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D E C I S I O N
of 30 March 2000

Case Number: T 0022/00 - 3.4.2

Application Number: 94906681.5

Publication Number: 0682771

IPC: G01B 9/02

Language of the proceedings: EN

Title of invention:
Method of topographically profiling a three-dimensional object surface

Applicant:
ZYGO CORPORATION

Opponent:
-

Headword:
-

Relevant legal provisions:
EPC Art. 56

Keyword:
"Inventive step (yes)"

Decisions cited:
-

Catchword:

Europäisches Patentamt | European Patent Office | Office européen des brevets

Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T 0022/00 - 3.4.2

D E C I S I O N
of the Technical Board of Appeal 3.4.2
of 30 March 2000

Appellant: ZYGO CORPORATION
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Decision under appeal: **Decision of the Examining Division of the European Patent Office posted 9 August 1999 refusing European patent application No. 94 906 681.5 pursuant to Article 97(1) EPC.**

Composition of the Board:

Chairman: E. Turrini
Members: M. A. Rayner
M. Lewenton

Summary of Facts and Submissions

I. The present appeal is against the decision of the examining division to refuse European patent application 94 906 681.5 (EP-A-682 771, International publication number WO-A-94/18521) for lack of inventive step of the subject-matter of claim 1. Reference was made in the decision to the following documents:

D1: Applied Optics, vol. 30, no. 21, 20 July 1991, pages 2975-2979: Danielson et al: "Absolute Optical Ranging using Low Coherence Interferometry"

D2: US-A-5 133 601.

The examining division found that document D1 described a method of determining ranges in a dispersive medium which it considered to be the same as determining a height of a location on a three-dimensional object surface through air which is a dispersive medium. The division saw the subject-matter of claim 1 as differing from the disclosure of document D1 because of it not being clear from figure 1 of document D1 whether the image of a whole array of surface locations of a sample or only single points of the sample are brought into interference on a detector. However, since parallel sampling of interferograms using a detector array, such as a CCD array, is a known principle in methods for determining surface profile, i.e. for topographically profiling a three-dimensional object surface, as is shown for example in column 3, line 54 to column 4, line 20 of document D2, such subject-matter does not involve an inventive step.

II. In its notice of appeal, the appellant (= patent applicant) requested that the decision be set aside and a patent granted. Oral proceedings were requested so far as the board has reservations about setting the decision aside. The appellant requested that amendments to the application documents filed during the appeal proceedings be taken into account in the request for grant of a patent. In support of inventive step, the appellant argued that document D1 is not concerned with an array of surface locations, but the distance between two surfaces and the present application employs a frequency domain analysis for the first time for surface topography measurement. Moreover, the teaching of documents D1 and D2 could not be combined in an obvious way.

III. The wording of claim 1 is as follows:

1. A method of topographically profiling a three-dimensional object surface (3), comprising the steps of for each location of an array of surface locations on said three-dimensional object:

(a) varying an optical path difference between a reference surface (8) and the object surface (3) in an interferometer (1) using an illumination source (4) so as to produce an interferogram on a detector (9) optically aligned with that object surface location;

(b) transforming the interferogram received at the detector (9) into the spatial frequency domain to define transformed interferogram data, wherein said transformed interferogram data represents

relative intensity and interferometric phase of the interferogram as a function of spatial frequency; and

(c) calculating a height of that object surface location using said transformed interferogram data by determining the interferometric phase of the interferogram as a function of wave number using said transformed interferogram data; and

(d) further comprising the step of creating a topographical profile of the object surface (3) using the heights calculated in step (c).

Reasons for the Decision

1. The appeal complies with the provisions mentioned in Rule 65(1) EPC and is therefore admissible.

2. The present application documents derives from subject-matter contained in the International application, for example, claim 1 derives from in claim 16 and page 12 thereof. The board is therefore satisfied that the rquirement of Article 123(2) EPC is satisfied.

3.1 Document D1 relates to determination of range in transparent material being determined from a Fourier analysis of the interferograms arising from surface reflections (see page 2975, left column, lines 27 to 30). A transparent dispersive sample is inserted in a test arm of a Michelson interferometer so that Fresnel reflection from the front surface occurs at the point of equal path difference. A scanning mirror generates a

second interferogram from the back surface and involves radiation propagating a distance z through the sample, introducing a phase shift into the back surface interferogram. A relationship between experimentally derived phase slope and the distance z is provided in equations 7 and 11. Throughout document D1, distance measured is taught to be "z" as can be seen, for example, from the last but one line of the right hand column on page 2976 or the first two lines of IV-B.

However, contrary to the finding of the examining division no method of topographically profiling a three-dimensional object surface is disclosed. In particular, there is no disclosure that air should replace the dispersive sample, the distance through which is measured (see for example the reference to a dispersive sample in line 11 of the left column on page 2976). The method according to present claim 1 also, as established by the examining division, differs from the disclosure of document D1 by the method steps being used for each location of an array of surface locations on said three-dimensional object.

3.2 Document D2 discloses a rough surface profiler. An interferometer is used employing a solid state imaging array (see column 3, line 54 to column 4, line 20). Most recently computed modulation for each pixel on incremental movement is compared with a stored prior value of modulation for that pixel and if greater replaces the prior value. Maximum contrast for each pixel can be so determined (see for example column 5, lines 48-66). Ways of improving resolution including phase shifting and amplitude demodulation (see for example column 7, lines 7-14) are disclosed. The

subject-matter of claim 1 differs from this disclosure through transforming the interferogram received at the detector into the spatial frequency domain to define transformed interferogram data representing relative intensity and interferometric phase and using the transformed interferogram data by determining the interferometric phase of the interferogram as a function of wave number.

3.3 The subject-matter of claim 1 is therefore new with respect to document D1 or D2.

4.1 If document D1 is considered closest prior art, to reach the subject-matter of claim 1, the skilled person would have had to make the jump from determining an essentially one dimensional distance z through a dispersive sample to topographically profiling a three-dimensional object surface. In the absence of any suggestion prompting in this direction, so doing is not obvious to the skilled person. Should document D2 be taken as closest prior art, then use of a method different to those actually taught would have been necessary, which again, in the absence of any suggestion prompting in this direction is not obvious to the skilled person.

4.2 Accordingly, the subject-matter of claim 1 could only have been reached by selecting particular features from documents D1 and D2 specifically to reach this subject-matter. This course of action would not have been obvious to the skilled person, because the teaching of document D2 relating to a rough surface profiler is inherently incompatible to that of document D1 relating to determination of a one dimensional distance through

a dispersive sample both in view of the dimensions being profiled and absence of a dispersive sample.

4.3 No other available prior art document casts doubt on inventive step of the subject-matter of claim 1 because none comes closer thereto than documents D1 and D2. Accordingly, the board is satisfied that the subject-matter of claim 1 can be considered to involve an inventive step within the meaning of Article 56 EPC.

5.1 Having regard to Article 111(1) EPC, the board considers it appropriate to exercise favourably the power of the examining division in the present case because it has convinced itself that the documents according to the request of the appellant meet the requirements of the Convention.

5.2 Since the request for oral proceedings was conditional on the board having doubts about setting aside the decison under appeal, which condition is not met, no oral proceedings are necessary.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the first instance with the order to grant a patent in accordance with the main request of the Appellant as follows:

Description: Pages 1-10, 12-21, 24, 25 as published
Pages 11, 22-23, 26 filed with the letter of 24 March 2000;

Claims: 1-13 filed with the letter of 24 March 2000;

Drawings: Sheets 1/5-5/5 as published.

The Registrar: The Chairman:

P. Martorana E. Turrini