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D E C I S I O N
of 16 July 1998

Case Number: T 0870/96 - 3.4.2
Application Number: 90201000.8
Publication Number: 0395156
IPC: G03B 21/00, G02B 3/00

Language of the proceedings: EN

Title of invention:

Optical illumination system and projection apparatus comprising such a system

Applicant:

Philips Electronics N.V.

Opponent:

-

Headword:

-

Relevant legal provisions:

EPC Art. 56

Keyword:

"Inventive step - choice of closest starting point - skilled person - problem and solution - could-would-approach"

Decisions cited:

T 0066/97

Catchword:

-



Case Number: T 0870/96 - 3.4.2

D E C I S I O N
of the Technical Board of Appeal 3.4.2
of 16 July 1998

Appellant: Philips Electronics N.V.
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Decision under appeal: Decision of the Examining Division of the European Patent Office posted 9 April 1996 refusing European patent application No. 90 201 000.8 pursuant to Article 97(1) EPC.

Composition of the Board:

Chairman: E. Turrini
Members: S. V. Steinbrener
V. Di Cerbo

Summary of Facts and Submissions

- I. The appellant lodged an appeal against the decision of the Examining Division to refuse European patent application No. 90 201 000.8 (publication No. EP-A-0 395 156).

In its decision, the Examining Division held that the subject matter of claim 1 as filed by the applicant during the oral proceedings dated 13 February 1996 did not involve an inventive step within the meaning of Article 56 EPC, in particular when taking account of documents (in the numbering of the Examining Division)

D1: US-A-3 296 923, and
D3: EP-A-0 266 184.

- II. In addition to further documents already considered during the examination proceedings, i.e.

D2: US-A-2 326 970,
D4: US-A-4 769 750,
D5: DE-B-1 144 498,
D6: US-A-2 186 123,
D7: G. Schröder: "Technische Optik", Vogel-Buchverlag, Würzburg 1984, pages 109 to 117, and
D10: US-A-4 735 495

the following document cited in the present application and submitted by the appellant with the statement of grounds has been referred to in the appeal proceedings:

D17: EP-A-0 239 007.

III. In a communication pursuant to Article 110(2) EPC dated 21 November 1997, the Board pointed out that the subject matter of amended claim 1 as submitted with the statement of grounds of appeal did not seem to be inventive with respect to a combination of documents D17 and D1. Moreover, the additional features of dependent claim 4 were considered to offend against Article 123(2) and 84 EPC, and apart from claims 35 to 37 relating to the particular lens plate configurations of Figures 29 to 31 not found in the available prior art, the remaining dependent claims did not appear to contain patentable subject matter. Therefore, in view of the present set of claims, dismissal of the appeal was to be expected.

The appellant defended the present version of claim 1 in its letter dated 23 January 1998 and requested oral proceedings for the event that the Board would still have the intention to dismiss the appeal.

Since the Board did not find the appellant's counter-arguments convincing as communicated to the appellant by letter of 7 May 1998, oral proceedings were appointed at the appellant's subsidiary request and took place on 16 July 1998. At the end of the oral proceedings, the Board's decision was pronounced by the Chairman.

IV. The appellant requested that the decision under appeal be set aside and that a patent be granted on the basis of

- claims 1 to 3 and 5 to 40 filed with the statement of grounds dated 14 August 1996;

- claim 4 filed with the letter of 23 January 1998;
- description pages 1 to 4 and 13 filed with the statement of grounds dated 14 August 1996 and pages 5 to 12 and 14 to 35 as originally filed; and
- drawings 1 to 34 as originally filed.

V. The wording of claim 1 on which the present decision is based, reads as follows:

- "1. An image projection apparatus comprising
- an information display (B) system having at least one display panel (1) with a rectangular surface for generating images to be projected,
 - a projection lens system (C) for projecting said images on a projection screen (D), and
 - an illumination system (A) for supplying an optical radiation beam (b) along its principal axis and for illuminating said at least one display panel (1), the illumination system comprising a radiation source (20) and a concave reflector (21) for concentrating radiation emitted by the radiation source and a lens system arranged in the path of said radiation beam, characterised in that the lens system successively comprises a first lens plate (25) provided with a plurality of first lenses (26) which, in a plane perpendicular to the principal axis, all have the same rectangular shape, a second plate (28) provided with a plurality of second lenses (29) whose

number is equal to or twice the number of first lenses (26) and a third lens (31), the first lens plate dividing said radiation beam incident thereon into a number of subbeams (b_1, b_2) equal to the number of the first lenses, which subbeams have their smallest constriction in the plane of the second lenses (29) and whose chief rays are directed towards the centres of the corresponding second lenses, wherein the third lens (31) together with the second lens plate (28) images the radiation spots formed on the first lens plate in a superimposed form in an object plane (1)."

Claims 2 to 40 are appended to claim 1.

VI. The appellant's arguments in support of its request may be summarised as follows:

The preamble of claim 1 is known from document D17 already mentioned in the original specification and being the closest prior art. To increase the brightness of the projected image which is one of the common objects of D17 and the present application, a linear Fresnel lens is provided in the projector of D17 between the light source and the liquid crystal panel so that the cross-section of the illuminating beam in the plane of the panel becomes elliptical. Because of this compression in only one direction, the beam intensity also becomes less uniform, and the available increase in brightness is limited. It should be noted that the second linear Fresnel lens optionally provided in some embodiments of D17 has a different, i.e. collimating, function in order to avoid colour mixing.

Document D17 also discloses in Figures 19 and 20 an LCD

projector aiming at a more uniform light distribution which is the second common object of document D17 and the present application. The prior art solution consists in using circular Fresnel lenses with a flat central portion, thereby increasing the intensity of the outer annular portion which becomes more equal to that of the central portion. The function of the second circular Fresnel lens is to convert the convergent beam from the first Fresnel lens into a parallel beam, as in the other embodiments of D17.

Thus, D17 is concerned with either improving the brightness or improving the uniformity of the illumination beam, but does not disclose that both objects can be obtained simultaneously, which, however, is the case in the projector of the present application.

Apart from the fact that a Fresnel lens would normally not be called a "lens plate", D17 does not disclose a third lens, neither as a stand-alone lens nor as a lens integrated with the second Fresnel lens. Instead of the prior art alternatives, i.e. one first linear Fresnel lens for beam compression in one direction, or one first circular Fresnel lens for compressing the outer beam portion, in the projector of the present application two plates with a matrix of imaging lenses are used together with a third lens to superimpose the images formed by the lenses of the lens plates.

The objective problem solved by this considerable difference is thus not providing merely an alternative illumination system but providing a new concept for a projector wherein in principle all light from the source is concentrated on the LCD panel and this light

is made uniform to a high degree.

The expert dealing with this problem is the designer of the total projector and not the LCD specialist. For this expert, it is not obvious to look at film projectors, like the projector of document D1, because the technique of video and LCD projection has developed independently from the film projection field. These are, in fact, two separate worlds, one dealing with professional entertainment of big audiences in large cinemas, the other being more or less restricted to private use as a consumer product. Therefore, if a specialist were to be contacted then this would possibly be an optical specialist, but certainly not a film specialist since there would be no confidence that solutions existing in the film projector field would also work in the LCD field.

Moreover, starting from document D17 it would not be obvious to replace the illumination system with a single lens by a totally different concept making use of two lens plates and a third lens as is the case in D1.

For a solution of said problem, several alternatives are available. The desired improvements can, e.g., be obtained by employing a light integrating sphere and a light pipe as proposed in document D10. Another possibility is to arrange between the source and the LCD panel a totally reflecting rod of transparent material. This again demonstrates that it is not obvious for the expert who has to solve the said problem, to take illumination systems for film projectors into consideration, because in his own field alternative solutions are already present. In this

case, it might be obvious to elaborate further on the existing solutions and to try to improve them but not to look for a solution from a different technical field.

That the introduction of the system with two lens plates and a third lens in the LCD projector was revolutionary is proven by the fact that other companies have taken over the idea as can be seen from several younger patent applications. In addition to that, the appellant received requests for a licence from a Taiwanese Institute and a German projector manufacturer. From these facts, no other conclusion can be drawn than that in the world of LCD projector manufacturers it is recognised and accepted that the appellant has made a real and important invention.

Having regard to document D1 and remaining documents D2, D4, D5, D6 and D7 which are not more relevant to the present application than D1, only the following remarks are made:

In D1, the angular spread of the light rays is restricted by the third lens with a high numerical aperture. In the projector of the present application, the angular spread is limited by the condenser system of Figure 6, so that the angular spread problem does not occur and a high aperture for the third lens is not needed. Simultaneously, the decrease in contrast which in accordance with document D10 is caused by angular spread of the light beam can be avoided.

Document D4 relates to a somewhat "exotic" condenser solution for a wafer stepper, which is more of theoretical importance. Although in the field of

lithographic projection a uniform and bright illumination is also very important, LCD projection and lithographic projection have developed in different ways.

Document D5 is only concerned with the uniformity of the beam and does not specify the shape of the lenses, let alone any relationship of this shape to the shape of the object to be illuminated.

Finally, the known condenser systems cannot be said to be of general purpose type but are limited to film projectors. In document D1, only a film projector is mentioned. Document D7 speaks about condenser systems in general, but the applications referred to are only film and slide projectors.

Reasons for the Decision

1. *Admissibility of appeal*

The appeal is admissible.

2. *Articles 84 and 123(2) EPC*

Claim 1 now under consideration is based on original claims 1 and 40 including further amendments of clarifying and limiting nature disclosed in the application documents as filed. Hence, the Board considers the subject matter of claim 1 to meet the requirements of Articles 84 and 123(2) EPC.

3. *Novelty*

None of the cited documents discloses an image projection apparatus comprising a display panel for generating images to be projected, i.e. typically a liquid crystal display (= LCD) panel, in combination with the claimed illumination system as will become apparent from the following assessment of inventive step (see item 4. below).

Thus, the subject matter of claim 1 is considered to be novel with respect to the available prior art (Article 54 EPC). This finding has, in fact, not been challenged during examination proceedings.

4. *Inventive step*

4.1 Closest prior art

The Board agrees with the appellant that a correct application of the problem-and-solution approach should be based on document D17 as closest prior art, and not on document D1 as has been done by the Examining Division: the former document already relates to an image projection apparatus having an LCD panel with a rectangular surface for generating images to be projected, and to the problem of increasing the brightness and uniformity of the illumination system associated with said display panel (see D17, column 2, lines 36 to 46 and column 11, lines 16 to 24 and page 3, lines 14 to 20 of the present application). Document D1 does neither concern an image projection apparatus, but a "lenticulated collimating condensing system", nor does it refer to LCD projection.

Therefore, as the Board has pointed out repeatedly in the past (see e.g. decision T 66/97, not published in

OJ EPO), such a generically different document cannot normally be considered as a realistic starting point for the assessment of inventive step. In accordance with established practice of the Boards of Appeal (see the decisions cited as examples in "Case Law of the Boards of Appeal of the European Patent Office", EPO 1996, Chapter I, D-3.2: "Choice of the closest starting point"), when trying to evaluate a skilled person's capabilities and behaviour in the problem-and-solution approach, as closest prior art a "bridgehead" position should be selected, which said skilled person would have **realistically** taken under the "circumstances" of the claimed invention insofar as these circumstances can be retrieved in one item of the prior art. Consequently, among these "circumstances", aspects as the designation of the subject matter of the invention, the formulation of the original problem and the intended use and the effects to be obtained should generally be given more weight than the maximum number of identical technical features.

From document D17, there is known

- an image projection apparatus comprising an information display system having at least one display panel with a rectangular surface for generating images to be projected (see D17, Figures 1, 2, 18 - 20 and associated text: rectangular LCD panel 1);
- a projection lens system for projecting said images on a projection screen (see D17, Figures 18 to 20: projection lens system 5; screen S); and
- an illumination system for supplying an optical

radiation beam along its principal axis and for illuminating said at least one display panel, the illumination system comprising a radiation source and a concave reflector for concentrating radiation emitted by the radiation source, and a lens system arranged in the path of said radiation beam (see D17, Figures 18 to 20: radiation source 3; reflector 4; lens system 9, 11 in Figure 18 and 12, 13 in Figure 19).

The question of whether or not from a formal point of view the known lens system can also be considered to consist of a first lens plate (Fresnel lens 12 in Figure 19 of D17), a second lens plate (Fresnel lens 13 in Figure 19 of D17) and a third lens integrated with the second lens plate having different curvatures (compare lens plate 13 in Figure 19 of D17 to lens plate 47 in Figure 13 of the present application) is in the Board's view not relevant for the present decision and may therefore be left aside.

Hence, the subject matter of claim 1 in substance differs from the closest prior art by the specific type of condenser system, i.e. a lens system consisting of lens plates provided with a respective plurality of first and second lenses, the first lenses, in a plane perpendicular to the principal axis, all having the same rectangular shape, and the number of the second lenses being equal to or twice the number of the first lenses. The first lens plate divides the radiation beam incident thereon into a number of subbeams equal to the number of the first lenses, which subbeams have their smallest constriction in the plane of the second lenses and whose chief rays are directed towards the centres of the corresponding second lenses. A third lens

together with the second lens plate images the radiation spots formed by the first lens plate in a superimposed form in an object plane.

4.2 Technical problem

The technical effects achieved by said differences are twofold, namely

- an increase in illumination intensity since the shape of the first lenses is adapted to the shape of the display panel onto which the first lenses are imaged so that substantially all radiation incident on the first lens plate reaches the panel; and
- an increase in illumination uniformity since the different radiation spots formed by the lenses of the first plate are projected in a superimposed form on the display panel by means of the second lens plate and the third lens, thus essentially evening out spatial intensity variations of the light source (see page 3, line 37 to page 4, line 9 of the present application).

Document D17 points in the same direction, albeit less effective, since by elliptical compression in vertical direction the rectangular shape of the display panel is only approximated, and by circular compression illumination uniformity is improved at the expense of radiation loss due to shape mismatch. Nevertheless, the appellant's argument that illumination intensity and uniformity are not dealt with simultaneously in D17 is not fully convincing since in the Board's view a skilled person would assume that by elliptical

compression the illumination intensity in vertical direction should become more similar to that of the central portion, i.e. illumination uniformity should also be improved - contrary to the appellant's opinion. On the other hand, with circular compression leading to more illumination uniformity, the illumination intensity is increased in the annular region so that again contributions to both effects are simultaneously obtained (see column 11, lines 16 to 24 of D17 in this context).

Therefore, the Board considers the objective technical problem to be solved with respect to the closest prior art to consist mainly in optimising the condenser system of an LCD projector of the known type having regard to illumination intensity **and** uniformity. Since both objects, illumination intensity and uniformity, are in any case (whether combined or separately) disclosed in D17, and since there can be no doubt that there is still room for improvement in the prior art (see e.g. Figure 4 of D17), posing said problem would be obvious to a skilled person.

4.3 The skilled person

In the present case, there had been a considerable amount of discussion on the expertise of the skilled person. In the Board's view, even if the field of LCD projection were considered to constitute a rather specific technical domain as the appellant asserts, it does not appear plausible that this field should be more or less isolated from its technical surroundings, thus causing the necessity of an ongoing series of "re-inventions". In particular in a complex modern system integrating aspects of electronics, optics and material

science, as is the case for LCD projectors, it must be assumed that already existing solutions to similar problems in closely related technical fields would naturally be taken into account. This means that if there is an optical problem in the context of a specific image projection apparatus which apart from the image generating medium has close similarities to conventional film and slide projection devices, a skilled person would readily look for solutions to the same problem in the more general projection apparatus field. If in the present case - in accordance with the appellant's assertions - the skilled person were a designer responsible for the overall LCD projector, then the Board is convinced that such an expert must at least have a basic knowledge of the existing general illumination and projection optics, and moreover would contact an optical expert in case of particular problems, i.e. the designer would either know himself the available optical alternatives in the field of image projection or be replaced by an optical engineer. In both cases, the skilled person to be considered under the present circumstances would be competent in illumination optics.

4.4 Proof of inventive step

It was not contested by the appellant that the claimed condenser system as defined by the different technical features specified in item 4.1 above is *per se* well-known in the field of image projection technology, see e.g. document D1, column 1, lines 9 to 40 and Figures 1 and 2 and associated text: first lens plate 5; second lens plate 6 having a number of second lenses equal to the number of first lenses; third lens 7; rectangular object 8. This document also deals with the requirement

of reduced angular spread of the incident light which is particularly important for the illumination of LCD panels (see e.g. D17, Figure 17 and associated text or D10, column 1, lines 8 to 27 and column 2, lines 9 to 24). The differences between the present application and D1 referred to by the applicant in this context are not relevant since they do not form part of the subject matter of claim 1.

Similar condenser lens systems are described in documents D2 (see Figure 1), D4 (see Figure 1: integrated first and second lens plates 40; third lens 50), D5 (see Figures 2 to 4), D6 (see Figures 11 to 15) and D7 (see Figure 6.7).

Therefore, the crucial question in the present case is whether a skilled person **would** apply the known condenser design in an LCD projector to solve the intensity and uniformity problem existing with respect to the closest prior art.

Since these well-known condenser systems clearly serve the purpose of optimising the illumination uniformity in high brightness projections (see D1, column 1, lines 15 to 23; D2, page 2, left-hand column, lines 4 to 46; D6, page 1, left-hand column, lines 35 to 38; and D7, page 116, left-hand column, last paragraph to right-hand column, first paragraph), there appears to be a strong *prima facie* incentive for a person competent in condenser optics to make use of these prior art solutions in the specific LCD projector case as well.

The appellant's counterargument is mainly based on the following allegations as to why a skilled person would

not utilise the known condenser systems for LCD projection:

- (i) It would not be obvious for an expert on LCD projectors to look at film projectors because the technique of LCD projection has developed independently from film projection.
- (ii) It is not obvious to replace the illumination concept of D17 by a completely different concept.
- (iii) Alternative solutions already exist in the LCD projection field so that consideration of solutions which have been exclusively provided for film projection, would be less probable.
- (iv) The appellant's important achievement has been recognised in the world of LCD projector manufacturers.

As has already been pointed out above (see item 4.3), the Board is, however, not convinced that an LCD designer would not take account of optical solutions in the general image projection field, which clearly meet identical requirements with respect to condenser design, which are common to various types of image projection devices. That there is a direct link to slide film projection based on far-reaching similarity of the overall design is also confirmed by document D17 (see column 1, lines 43 to 51).

Moreover, even if argument (i) were accepted, application of the known condenser design cannot be said to be limited to the film projection field.

Document D1 relates to light projection systems in general without specifying the object to be projected (see column 1, lines 9 to 14). Document D4 suggests the use of a lens system similar to that of D1 for lithographic projection, photochemical vapour deposition and laser annealing (see column 1, lines 12 to 31), and document D7 which is a standard textbook does not relate to image projection at all but to uniform illumination of an aperture (see Figure 6.7 and associated text). Therefore, the claimed condenser design must be considered to be also known outside the film projection field as general condenser solution combining high illumination intensity with high illumination uniformity, and thus would be available to an optical practitioner in a straightforward way.

As regards arguments (ii) and (iii), from document D17 a further need for improvement can be easily derived since the solution proposed in the closest prior art is certainly not perfect. In general, an improvement can be reached by modifying or replacing an existing concept. Therefore, in the Board's view a skilled person would not be barred by an inferior existing solution to try different concepts, nor would the skilled person be barred by existing alternative solutions to look for further alternatives which - on the contrary - would be quite a routine task.

Finally, the professional recognition as expressed by technically related applications of competitors and license requests (argument (iv)) does not seem to be persuasive since it may be based on the conviction of non-patentability of the basic principle claimed in the present application and on merely commercial considerations, respectively.

In consequence, the Board comes to the conclusion that the subject matter of claim 1 does not involve the inventive step required by Article 56 EPC, and claim 1 is not allowable for this reason.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:

The Chairman:

E. Görgmaier

E. Turrini