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Title of invention:
COMPONENTS FOR ELECTRO-OPTIC DISPLAYS

Applicant:
E Ink Corporation

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EPC 1973 Art. 56

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Case Number: T 1650/16 - 3.4.02

D E C I S I O N
of Technical Board of Appeal 3.4.02
of 5 April 2019

Appellant: (Applicant)	E Ink Corporation 1000 Technology Park Drive Billerica, MA 01821 (US)
Representative:	Hoffmann Eitle Patent- und Rechtsanwälte PartmbB Arabellastraße 30 81925 München (DE)
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted on 2 February 2016 refusing European patent application No. 06839457.6 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman	R. Bekkering
Members:	A. Hornung
	G. Decker

Summary of Facts and Submissions

I. The applicant appealed against the decision of the examining division refusing European patent application No. 06839457.6 on the basis of Article 56 EPC.

II. The applicant requested 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 or the auxiliary requests 1 and 2, all requests filed with the letter dated 1 March 2019.

III. Oral proceedings before the board were held on 5 April 2019.

IV. The present decision refers to the following documents:

D2: US2005/0105159 A1
D6: US2004/0155857 A1
D7: US2003/0025855 A1

V. Independent claim 1 according to the main request reads as follows:

"An electro-optic display comprising, in order:

a backplane comprising a plurality of pixel electrodes;

a layer of a solid electro-optic medium comprising an electrophoretic medium having a plurality of electrically charged particles disposed in a fluid and capable of moving through the fluid on application of an electric field to the electro-optic medium, the electrically charged particles and the fluid being encapsulated within a plurality of capsules;

a first adhesive layer; and

a light-transmissive electrically-conductive layer,

the electro-optic display being characterized in that the electro-optic medium is separated from the backplane by a second adhesive layer, the second adhesive layer having a thickness not greater than the larger of 10 µm and one half the thickness of the first adhesive layer, and in that the first adhesive layer comprises at least two sections having differing colors."

First auxiliary request

Independent claim 1 according to the first auxiliary request differs from claim 1 of the main request in that the first adhesive layer is "a first adhesive layer **having a thickness of from 10 to 50 µm**" (the difference between the main and first auxiliary request is highlighted by the board).

Second auxiliary request

Independent claim 1 according to the second auxiliary request differs from claim 1 of the first auxiliary request in that the word "only" is added in the following feature of claim 1 "electro-optic medium is separated from the backplane **only** by a second adhesive layer" (the difference between the first and second auxiliary request is highlighted by the board).

Reasons for the Decision

1. Main request

1.1 The subject-matter of claim 1 lacks an inventive step in view of D6 in combination with common general knowledge as exemplified by D7 (Article 56 EPC 1973).

1.1.1 D6 is a suitable starting point to assess inventive step of the claimed subject-matter. As in substance communicated to the applicant in the board's communication annexed to the summons to oral proceedings (point 7.1.1), D6, with reference to figure 3 and paragraphs [0028], [0097], [0124] and [0127], discloses an electro-optic display comprising, in order:

a backplane comprising a plurality of pixel electrodes (see [0097] and [0127]),

a layer of a solid electro-optic medium (302) comprising an electrophoretic medium having a plurality of electrically charged particles disposed in a fluid and capable of moving through the fluid on application of an electric field to the electro-optic medium, the electrically charged particles and the fluid being encapsulated within a plurality of capsules (304) (see [0028]);

a first adhesive layer (308);

a light-transmissive electrically-conductive layer (see [0127]),

wherein the electro-optic medium (302) is separated from the backplane by a second adhesive layer (312).

1.1.2 It follows that the claimed subject-matter differs from the display of D6, figure 3, in that:

(i) the second adhesive layer (312) has a thickness not greater than the larger of 10 µm and one half the thickness of the first adhesive layer (308) and in that

(ii) the first adhesive layer (308) comprises at least two sections having differing colors.

1.1.3 As explained in the annex to the oral proceedings (point 7.1.3), the technical effect of the distinguishing feature (i) is to limit the layer thickness of the second adhesive layer. Since the electrical resistance of the adhesive layer increases with its thickness, this means that the technical effect of the differing feature (i) is actually to provide an adhesive layer with a reduced electrical resistance. It is well-known that such a layer with a reduced electrical resistance is advantageous for multiple reasons, such as minimizing the voltage drop across the adhesive layer and the electrical power consumption or improving the switching time of the display (see D6, [0118], referring to colored layers placed between the electrodes of the display, in combination with [0119] referring to a lamination adhesive disposed between the electrodes).

The problem to be solved can, therefore, be seen as how to improve the electrical operation of the display.

D6 deals with the aspect of limiting the electrical resistance of the constituting layers of the display. In particular, D6, [0029] and [0030], discloses a maximum value for the resistance of the color filter array, corresponding to a maximum thickness of the layer. Moreover, D6, [0119], refers to document D7, disclosing various reasons well-known in the art why the reduction of the thickness of the adhesive layer is advantageous (see D7, [0144]): "[t]oo thick a layer of lamination adhesive

introduces unnecessary resistance between the electrodes, thus increasing the operating voltage and power consumption of the display, or increasing the switching time of the display. In addition, an unnecessarily thick layer of lamination adhesive increases the distance between the backplane electrodes and the electro-optic medium, and may thus tend to increase 'blooming' or 'dot-gain' in the display".

In order to optimise the electrical parameters of the display, for the skilled person, based on its own knowledge and guided by the teaching of D7, [0144], it would be obvious to reduce the electrical resistance of the second adhesive layer (312) and, hence, reduce its thickness to a minimum. In particular, depending on the actual construction of the display and on the technical characteristics of the layers, selecting a thickness below 10 microns is an obvious possibility, thereby arriving automatically at a thickness of the second adhesive layer fulfilling the criteria defined in claim 1.

1.1.4 The effect of the distinguishing feature (ii) is to provide a colored adhesive layer. The problem to be solved may be seen as how to provide a colored display.

D6, [0099], discloses a color filter provided "in a lamination adhesive used to secure the electrophoretic medium to a substrate which forms the viewing surface of the display". The color filter "has varying colors in different areas of the display" (see D6, [0098]), which implies that the color filter comprises at least two sections having differing colors. Even though the first adhesive layer (308) of the embodiment of D6 described in paragraph [0124] and shown in figure 3 does not comprise a color filter, for the skilled person, guided by the indications in paragraphs [0028], [0074] and [0119] that

the color filter may be disposed in the adhesive layer, it would be obvious to consider the option to form a first adhesive layer comprising at least two sections having differing colors, for instance, if a reduced number of layers is desired.

1.1.5 In conclusion, the skilled person, starting from D6, in combination with common general knowledge as exemplified by D7, would arrive at the subject-matter of claim 1 without exercising any inventive skills.

1.2 The applicant presented the following counter-arguments:

1.2.1 Starting from D6, the skilled person would learn from paragraph [0128] that the "distance from the color filter back surface to the optically active layer [should be] as small as possible". Furthermore, "the lamination adhesive on the front of the display and the capsule wall should both be as thin as possible. It is conceivable that these layers may be reduced to thicknesses approaching 1 µm".

The applicant further pointed to paragraph [0146] of D6, disclosing that "for pixels that are 100 µm wide, one should ensure that the distance from the surface of the color filter stripe to the front surface of the optically active material be smaller than, say 10 µm. This gap may be filled with lamination adhesive, a polymeric binder, capsule wall material, thin films above the tinted regions of the color filter, and surface treatments applied to the color filter".

Moreover, the applicant noted that D6 was silent about any numerical value of the thickness of the second adhesive layer.

The applicant deduced from these passages that D6 advised a thickness between 1 and 10 microns for the first adhesion layer and no value at all for the thickness of the second adhesive layer, whereas claim 1 defined a specific thickness of the second adhesive layer which was either smaller than 10 microns or half the thickness of the first adhesive layer.

1.2.2 The applicant was of the opinion that the skilled person would not find any hint in D6 to look into D7 for specifically defining the thickness of the second adhesive layer. But even if the skilled person consulted D7, it would learn from D7, [0144], that the thickness of the second adhesive layer should be "in the range of about 10 to about 50 µm", which laid outside the numerical range "not greater than 10 µm" defined in claim 1.

1.2.3 Neither D6 nor D7 disclosed a maximum thickness of the second adhesive layer that was defined relative to the thickness of the first adhesive layer.

1.2.4 No counter-arguments were put forward by the applicant concerning feature (ii).

1.3 The board is not convinced by the applicant's counter-arguments for the following reasons:

1.3.1 The skilled person, starting from the embodiment of figure 3 of D6, would not be limited to the precise numerical values mentioned in D6 for the thickness of the second adhesive layer because such precise numerical values depend upon numerous parameters of the electro-optic display which are undefined in the description of the embodiment of figure 3 of D6. Instead, depending upon the concrete configuration of the layers of the electro-optic display and the constraints of its use, such as the exact

layer compositions, the thermal, optical and mechanical desired performances of the display, cost and manufacturing aspects of the display, the skilled person would use common general knowledge to ascertain an adequate value for the thickness of the second adhesive layer.

As explained above (see point 1.1.3), the skilled person, based on the disclosure in D6 and on common general knowledge as exemplified by D7, would apply the following well-known, general guidelines to adjust the thickness of the second adhesive layer of the embodiment of D6, figure 3:

- "The thickness of the lamination adhesive needs to be carefully controlled to ensure proper adhesion and a robust display" (see D7, [0144]).

- Any layers, e.g. adhesive layers or color filters, disposed between the electrodes of the display have a certain electrical resistance which, "at any given operating voltage between the electrodes, reduces the voltage across the electro-optic medium itself, since the voltage across the electro-optic medium is equal to the operating voltage minus the voltage drop across the colored layers. The reduced voltage across the electro-optic medium typically slows the switching rate of the medium" (see D6, [0118]). This passage of D6 confirms the common general knowledge that, in general, for limiting unnecessary voltage drop across the non-optically active layers, the thickness of any intermediate layer, be it a colored layer or an adhesive layer, should be as thin as possible.

- However, on the one hand, adhesive layers should not be too thin in order to produce proper adhesion

between the sub-assemblies, to render the display not too susceptible to mechanical shock and, if desired, to ensure planarization of the non-planar surface of the encapsulated electrophoretic media. See D7, [0144].

- On the other hand, adhesive layers should not be too thick in order not to introduce unnecessary resistance between the electrodes which increases operating voltages, power consumption and switching time of the display and in order not to increase blooming or dot-gain in the display. See D7, [0144].

Based on these general design considerations of the electrophoretic display, the skilled person, after having decided on the desired compromise concerning the overall performance of the display, selects the adequate thickness of the second adhesive layer. Actually, depending on the exact configuration and intended use of the display, many different possibilities exist for selecting an adequate thickness of the second adhesive layer. In particular, selecting a thickness not greater than, for instance, 10 µm is one of these obvious and equivalent possibilities.

1.3.2 The board does not discern a special technical effect related to the claimed thickness range of not greater than 10 µm, other than the well-known effects enumerated in point 1.3.1 above or any other effects based on general considerations of the physics of an electrophoretic display.

No special technical effect is related either to the relationship between the thicknesses of the first and the second adhesive layer defined in claim 1. The applicant did also not argue any special technical effect related to

the thickness range or the relationship between the thicknesses of claim 1.

1.3.3 Thicknesses in the range of 10 to 50 µm, as referred to by the applicant and based on D7, [0144], represent thicknesses corresponding to a certain compromise made by the skilled person in view of the actual set-up and use of the display. There is no compelling reason argued by the applicant why the skilled person would necessarily select a thickness within the range of 10 to 50 µm for an embodiment fulfilling the general description given in paragraph [0124] of D6.

Concerning the thicknesses of the first adhesive layer in the range of 1 to 10 µm, disclosed in D6, [0128], the board notes that paragraph [0128] relates to a display comprising both a color filter and an adhesive layer. This represents a different type of display as the display under discussion comprising an adhesive layer forming also the color filter. Any conclusion drawn from [0128], D6, is not directly applicable to the display under discussion.

2. First auxiliary request

2.1 The subject-matter of claim 1 lacks an inventive step in view of D6 in combination with common general knowledge as exemplified by D7 (Article 56 EPC 1973) for essentially the same reasons as given in point 1.1 above.

Starting from the general description of the embodiment of D6, [0124], the skilled person, based on common general knowledge as exemplified by D7, would consider many different possibilities for selecting a thickness for the two adhesive layers of the embodiment, all of these equivalent possibilities being obvious and equally likely. In particular, it is well-known that a typical thickness

of an adhesive layer in an electro-optic display is in the range of about 10 to 50 µm (see e.g. D7, [0144]), but also that a compromise has to be made between aspects such as strong adhesion, planarization effect, shock absorption and low electrical resistance (see e.g. D6, [0118], [0119]; D7, [0144]).

Therefore, an electro-optic display comprising a first adhesive layer having a thickness from 10 to 50 µm and a second adhesive layer having a thickness not greater than the larger of 10 µm and one half the thickness of the first adhesive layer corresponds to one of these possibilities, which the skilled person would select depending upon the actual configuration of the display, thereby arriving at the claimed display in an obvious manner.

2.2 The applicant agreed that in general a compromise had to be found so that the thickness of an adhesive layer was neither too thick nor too thin.

However, in the technical field of electrophoretic displays, the skilled person was primarily taught that the thickness of the second adhesive layer should be as thin as possible and preferably be eliminated, if possible. See, for instance, D6, [0118] and [0128], and D7, [0144]. According to the embodiment of figure 1 of D7, no first adhesive layer existed between the light-transmissive electrode (120) and the electro-optic layer (130). The applicant also pointed to paragraphs [0037] and [0038] of D2. According to D2, [0038], "the electrophoretic layer typically comprises a binder which surrounds the capsules and maintains them in the form of a mechanically coherent layer". In D2, it has been "discovered that, if the properties of this binder (...) are chosen carefully, the binder can also serve as a lamination adhesive, thus

removing the need for a separate lamination adhesive layer".

Claim 1, on the contrary, required an electro-optic display comprising two adhesive layers. The skilled person, following the guidance provided in D7 and D2, would, however, eliminate at least one of the adhesive layers disclosed in the embodiment of D6, figure 3. Therefore, the subject-matter of claim 1 was not obvious.

Regarding the additional feature of claim 1 of the first auxiliary request about a first adhesive layer having a thickness of from 10 to 50 µm, the applicant, during oral proceedings, referred generally to the section of the patent application relating to the experimental data, but acknowledged that no concrete special technical effect linked to the additional feature of claim 1 could be deduced from it.

2.3 The board is not persuaded by the applicant's arguments.

First of all, the starting point of the board's reasoning as to lack of inventive step is the embodiment of D6, [0124], figure 3, comprising two adhesive layers. In view of the production process of this embodiment (see D6, [0124] to [0127]), including peeling off the two release sheets on the two sides of the electrophoretic layer and then laminating a conductive layer and a backplane on the two sides, respectively, the board does not see any obvious reason for abandoning one of the adhesive layers disclosed in D6.

Secondly, the embodiments of D2 and D7 referred to by the applicant are of a substantially different type of electro-optic displays than the display of D6 and of claim 1. In particular, the colors of the display in D2 and D7

are not provided by a color filter array made of an adhesive layer comprising colored sections as in D6 and in claim 1, but by other means inherently obviating the necessity of providing an additional colored adhesive layer.

3. Second auxiliary request

The subject-matter of claim 1 lacks an inventive step in view of D6 in combination with common general knowledge as exemplified by D7 (Article 56 EPC 1973) for essentially the same reasons as given in point 2 above. Indeed, the additional feature concerning the electro-optic medium being separated from the backplane only by a second adhesive layer is not new in view of the embodiment of D6, figure 3.

The applicant explained that the amendment was intended to clarify that no further layers may exist between the backplane and the second adhesive layer. No specific argument supporting inventive step was brought forward in respect of this feature.

4. In view of the above, none of the applicant's requests is allowable and, therefore, the board sees no reason to set aside the contested decision. Consequently, the appeal must be dismissed.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

M. Kiehl R. Bekkering

Decision electronically authenticated