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File Number: T 100/91 - 3.4.2

Application No.: 84 110 537.2

Publication No.: 0 138 026

Title of invention: Phase retardation element and prism for use in an optical data storage system

Classification: G02B 5/30

D E C I S I O N
of 7 December 1992

Applicant: International Business Machines Corporation

Headword:

EPC Articles 56 and 123(2) EPC

Keyword: "Main request: feature in Claim 1 - not originally disclosed"
"Auxiliary request: inventive step (no)"



Case Number : T 100/91 - 3.4.2

D E C I S I O N
of the Technical Board of Appeal 3.4.2
of 7 December 1992

Appellant : International Business Machines Corporation
Old Orchard Road
Armonk, NY 10504 (US)

Representative : Vekemans, André
Compagnie IBM France
Département de Propriété Intellectuelle
F - 06610 La Gaude (FR)

Decision under appeal : Decision of the Examining Division of the
European Patent Office dated 24 September 1990
refusing European patent application
No. 84 110 537.2 pursuant to Article 97(1) EPC.

Composition of the Board :

Chairman : W.W.G. Hofmann
Members : R. Zottmann
L.C. Mancini

Summary of Facts and Submissions

I. European patent application No. 84 110 537.2 (publication No. 0 138 026) was refused by decision of the Examining Division.

II. The reason given for the refusal was that Claim 1 contained subject-matter extending beyond the content of the application as filed in the sense of Article 123(2) EPC. The Examining Division held in particular that the reference in Claim 1 to a wavelength range of 0.74 μm to 0.98 μm had no support in the application as originally filed.

Moreover, the Examining Division stated in its decision that even if the objections under Article 123(2) EPC were overcome, which could be done by deleting the specified wavelength range, no inventive step could be seen in the subject-matter of Claim 1, having regard to the documents

(D1) US-A-2 409 407 and

(D3) US-A-4 312 570.

No objections were raised with regard to independent Claim 4.

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

IV. Together with the summons to oral proceedings which had been requested by the Appellant, the Board sent a communication in which it expressed its provisional view that Claim 1 contravened Article 123(2) EPC and that the subject-matter of independent Claim 4 lacked an inventive step in the sense of Article 56 EPC, having regard to D1

and

(D6) EP-A-0 088 671 (cited during the examination procedure).

V. Oral proceedings were held at the end of which the Appellant requested that the decision under appeal be set aside and that a patent be granted on the basis of

the main request: Claims 1 to 3 received on 7 August 1990 and Claims 4 to 9 received on 29 November 1989, and

the subsidiary request: Claims 1 to 6 submitted at the oral proceedings.

VI. Independent Claims 1 and 4 according to the main request read as follows:

"1. An optical element for producing a phase difference of 90° between two perpendicular polarized components of a beam of radiation, internally reflected in said element, characterized in that it comprises:

an optical member formed of a material capable of supporting the propagation of a beam of radiation having a wavelength within a wavelength range extending from 0.74 μm to 0.98 μm ;

a plane surface portion of said element;

a plurality of thin film coatings of dielectric materials layered on said plane surface portion;

said thin film coatings being of materials and thicknesses to produce throughout said wavelength

range a substantially constant phase difference of 90° between two perpendicular polarized components of said beam of radiation when said beam is internally reflected at said plane surface portion."

- "4. An optical data storage system having a source producing a polarized coherent beam (3) of radiation, an information storage medium (8), radiation detection means and an optical system comprising an objective lens (7) for focusing said beam of radiation onto said storage medium and for focusing the portion of said beam reflected by said storage medium onto said radiation detection means comprising;

a collimating lens (2) for collimating said beam of radiation,

a first prism (4) having an entrance face cut at an angle to convert an incident beam of elliptical cross section to an internal beam of circular cross section, and

a polarizing beam splitter (5),

characterized in that a second prism (10) having a plane surface portion for internally reflecting the light beam at an oblique angle is positioned between the beam splitter and the storage medium, said plane surface having a thin film coating structure (11) and said thin film coating structure being of materials and thicknesses to produce a phase difference of 90° between the incident and reflected portions of two perpendicular polarized components of the beam of radiation incident on said surface, and in that the radiation detecting means is detecting the portion of

said beam which after reflection by said storage medium is reflected a second time by said plane surface of said second prism."

Claims 2, 3 and 5 to 9 are respectively dependent on Claims 1 and 4.

Claim 1 according to the subsidiary request corresponds to Claim 4 according the main request, with the only exception that the reference number "(19)" has been inserted after "radiation detection means".

Claims 2 to 6 are dependent on Claim 1.

VII. The essential arguments presented by the Appellant were as follows:

The original disclosure of the feature "having a wavelength within a wavelength range extending from 0.74 μm to 0.98 μm ", which is only a feature limiting the scope of the claim, is based on the text of page 5, third paragraph, and Figure 5 in both of which the obvious error in the definition of the wavenumber has to be corrected to read " λ / λ_0 ". It is clear that the reference wavelength λ_0 has to be taken as that of a semiconductor laser (page 3, line 27 of the original description), and in particular as the centre design wavelength of 0.82 μm of a GaAs laser in accordance with the article of Robert A. Bartolini, cited on page 3, lines 25 to 27. If 0.82 μm is used as the reference wavelength λ_0 , the disclosed range of 0.9 to 1.2 for the wavenumbers corresponds to the wavelength range of 0.74 to 0.98 μm now contained in Claim 1.

The optical data storage system according to Claim 1 of the subsidiary request is distinguished from the system

disclosed in D6 by the fact that the phase difference of 90° between the two perpendicularly polarised components of the beam of radiation is not produced by a quarter wave plate, but by a thin film coating structure on a plane surface of a second prism, on which surface the beam of radiation is internally reflected at an oblique angle. Combining the teaching of D6 with that of D3 would not lead to the invention since according to D3 the radiation is not internally, but externally reflected and the coating materials are chosen for transmitting light of much longer wavelength than is used according to the invention. A combination of D6 with D1 would not be obvious since D1 does not indicate that a multilayer coating could be used for obtaining a 90° phase difference in a system as the one according to D6.

Reasons for the Decision

1. The appeal is admissible.
2. Main request
 - 2.1 Claim 1 according to this request contains the feature - added during the examination procedure - that the material of the optical member is capable of supporting the propagation of a beam of radiation "having a wavelength within a wavelength range extending from 0.74 μm to 0.98 μm " and that said thin film coatings are of materials and thicknesses to produce "throughout said wavelength range" a substantially constant phase difference of 90° between two perpendicularly polarised beam components. The fact that this wavelength range is not explicitly disclosed in the original application, is not contested by the Appellant. However, the Appellant sees an implicit

disclosure, primarily based on Figure 5 of the drawings and the third paragraph of page 5 referring to said figure.

It is true that these two sources of disclosure taken together disclose a certain range of relative "wavenumbers", from 0.9 to 1.2 (page 5, line 20), within which (for a three-layer coating with layers each having specific values of relative thickness d/λ and refractive index, for an optical member with a refractive index of 1.509, and for an angle of incidence of 45°) the phase difference is substantially 90° . However, the transformation of these relative values of 0.9 and 1.2 into the absolute wavelengths $0.74 \mu\text{m}$ and $0.98 \mu\text{m}$ would require that disclosure regarding the following two assumptions could be unambiguously derived from the original application:

- (a) According to the Appellant, the reference wavelength λ_0 must be chosen to be $0.82 \mu\text{m}$. This value is nowhere mentioned in the application. A GaAs laser is mentioned on page 1, line 25, but with reference only to prior art optical data storage systems, and there is no indication that this specific laser is to be used in the invention as claimed. Moreover, the emission wavelength of a GaAs laser is not necessarily $0.82 \mu\text{m}$.

The fact that a semiconductor laser is used, is mentioned on page 3, line 27, but again only with reference to prior art devices. Moreover, the emission of the various types of semiconductor lasers covers an undefined range of wavelengths.

The Appellant argues that the content of the article of Robert A. Bartolini, cited on page 3, lines 25 to

27 of the original application, is incorporated in the present application by reference, and that the only semiconductor laser used according to this article is an AlGaAs laser emitting a wavelength of 0.82 μm . However, this article is again only cited in context with optical data storage systems according to the prior art, and no indication is given that it is specifically the laser according to this document that should be used in the present invention. Moreover, in the absence of any specific reference in the application to particular features described in the cited document, not every detail mentioned therein can automatically be assumed to be incorporated in the disclosure of the application.

Thus, no unambiguous implicit disclosure of a reference wavelength of 0.82 μm can be found in the application as filed.

- (b) Even assuming a reference wavelength λ_0 of 0.82 μm , the calculation of the wavelengths corresponding to the "wavenumbers" 0.9 and 1.2 based on the information given on page 5, lines 19 and 20 of the application, would not lead to the wavelength values inserted into Claim 1. The further assumption would be required that, according to the argumentation of the Appellant, the definition of the "wavenumbers" as disclosed on page 5, lines 19 and 20 of the application is wrong and should actually be the reciprocal of the term " λ_0/λ ". (The definition given in Figure 5 does not help since " λ_0/λ_0 " is an obvious error.)

However, there is not the slightest indication in the original application that " λ_0/λ " should be wrong. On the contrary, the description of this term as

(relative) wavenumber agrees well with the fact that wavenumbers are the reciprocal of wavelengths.

Thus, neither one of the assumptions (a) and (b) is supported by the original disclosure of the application.

- 2.2 Since the wavelength range of 0.74 μm to 0.98 μm inserted into Claim 1 is not disclosed in the original application, the present application contains subject-matter which extends beyond the content of the application as filed in the sense of Article 123(2) EPC. Claim 1 is therefore not allowable.

Since Claim 1 is not allowable, the main request of the Appellant has to be refused.

3. Subsidiary request

- 3.1 Claim 1 according to this request corresponds to Claim 4 of the main request. It does not contain the above-mentioned wavelength range. All of the features of this claim are disclosed in the application as filed. Therefore, no objection arises under Article 123(2) EPC.

3.2 Novelty

- 3.2.1 D6 (cf. in particular Figure 4 and corresponding text) discloses an optical data storage system having all the features according to the pre-characterising part of Claim 1, in particular a source of a polarised coherent beam of radiation, an information storage medium, radiation detection means, and an optical system for focusing the beam onto the storage medium and the reflected beam onto the radiation detection means, comprising a collimating lens, a prism to convert the

elliptical cross section of the beam to circular cross section, and a polarising beam splitter. Moreover, the radiation detection means according to D6 detects the portion of the beam which is reflected by the storage medium. Between the beam splitter and the storage medium a quarter wave plate is positioned for producing a phase difference of 90° between two perpendicularly polarised components of the beam.

The subject-matter of Claim 1 is distinguished from this known system by the fact that the 90° phase difference producing element is not a quarter wave plate, but a second prism having a plane surface portion for internally reflecting the light beam at an oblique angle, which plane surface has a thin film coating structure of materials and thicknesses to produce said phase difference.

3.2.2 D1 (cf. in particular Figures 1 to 3; column 3, lines 37 to 48; column 7, lines 21 to 62; column 9, lines 19 to 21 and 37 to 41; column 10, lines 61 to 67; and column 13, lines 37 to 40) describes an optical element for shifting, by a predetermined amount, the phase difference between two perpendicularly polarised components of a beam of radiation. The optical element is a prism having a plane surface portion for internally reflecting the light beam at an oblique angle, and the plane surface has a thin film coating structure. The materials and thicknesses of the coating structures are chosen so that, besides other values, a phase difference of 90° is produced (cf. column 2, lines 33 to 36; column 12, lines 19 to 35; and column 13, lines 60 to 62).

The subject-matter of Claim 1 is distinguished from this known optical element by the application of this element to an optical data storage system as defined in the pre-characterising portion of the claim and the arrangement of

the optical element between the beam splitter and the storage medium.

- 3.2.3 Document D3 cited above does not come closer to the claimed subject-matter.

Therefore, the subject-matter of Claim 1 is novel in the sense of Article 54 EPC.

3.3 Inventive step

- 3.3.1 Starting from the prior art represented by D6 (see point 3.2.1 above), the objective problem solved by the present subject-matter is to be seen in reducing the cost of the assembly and opening up the possibility of obtaining less dependence of the phase retardation on the wavelength of the light beam (cf. page 1, last paragraph and page 5, lines 7 to 11 of the description).

Reducing cost is quite generally always an aim in technics; and it is evident that in view of the fact that the emission wavelengths of semiconductor lasers are not always reproducible, a certain flexibility regarding slight variations of the operation wavelength of the apparatus would be desirable. Therefore, no inventive merit can be seen in recognising the above-mentioned problem.

- 3.3.2 For solving the above-mentioned problem, Claim 1 provides that the quarter wave plate of D6 is replaced by an optical element as is described in D1 (cf. point 3.2.2 above). Since it is clear that thin film coatings on prisms are relatively easy and inexpensive to make, and since D1 indicates that the sensitivity to changes of the wavelength can be reduced in such a prism - film combination (by choosing the desired phase shift at the

maximum or minimum of the curve, cf. column 10, lines 61 to 67, and column 11, lines 1 to 3; which teaching is evidently applicable for each phase shift desired), it was obvious for a person skilled in the art to combine the teachings of D1 with that of D6.

Claim 1 does not clearly specify that the thin film coating structure consists of a plurality of superimposed coatings. However, the precise interpretation of this feature does not matter since the teachings of D1 in any case also comprise the use of multiple films (cf. column 13, lines 37 to 40).

No unexpected effect is achieved by combining the teachings of D6 and D1, or has in fact been claimed by the Appellant. It should be mentioned that Claim 1 does not even contain any features which would guarantee a broad band constant phase shift. This would require the definition of specific values of the refractive indices and of the relative thickness of the film(s) as compared with the wavelength of the light. The fact alone that a thin film coating structure on a prism is used, only opens up the possibility of constructing such an optical element.

- 3.3.3 The Board, therefore, comes to the conclusion that the subject-matter of Claim 1 according to the subsidiary request lacks an inventive step in the sense of Article 56 EPC. Consequently, the subsidiary request is not allowable having regard to Article 52(1) EPC.
- 3.3.4 None of the dependent Claims 2 to 6 forms the subject of a separate request. Therefore, they fall together with Claim 1 of the subsidiary request. Moreover, the Board considers that providing anti-reflection coatings and a suitable arrangement of the beam splitting surface,

according to the additional features contained in these claims, fully lies within the competence of a person skilled in the art and could not therefore be deemed inventive.

- 3.4 Although the decision of the Examining Division was not based on lack of inventive step, this matter (with respect to the claimed optical element as well as to the claimed optical data storage system) has been fully dealt with by the Examining Division in its two communications and its decision. Therefore, even regarding the subsidiary request, the Board saw no necessity to remit the case to the Examining Division for further prosecution.

Order

For these reasons, it is decided that:

The appeal is dismissed.

The Registrar:

The Chairman:

P. Martorana

W. Hofmann