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D E C I S I O N
of 14 October 2005

Case Number: T 0007/03 - 3.4.02

Application Number: 95927839.1

Publication Number: 0774130

IPC: G02B 26/08

Language of the proceedings: EN

Title of invention:
Display system

Applicant:
TEXAS INSTRUMENTS INCORPORATED

Opponent:
-

Headword:
-

Relevant legal provisions:
EPC Art. 52(1), 54, 56

Keyword:
-

Decisions cited:
-

Catchword:
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Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T 0007/03 - 3.4.02

D E C I S I O N
of the Technical Board of Appeal 3.4.02
of 14 October 2005

Appellant: TEXAS INSTRUMENTS INCORPORATED
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Decision under appeal: **Decision of the Examining Division of the European Patent Office posted 22 July 2002 refusing European application No. 95927839.1 pursuant to Article 97(1) EPC.**

Composition of the Board:

Chairman: A. G. Klein
Members: A. G. M. Maaswinkel
G. E. Weiss

Summary of Facts and Submissions

I. The appellant lodged an appeal, received on 19 September 2002, against the decision of the examining division, dispatched on 22 July 2002, refusing the European patent application 95927839.1. The fee for the appeal was paid on 19 September 2002 and the statement setting out the grounds of appeal was received on 22 November 2002.

II. The examining division objected that claim 2 of the main request then on file was objectionable under Article 123(2) EPC and that the subject-matter of independent claims 1 and 2 of the auxiliary request then on file did not involve an inventive step according to Article 56 EPC. The examining division also noted that an allowable request had been identified, which formed the basis of a communication under Rule 51(4) EPC, but that the applicant had not approved the text of that request. In the decision reference was made to the following documents:

D1: Patent Abstracts of Japan, vol. 16, no. 147 (P-1336), abstract of JP-A-4 003 041

D1a: Translation of JP-A-4 003 041

D2: GB-A-2 251 511

D3: WO92/13424

D4: US-A-5 035 475

III. With the statement containing the grounds of appeal the appellant filed four sets of claims to be considered as its main and first to third auxiliary requests.

IV. In a Communication pursuant to Article 11(1) RPBA and accompanying a summons to oral proceedings to be held on 29 September 2005 the board raised objections under Article 52(1), 54, 56 and 84 EPC.

V. With a facsimile letter received on 25 August 2005 the appellant submitted an amended claim 1 of its main request. In a telephone consultation with the appellant on 5 September 2005 the rapporteur pointed to remaining deficiencies in the dependent claims and objected that the description pages were not adapted to the claims.

VI. With a facsimile letter received on 8 September 2005 the appellant filed revised claims and description pages to be considered as its main request. These include:

Claims: 1 to 15;

Description: pages 1 to 11;

Drawings: sheets 2/4 to 4/4 as originally filed;
sheet 1/4 as received on 22 July 1998
with letter of 21 July 1998.

VII. In an order issued on 12 September 2005 the appellant was informed that the oral proceedings were cancelled.

VIII. The wording of independent claim 1 reads as follows:

" A display system comprising:

a light source (401);

a plurality of spatial light modulators (405, 407, 509, 511, 513, 515);

wavelength selective means (509, 511) for splitting light of different spectral compositions between the spatial light modulators;

means (513) for splitting light of one of said different spectral composition from the light source between at least two further spatial 1icht modulators (506, 507);

means (509, 511, 513, 515) for combining spatial1y modulated light produced by the spatial light modulators to create an image for projection onto a display; and

means (411) for displaying the combined light, characterised in that:

the spatially combined light of that spectral composition that has been split between said at least two further spatial light modulators and forming the image has a greater luminous flux than the light produced by each of said spatial light modulator".

The wording of independent claim 12 reads as follows:

"A display apparatus comprising:

a light source (601);

a spatial light modulator in the form of a deflectable mirror array (117) comprising an array of mirror elements (M_{11}, .. M_{mm}), each mirror element (M_{11}, .. M_{mm}) corresponding to a respective pixel of an image to be displayed and being deflectable between a

first orientation effective to reflect light incident on the mirror element (M_{11}, .. M_{mm}) at a predetermined angle not normal to the plane of the array along an "ON" path for the array and a second orientation effective to reflect light incident on the mirror element (M_{II}, .. M_{mm}) at said predetermined angle along an "OFF" path for an array; and

control means (119) for supplying address signals to the array effective to control the orientation of each of the mirror elements (M_{II}, .. M_{mm}) of each array dependent on the image to be displayed;

the apparatus being characterised in comprising:

means (605, 607) for sequentially directing light of different spectral compositions from the light source (60l) onto a polarising splitting means (609), the splitting means being effective to split light of the same spectral composition from the light source between at least two spatial light modulators of the said type (611, 613);

means (609) for combining the spatially modulated light produced by the spatial light modulators (611, 613); and

means (615) for directing the combined light towards a display surface;

the combined spatially modulated light having a greater luminous flux than the light produced by each deflectable mirror array (611, 613)".

The wording of independent claim 14 reads as follows:

"A projection system including a display apparatus according to any preceding claim and a projection screen (411) forming a display surface".

The wording of independent claim 15 reads as follows:

"A method of projecting an image using a display apparatus according to any preceding claim, or a projection system according to claim 14".

Claims 2 to 11 and claim 13 are dependent claims.

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

Amended claim 1 comprises the features of claim 1 as originally filed with the clarification that it is one of the split spectral bands that is further split between modulators and the further clarification that the displayed combination is a spatial combination. Claims 12 to 15 basically correspond to those which were considered allowable in the notice under Rule 51(4) EPC with some clarifications. The description has been adapted to acknowledge the prior art and to correct some errors and informalities. Therefore these amendments should be admissible.

Claim 1 is in the two part form with respect to Dl, which is considered as the closest prior art and which discloses a colour display system including a plurality of spatial light modulators and wavelength selective means for splitting the light of different spectral compositions. The invention as now claimed is distinguished from the disclosure in D1 in that;
a) one of the different spectral compositions is separated to further spatial light modulators, and
b) the flux of the combined light from the further modulators in the image is greater than that handled by any of the modulators alone.

It is clear that feature (b) is not present in Dl since the effect of the extra green light modulator (light valve 2 of Fig. 1 of D1, for example) is the provision of extra green pixels (pixels 19 of Fig. 4) which are over and above the pixels (pixels 18 of Fig. 4) produced by the first green modulator (light valve 1 of Fig. 1).

Hence the light from the further modulators of Dl is not combined and therefore at no position in the image can the flux of the green light be greater that that from a single modulator.

It is also clear from Dl that the green pixels cannot be combined (for example superposed) without sacrificing the whole point of Dl altogether, which is improved resolution (see abstract of D1, section headed "Purpose"). If the green pixels of Dl were combined, then they would be in number exactly the same as original system with no improvements in resolution whatsoever. The image would be brighter; but that would be to make the present invention. The fact that Dl provides no indication that pixels of the spectrum that has been further split should be combined but rather teaches the opposite provides a sound argument in favour of an invention step of the present invention.

Moreover, D1 and the present invention solve different problems in different ways: Dl is concerned with resolution and provides a way of avoiding expensive extra and/or smaller structures in the modulator itself. The present invention addresses the completely different problem of a hard limit set on the brightness

due to the limit on input intensity that the modulators can withstand. The invention provides a way of enhancing brightness without a mere increase of capacity of the system as a whole. Rather it has been realised that if part of the spectrum is split between modulators, each of those modulators could be taken to the limit and the fact that light balance is not evenly distributed across the primary colours thereby exploited so that the whole system can be driven harder. This overall improvement is achieved at the expense of only extra complexity in one (not three) channels.

Certainly in D1 there is no suggestion that the input luminous flux drive should or even could be increased or that any of the modulators could receive more intense input.

Claim 12 defines a further solution to the same technical problem by means for sequentially directing light from different spectral compositions onto a polarising beam splitter means and spatially combining the light modulated by the spatial light modulators to render a modulated beam having a greater luminous flux than that of the individual beams. This claim had been considered allowable by the examining division. Its subject-matter is not disclosed or rendered obvious by any of the available documents.

Reasons for the Decision

1. The appeal is admissible.

2. *Amendments*

According to the appellant, claim 1 is based on claim 1 as originally filed with further features concerning the splitting of the light of one of the spectral compositions and recombining these beams in order to increase the luminous flux in the displayed image. This is fairly supported by the original application documents, in particular addressed in the embodiment shown in Figure 5 and the corresponding part of the description. Similarly the subject-matter of claim 12 is supported by the embodiment in Figure 6. The further claims equally find their support in the original application. The description has been adapted which was found to be admissible under Article 123(2) EPC. The claims also meet the requirements of Article 84 EPC.

3. *Patentability*

3.1 Novelty

Claim 1

3.1.1 Document D1 discloses in Figure 1 a display system comprising a light source 4; spatial light modulators 1, 2, 3; wavelength selective means 5 for splitting light of different spectral compositions between the spatial light modulators (red and blue to modulator 3; green to modulators 1 and 2); means 6 for splitting light of one of the spectral compositions (green) between spatial light modulators 1 and 2; means 9 for combining the spatially modulated light to create an image for projection onto a display; and means (10, 11) for displaying the light.

3.1.2 The display system defined in claim 1 differs from this disclosure in the way the spatially modulated beams are combined: the arrangement in the display system of D1 is such that the modulated (green) light beams from the spatial light modulators 1 and 2 are projected so as to double the spatial resolution, see Figure 4, pixels 18 and 19 and page 5, 2nd paragraph of the translation document D1a. In contrast, in the system according to claim 1 the splitting is such that the produced image has a greater luminous flux, i.e. the images are superposed in order to increase the brightness.

3.1.3 The other documents disclose a more remote prior art. Document D2 discloses a display device based on a plurality of deformable mirror devices arranged in a matrix. It does not relate to splitting of light of different spectral compositions. Document D3 addresses a prior art display system for producing a colour image acknowledged in Figure 1 of the present patent application. Dichroic mirrors and spatial light modulators are employed to modulate green, red and blue beams which are recombined to provide a colour image. Document D4 discloses a video projector TV display system in which a light source beam is split into two paths. Two arrays of movable mirrors are arranged behind baffles in order to provide modulated beams. The document does not disclose means for splitting light of different spectral compositions.

3.1.4 The subject-matter of claim 1 is therefore novel.

3.1.5 Claim 12

This claim addresses a display apparatus comprising spatial light modulators of the deflectable mirror type. Such arrangements are known from documents D2 and D4 (no spectral splitting of light of different spectral compositions) and from document D3 (simultaneous splitting of spectral components by dichroic beamsplitters). None of the prior art documents discloses an arrangement in which light of different spectral compositions is sequentially directed onto a polarising beamsplitter. The subject-matter of this claim is therefore novel.

3.1.6 Claims 14 and 15

These claims define a projection system including display apparatus according to any preceding claim (therefore also claim 1 or claim 12) and a method of projecting an image using such a system. The subject-matter of claims 1 and 12 being novel, the same applies to these claims.

3.2 Inventive step

Claim 1

3.2.1 As discussed in point 3.1.1, both in the system of D1 and in the apparatus defined in claim 1, one of the beams having a particular spectral composition is further split and modulated at two further modulators. In the system disclosed in document D1 the purpose of this feature is to increase the resolution of the display device. This differs from the aim addressed by

the apparatus of claim 1, where the technical problem is to provide a display device in which the amount of total light flux of the system may be increased.

3.2.2 Neither document D1, nor any of the other available documents discusses the problem of the limit of light flux that can be handled by spatial light modulators. It is not obvious why the skilled person would modify the apparatus of D1 in the way defined in claim 1, because, as correctly argued by the appellant, a modification in such a way would imply discarding the advantages offered by document D1. Therefore the skilled person would not be lead by the available prior art to the solution in claim 1.

3.2.3 It is concluded that the subject matter of claim 1 involves an inventive step.

Claim 12

3.2.4 Starting from the disclosure in document D3 as the closest prior art the subject-matter of claim 12 differs from the system in D3 in that light of different spectral compositions is directed sequentially onto a polarising beamsplitter; and in that the light components, after being split by this beamsplitter and being modulated by at least two deflectable mirror type spatial light modulators, are recombined to provide an image having a greater luminous flux than that of the single beams. This claim addresses the same technical problem as claim 1. As pointed out, none of the available documents addresses the problem of the flux handling limits of spatial light modulators. Therefore the subject-matter of this

claim involves an inventive step for the same reasons as discussed in context of claim 1.

3.2.5 Claims 14 and 15

Since claims 1 and 12 define patentable subject-matter, claims 14 and 15, defining a projection system including display apparatus according to any preceding claim (including claim 1 or claim 12) and a method of projecting an image using such a system, also are allowable.

3.2.6 This similarly applies to claims 2 to 11 and claim 13, which are dependent claims.

4. For the above reasons, the board finds that the appellant's request meets the requirements of the EPC and that a patent can be granted on the basis thereof.

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 15;

Description: pages 1 to 11;

Drawings: sheets 2/4 to 4/4 as originally filed;
sheet 1/4 as received on 22 July 1998
with letter of 21 July 1998.

The Registrar: The Chairman:

P. Martorana A. Klein