

Internal distribution code:

- (A) Publication in OJ
(B) To Chairmen and Members
(C) To Chairmen
(D) No distribution

**Datasheet for the decision
of 17 October 2007**

Case Number: T 0272/06 - 3.4.02

Application Number: 99310470.2

Publication Number: 1014159

IPC: G02F 1/1335

Language of the proceedings: EN

Title of invention:

Illumination apparatus and projection apparatus

Applicant:

CANON KABUSHIKI KAISHA

Opponent:

-

Headword:

-

Relevant legal provisions:

EPC Art. 52(1), 54, 56

Keyword:

"Novelty and inventive step (yes - amended claims)"

Decisions cited:

-

Catchword:

-



Case Number: T 0272/06 - 3.4.02

D E C I S I O N
of the Technical Board of Appeal 3.4.02
of 17 October 2007

Appellant:

CANON KABUSHIKI KAISHA
30-2, 3-chome, Shimomaruko
Ohta-ku
Tokyo (JP)

Representative:

Beresford, Keith Denis Lewis
BERESFORD & Co.
16 High Holborn
London WC1V 6BX (GB)

Decision under appeal:

Decision of the Examining Division of the
European Patent Office posted 6 October 2005
refusing European application No. 99310470.2
pursuant to Article 97(1) EPC.

Composition of the Board:

Chairman: A. Klein
Members: F. Narganes-Quijano
M. J. Vogel

Summary of Facts and Submissions

I. The appellant (applicant) lodged an appeal against the decision of the examining division to refuse European patent application No. 99310470.2 published with the publication No. 1014159.

In the decision under appeal the examining division referred to documents

D1: EP-A-0825472

D2: EP-A-1006734

D6: "Optics", E. Hecht; Addison Wesley, 4th ed., 2002, USA; pages 253 to 268

and held that the subject-matter of claim 1 then on file was not new over the disclosure of document D2 within the meaning of Articles 52(1) and 54(3) EPC for the contracting states FR, DE and GB, and that in any case the claimed subject-matter did not involve an inventive step (Articles 52(1) and 56 EPC) over the disclosure of document D1 in view of well established principles known in optics and shown in document D6.

II. With the statement setting out the grounds of appeal the appellant submitted application documents amended according to a main and an auxiliary request and requested setting aside of the decision under appeal and the grant of a patent. The application documents according to the auxiliary request then on file are the following:

- claims 1 to 7 filed with the letter dated 16 February 2006;
 - description pages 2 to 4, 18 to 21, 23, 24, 26 to 30 and 32 to 37 as originally filed, pages 1, 5, 6, 8, 17, 22, 25 and 31 filed with the letter dated 17 August 2005, and pages 6a, 6b, 7 and 16 filed with the letter dated 16 February 2006, pages 9 to 15 being cancelled according to the letter dated 17 August 2005; and
 - drawing sheets 1/11 to 11/11 as originally filed.
- III. In response to the preliminary opinion expressed by the Board in a communication annexed to summons to oral proceedings, the appellant withdrew with its letter dated 6 September 2007 the previous main request and filed an amended page 38 containing part of claim 1, two pages 40 containing part of claim 1, claims 2 and 3 and part of claim 4 respectively amended according to a main and an auxiliary request, and an amended page 33 of the description replacing the corresponding documents of the auxiliary request then on file, and also requested the cancellation of page 8 of the description. In reply to a subsequent telephone call by the rapporteur informing the appellant that the oral proceedings were maintained in order to discuss the allowability of the main request, the appellant withdrew with its letter dated 27 September 2007 the main request and asked the Board to cancel the oral proceedings.

After consideration of the amendments made to the application documents according to the sole request of the appellant, the Board cancelled the oral proceedings.

IV. Claim 1 amended according to the sole request of the appellant reads as follows:

"An image projection apparatus including three image display elements (RLCD, GLCD, BLCD), an illumination optical system (2 to 10, DM1, DM2, RF, GF, BF) for illuminating said three display elements by light from a light source (1), and a projection optical system (14) for projecting light from said three illuminated image display elements; wherein

said illumination optical system comprises, in the following order from said light source (1):

an integrator optical system including:

(a) a first lens array (3) having a plurality of lenses and a second lens array (4) having a plurality of lenses; or

(b) a rod integrator (23);

a colour separation system (DM1, DM2) for separating light emerging from said integrator optical system into three light beams each of which is directed to a respective one of the three image display elements respectively; and

a relay lens system (10), provided on an optical path of one light beam of the three light beams emerging from said colour separation optical system, which relay lens system (10) comprises a first lens unit (G1), a second lens unit (G2) remote from said first lens unit (G1), and a third lens unit (G3), in

the stated order from the side of said light source (1);

characterised in that:

the position at which the peripheral image formed by the relay lens system (10), of either the light incidence plane of said first lens array (3) or the light exit plane of said rod integrator (23) is nearer to the light source side than the position at which a paraxial image is formed by the relay lens system (10), of either the light incidence plane of said first lens array or the light exit plane (23b) of said rod integrator;

the position of the illuminated surface of the one (BLCD) of said three image display elements (RLCD, GLCD, BLCD), illuminated by said one of the light beams is nearer to said light source side than the position at which said paraxial image is formed; and

said first and third lens units (G1, G3) of said relay lens system (10) satisfy the following condition:

$$0.9 < PW1/PW3 < 1.3$$

where PW1 and PW3 are the refracting powers of the first lens unit (G1) and the third lens unit (G3), respectively."

Claims 2 to 7 are all dependent claims referring back to claim 1.

V. The arguments of the appellant in support of its requests are essentially the following:

Document D1 discloses a projector having a relay lens system consisting of three convex lenses. In the document, no adverse effect caused by curvature of the image is disclosed at all, nor is any measure for

accommodating image curvature disclosed. The same applies to document D2.

The invention addresses the problem that the image of the light incidence plane of the first lens array or the light exit plane of the rod integrator formed by the relay lens system is curved, and this problem is neither mentioned nor resolved in documents D1 and D2.

In the claimed invention, by controlling the paraxial position of the image, the distribution of illumination intensity of the image display element illuminated via the relay lens system is significantly improved. In addition, according to the invention the refractive powers of the first and the third of the relay lenses satisfy the claimed relationship, and therefore it is possible to suppress distortion aberration. Outside of the claimed range, a bobbin type or a barrel type distortion aberration results, and the illumination intensity at the peripheral area of the image display element or the central area of the image display element decreases. However, documents D1 and D2 are silent as to the values of the refracting powers of the lens units and also silent as to any positional relationship between the paraxial and the peripheral images and between the paraxial image and the plane that is to be illuminated.

Reasons for the Decision

1. The appeal is admissible.

2. *Novelty*

2.1 Document D1

2.1.1 Document D1 discloses an image projection apparatus (Figure 4 and the corresponding description) comprising three image display elements (925R, 925G, 925B) each illuminated by an illumination optical system, and a projection optical system (910, 6) for projecting light from the display elements. In addition, the illumination optical system comprises an integrator optical system including two lens arrays (921, 922), a colour separation system (941, 942) for directing light of a different colour to each of the display elements, and a relay lens system constituted by three lens units (953, 973, 954) and provided in the light path from the colour separation system to one of the display elements (925B).

In addition, the lens surfaces of the lens units of the relay lens system are concave (Figure 4), i.e. have a positive refractive optical power. It follows that, as a consequence of the spherical aberration and the curvature of field inherent to any lens having a positive refractive power (see document D6, Figures 6.14 and 6.29 and the corresponding description), the image of the light incidence plane of the first lens array formed by the relay lens system is inherently curved towards the object side, i.e. the peripheral portion of the image is nearer to the light source side than the paraxial portion of the image as required by the subject-matter of claim 1.

2.1.2 However, contrary to the view expressed by the examining division in the decision under appeal, there is no disclosure in document D1 that would allow the conclusion that the position of the illuminated surface of the image display element 925B is nearer to the light source side than the position at which the paraxial image of the light incidence plane of the first lens array formed by the relay lens system is formed as required by claim 1.

In addition, document D1 is silent as to the refracting optical powers of the lens units of the relay lens system and there is no disclosure that would anticipate expressly or at least implicitly the relationship between the refracting powers of the first and the third of the lens units defined in the amended claim 1.

2.1.3 It follows that document D1 fails to anticipate an image projection apparatus comprising the two features mentioned in point 2.1.2 above and that, consequently, claim 1 defines novel subject-matter over the disclosure of document D1.

2.2 Document D2

Document D2 discloses with reference to Figures 31 to 33 and 38 an image projection apparatus projecting light from three image display elements (111B, 111G, 111R) each illuminated by an illumination optical system. The illumination optical system comprises a light source, two lens arrays (103, 104), a colour separation system (135, 136) directing light to each of the image display elements, and a relay lens system comprising three lens units (108, 109, 110B; 108R,

109R, 110R) in the optical path of one of the light beams from the colour separation system.

According to the examining division, in view of the brightness adjustment mechanism disclosed in document D2 (paragraphs [0011], [0177] and [0178]), the optical arrangement of the image projection apparatus disclosed in document D2 is also such that the positions of the peripheral and the paraxial images formed by the relay lens system of the light incidence plane of the first lens array and the position of the illuminated surface of the corresponding image display element intrinsically satisfy the claimed conditions. However, even if the opinion of the examining division in this respect is followed, there is no express or implicit disclosure in document D2 that would allow the conclusion that the ratio between the refracting powers of the first and the third of the lens units is between 0.9 and 1.3 as required by claim 1 amended according to the present request of the appellant. The view expressed by the examining division in its decision that this feature, defined in one dependent claim then on file, is a feature customarily used in the art likely to overlap with the disclosure of document D2 is, in the absence of any express or at least implicit disclosure in the document relating to the optical power of the individual lens units, insufficient to conclude that the feature is anticipated either explicitly or implicitly by the disclosure of the document.

Therefore, document D2 fails to disclose an image projection apparatus comprising all the features of the apparatus defined in claim 1 as presently amended.

- 2.3 The remaining documents on file are less relevant and do not anticipate the claimed subject-matter.

In view of the above considerations, the Board concludes that claim 1 amended according to the present request of the appellant and dependent claims 2 to 7 define novel subject-matter over the available prior art (Articles 52(1) and 54 EPC).

3. *Inventive step*

- 3.1 Document D2 constitutes prior art within the meaning of Article 54(3) EPC and therefore is not to be considered in the assessment of inventive step of the claimed subject-matter (Article 56 EPC, second sentence).

The Board concurs with the examining division in considering document D1 as the closest state of the art. The claimed image projection apparatus differs from that disclosed in document D1 in the two features identified in point 2.1.2 above, i.e. in that

- (i) the position of the illuminated surface of the image display element optically coupled to the relay lens system is nearer to the light source side than the position at which the paraxial image of the light incidence plane of the first lens array is formed by the relay lens system, and
- (ii) the ratio between the refractive powers of the first and the third of the lens units of the relay lens system is between 0.9 and 1.3.

3.2 According to the appellant and the disclosure of the invention, feature (i) identified above compensates the nonuniformity of illuminance and the colour irregularity of the peripheral portion of the projected image caused by the curved image plane projected by the relay lens system on the image display element (page 4, line 17 to page 5, line 13 of the application) and feature (ii) allows for correction of image distortion and therefore improves the light utilization efficiency of the optical system (paragraph bridging pages 25 and 26 of the description).

Therefore, the problem solved by the claimed subject-matter over the image projection apparatus disclosed in document D1 can be seen in improving the image illuminance uniformity and the light utilization efficiency of the apparatus.

3.3 None of the prior art documents on file discloses or suggests solving the problem formulated above by means of features (i) and (ii).

In particular, document D1 addresses a similar problem (column 3, line 56 to column 4, line 21, and column 17, lines 21 to 28) and proposes adjusting the position of a lens of the integrator optical system in a direction orthogonal to the optical axis or along the optical axis (abstract, column 15, lines 16 to 37) and also adjusting the orientation of reflecting mirrors intercalated in the optical path (column 15, line 38 *et seq.*); the adjustments disclosed in the document, however, have only the effect of adjusting the position of the illumination area projected on the image display element with respect to the image forming area of the

image display element in the plane of the element (Figures 5(B), 5(D), 7 and 14 and the corresponding description) and do not affect the axial position of the paraxial image of the light incidence plane of the first lens array formed by the relay lens system with respect to the position of the illuminated surface of the image display element. In addition, the remaining prior art documents on file are also silent as to any positional shift of the paraxial image plane relative to the image display element along the optical axis of the optical system.

Furthermore, document D1 and the remaining prior art documents on file are also silent as to any relationship of the optical power of the lenses of the relay lens system with the problem formulated above. The view expressed by the examining division in its decision with respect to a dependent claim then on file that selecting the optical powers as claimed is a feature customarily used in the art and that is likely to overlap with the disclosure of document D1 is, in the absence of any appropriate evidence or technical argument, insufficient to conclude to the obviousness of the claimed relationship. The Board acknowledges in this respect that the skilled person would be aware that the correction of aberrations such as pincushion and barrel distortion would impose predetermined conditions on the optical parameters of the optical system and in particular of the relay lens system; however, there is no evidence on file that this approach would result in the combination of the technical features (i) and (ii) as claimed.

3.4 The Board concludes that the subject-matter of present claim 1 involves an inventive step over the available prior art (Articles 52(1) and 56 EPC). The same conclusion applies to dependent claims 2 to 7 by virtue of their dependence on claim 1.

4. The Board is also satisfied that the application documents amended according to the present request of the appellant and the invention to which they relate meet the remaining requirements of the EPC within the meaning of Article 97(2) EPC, and in particular the requirements of Article 123(2) EPC. More particularly, claim 1 is based on claim 26 as dependent on claim 11 as filed together with page 15, lines 17 to 21, page 22, line 22 to page 23, line 2, page 25, lines 12 to 22 and Figures 1 and 3 of the application as filed, and dependent claims 2 to 7 are based on page 21, lines 25 to 27, page 23, lines 3 to 10 and 22 to 25, page 24, lines 8 to 20, 26 and 27, and page 25, lines 1 to 3 and 12 to 22 together with Figures 4 to 6 and examples 1 to 3 of the application as filed.

In view of the above conclusions and considerations, the Board concludes that the decision under appeal is to be set aside and a patent be granted on the basis of the application documents amended according to the appellant's request (Articles 97(2) and 111(1) EPC).

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 application documents:
 - claim 1 (part) on page 38 filed with the letter dated 6 September 2007, claim 1 (part) on page 39 labelled "auxiliary request" filed with the letter dated 16 February 2006, claim 1 (part) together with claims 2 and 3 and claim 4 (part) on page 40 labelled "auxiliary request" filed with the letter dated 6 September 2007, and claim 4 (part) together with claims 5 to 7 on page 41 labelled "auxiliary request" filed with the letter dated 16 February 2006;
 - description pages 2 to 4, 18 to 21, 23, 24, 26 to 30, 32 and 34 to 37 as originally filed, pages 1, 5, 6, 17, 22, 25 and 31 filed with the letter dated 17 August 2005, pages 6a, 6b, 7 and 16 labelled "auxiliary request" filed with the letter dated 16 February 2006, and page 33 filed with the letter dated 6 September 2007, pages 8 to 15 as originally filed being cancelled; and

- drawing sheets 1/11 to 11/11 as originally filed.

The Registrar:

The Chairman:

M. Kiehl

A. G. Klein