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File No.: T 0361/92 - 3.4.2
Application No.: 86 901 574.3
Publication No.: 0 215 839
Classification: G03H 1/18, G03C 1/66
Title of invention: Efficient Holograms and method for making same

D E C I S I O N
of 20 September 1993

Applicant: Hughes Aircraft Company

Headword: Hologram/Hughes Aircraft

EPC: Art. 54(1) to (4); 56

Keyword: "Novelty and inventive step (yes, after limitation)"

Headnote
Catchwords



Case Number: T 0361/92 - 3.4.2

D E C I S I O N
of the Technical Board of Appeal 3.4.2
of 20 September 1993

Appellant:

Hughes Aircraft Company
7200 Hughes Terrace
P.O. Box 45066
Los Angeles, California 90045-0066 (US)

Representative:

Colgan, Stephen James
CARPMAELS & RANSFORD
43 Bloomsbury Square
London WC1A 2RA (GB)

Decision under appeal:

Decision of the Examining Division of the
European Patent Office dated 17 September 1991
posted on 29 November 1991 refusing European
patent application No. 86 901 574.3 pursuant to
Article 97(1) EPC.

Composition of the Board:

Chairman: E. Turrini
Members: R. Zottmann
L.C. Mancini

Summary of Facts and Submissions

- I. European patent application No. 86 901 574.3 with publication No. 0 215 839 was refused by decision of the Examining Division.

The reason given for the refusal was that no inventive step could be seen in the subject-matters of the independent claims, having regard to

- A1 = an English translation of
- A = JP-A-57-190 984 (said translation) filed with the letter dated 26 November 1990,
- A2 = the abstract of A: The Patent Abstracts of Japan (JP-A-57 190 984), Vol. 7, No. 38, page 76, February 1983

and the general knowledge of the skilled person.

- II. The following further documents were cited during the appeal proceedings:

- B = J. V. Drazil: quantities and units of measurement, a dictionary and handbook; London: Mansell; Wiesbaden: Brandstetter; 1983; pages 197, 199, 202, 227 and 228;
- C = EP-A-207 156 (corresponds to WO-A-8 603 852);
- D = EP-A-207 992 (corresponds to WO-A-8 803 853).

III. The Appellant (Applicant) lodged an appeal against said decision.

IV. In a communication pursuant to Article 110(2) EPC the Board expressed its preliminary opinion that the application did not meet the provisions of the EPC and informed the Appellant by which amendments the existing deficiencies could be removed.

V. To meet these objections, the Appellant filed amended claims and a correspondingly adapted description.

VI. The Appellant requested that the decision under appeal be set aside and that a patent be granted on the basis of the following documents:

Claims: Nos. 1 to 5 as filed with letter of 25 August 1993;

description: pages 1 to 3, 7 to 9, 11 and 12 as originally filed, pages 5, 6 and 10 as filed with the letter dated 25 August 1993 and pages 4 and 5a as filed with the letter dated 29 June 1989;

drawings: sheets 1/2 and 2/2 as originally filed.

VII. Claim 1 according to the Appellant's request reads as follows:

"1. A method of making a hologram (38) comprising:

exposing a single layer (40) of photoreactive gelatin applied to a surface (46) of a substrate (42) to coherent light (48, 50) to record a slant fringe pattern (52) therein,

causing said layer to swell to emphasize the recorded fringe pattern,

exposing the surface region of said layer (40) adjacent the substrate to incoherent light (44) absorbed in said region before the step of causing said layer to swell,

characterized in that

said incoherent light has a wavelength between 200 and 500 nm, is highly absorbed in the photoreactive gelatin layer and causes radiant exposure within a range of 70 to 420 mJ/cm², such that the fringe contrast decreases through said region approaching zero in a thin layer adjacent said surface (46) of the substrate (42)."

VIII. Arguments particularly supporting the request to grant a patent on the basis of the documents as cited in VI. above were not submitted by the Appellant. However, mainly the following argument put forward in the Statement of Grounds of Appeal seems to support also said request:

Document A1/A2 seems to teach away a skilled person from the method of the application-in-suit. The aim and the effect of the method described there is to harden deep portions, that is portions adjacent the substrate, to ensure that the relatively soft medium is hardened throughout to prevent "white cloudiness" in said portions. The relatively large amount of irradiation employed in A1 is needed to ensure that said portions of the soft gelatin are hardened thoroughly whereas the invention uses a much lower irradiation which is not intended to substantially harden the medium as in A1.

Reasons for the Decision

1. The appeal is admissible.
2. *Allowability of the amendments of the documents*

The Board finds that all features of the claims can be identified in the originally filed documents and that the amendments of the description do not introduce subject-matter not disclosed in the originally filed documents. As to the amendments of optical quantities, reference is made to paragraph 3.1 below.

There is therefore no objection under Article 123(2) EPC.

3. *Novelty according to Article 54 paragraphs 1 to 4 EPC*

- 3.1 A method of making a hologram in accordance with the preamble of Claim 1 is known from A1/A. Following the exposure to coherent light to record a slant fringe pattern, the photoreactive gelatin (dichromatic acid gelatin (DCG)) is irradiated preferably with UV light to harden the gelatin at the region touching close a transparent substrate.

Apparently, the passage " ... and then the ultraviolet rays are irradiated with 200mw/cm² luminous intensity of the light source and for 2-5min ... " of A and the sentence bridging pages 6 and 7 of A1 ("With an illuminance of 200 mW/cm², the irradiation time is preferably about 2 - 5 minutes.") mean that the rear side of the DCG is irradiated with an irradiance of 200 mW/cm² and exposed to a radiant exposure of preferably about 24,000 to 60,000 mW/cm².

First, the terms "irradiated" and "illumination" indicate that the cited units characterize the light **impinging** on the DCG and not the light emitting from the light source. The quantity "illumination" was formerly used for the photometric quantity "illuminance" (SI unit: $lx = cd \cdot sr \cdot /m^2$) and characterised the light **impinging** on an area. Second, the only units which are important for the described method are units which indicate the light impinging on the light sensitive medium DCG whereas the quantities characterizing the light emitting from the light source are unimportant, unless further data which would permit calculation of the quantities characterising the light impinging on the DCG were disclosed at the same place. Third, since the units used in A1/A2 are radiation units but not photometric units and since in the described method only radiation quantities are adequate, the correct (radiation) quantity is **irradiance** and not "luminous intensity" or "illumination". For example, reference is made to B where the relevant quantities and units are disclosed.

Similarly, it was correct (under Rule 88 EPC) to replace "illumination" on page 10 of the description of the application-in-suit by "radiant exposure" and, as a consequence, to use the latter quantity in Claim 1.

In the example described in the paragraph bridging pages 8 and 9 of A1, the coated glass plate is irradiated with light from the glass plate side in a location that was 20 cm below a 20 W fluorescent lamp. However, neither the type of the fluorescent lamp nor the period of irradiation and thus the radiant exposure is disclosed there. Since the only relevant clear, quantitative teaching of this radiant exposure (about 24,000 to 60,000 mW/cm^2 ; period of irradiation: 2 to 5 min.) is contained in the paragraph bridging pages 6 and

7 (and A2), it is clear for the skilled person that only such a radiant exposure should be used. This means that the period of irradiation in the example should be chosen accordingly but not that said irradiation period of 2 to 5 minutes (mentioned on pages 6/7) should be used in the example (described on page 8 paragraph 3 to page 9 paragraph 2) which would lead to a much lower radiant exposure.

Thus, the radiant exposure as disclosed in the characterising part of Claim 1 (70 to 420 mJ/cm²) and in A/A1/A2 (24 000 to 60 000 mJ/cm²) are quite different and, as a consequence and due the high absorbance of the incoherent light in the photoreactive gelatin layer, the fringe contrast will become zero at least in the whole surface region adjacent the substrate when irradiated according to A1/A2 but will not decrease through said region approaching zero in a thin layer adjacent the substrate as according to Claim 1.

3.2 The remaining documents of the Search Report published before the priority date of the application-in-suit are much less relevant since none of them discloses a method step similar to the step of Claim 1 where only the surface region adjacent the substrate is exposed to incoherent light.

3.3 C and D represent prior art under Article 54(3)(4) EPC. These documents describe methods of recording a hologram by reducing the sensitivity at opposed surface regions of the medium such that the hologram has a high refractive index modulation at the centre of the layer and decreasing towards the surfaces of the layer.

3.4 To summarise, the subject-matter of Claim 1 is novel in the sense of Article 54 paragraphs 1 to 4 of the EPC with respect to the prior art on file.

4. *Inventive step*

4.1 It is undisputed that the nearest prior art with respect to the subject-matter of the application is described in A/A1/A2 (see also paragraph 3 above).

4.2 This prior art differs from Claim 1 of the application-in-suit above all in that the radiant exposure of the surface region of the photoreactive layer adjacent the substrate is much - at least 57 times higher. As disclosed in A1, such a high exposure seems to be necessary to avoid "white cloudiness" in said region due to insufficient hardening.

This difference has the effect that the diffraction efficiency of the hologram made with the method of Claim 1 is increased - probably due to the suppression of the fringes in a small region where the fringes are distorted or remain closer together during swelling owing to an anchoring of said region to the substrate.

4.3 The objective problem underlying the invention according to Claim 1 is therefore to improve the method of A/A1/A2 in such a manner that the above-mentioned effect is obtained.

The Board finds that the definition of said problem is *per se* obvious for the person skilled in the art of manufacturing holograms and thus cannot contribute to inventive step.

- 4.4 However, the solution according to Claim 1 is not considered as being obvious.

In order to arrive at said solution when starting from said nearest prior art the skilled person has to change an essential feature of the method of manufacturing a hologram: he has to reduce by a factor of at least 57 the radiant exposure of the photoreactive layer by incoherent light and, moreover, he has to realise the other measures disclosed in the characterising part of Claim 1 (high absorption in said layer and particular fringe contrast change through the region adjacent the substrate). There can be seen no suggestion for such a high reduction of the radiant exposure of the known method in A/A1/A2. On the contrary, the skilled person, when taking into consideration this prior art, would expect that such changes of the known method would lead to a hologram with "white cloudiness" and thus to a hologram of very poor quality.

The remaining documents of the Search Report published before the priority date of the application-in-suit cannot hint at the solution just as little since none of them discloses a method step similar to the step of Claim 1 where the surface region adjacent the substrate is exposed to incoherent light.

- 4.5 Therefore, the subject-matter of Claim 1 involves an inventive step as defined in Article 56 EPC, and consequently said claim is allowable (Article 52(1) EPC).
5. Dependent Claims 2 to 5 concern particular embodiments of the method of Claim 1 and are, therefore, likewise allowable (Article 52(1) EPC).

6. In the result, the Board takes the view that the claims comply with the requirements of the EPC. Since this applies also to the other documents of the application, a patent can be granted on the basis of the documents according to paragraph VI above.

Order

For these reasons, it is decided that:

1. The decision under appeal be set aside.
2. The case is remitted to the first instance with the order to grant a patent on the basis of the following application documents as agreed by the Board;

Claims: Nos. 1 to 5 as filed with letter of 25 August 1993;

description: pages 1 to 3, 7 to 9, 11 and 12 as originally filed, pages 5, 6 and 10 as filed with the letter dated 25 August 1993 and pages 4 and 5a as filed with the letter dated 29 June 1989;

drawings: sheets 1/2 and 2/2 as originally filed.

The Registrar:

The Chairman:

P. Martorana

E. Turrini