 32).

The remaining documents on the file do not come closer to the claimed subject-matter.

Thus it emerges that the claimed combination on the one hand comprises features which are known only in isolation in the prior art, like the linear light source extending along the full length of a side end portion of the transparent plate of document A6, the light scattering plate provided on the front surface of the transparent plate of document A5 or the light scattering back surface of the transparent plate of document A3. The claimed combination on the other hand

comprises features which are known from none of the citations, such as the use of a light scattering material having a refractive index higher than the refractive index of the transparent plate, and arranged in the form of dots of a size from 0.2 to 3 mm coated on the back surface of the transparent plate.

The Board therefore can see no conclusive chain of reasoning steps which could have led the skilled person in an obvious way from any of the known devices to the new combination of closely cooperating features set out in claim 1.

The subject-matter of claim 1 therefore involves an inventive step within the meaning of Article 56 EPC. So does the subject-matter of dependent claim 2 by virtue of its appendence to claim 1.

4. Since, taking into consideration the amendments made by the proprietor of the patent, the patent and the invention to which it relates thus meet the requirements of the Convention, maintenance of the patent so amended can be decided in accordance with Article 102(3) EPC.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The case is remitted to the first instance with the order to maintain the patent in amended form as follows:

Claims: claim 1 of the main request as filed with the statement of the grounds of appeal dated 12 June 1998 and claim 4 set out in the letter dated 23 March 2000 to become claim 2;

Description: columns 1 to 4 as granted;

Drawings: Figures 1 to 5 as granted.

The Registrar:

The Chairman:

P. Martorana

E. Turrini