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Bezeichnung der Erfindung: Electro-optical display device provided with
Title of invention: fiber optic light trap
Titre de l'invention :

Klassifikation / Classification / Classement : G02F1/133, G02B5/17, G02F1/135

ENTSCHEIDUNG / DECISION

vom / of / du 28 January 1987

Anmelder / Applicant / Demandeur : Hughes Aircraft Company

Patentinhaber / Proprietor of the patent /
Titulaire du brevet :

Einsprechender / Opponent / Opposant :

Stichwort / Headword / Référence :

EPÜ / EPC / CBE

Articles 54(1), 56, 84

Kennwort / Keyword / Mot clé :

"Novelty" (Yes)
"Inventive step" (Yes)
"Inconsistency between the description and the claims" (No)

Leitsatz / Headnote / Sommaire

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Case Number : T 104/84

D E C I S I O N
of the Technical Board of Appeal 3.4.1
of 28 January 1987

Appellant : Hughes Aircraft Company
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Culver City, California 90009 (US)

Representative : Andrew B. Crawford
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Decision under appeal : **Decision of Examining Division 040 of the European Patent Office dated 14.12.1983 refusing European patent application No. 81 300 233.4 pursuant to Article 97(1) EPC**

Composition of the Board :

Chairman : K. Lederer
Member : E. Turrini
Member : P. Ford

Summary of facts and submissions

I. The European patent application No. 81 300 233.4 filed on 20 January 1981 (publication number 0 036 242) was refused by the decision of the Examining Division 040 of the European Patent Office dated 15 December 1983.

This decision was based on Claims 1 to 6 filed with letter of 17 June 1983.

The reason given for the refusal was that in view of the prior art document US-A-4 017 157, the subject-matter of Claim 1 was not novel within the meaning of Article 54(1) EPC and the claim was thus not allowable under Article 52(1) EPC.

II. On 24 February 1984 the Appellant lodged an appeal against this decision. The appeal fee was paid and the Statement of Grounds filed in due time. With the Statement of Grounds two subsidiary sets of claims were added to the set of Claims 1 to 6 on file which was to be considered as the main set of claims.

III. The Appellant argued that US-A-4 017 157, contrary to the invention, does not utilise a specularly reflecting display surface. Thus according to the Appellant, while the present invention teaches a predetermined angular relationship between the axis of the optical fibers and the specularly reflecting display surface (the angular relationship must be such that light entering the front surface of the faceplate and passing through it is reflected back to the faceplate outside the angular acceptance range of the optical fibers), US-A-4 017 157

teaches a predetermined angular relationship between the direction of the ambient light and the front surface of the faceplate, (the ambient light must be incident on the front surface at an angle outside of the angular acceptance range of the optical fibers).

IV. Following an exchange of communications and answers, the Appellant is now requesting that the decision of the Examining Division be set aside and a European patent granted on the basis of Claims 1 to 6 (main request) received on 17 December 1986.

V. Claim 1 reads as follows:

"1. An electro-optical display device comprising an electro-optical display panel (10) for selectively providing randomly directed light, the display panel including a specularly reflecting display surface arranged to reflect light toward a viewer, said display device also comprising a fiber face-plate (14) having a front surface (24) placed in the viewer's line of sight and a back surface (26) disposed adjacent the display panel (10), the faceplate (14) having a plurality of parallel optical fibers slanted at an angle to the specularly reflecting display surface so that light which enters the front surface and passes directly through the faceplate (14) and is then reflected by the specularly reflecting display surface back to the faceplate (14) is, in absence of scattering, directed outside of the angular acceptance range of the optical fibers while a substantial portion of the randomly directed light provided by the display panel (10) is directed toward the faceplate (14) within the angular acceptance range of the optical fibers and is therefore transmitted through the faceplate to the viewer, characterized in that the

specularly reflecting display surface is flat and parallel to the back surface (26) and in that an optically absorbing material (38) is positioned between the optical fibers so that the said light reflected to the faceplate is trapped within the faceplate by absorption."

Claims 2 to 6 are dependent on Claim 1.

The auxiliary requests based on set A of Claims 1 to 4 and set B of Claims 1 to 5 received on 5 June 1985 still stand.

Reasons for the Decision

1. The appeal complies with Articles 106 to 108 and Rule 64 EPC and is, therefore, admissible.

2. There is no objection to the current version of claims, description and drawings as far as Article 123(2) EPC is concerned, since they are adequately supported by the original disclosure.

In particular, the cancellation of "all" in the expression "all light" (page 7, line 29 of the original description) is supported by the wording of Claim 1 as originally filed.

3. There is no inconsistency between the description and the claims. The Examining Division referring in its Decision to the embodiments of figures 3 and 5 of the present invention relative to active light emitting display, argues that the light is only shown to be reflected on the front face of the display panel, between the display panel and the fiber faceplate and said front face cannot be a specularly reflecting surface, because this would impede the observation of the display. However as well known in the art and as also

stressed by the Appellant in his Statement of Grounds, in the displays of the type of the aforementioned embodiments the index of refraction of the material of the front face of the display panel is normally chosen in such a way that the amount of internally generated light that will escape the display is maximised. This choice of the refraction index indeed simultaneously increases the reflectivity of the front face of the panel with regard to externally generated ambient light. Thus Claim 1 which discloses a display panel including a specularly reflecting display surface covers the above mentioned embodiments.

4. Novelty

4.1 US-A-3 891 309

(Column 1 "Background of the invention"; column 2 "Summary of the invention"; figure 1 and corresponding description) discloses an electro-optical display device which includes the features of the preamble of claim 1 (display panel 12 to 20; specularly reflecting display surface 14; fiber faceplate 21 with front 23 and back 22 surfaces). It is pointed out that, although this document does not explicitly mention the "angular acceptance range", the optical fibers have by definition an angular acceptance range and the reflecting surface is slanted at an angle to the axes of the optical fibers so that light reflected by the reflecting surface and not scattered is directed outside of the angular acceptance range of the fibers so as to avoid reflection in the fibers (reference 27).

However, in this document, contrary to the present invention, the specularly reflecting display surface is not flat and is constructed of several facets (12) which are slanted with respect to the back surface of the faceplate, the axes of the optical fibers are

perpendicular to the back surface and there is no optically absorbing material positioned between the optical fibers (beams of light 27 transversing obliquely the optical fibers and description, column 4, lines 4 to 6).

4.2 US-A-4 017 157

(Columns 1 to 4 of the description; figures 10 and 17 and the corresponding description) refers to an electro-optical display device comprising an electro-optical display panel (21, 24, 25 and 29) for selectively providing randomly directed light and a fiber faceplate (88) having a front surface (116) placed in the viewer's line of sight and a back surface disposed adjacent the display panel, the faceplate having a plurality of parallel optical fibers (89) which are slanted at an angle to the back surface. An optically absorbing material (71) is positioned between the optical fibers so that light directed outside of the angular acceptance range is trapped within the faceplate by absorption (column 12, lines 35 and 36), while a substantial portion of the randomly directed light provided by the display panel is directed towards the faceplace within the angular acceptance range of the optical fibers and is therefore transmitted through the faceplate to the viewer.

However, in this document, contrary to the present invention, "a specularly reflecting display surface arranged to reflect light towards a viewer" is not present and the slant angle is chosen in such a way that the light beam (26a) perpendicular to the back surface of the faceplate is directed outside of the angular acceptance range of the optical fibers.

Indeed, it is pointed out that this document does not mention any specularly reflecting display surface and that the reference at column 4, lines 35 to 37, contrary to the opinion of the Examining Division in its decision, is not considered to support the existence of a reflecting surface included in the display panel.

It is true that, as stressed by the Examining Division in its decision, the device of this document includes layers of different materials, this however does not tell anything about the presence of a specularly reflecting display surface, because there is no indication concerning a step of refractive index between two layers. As emphasized by the Appellant in his Statement of Grounds, it is more likely that the materials would be chosen to minimize any reflection from the interfaces between the layers, in order to improve the desired transmissive mode of operation.

4.3 The other cited documents of the prior art are not relevant with respect to the present invention.

4.4 For the above reasons the subject-matter of Claim 1 is deemed to be novel within the meaning of Article 54 EPC.

5. Inventive step

5.1 Claim 1 is based on US-A-3 851 309, which is in the Board's opinion the nearest prior art. Starting from the disclosure of this document, the problem underlying the present invention is to simplify the device construction, whilst reducing unwanted specular reflections (in the absence of scattering) by the reflecting display surface back to the viewer.

Said problem is solved by rendering the specularly reflecting display surface flat and parallel to the back surface of the faceplate and by positioning an optically absorbing material between the optical fibers as set out in the characterising portion of Claim 1.

5.2 The identification of the problem is per se not inventive, since the general addressee would as a matter of course try to simplify the construction of the device and improve its performances.

5.3 As far as the solution to this problem is concerned, the skilled man in the art could try, prima facie, to avoid the complex multifacet construction of the reflecting surface by proposing a solution in which the reflecting surface is flat and parallel to the back surface of the faceplate and the slant angle between the optical fiber axes and the reflecting surface is obtained by slanting the optical fibers to the reflecting surface. However, this solution is not fully equivalent to that proposed by US-A-3 851 309, because the viewer placed in front of the faceplate sees the fibers from a different sight angle. The skilled man would therefore be discouraged to go that way.

US-A-4 017 157, despite the disposition of the optical fibers slanted with respect to the back surface of the faceplate, could not help the skilled man, because it deals with another category of devices, namely those without a specularly reflecting display surface arranged to reflect light towards a viewer.

Thus the skilled man could not utilise the suggestions of US-A-4 017 157 concerning the slant angle for the device disclosed in US-A-3 891 309.

Moreover, the skilled man should solve the aspect of the technical problem concerning the reduction of unwanted specular reflections. The solution of positioning an optically absorbing material between the optical fibers is known from US-A-4 017 157 (figure 10), but not directly related to the reduction of unwanted specular reflections.

Thus, the teaching of US-A-3 891 309 plus the measure of the optically absorbing material known from US-A-4 017 157 would not lead the skilled man to the subject-matter of Claim 1.

5.4 For the above reasons the subject-matter of Claim 1, which is novel, is also considered to involve an inventive step within the meaning of Article 56 EPC. Claim 1 is therefore allowable under Article 52(1) EPC.

5.5 Claims 2 to 6 relate to particular embodiments of the invention. They are therefore allowable as dependent claims in agreement with Rule 29(3) EPC.

5.6 Under these circumstances, the auxiliary requests do not have to be considered.

Order

For these reasons, it is decided that:

1. The decision of the Examining Division dated 15 December 1983 is set aside.

2. The case is remitted to the first instance with the order to grant a European patent on the basis of the following documents:

2.1 Description:

- pages 11 and 12 as originally filed with page 12 amended as suggested in the letter received on 3 January 1983;

- pages 1 to 3 received on 3 January 1983 with the following amendment: page 3, line 14 "viewers" is replaced by "viewer's";

- page 5, 8 to 10 and 13 received on 5 June 1986 with the following amendments: page 5, line 20, insert after "schematic" the word "view"; page 8, line 31, change the position of the round bracket in equation (3) so as to be identical with that in equation (4) on page 9;

- pages 4, 4a, 4b, 6 and 7 received on 17 December 1986 with the following amendment: page 7, line 30 "all light" is replaced by "light":

2.2 Claims:

Nos. 1 to 6 received on 17 December 1986.

2.3 Drawings:

- Figures 2 and 3 received on 5 June 1986;
- Figures 1, 4 and 5 received on 17 December 1986.

The Registrar: The Chairman:

Rückerl Lederer

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