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**Datasheet for the decision
of 22 September 2015**

Case Number: T 1829/11 - 3.4.02

Application Number: 98402512.2

Publication Number: 0908758

IPC: G02F1/17

Language of the proceedings: EN

Title of invention:

Ultraviolet radiation-curable light-modulating film for a light valve, and method of making same

Applicant:

RESEARCH FRONTIERS INCORPORATED

Relevant legal provisions:

EPC 1973 Art. 56

Keyword:

Inventive step (main and auxiliary requests: no)



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Case Number: T 1829/11 - 3.4.02

D E C I S I O N
of Technical Board of Appeal 3.4.02
of 22 September 2015

Appellant: RESEARCH FRONTIERS INCORPORATED
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Decision under appeal: **Decision of the Examining Division of the
European Patent Office posted on 15 March 2011
refusing European patent application No.
98402512.2 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairwoman T. Karamanli
Members: F. J. Narganes-Quijano
A. Hornung

Summary of Facts and Submissions

I. The appellant (applicant) lodged an appeal against the decision of the examining division refusing European patent application No. 98402512.2 (publication No. 908758).

During the first-instance proceedings the examining division referred to documents

D1: WO-A-9411772
D2: US-A-5516455
D3: US-A-5463491
D4: EP-A-0523611,

and in its decision the examining division held that the subject-matter of claim 1 of the main request and the auxiliary request then on file did not involve an inventive step (Article 56 EPC).

Claim 1 of the main request reads as follows:

"A method of preparing a film suitable for use as the light-modulating unit of an SPD light valve, comprising a cross-linked polymer matrix having droplets of a liquid light valve suspension distributed in the cross-linked polymer matrix, said light valve suspension comprising particles suspended in a liquid suspending medium and being immiscible with said polymer matrix; which comprises admixing a cross-linkable liquid oligomer or polymer and said liquid light valve suspension, emulsifying the resulting admixture to form an emulsion of said liquid light valve suspension in said cross-linkable liquid oligomer or polymer, and cross-linking said cross-linkable liquid oligomer or

polymer while said admixture is in the form of a thin layer of said emulsion

characterized in that

the liquid suspending medium is a fluorinated polymer and the cross-linkable liquid oligomer or polymer is a siloxane copolymer containing internal aromatic pendant cross-linkable functional groups, in that the refractive indexes of said polymer matrix and said liquid suspending medium closely match, and in that the cross-linking step is done by exposing said thin layer of said emulsion to an UV-radiation or to an electron beam."

The wording of claim 1 of the auxiliary request differs from the wording of claim 1 of the main request in that the characterizing portion reads as follows:

"the cross-linkable liquid oligomer or polymer is a siloxane copolymer containing internal aromatic and pendant cross-linkable functional groups and the liquid suspending medium is a fluorinated polymer, and in that the cross-linking step is done by exposing said thin layer of said emulsion to an UV-radiation or to an electron beam."

- II. With the statement setting out the grounds of appeal the appellant submitted that the subject-matter of the set of claims of the main and auxiliary requests underlying the decision under appeal was new and involved an inventive step and it gave reasons why the decision under appeal was incorrect. The appellant requested that the decision under appeal "*be cancelled and a patent be delivered*". Oral proceedings were also requested on an auxiliary basis.

- III. Oral proceedings were appointed by the Board. In a communication annexed to the summons to attend oral

proceedings the Board gave a preliminary assessment of the appellant's case on appeal. In particular, the Board introduced into the proceedings the following document cited in the introductory part of the description of the application:

A1: US-A-4919521

and, as regards the subject-matter of claim 1 of the main request and the auxiliary request, the Board gave its preliminary opinion as follows:

"2. - Main request

2.1 - Claim 1 is directed to a method of preparing a film suitable for use as the light-modulating unit of a SPD light valve, the method comprising, among other features, the step of emulsifying an admixture of a liquid light valve suspension and a siloxane copolymer containing internal aromatic pendant cross-linkable functional groups, and the subsequent step of crosslinking the resulting emulsion so as to form a film constituted by a cross-linked polymer matrix having droplets of the liquid light valve suspension distributed therein having the characteristics defined in the claim.

In its decision the examining division held that

a) document D1 represented the closest state of the art,

b) the method of claim 1 differed from the method disclosed in document D1 (cf. abstract together with page 2, line 14 to page 3, line 10, page 12, line 6 to page 14, line 15, page 18, second paragraph, and page 23, line 24 to page 24, line 2) only in that the crosslinking step is carried out by exposing the

emulsion to an UV-radiation or to an electron beam, whereas in document D1 this step is carried out by thermal treatment (see for instance Example 2, page 33, lines 12 to 16), and

c) cross-linking the emulsion disclosed in document D1 by exposure to UV-radiation or to an electron beam constituted an obvious alternative to the step disclosed in document D1 of cross-linking the emulsion by thermal treatment.

In the statement of grounds of appeal the appellant has not disputed the findings mentioned in paragraphs a) and b) above, but has contested the examining division's view that cross-linking the emulsion by exposure to UV-radiation or to an electron beam constituted an obvious alternative to the disclosure of document D1.

2.2 - After consideration of the reasons given by the examining division in the decision under appeal and of the arguments of the appellant in the statement of grounds of appeal, the Board is inclined to follow the examining division's view that the claimed alternatives do not involve an inventive step, the reasons being as follows:

2.2.1 - In the examples given in document D1 the siloxane copolymer is cross-linked by thermal treatment at 85°C (see Example 2, page 33, lines 12 to 16; see also Examples 4, 6, 8, 10, 12 to 16, 19, 26 and 27), but the disclosure of the document is not restricted to curing under these specific conditions. In particular, the introductory part of the document appears to disclose in general terms, and without being confined to crosslinking by thermal treatment (page 2, line 14 et seq.), that the cross-linking conditions (page 13, last paragraph et seq.), in particular "e.g., temperature,

pressure, etc., must [...] be compatible with and not adversely affect the cross-linkable copolymer emulsifier, the cross-linked polymer matrix and/or the light valve suspension" (page 14, last paragraph). More particularly, the document teaches that "For example, if the particles are heat-sensitive, the cross-linking reaction must take place at a temperature at which the particles are stable" (page 14, lines 25 to 28).

In case that the skilled person would consider the specific cross-linking conditions disclosed in the examples of document D1 as inappropriate for some of the reasons already mentioned in document D1, he would look for alternative cross-linking conditions - such as cross-linking by thermal treatment at temperatures below the value 85°C disclosed in the examples of document D1 - and/or for alternative cross-linking methods.

It is common general knowledge in this art that oligomers and polymers, and in particular siloxane copolymers of the type considered in document D1, can be cross-linked by heating - as in the examples of document D1 - and also by other alternative methods such as exposure to ultraviolet-radiation or to an electron beam. As an illustration of this common general knowledge, reference is made to

- document A1 pertaining to the same technical field as document D1 (see abstract of document A1) and disclosing in general terms hardening of the corresponding emulsion "by heating, UV radiation and the like" (column 5, lines 8 to 16), and

- to document D4 also pertaining to the technical field of light controlling materials constituted by a polymer matrix having particles dispersed therein (abstract and page 2, lines 1 to 4), the polymer matrix being the cured product of "thermally curable polymers,

photo-curable polymers, electron beam curable polymers [or] radiation-curable polymers" (page 5, lines 17 to 21), and more particularly of "a heat-curable polyorganosiloxane [or] a photo-curable polyorganosiloxane" (page 6, lines 30 to 39). It is also noted that the description of the application acknowledges that "it is known in the art that such ultraviolet radiation-curable polymers and films can also be cured by using electron beam curing methods" (page 19, second paragraph).

Therefore, the skilled person confronted with the problem of finding an alternative to the cross-linking process disclosed in document D1 would consider crosslinking by exposure to UV-radiation or to an electron beam as a straightforward solution to that problem.

2.2.2 - The skilled person is aware of the technical effects, and in particular of the advantages and disadvantages, of using one or the other of the alternative crosslinking techniques mentioned above and he is also aware of the different physical conditions that may affect the different techniques (see for instance document D1, paragraph bridging pages 14 and 15, document D2, paragraph bridging columns 5 and 6, and document D3, column 5, line 58 et seq.). In this context, the advantages mentioned in the description of the application as being associated with the use of UV-radiation as a cross-linking technique (paragraph bridging pages 2 and 3 of the description) do not appear to go beyond those that are manifestly associated with this technique and that the skilled person would readily consider in advance. In addition, no unexpected or surprising effect appears to result from the claimed invention.

The Board is also unable to identify any circumstance in document D1 - let alone any technical prejudice in the art - that would have dissuaded the skilled person from considering the use of exposure to UV-radiation or technique. As a matter of fact, these alternative cross-linking techniques have also been used in analogous circumstances, see for instance document D2 pertaining to a technical field close to that of document D1 and disclosing an organosiloxane polymer matrix having dispersed therein liquid crystal material and cured by exposure to UV-radiation or to an electron beam (see abstract and column 5, line 61 to column 6, line 4; see also Example 6).

2.3 - As regards the arguments of the appellant in the statement of grounds of appeal, the following is noted:

- Documents D2, D3 and D4 have been referred to in point 2.2 above, not as providing a specific teaching that the skilled person would have considered in solving a particular problem, but only as an illustration of what is generally known by the skilled person working in this field. The appellant himself acknowledges with reference to document D2 that "there is [...] no teaching about cross-linking a thin layer of an emulsion, except that, as already widely known, photoinitiators with organosiloxanes polymers can be polymerized by UV radiation or by an electron beam" (statement of grounds of appeal, page 3, first paragraph).

- It is well established that curing by exposure to UV-radiation can be faster than curing by heating (see for instance document D2, column 12, lines 21 and 22, and Table 4).

- The remaining arguments of the appellant are already considered explicitly or implicitly in point 2.2

above, or do not appear to be supported by the subject-matter actually claimed, it being noted that the performances of a curing process and the characteristics of the resulting cured polymer matrix depend considerably on the specific curing conditions selected in carrying out the curing process as illustrated by the numerous examples in documents D1 to D4 and A1.

3. - Auxiliary request

As found by the examining division in its decision (page 6 of the decision, last paragraph), claim 1 of the auxiliary request appears to differ from claim 1 of the main request only in that the feature "the refractive indexes of said polymer matrix and said liquid suspending medium closely match" is omitted in the wording of the claim.

Accordingly, the subject-matter of claim 1 of the auxiliary request would not appear to involve an inventive step (Article 56 EPC 1973) for the same reasons as those given in point 2 above with regard to that of claim 1 of the main request."

- IV. In reply to the summons to oral proceedings, the representative of the appellant informed the Board by letter dated 15 April 2015 that neither the appellant nor its representative would be attending the oral proceedings. He also submitted comments on the preliminary opinion of the Board.
- V. Oral proceedings were held by the Board on 22 September 2015 in the appellant's absence.

The Chairwoman noted that the Board interpreted the written submissions of the appellant as requesting that

the decision under appeal be set aside and that a patent be granted on the basis of one of the sets of claims of the main and auxiliary requests underlying the decision under appeal.

At the end of the oral proceedings the Chairwoman announced the Board's decision.

Reasons for the Decision

1. The appeal is admissible.
2. *Procedural matters*

With the letter dated 15 April 2015 the representative of the appellant informed the Board that neither the appellant nor its representative would attend the oral proceedings previously scheduled by the Board.

The duly summoned appellant did not attend the oral proceedings. However, under Rule 71(2) EPC 1973, the proceedings continued without the appellant.

In accordance with Article 15(3) of the Rules of Procedure of the Boards of Appeal (RPBA, OJ EPO 2007, 536) the Board relied for its decision only on the appellant's written submissions. With the aforementioned letter the appellant submitted counter-arguments in reply to the preliminary assessment of the case made by the Board in its communication. Accordingly, noting that the appellant relies on its written submissions only and that it has had due opportunity to comment on the

Board's preliminary assessment of the case, the Board was in a position to reach a final decision on the basis of the appellant's written submissions. The Board was thus in a position to decide at the conclusion of the oral proceedings, since the case was ready for decision (Article 15(5) and (6) RPBA), and the voluntary absence of the appellant was not a reason for delaying a decision (Article 15(3) RPBA).

3. *Inventive step*

3.1 In the communication annexed to the summons to oral proceedings the Board explained in detail (see point III above) why in its preliminary opinion the subject-matter of claim 1 of each of the main request and the auxiliary request did not involve an inventive step with respect to the prior art (Article 56 EPC 1973).

3.2 The arguments submitted by the appellant in reply to the preliminary assessment of the case made by the Board in its communication are essentially the following:

a) It could not be agreed that document D1 was not limited to heat curing. Example 13 of document D1 was an attempt at UV curing of the emulsion that was deficient and would have taught the skilled person away from the use of UV or electron-beam curing.

b) In document A1, Example 1 was the only example that described the formation of a cured optically active film. Contrary to the case of the present application, the document failed to specify the need for particles and the suspending liquid to be compatible. Undue and costly experimentation would be required to find combinations of particles, suspending liquid and film compositions that would function. In addition, Example 1 of document D1 relied on the use of 10 g trifunctional polyethylene glycol, but the document was silent as to

the identity and number of curable groups on the functionality pendant from the ethylene glycol. The example also failed to specify the molecular weight of the polyethylene glycol, the molecular weight determining the properties of the same (viscosity, state and miscibility with other polymers or liquids). Therefore, the disclosure of document A1 required undue experimentation and its disclosure was not enabling.

3.3 In the Board's view, however, these arguments are not persuasive for the following reasons:

As noted by the appellant, Example 13 of document D1 mentions curing by exposure to UV radiation. However, what is cured by exposure to UV radiation in this specific example is not a film of the type under consideration, but only a UV-curable adhesive sealing the edges of a sandwich cell formed by a film and a sheet of ITO coated glass (page 46, lines 19 to 23), the film having previously been cured by thermal heating (page 46, lines 8 to 12). Therefore, irrespective of whether Example 13 of document D1 results - as submitted by the appellant - in a device deficient in some respect, there is no disclosure in this specific example that would have taught the skilled person away from using ultraviolet - let alone electron-beam - exposure techniques to cure a film of the type under consideration.

As regards document A1, the passage in column 5, lines 8 to 16 of the document reading "To harden the emulsion by heating, UV radiation and the like." was specifically cited in the preliminary assessment of the case by the Board (see point 2.2.1 in point III above) only as a further illustration that it was common general knowledge in this art that oligomers and polymers, and

in particular siloxane copolymers of the type considered in document D1, can be cross-linked by heating - as in the specific examples of document D1 - and also by other alternative methods such as exposure to ultraviolet-radiation. In this context, the contention of the appellant that Example 1 of document A1 did not constitute an enabling disclosure has no effect on the general statement of document A1 that the emulsion is hardened "by heating, UV radiation and the like", it being noted that

- Example 1 of document A1 only constitutes a specific embodiment and does not exemplify the whole, more general disclosure of the document,

- the appellant's submissions that the disclosure of Example 1 was insufficient to qualify as an enabling disclosure rely, not on the curing technique, but on the features of the composition of the emulsion, and

- in any case, Example 1 involves curing by heating, and not by exposure to ultraviolet radiation, so that the question of whether this specific example represents an enabling disclosure is not relevant for the issues under consideration.

3.4 In view of the above, the Board sees no reason to depart from the preliminary opinion already expressed in its communication. The Board therefore concludes that the claimed subject-matter of claim 1 of the main request and the auxiliary request does not involve an inventive step (Article 56 EPC 1973) and that, consequently, the appeal must be dismissed.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:

The Chairwoman:



M. Kiehl

T. Karamanli

Decision electronically authenticated