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Datasheet for the decision of 3 August 2021

Case Number: T 0701/19 - 3.4.02

Application Number: 13865018.9

Publication Number: 2901201

IPC: G02B26/10, G02B3/00, G02B27/01, G02B27/48

Language of the proceedings: EN

Title of invention:
LENS ARRAY AND IMAGE DISPLAY DEVICE INCORPORATING THE SAME

Applicant:
Ricoh Company, Ltd.

Headword:

Relevant legal provisions:
EPÜ Art. 56

Keyword:
Inventive step - (yes)

Decisions cited:

Catchword:

Europäisches Patentamt
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Office européen des brevets

Beschwerdekammern

Boards of Appeal

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Case Number: T 0701/19 - 3.4.02

D E C I S I O N
of Technical Board of Appeal 3.4.02
of 3 August 2021

Appellant: (Applicant)	Ricoh Company, Ltd. 3-6, Nakamagome 1-chome Ohta-ku Tokyo 143-8555 (JP)
Representative:	J A Kemp LLP 14 South Square Gray's Inn London WC1R 5JJ (GB)
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted on 24 September 2018 refusing European patent application No. 13865018.9 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman	R. Bekkering
Members:	H. von Gronau
	T. Karamanli

Summary of Facts and Submissions

I. The applicant's appeal is directed against the decision of the examining division to refuse European patent application No. 13865018.9. The examining division refused the application on the grounds that the subject-matter of independent claim 1 of the main request and the first auxiliary request did not involve an inventive step over document

D1: US 2009/135374 A1

as the closest prior-art document in combination with document

D4: US 2011/083542 A1.

II. With the statement setting out the grounds of appeal of 7 January 2019, the appellant filed claims 1 to 15 labelled as "Main Request" and claims 1 to 13 labelled as "Auxiliary Request".

The appellant 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, as an auxiliary measure, according to the auxiliary request.

III. In a communication pursuant to Rule 100(2) EPC dated 13 July 2021, the board informed the appellant of its provisional opinion that the claims according to the main request filed with the statement setting out the grounds of appeal complied with the requirements of the EPC and invited the appellant to confirm the application documents (description, claims and drawings) forming the main request.

IV. By letter dated 13 July 2021, the appellant confirmed its main request that the decision under appeal be set aside and that a European patent be granted in the following version:
Description: Pages 1, 2, 4-26 as published, Page 3 filed with the letter of 6 January 2016.
Claims: Nos. 1-15 filed with the letter of 7 January 2019 in pages 27-30 marked "Main Request".
Drawings: Sheets 1/7-7/7 as published.

V. Claim 1 of the main request filed with the statement of grounds of appeal reads as follows:

"An image display device comprising:
a laser light source (100) for projecting a light beam having a wavelength;
an imaging element (6) to form an image with the light beam from the light source; and
a lens array (8) comprising a plurality of lenses (801) adjacently arranged, configured to be illuminated with the light beam forming the image for image display, the lens array (8) being formed from a resin material;
wherein the laser light source (100) includes three laser light sources (RS, GS, BS) to project light beams with red, blue and green wavelengths respectively and characterised in that borders of neighbouring lenses are formed in at least two directions and surfaces of said borders have a curvature radius set to be smaller than a longest wavelength among wavelengths of the light beams."

Reasons for the Decision

1. The appeal is admissible.

2. Main request - claim 1 - inventive step (Article 56 EPC)

2.1 The examining division considered document D1 to be the closest prior-art document that disclosed all the features of claim 1 except that:
a) the lens array is formed from a resin material;
b) the surfaces of borders between neighbouring lenses have a curvature radius set to be smaller than a longest wavelength among wavelengths of the light beams.

Feature a) was considered obvious because the selection of resin material was a standard design option, and feature b) solved the problem of providing an alternative way to avoid unwanted divergence of the beam and reduce interfering noise, without the reduction of light beam intensity caused by the light shielding layer of D1, and was considered obvious in view of document D4 (see grounds for the decision, 11.1).

2.2 The appellant was of the opinion that the subject-matter of claim 1 involved an inventive step because there was a synergistic effect arising from the two differing features, and with a proper formulation of the objective technical problem (*to provide an image display device which can effectively reduce visible interfering noise while maintaining the brightness of an enlarged virtual image displayed by two-dimensional scanning with a coherent light beam*) as stated in the application (see paragraph [0012] of the application as

filed), the person skilled in the art would not have considered the teaching of document D4, which was prior art in a different technical field. Even if document D4 were considered, it would not provide a solution that corresponded to the claimed solution (see grounds of appeal, 3.2).

2.3 The board agrees with the view of the examining division and the appellant that document D1 can be considered as the closest prior art.

2.3.1 Document D1 discloses in particular in its fourth embodiment (see paragraphs [0093] to [0099], Figure 12) an image display device 20 for displaying an image 350 comprising:
- laser light sources 110b, 110g, 110r for projecting a light beam 112;
- an imaging element 118 to form an image with the light beam 112 from the light source; and
- a lens array 140 comprising a plurality of lenses 145 (see Figure 11) adjacently arranged, configured to be illuminated with the light beam forming the image for image display,
wherein the laser light source includes three laser light sources 110b, 110g, 110r to project light beams with red, blue and green wavelengths respectively (see Figure 12, paragraphs [0093] to [0098], claims 3 and 4), and
wherein borders of neighbouring lenses are formed in at least two directions (see e.g. alternative of Figure 9C, paragraph [0076]).

Document D1 further discloses a light shielding layer 148 in the border regions of the lenses to shield the border region and thus to avoid interference and speckles (see D1, paragraphs [0089] and [0097]).

2.3.2 Therefore, the board agrees with the view of the examining division that the subject-matter of claim 1 differs from the disclosure of document D1 in that:
a) The lens array is formed from a resin material.
b) The surfaces of borders between neighbouring lenses have a curvature radius set to be smaller than a longest wavelength among wavelengths of the light beams.

2.3.3 The differing features have the following effects:
a) They provide a material for the lens array (see application, paragraphs [0070] and [0071], no particular effect is described for the selection of resin for the lens array).
b) The border 843 with a curvature radius r smaller than the wavelength λ does not function as a lens so that the light beam is transmitted straight through it and is not diverged (see application paragraph [0061], Figure 3C).

2.3.4 In order to determine the objective technical problem which the claimed invention solves with respect to the closest prior art, it is essential not to include in the formulation the problem which has already been solved by the closest prior-art document D1 and not to include a pointer to the claimed solution. Document D1 discloses a light shielding layer 148 in the border regions of the lenses to shield the border region and thus to avoid interference and speckles (see D1, paragraph [0089]). The board does not consider the problem formulated by the appellant, "*to provide an image display device which can effectively reduce visible interfering noise while maintaining the brightness of an enlarged virtual image displayed by two-dimensional scanning with a coherent light beam*",

to be the correctly formulated problem, because in document D1 visible interfering noise is already reduced. On the other hand, the board also considers problem b) formulated by the examining division, "*to provide an alternative way to avoid unwanted divergence of the beam and reduce interfering noise, without the reduction of light beam intensity caused by the light shielding layer of D1*", to be unsuitable, as it contains a pointer to the claimed solution by addressing a problem with the shielding layer which is not mentioned in document D1 (see D1, paragraph [0090]) but is part of the claimed solution.

2.3.5 Starting from document D1 the person skilled in the art therefore had to solve the following two problems:
a) Select a material for the lens array.
b) Provide an improved image display device while maintaining reduction of visible interfering noise.

2.3.6 With respect to problem a), the board agrees with the opinion of the examining division that it would have been obvious for a person skilled in the art to select resin as a material for the lens array because resin was widely used in the field of lenses and can thus be considered as a standard design option in the field of transparent optical elements.

2.3.7 With respect to problem b), the examining division was of the opinion that document D4, which disclosed a similar micro-lens array (30) with micro-lenses that were also arranged closely to each other, gave the clear incentive to reduce the radius of the border (or edge) regions to an ideal value of zero, and, in practice, down to values comparable to the wavelength of the light source, in order to avoid undesired refraction from these regions. Such an incentive also

applied for two-directional arrays and dealt with the very physical (refractive) interaction of any lens array with incoming light at its border regions between the lenses. This would be well understood by the skilled person, in combination with their standard technical knowledge, to be applicable in any lens array (e.g. the array of D1) regardless of its use, function, transmission wavelength or material. It was considered basic optical knowledge and well known to the skilled person that an optical structure did not exert lens effects (i.e. refraction) on light with a wavelength larger than the size of the structure itself. Therefore, when applying such an incentive to a known lens array, the skilled person would have obviously limited themselves to adjusting the radius of curvature of the edges between the lenses without changing other features (material, manufacturing process, shape of the lenses, etc.) that were linked to the use and function of the known lens array within its system.

However, the board is of the opinion that the assessment of the examining division was focused on the claimed solution. In fact, the person skilled in the art with the above formulated objective technical problem b) in mind (*provide an improved image display device while maintaining reduction of visible interfering noise*) would not have considered document D4, because this prior art does not address problem b). Rather, the person skilled in the art would have had to identify how the image display device of D1 could be improved. Without knowledge of the claimed solution, the person skilled in the art would not have been focused on the lens array and would therefore have had to identify that the brightness of the enlarged virtual image of the display device needed to be improved. The person skilled in the art then would have

had to find out that this problem could be solved not only by other measures (e.g. modifying the light source) but also by modifying the shielding layer of the lens array. Furthermore, the person skilled in the art, with their general knowledge that an optical structure does not exert lens effects (i.e. refraction) on light with a wavelength larger than the size of the structure itself, would have had to reach the point that it is possible to get rid of the shielding layer completely while maintaining reduction of visible interference noise by reducing the curvature radius of the borders between lenses to a value smaller than the wavelength of the used light beam. The person skilled in the art would have considered document D4 only if they had reached the point of wanting to get rid of the shielding layer of the lens and to implement very small edge curvatures.

As shown above, starting from document D1 and faced with the above objective technical problem b), the skilled person would have to go through a series of steps, each offering several options, without being guided by any other prior-art document. Given the number of steps required to achieve the claimed solution and the number of possible options to be taken, the claimed solution is not obvious to a person skilled in the art without hindsight.

2.4 The board therefore concludes that the subject-matter of claim 1 involves an inventive step.

3. Claims 2 to 15 of the main request are dependent upon claim 1, and therefore their subject-matter also involves an inventive step.

4. The board is satisfied that claims 1 to 15 according to the main request meet the requirements of the EPC. Therefore, there is no need to examine the claims of the auxiliary request.

5. The Japanese family document of document D1 is cited as reference 1 in the description, and the description has been adapted to the amended claims. The board is therefore satisfied that the application according to the main request meets the requirements of the EPC.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the examining division with the order to grant a European patent in the following version:

Description:
Pages 1, 2, 4-26 as published
Page 3 filed with the letter of 6 January 2016.

Claims:
Nos. 1 to 15 filed with the statement of grounds of appeal of 7 January 2019 and marked "Main Request".

Drawings:
Sheets 1/7-7/7 as published.

The Registrar: The Chairman:

H.Jenney R. Bekkering

Decision electronically authenticated