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**Datasheet for the decision
of 09 December 2008**

Case Number: T 1661/06 - 3.4.02

Application Number: 98300476.3

Publication Number: 0860716

IPC: G02B 5/30

Language of the proceedings: EN

Title of invention:

Broadband cholesteric optical device, polariser, filter liquid crystal device and polarising beam-splitter

Patentee:

Sharp Kabushiki Kaisha

Opponent:

-

Headword:

-

Relevant legal provisions:

EPC Art. 52(1), 54, 56

Relevant legal provisions (EPC 1973):

-

Keyword:

-

Decisions cited:

-

Catchword:

-



Case Number: T 1661/06 - 3.4.02

D E C I S I O N
of the Technical Board of Appeal 3.4.02
of 09 December 2008

Appellant: Sharp Kabushiki Kaisha
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Decision under appeal: Decision of the Examining Division of the
European Patent Office posted 15 May 2006
refusing European application No. 98300476.3
pursuant to Article 97(1) EPC 1973.

Composition of the Board:

Chairman: A. Klein
Members: F. Maaswinkel
C. Rennie-Smith

Summary of Facts and Submissions

I. The appellant lodged an appeal, received on 23 June 2006, against the decision of the examining division, dispatched on 17 May 2006, refusing the European patent application 98300476.3. The fee for the appeal was paid on 21 June 2006 and the statement setting out the grounds of appeal was received on 12 September 2006.

II. In its Decision the examining division had objected that the claims of the main and the second auxiliary requests then on file were objectionable under Article 123(2) EPC; that the first auxiliary request was not allowable under Rule 86(4) EPC 1973; and that claim 1 according to the third auxiliary request was not new over the disclosure in document D7. The documents cited in the examining proceedings are:

D2: EP-A-0 606 939
D4: WO-A-97 19385
D5: EP-A-0 610 924
D6: WO-A-96 02016
D7: US-A-5 380 459.

III. With the statement containing the grounds of appeal the appellant filed respective sets of claims of a main request and first to fourth auxiliary requests and requested that these be considered by the Board. In addition the appellant requested that claims based on the use of the device defined in the claims of these auxiliary requests should be the subject of further auxiliary requests 5 to 9 and also filed an auxiliary request for oral proceedings.

IV. In telephone conversations on 27 November and 1 December 2008 with the representative of the appellant the rapporteur pointed to minor inconsistencies in the description and invited the appellant to submit amended documents. These were filed by fax on 28 November and 1 December 2008.

V. The documents now comprising the main request include:

Claims: 1 to 11, as received with the letter of 1 December 2008;

Description: pages 1, 2, 2a, 3 to 6, 6a, and 7 to 19 as received with the letter of 28 November 2008;

Drawings: sheets 1/18 to 18/18 as originally filed.

VI. The wording of independent claim 1 according to the main request reads as follows:

"A broadband cholesteric polariser comprising at least one pair of adjacent layers (20-22, 20, 31), the at least one pair comprising a cholesteric polarising layer (20, 22, 31) and a compensating layer (21, 23, 30), characterised in that the compensating layer (21, 23, 30) has a refractive index perpendicular to the compensating layer (21, 23, 30) greater than every refractive index oriented within the compensating layer (21, 23, 30)".

Claims 2 to 11 of this request are dependent claims. The wording of the claims of the auxiliary requests is not relevant for the purpose of this Decision.

VII. The appellant's arguments may be summarised as follows:

Claim 1 is amended to delete the wording which was considered by the examining division to add subject matter. Claim 1 is further amended to indicate that the cholesteric layer is a polarising layer and that the compensating layer has a refractive index perpendicular to the layer which is larger than every refractive index within the layer. Support for the former feature may be found, for example, at page 16 line 14 ("the polarising layer 20") and support for the latter feature may be found in the paragraph beginning at page 16 line 17 and in Figures 15 and 16 of the patent application. In particular, the paragraph on page 16 states that "the refractive index $n_{\text{perpendicular}}$ perpendicular to the layer 21 is greater than **the** refractive index n_{parallel} which is oriented in the layer 21". The refractive indices $n_{\text{perpendicular}}$ and n_{parallel} are illustrated in Figure 15 of the patent application. The direction of incident light is shown by the arrow in Figure 15. Figure 15 therefore shows diagrammatically a cross-section through the polariser with the plane of the cross-section being perpendicular to the layers of the polariser. There is nothing special or significant about the plane of the cross-section; its angular orientation or azimuthal angle about the direction perpendicular to the layers is wholly arbitrary. In other words, the plane of the cross-section is representative of any and every azimuthal angle. The above-mentioned statement in the paragraph on page 16

uses the definite article "the" when comparing the refractive index $n_{\text{perpendicular}}$ to the refractive index n_{parallel} . The refractive index n_{parallel} refers to the refractive index in the plane of the layer 21 and in the plane of the cross-section shown in Figure 15. Because the azimuthal angle of the plane of the cross-section is arbitrary and the definite article has been used, the meaning of this is that the refractive index $n_{\text{perpendicular}}$ is greater than every refractive index n_{parallel} for all azimuthal angles of orientation of the plane of the cross-section. This follows logically and linguistically and no other interpretation is possible.

The present invention as defined in the amended claim 1 differs dramatically from the arrangement disclosed in D6. The relevant paragraphs in D6 are those on page 3 from line 2 to 20. D6 discloses an illumination system including a cholesteric polariser and a quarter wave plate. The quarter wave plate is said to be composed of a material having a negative anisotropy in its refractive index (page 2, line 32). The relevant paragraphs on page 3 define what is meant by "negative anisotropy in the refractive index". These paragraphs define a material having a refractive index n_y , which is less than the constant refractive index ($n_z=n_x$) and with the smaller refractive index n_y being oriented in the plane of the quarter wave plate. The present invention as defined in claim 1 of the present application as amended defines an uniaxial material of positive anisotropy (using the terminology as in D6) with the orientation of the material being effectively perpendicular to the orientation of the uniaxial material disclosed in D6. Using the same notation as in D6, the compensating layer of the present invention has

refractive indices such that $n_z > n_x, n_y$. Thus, D6 uses a quarter wave plate of negative anisotropy with its optic axis oriented in the plane of the quarter wave plate whereas the present invention uses material of positive anisotropy with its optic axis oriented perpendicular to the compensating layer. The present invention as defined in the amended claim 1 is therefore clearly novel with respect to the disclosure of D6. It is submitted that the present invention is clearly patentable and non-obvious over D6 because D6 actually discloses an arrangement which leads away from the solution of the present invention. It is further pointed out that D6 is actually disclosing the use of a quarter wave plate to convert the circularly polarised light from the cholesteric polariser to linearly polarised light. In other words, the combination of the cholesteric polariser and the quarter wave plate provides a linear polariser. The disclosure of D6 does not make clear whether the orientation of the uniaxial material forming the quarter wave plate improves the performance of the quarter wave plate itself or of the combination. The disclosure of D6 makes it clear that the use of the negative birefringent quarter wave plate with its optic axis in the plane of the plate was found inadvertently to improve the viewing angle of the cholesteric polariser. However, the structure and function of the quarter wave plate of D6 are completely different from the structure and function of the compensating layer of the present invention. In paragraph 5 of the Summons to oral proceedings issued by the examining division on 30 November 2005, the examining division comments that "it is evident that any birefringence layer inserted into a polariser will have an effect". This statement is a truism. However,

the effects of different compensation films can only be predicted with great skill and insight. This is not a trivial or simple matter but instead, in order to provide the present invention and thereby achieve the resulting advantages and improvements in performance, significant inventive activity was required. The further document D7 cited by the examining division discloses a liquid crystal display device in which a compensation layer is provided within a liquid crystal display using a birefringent mode. This is clearly disclosed in the paragraph beginning at column 1 line 34 and examples of birefringent modes are given in column 1 lines 49 to 53. There is a similar passage in the detailed description at column 13 lines 40 to 44. The only modes referred to in D6 as having any twist are the super twisted nematic (STN) and the super twisted birefringent effect (SBE) modes. Of these two modes, only the STN mode is described in any detail and the sentence at page 12 lines 63 to 65 gives a preferable range of the angle of twist for an STN display.

In its e-mail to the appellant's representative dated 15 March 2006, the examining division objected that D7 anticipates the claim of what was then the third auxiliary request. The appellant submitted that this conclusion is entirely wrong and equally so respect of the claim of the present main request. D7 discloses a liquid crystal display device. Claim 1 of the main request is explicitly limited to a cholesteric polariser. The liquid crystal device of D7 is not a cholesteric polariser, nor does it contain a cholesteric polariser. The device is operating in the birefringent mode and, although linear polarisers are

necessary in order for the device to work, there is no disclosure whatever in D7 of a cholesteric polariser. In particular, even in the case of an STN device, the twisted nematic material does not perform any polarisation function whatever. It is therefore completely impossible for D7 to anticipate claim 1 of the present main request. In order to emphasise this, claim 1 of the present main request includes the feature that the cholesteric layer is a polarising layer. D7 fails to disclose or suggest a cholesteric polariser and further fails to disclose or suggest a cholesteric layer constituting or acting as a polarising layer. It is well known that compensation films may be used to compensate for undesirable viewing angle properties of liquid crystal devices. The real skill in providing displays which perform well in this and other respects is to design the correct type of compensation film for a particular situation and this requires specialist knowledge. However, liquid crystal displays and cholesteric polarisers function in entirely different ways so that what is known in the context of liquid crystal displays is largely irrelevant to the design of effective cholesteric polarisers. In other words, the person of ordinary skill in this general technical field, when attempting to improve the performance of a cholesteric polariser, would not refer to compensation films in liquid crystal displays because the technical problems to be solved are entirely different. In addition to the problems being different, the way the compensation film of D7 functions is entirely different from the function of the compensating layer of the present invention. Indeed, although the disclosure of D7 indicates that the refractive index of the film perpendicular to the

film may be greater than every refractive index in the plane of the film, it indicates a preference for an arrangement in which the refractive index perpendicular to the film is between the maximum and minimum refractive indices in the plane of the film; for example, this is explicitly claimed in claim 3 of D7. Any suggestion that D7 might be relevant to the inventive step of claim 1 of the present main request is therefore the result of ex post facto analysis and goes completely against the actual state of the art at the priority date of the present application.

It is further pointed out that the present application discloses, for the first time ever, the mechanism by which the change in polarisation of light passing through a cholesteric polariser can be compensated by using a passive compensating layer. This mechanism was completely unknown prior to the present application and, for example, D7 is absolutely silent on the mechanism by which compensation occurs in the arrangements which it discloses.

Reasons for the Decision

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

The board is satisfied that the amendments in claim 1 of the main request find support in claim 1 and in page 16, line 17 to page 17, line 3 in combination with Figure 15, layer 21 of the application as originally filed (Article 123(2) EPC). Also the acknowledgement of the prior art is not objectionable.

3. *Patentability*

3.1 *Novelty - Claim 1*

None of the documents referred to during the examining proceedings discloses a cholesteric polariser comprising a cholesteric polarising layer and a compensating layer with refractive index functionality perpendicular and oriented within this layer as defined in claim 1. In particular documents D2 and D4, which had only been referred to in the context of a lack of unity objection of the original claims, disclose a cholesteric polariser in combination with a quarter wave plate. For this latter plate documents D2 and D4 do not disclose any details of the plate's refractive index and, furthermore, the publication date of document D4 (29 May 1997) is later than the priority dates of the present patent application (24 and 31 January 1997).

Document D5 had been introduced by the examining division in its Official Communication of 7 October 2004 and had been considered to anticipate the subject-matter of claim 1 then on file. In its reply of 21 March 2005 the applicant convincingly argued that, contrary to the device defined in claim 1, D5 does not disclose a broadband cholesteric polariser but relates to a multi-domain liquid crystal display. Referring to the paragraph in column 9, line 51 of D5 it was furthermore noted that the optical compensator plate of that device has a refractive index in the directions parallel to the plate larger than the refractive index in the thickness direction, which is

the exact opposite of the feature of the compensating layer defined in claim 1.

Document D6 discloses an illumination system including a cholesteric polariser and a quarter wave plate in combination with the cholesteric polariser to convert the incident light into linearly polarised light. According to document D6, see claim 4 and page 8, lines 9 to 15, the quarter wave plate should preferably be composed of a material having a negative anisotropy in the refractive index, because this results in the best brightness and coloration as a function of the viewing angle for the particular system. On page 3, lines 11 to 14 document D6 defines for the particular birefringent layer (when used as a quarter wave plate) that "negative anisotropy" implies that the refractive index perpendicular to the layer (n_z) equals n_x and is larger than n_y , wherein n_x and n_y are the refractive indices within the layer. Clearly, this is a different condition than the requirement for the refractive index of the compensating layer defined in claim 1.

Finally the Board agrees with the appellant that document D7 does not disclose a broadband cholesteric polariser but relates to a liquid crystal display device. In the embodiment in example 3 specifically referred to by the examining division, the liquid crystal material is super-twisted nematic (STN), which is a chiral nematic liquid crystal, also referred to as cholesteric liquid crystal. The Board finds the appellant's argument credible that, even in the case of an STN device, the twisted nematic material does not perform any polarisation function. Indeed, the typical twisting angle of an STN-liquid crystal display is

between 180° and 270° which does not resemble the helical arrangement in a cholesteric polariser, in which the polarising effect arises from the cholesteric material being arranged in a plurality of full 360° periods of the pitches (resulting in Bragg reflection of one component of circularly polarised incident light). Therefore this document is considered not relevant to the presently claimed device.

It is concluded that the subject-matter of claim 1 is novel (Art. 52(1) and 54 EPC).

3.2 *Inventive step*

3.2.1 *Closest prior art*

Neither in the decision nor during the examining proceedings was the issue of inventive step addressed. Of the available documents it appears that document D6 may be identified as disclosing the closest prior art, since it is the only document disclosing a cholesteric polariser comprising a compensation film (see page 5, line 8 of D6) and in which document the problem of viewing angle dependence of its performance (brightness and colour) is addressed.

3.2.2 The subject-matter of claim 1 differs from the cholesteric polariser with compensation plate disclosed in document D6 in the refractive index properties of the compensation layer or plate. According to this document this plate should comprise a birefringent material cut with the optical axis parallel to the plane of the layer, having in this plane refractive indices n_x and n_y , and having a refractive index perpendicular to this layer $n_z = n_x > n_y$. In contrast the

present patent application requires that the refractive index perpendicular to the layer (in terms of D6: n_z) is larger than the refractive index in the direction parallel to the layer (n_x, n_y).

3.2.3 Both in document D6 and the present patent application this compensation plate or layer is arranged to optimise the viewing properties of the device including a cholesteric polariser. Therefore the technical problem is similar. The compensation plate in D6 is a quarter wave plate having the function to change the circular polarised light at the output of the cholesteric polariser to linear polarised light. This property of this plate is based on the birefringence in the plane of the plate which causes two orthogonally polarised components of a light beam propagating through the plate undergoing a quarter wave phase difference. Therefore in the direction parallel to the plane the refractive indices n_x and n_y must be different. Since by the choice of a quarter wave plate these properties are fixed, the only degree of freedom is then the choice of the material to be positive or negative anisotropic with the resulting refractive index $n_z = n_y < n_x$ or $n_z = n_x > n_y$, respectively. In document D6 it was found that the best compensation effect for a quarter wave plate is obtained with a material having a negative anisotropy, therefore $n_z > n_y$ but not larger than n_x .

3.2.4 In contrast, the cholesteric polariser defined in claim 1 includes a compensating layer which has a refractive index perpendicular to the compensating layer greater than every refractive index within the compensating layer. The Board understands the design of

the device in document D6 to be based on the combination of a cholesteric polariser and a quarter wave plate, wherein in a further step the still freely selectable parameters of this plate (positive or negative anisotropy) are chosen for optimised angular viewing. Therefore starting from this teaching in document D6, the skilled person would not arrive at the subject-matter of claim 1, because it would appear that the properties of a quarter wave plate, requiring birefringence in the plane of the plate and cutting the plate with its optical axis within the plate's plane, are not reconcilable with those defined for a compensating layer of the device of claim 1, which requires a material being effectively oriented perpendicular to the orientation of the material in D6.

3.2.5 The remaining citations referred to in the examining proceedings are not more relevant.

3.2.6 Therefore, in the opinion of the Board, the subject-matter of claim 1 involves an inventive step (Art. 52(1) EPC and 56 EPC).

3.3 The further claims 2 to 11 are dependent claims and are therefore equally allowable.

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 documents:

Claims: 1 to 11, as received with the letter of
1 December 2008;
Description: pages 1, 2, 2a, 3 to 6, 6a, and 7 to 19
as received with the letter of
28 November 2008;
Drawings: sheets 1/18 to 18/18 as originally
filed.

The Registrar:

The Chairman:

M. Kiehl

A. G. Klein