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**D E C I S I O N**  
of 24 February 1998

**Case Number:** T 1016/96 - 3.4.2

**Application Number:** 92911842.0

**Publication Number:** 0581871

**IPC:** G01B 9/02

**Language of the proceedings:** EN

**Title of invention:**

Method and apparatus for optical imaging and measurement

**Applicant:**

Massachusetts Institute of Technology, et al

**Opponent:**

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**Headword:**

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**Relevant legal provisions:**

EPC Art. 56, 111

**Keyword:**

"Prior art document introduced ex-officio by the Board"  
"Remittal of the case to the Examining Division for further  
prosecution"

**Decisions cited:**

-

**Catchword:**

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Boards of Appeal

Chambres de recours

Case Number: T 1016/96 - 3.4.2

**D E C I S I O N**  
of the Technical Board of Appeal 3.4.2  
of 24 February 1998

**Appellant:** Massachusetts Institute of Technology  
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Cambridge  
MA 02139 (US)

**Representative:** Fey, Hans-Jürgen  
Carl Zeiss  
Patentabteilung  
73446 Oberkochen (DE)

**Decision under appeal:** Decision of the Examining Division of the  
European Patent Office posted 9 July 1996  
refusing European patent application  
No. 92 911 842.0 pursuant to Article 97(1) EPC.

**Composition of the Board:**

**Chairman:** E. Turrini  
**Members:** A. G. Klein  
B. J. Schachenmann

11

## Summary of Facts and Submissions

- I. European patent application No. 92 911 842.0 (international publication No. WO-A-92/19 930) was refused by the Examining Division.

The reason for the refusal was that the subject-matter of independent claim 1 lacked an inventive step in the meaning of Article 56 EPC in view of the contents of document DE-A-2 528 209 (hereinafter document D1).

- II. The appellants (applicants) filed an appeal against the decision.

- III. The appellants requested that the decision under appeal be set aside and that a patent be granted on the basis of an amended set of claims of which claim 1, the only independent claim, reads as follows:

"1. Apparatus for interferometrically imaging or measuring of the internal structure of a sample comprising:

- a two beam interferometer having a reference beam path (30) with a reference reflector (44) and a measuring beam path (26) leading to the sample (84),
- an optical radiation source (12, 12a, 12b, 79) providing light to the two beam interferometer (30, 26, 44),
- a probe module (28) arranged in said measuring beam path (26) at its terminating portion, the probe module (28) comprising means (86, 100, 110, 95) for scanning the sample (84) by steering the direction of light propagation applied to the sample (84),

- means (22) for combining light reflected at said reference reflector (44) and light reflected within the sample (84),
- a detector (52, 52') detecting the superimposed light,
- means (46, 46') for changing the longitudinal depth within said sample (84) for which the light reflected within the sample (84) interferes with light reflected at the reference reflector (44) and
- means for processing the output signal of said detector (52, 52') to generate a longitudinally resolved image or measurement of said sample (84) including information received from reflections or scatterings in various depths within said sample (84)."

Oral proceedings were requested if the decision was not set aside in consideration of the applicants' written submissions.

IV. In support of their requests the appellants essentially submitted that, contrary to the claimed apparatus which was able to provide a three dimensional map of an object, the system of document D1 did not truly scan in a depth dimension but only sought to track a surface of which it determined the profile. Providing a longitudinally resolved image or measurement of a sample including information received from reflections or scatterings in various depths within the sample was neither disclosed nor suggested by document D1.

Neither did document D1 teach the claimed specific scanning of the object, whereby both the overall apparatus and the sample could remain fixed in space.

**Reasons for the Decision**

1. The appeal is admissible.
  
2. Present claim 1 is directed to an apparatus for interferometrically imaging or measuring the internal structure of a sample. The claimed apparatus in particular comprises a two beam interferometer having a reference beam path with a reference reflector and a measuring beam path leading to the sample. An optical radiation source provides light to the two beam interferometer. In accordance with the principle of interferometer measurements, the light beam reflected at the reference reflector is combined with the light beam reflected by the sample and the superimposed light is detected by a detector.

In addition, means are provided for changing the longitudinal depth within the sample for which the light reflected within the sample interferes with light reflected at the reference reflector. These means, which thus achieve longitudinal scanning of the sample, can, in accordance with various embodiments disclosed in the description, be constituted for instance by a reciprocating mirror or corner cube reflector (see page 21, lines 6 to 11 and page 22, lines 4 to 7), for varying the length of the reference beam path.

The claimed apparatus further comprises means for processing the output signal of the detector to generate a longitudinally resolved image or measurement of the sample including information received from reflections or scatterings in various depths within the sample. Thus, the presence of a reflection or

scattering site at a given longitudinal depth within the sample as set by the depth changing means is deduced from the detection of interference fringes in the superimposed light fed to the detector.

Finally, a probe module for the sample comprises means for scanning the sample by steering the direction of light propagation applied to it.

Thus the generating of a longitudinally resolved image or measurement of a sample including information on the position of reflection or scattering sites at various depths within the sample is an essential feature of the claimed apparatus.

3. D1 is the sole prior art document relied upon by the Examining Division in its argumentation against the patentability of the subject-matter of claim 1.

Document D1 undisputedly discloses an apparatus for interferometrically measuring a sample comprising:

- a two beam interferometer having a reference beam path with a reference reflector 7 (Figure 1) and a measuring beam path leading to the sample 4,
- an optical radiation source 1 providing light to the two beam interferometer,
- a probe module 5 arranged in said measuring beam path at its terminating portion,
- means 2 for combining light reflected at said reference reflector 7 and light reflected within the sample 4,
- a detector 11 detecting the superimposed light,
- means 8 for changing the longitudinal depth for which the light reflected by the sample interferes with light reflected at the reference reflector 7 and

- means for processing the output signal of said detector (see page 10, line 8 to page 11, line 3).

In this known device, the means for changing the longitudinal depth (or longitudinal position of a plane) for which the light reflected by the sample interferes with light reflected at the reference reflector is constituted by a loudspeaker membrane onto which the reference reflector is glued. An appropriate signal fed to the loudspeaker causes the reflector to reciprocate.

The Board does not however share the Examining Division's view that document D1 was also adapted "for imaging or measuring of the internal structure of a sample, to generate a longitudinally resolved image or measurement of said sample including information received from reflections or scatterings in values depths within said sample" as is further set out in claim 1.

As expressly stated in the first paragraph of document D1, the apparatus disclosed there is intended for the probing or scanning of surface profiles ("Abtastung von Oberflächenprofilen") and it comprises a distance sensor ("Abstandsfühler") which in a small measuring field determines the deviation of the upper surface of the measured object from a plane defining a zero position. To this effect the light beam from object 4 (see Figure 1) is combined with the light from the reciprocating reflector 7 located in the reference beam path and the superimposed image is analysed by photodetector 11. The output signal from the detector is processed to generate information as to the height of the various points of the upper surface of the object 4 in the measuring field, based on the instantaneous position of the reciprocating reflector 7 when interference fringes are detected by

photodetector 11. In a specific feed-back operation mode, the vertical position of the measured object can be varied as a function of the measured profile height, in such a way that the measured point always remains in the zero position plane (see page 6, last paragraph).

It is therefore clear that the apparatus of document D1 is specifically designed for the measuring of surface profiles of objects. This was recognised also by the Examining Division which however went on to rule that, if the optically opaque sample was replaced by an optically transparent sample having reflecting internal layers, the apparatus known from document D1 would be adapted to, and would actually, image and measure internal structures of such a transparent sample without any further modifications. Consequently the features of claim 1 directed to the imaging or measuring of the internal structure of a sample were considered to be actually known from document D1 (see point 1.4 of the Grounds).

In the Board's view, however, there is no basis in document D1 for the assumption that the signal processing means described there for determining the profile of the upper reflecting surface of an object could correctly cope also with detector signals comprising interferometric components originating from different depths in a transparent object. The apparatus of document D1 has clearly not been designed for detecting a succession of overlaying reflection sites within a sample and it is highly improbable that it would operate adequately in such an unforeseen situation and generate a longitudinally resolved image or measurement of the sample as set out in present claim 1.



Concerning the feature of claim 1 which is directed to the lateral scanning of the sample by steering the direction of light propagation applied to it, the Board cannot either endorse the Examining Division's opinion in the appealed decision (see point 1.5 of the Grounds) that in the apparatus of document D1 **the sample** was scanned in an horizontal direction by using a ROCHON prism 9. As clearly disclosed in the first paragraph of page 13 referred to also by the Examining Division, the ROCHON prism 9 is located immediately in front of the aperture 10 of photodetector 11 and its lateral displacement results in the whole interference image being moved over the aperture. This results in a scanning of the obtained image only, and not of the sample itself as is set out in claim 1.

The Examining Division's decision was thus based on an incorrect ex post facto assessment of the actual content of document D1 and, for that reason already, it should be set aside.

5. *Further prosecution of the application*

In the Board's opinion, there is nothing in document D1, nor in any of the documents cited either in the International Search Report drawn up by the US Patent Office or in the supplementary European Search Report drawn up by the EPO, all correctly classified into the A category dedicated to technological background, which could in an obvious manner suggest the skilled person to modify the prior art apparatus disclosed in document D1 in such a way that it generates longitudinally resolved images or measurements of samples including information received from reflections or scatterings in various depths within the sample.

18

However, the Board has become aware of the further references cited during the prosecution of the appellants' priority application in the USA:

GB-A-2 191 855 (R1); and

"Optical coherence - domain reflectometry: a new optical evaluation technique"; R. C. Youngquist et. al.; Optics Letters vol. 12, No. 3, pages 158 to 160, 19 March 1987 (R2).

These documents prima facie appear to be highly relevant to the claimed subject-matter. As a matter of fact, they seem to disclose an apparatus for interferometrically imaging or measuring the internal structure of a sample and for generating longitudinally resolved images thereof, which comprises most of the features set out in claim 1 (see Abstracts and Figures 1 and 2 of both references; compare the longitudinally resolved image shown in Figure 2A of the present application and those of Figures 2 in both references).

Since the prior art disclosed in references R1 and R2 clearly comes much closer to the claimed subject-matter than the prior art considered by the Examining Division, it should be duly taken into consideration when assessing the patentability of the claimed subject-matter.

The late discovery of highly relevant prior art only in the appeal procedure is indeed regrettable, since remittal of the case to the Examining Division for further prosecution could considerably delay the proceedings.

19

As mentioned above, references R1 and R2 have both been cited during the prosecution of appellant's patents US-A-5 321 501 and US-A-5 459 570 (see the cover pages of these patents), issued in continuation of the US patent application No. 692 877 of 29 April 1991, of which the present European patent application claims the priority. It thus appears that already before the start of the examining procedure the appellants were aware of this highly relevant prior art and that they could have avoided the present unsatisfying situation, had they brought the references to the Examining Division's attention.

Taking however also into consideration that the examining procedure up to the refusal was conducted in a speedy way and that references R1 and R2 were discovered right at the beginning of the appeal procedure, and in order not to deprive the appellants of the possibility of having their case considered by two instances the Board considers it appropriate in the circumstances to make use of the powers conferred on it by Article 111 EPC to immediately remit the case to the first instance for further prosecution.

Oral proceedings, which were requested by the appellants only in case the decision of the Examining Division was not set aside, need not be summoned, accordingly.

20

**Order**

**For these reasons it is decided that:**

1. The decision under appeal is set aside.
2. The case is remitted to the Examining Division for further prosecution.

The Registrar:

The Chairman:

P. Martorana

E. Turrini

