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D E C I S I O N
of 15 May 2000

Case Number: T 0022/99 - 3.4.2

Application Number: 92911454.4

Publication Number: 0542962

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Language of the proceedings: EN

Title of invention:
Confocal spectroscopy

Patentee:
RENISHAW plc

Opponent:
Carl Zeiss Jena GmbH

Headword:
-

Relevant legal provisions:
EPC Art. 54, 56, 84, 123(2)

Keyword:
"Novelty, inventive step (confirmed)"
"Clarity and admissibility of the amendments (third auxiliary request: yes)"

Decisions cited:
-

Catchword:
-

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Case Number: T 0022/99 - 3.4.2

D E C I S I O N
of the Technical Board of Appeal 3.4.2
of 15 May 2000

Appellant: (Opponent)
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Decision under appeal: **Interlocutory decision of the Opposition Division of the European Patent Office posted 19 October 1998 concerning maintenance of European patent No. 0 542 962 in amended form.**

Composition of the Board:

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

Summary of Facts and Submissions

I. European patent 0 542 962 (application No. 92 911 454.4) was opposed under Article 100(a) EPC on the ground that its subject-matter lacked novelty and inventive step in view of the following documents:

D1: WO-A-90/07108;

D2: "Studying single living cells and chromosomes by confocal Raman microspectroscopy" by G. Puppels et al, Nature, vol. 347, 20 September 1990, pages 301 to 303;

D3: EP-A-0 380 904;

D4: "Three-dimensional surface measurement using the confocal scanning microscope" by D. Hamilton et al, Applied Physics B 27, 1982, pages 211 to 213;

D5: DE-C-3 037 983; and

D6: EP-A-0 485 803.

The patent was maintained in amended form by an interlocutory decision of the Opposition Division.

II. The appellant (opponent) appealed against the interlocutory decision.

III. Oral proceedings were held on 15 May 2000, at the end of which the appellant requested that the decision under appeal be set aside and that the European patent be revoked.

The respondent (proprietor of the patent) for his part requested that the appeal be dismissed and that the patent be maintained on the basis of the set of claims filed on 17 April 2000 as a main request, or on the basis of one of the sets of claims offered on the same date as the first to eleventh auxiliary requests.

Independent claims 1, 3 and 9, the only independent claims of the main request, and dependent claims 2, 4 and 10 as attached respectively to independent claims 1, 3 and 9 read as follows:

"1. A spectroscopy method comprising:

illuminating a sample (18), to obtain therefrom a spectrum of scattered light;

analysing said spectrum;

passing at least one component of the analysed spectrum to a photodetector (24) which comprises an array of pixels (40), light scattered from a given plane in the sample being brought to a tight focus in a given area (42,44,60) on the photodetector; and

detecting light which is received in said given area (42,44,60) on the photodetector;

characterised in that light scattered from other planes in the sample is brought to a more diffuse focus (38,46,62) on the photodetector or on a plane thereof; and the light received in said given area (42,44,60) is detected without or separately from light outside said given area by selectively binning together the data from pixels (40) in said given area, thereby reducing the effect of light scattered from said other planes in the sample."

"2. A method according to claim 1, wherein said step of detecting light in said given area (44) on the

photodetector provides confocal action in one dimension."

"3. A spectroscopy method comprising:

illuminating a sample (18), to obtain therefrom a spectrum of scattered light;

analysing said spectrum;

passing the analysed spectrum to a photodetector (24), light scattered from a given plane in the sample being brought to a tight focus in a given area (44) on the photodetector; and

detecting light which is received in said given area (44) on the photodetector;

characterised in that light scattered from other planes in the sample is brought to a more diffuse focus (46) on the photodetector or on a plane thereof; the light received in said given area (44) is detected without or separately from light outside said given area, thereby reducing the effect of light scattered from said other planes in the sample; and said given area (44) is defined by a region extending between parallel lines across the detector and along which the spectrum is dispersed, so that said step of detecting light in said given area provides confocal action in one dimension."

"4. A method according to claim 3, wherein the photodetector (24) comprises an array of pixels (40), and the light which is received in said given area (44) is detected by selectively binning together the data from pixels in said given area."

"9. Spectroscopy apparatus comprising:

means (10,12,16) for illuminating a sample (18), to obtain therefrom a spectrum of scattered light;

means (20) for analysing said spectrum;

a photodetector (24);

means (22) for passing and focusing the analysed spectrum to the photodetector, light scattered from a given plane in the sample being thereby brought to a tight focus in a given area (44) on the photodetector; and

means (24, 25) for detecting light which is received in said given area (44) on the photodetector;

characterised in that light scattered from other planes in the sample is brought to a more diffuse focus (46) on the photodetector or a plane thereof; said detecting means (24,25) detects the light received in said given area (44) without or separately from light outside said given area, thereby reducing the effect of light scattered from said other planes in the sample; and said given area (44) is defined by a region extending between parallel lines across the detector and along which the spectrum is dispersed, so that detecting the light in said given area provides confocal action in one dimension."

"10. Apparatus according to claim 9, wherein the photodetector (24) comprises an array of pixels (40), and said detecting means (24,25) detects the light received in said given area (44) by selectively binning together the data from pixels (40) in said given area."

The set of claims in accordance with the first auxiliary request corresponds to the set of the main request, after deletion of dependent claims 4 and 10, renumbering of the remaining claims and changing of their dependencies, where required.

The set of claims in accordance with the second auxiliary request corresponds to the set of the main request, after deletion of dependent claim 2, renumbering of the remaining claims and changing of their dependencies, where required.

The set of claims in accordance with the third auxiliary request corresponds to the set of the main request, after deletion of dependent claims 2, 4 and 10, renumbering of the remaining claims and changing of their dependencies, where required.

IV. In support of his request the appellant in particular submitted that the set of claims in accordance with the respondent's main request comprised claims which for the first time concretely defined certain combinations of features, like the combination of selective binning with the use of a dispersive light analyser which resulted from the reading of dependent claim 10 in conjunction with independent claim 9. This shifted the area of the scope of protection conferred by the claims by virtue in particular of the equivalence doctrine, in contravention of the requirement of Article 123(3) EPC. The amended dependencies also gave rise to clarity objections under Article 84 EPC, which it was the duty of the Board to consider, since they resulted from an amended version of the claims.

In respect of the patentability of the claimed subject-matter, the appellant submitted that, if the arrangement of document D2, in which confocality was provided by a pin-hole arrangement, was considered to represent the nearest prior art, only two elementary steps were required from the skilled person to achieve

the alleged invention. The skilled person would indeed easily recognise the drawbacks of using a pin-hole arrangement, in particular the difficulty of adjusting its position, and he would therefore immediately contemplate dispensing with it. He would also easily notice that removal of the pin-hole results in an increase of the area of the light spot formed onto the CCD array detector, obviously caused by additional light which originates from off-focus planes and is no longer blocked by the pin-hole. He would then simply eliminate the contribution of this additional, peripheral radiation when reading the CCD signals and thus get at the claimed methods and apparatus, without exercising any inventive skill.

The appellant also pointed at the fact that the Opposition Division in the appealed decision correctly held that an **apparatus** claim which corresponded to present independent method claim 1 but was later abandonned, was fully anticipated by the disclosure of document D1. The Opposition Division however considered the **method** itself as being distinguished therefrom only by the use of a specific sample providing scattering from different planes. The method claim 1 of the main request comprised substantially the same features as the corresponding apparatus claim considered unallowable in the opposition procedure, so that the objection of lack of novelty equally applied to it. Moreover, document D1 explicitly referred to the possibility of illuminating the interior of a transparent sample (see page 5, lines 12 to 15) and to focusing the resulting image onto a small group of pixels on the CCD, the outputs of which were averaged by the computer (see page 11, lines 2 to 4).

V. The respondent denied that the amended claims introduced combinations not disclosed in the original application documents, referring in particular to the claims as originally filed and to the passages of the description directed to the achieving of partial confocal behaviour as illustrated in Figures 3 to 5, which expressly referred to the computer being programmed in the same way as in the embodiment achieving full confocal behaviour by selective binning, as illustrated in conjunction with Figure 2.

He also contested that objections under Article 84 EPC against alleged deficiencies which were already present in the granted version of the claims, could still be addressed by the Board in the present opposition appeal procedure.

In respect of the patentability of the claimed subject-matter, the respondent essentially denied that document D2 provided any incentive for the skilled person to suppress the pin-hole, which was an essential element of the design presented there, or that document D1 disclosed any confocal arrangement. Neither did the latter document in any way describe or hint at discriminating between light radiation originating from different planes internally of a sample.

Reasons for the Decision

1. The appeal is admissible.

2. *Main request*

2.1 Compliance of the amended claims with the requirement of Article 123(2) EPC

Independent claims 3 and 9 of the main request are directed respectively to a spectroscopy method and to a spectroscopy apparatus in both of which an analysed spectrum is passed to a photodetector and confocal action in one direction is provided by detecting light brought to a tight focus in an area defined by a region extending between parallel lines across the detector and along which the spectrum is dispersed, without or separately from light outside said given area.

Dependent claims 4 and 10 as respectively appended to independent claims 3 and 9 define combinations of the subject-matter of the latter independent claims with the feature of detecting the light received in said given area by selectively binning together the data from pixels in said given area. This combination, which was not recited in any of the claims as originally filed, in the Board's opinion is not disclosed either in the original description and drawings.

As a matter of fact, the selective binning of data from certain pixels was described originally only in conjunction with the arrangement of Figures 1 and 2, which is said to achieve the same full confocal effect as the pin-hole in a conventional spatial filter (see page 4, lines 35 to 37 and page 5, lines 5 to 12 of the description as originally filed). This "selective binning" consists in the computer reading the data from each pixel of the detector array serially, adding together the data from only those pixels which receive

tightly focussed light scattered from the focal point, and ignoring the data from the rest, including those pixels which receive the more diffusely focussed light scattered from elsewhere in the sample (see page 4, lines 15 to 33). The following description in conjunction with Figures 3 to 7 then illustrates the achieving of confocal action in one direction by detection of light from an analysed spectrum in an area defined by a region extending between parallel lines across the detector, along which the spectrum is dispersed, without referring any further to selective binning of the data from certain pixels.

The respondent in this respect submitted that the indication in line 23 of page 5 of the description as originally filed that, for the achieving of partial confocal action in accordance with the embodiment of Figure 3, the computer was programmed "in a similar manner to that described above" necessarily meant that the selective binning disclosed in conjunction with the embodiment of Figures 1 and 2 was performed also in the following embodiments. In the Board's view, however, the above-quoted mention only implies that, like in the embodiment of Figures 1 and 2, the computer is programmed so as to capture data only from certain pixels and to exclude light received elsewhere on the CCD, as is explained further in the same passage (see page 5, lines 21 to 27: data are captured only from those pixels which lie in an area defined by a region extending between parallel lines across the detector and along which the spectrum is dispersed). The mention does not however unequivocally mean that selective binning (i.e. the reading of data from each pixel of the detection array serially, and the selective adding of data only from pixels which

receive tightly focussed light) is to be performed, the less so since the passage also states that full confocal spectroscopy is not possible with the simple software disclosed in conjunction with Figures 1 and 2 (see page 5, lines 8 to 12).

Accordingly, the subject-matter of dependent claims 4 and 10 as appended to independent claims 3 and 9, respectively, extends beyond the content of the application as filed, in contravention of the requirement of Article 123(2) EPC.

2.2 Clarity of dependent claim 2 as appended to claim 1 and its support by the description

2.2.1 Lack of clarity of the claims within the meaning of Article 84 EPC is no ground for opposition under Article 100 EPC. The Board therefore concurs with the respondent's submission that assessing the compliance of the claims with the requirement of Article 84 EPC should be restricted, within the frame of the present opposition appeal procedure, to matters which actually result from amendments brought to the claims after grant.

In the present circumstances, the set of claims as granted comprised a single independent method claim and a single corresponding apparatus claim, both of which in substance only required that tightly focused light received in a given area from a given plane in the sample be detected without or separately from light outside that given area as received from other planes in the sample (see independent claims 1 and 9, respectively). In the course of the opposition procedure, the granted generic method claim was

replaced by the present two independent method claims 1 and 3, directed respectively to the selective binning of the data from pixels in said given area, and to the detection of light in a given area defined by a region extending between parallel lines across the detector so as to provide confocal action in one dimension. The generic independent apparatus claim as granted was for its part replaced by a more restricted version corresponding to the method of independent claim 3.

The dependent claims as granted were re-distributed between the amended independent claims.

Accordingly, the issue of the consistency of the re-distributed dependent claims with the respective independent claims, and the question of whether the resulting combination of features is actually supported by the description within the meaning of Article 84 EPC arise from amendments brought to the patent as granted, and they shall therefore be examined by the Board.

2.2.2 Independent claim 1 of the main request in substance specifies that light scattered from a given plane in the sample as brought to a tight focus in a given area on the photodetector is detected without or separately from light outside said given area as received from other planes in the sample by selectively binning together the data from pixels in said given area.

As indicated in point 2.1 above in relation to the issue of the compliance of the claims with the requirement of Article 123(2) EPC, selective binning is disclosed in the description in conjunction only

with the embodiments illustrated in Figures 1 and 2 (see in particular column 3, lines 23 to 58 of the granted specification), where it is stressed also that the same, full confocal, effect as the pin-hole in a conventional spatial filter is achieved.

In contrast, dependent claim 2 as appended to independent claim 1 specifies that the step of detecting light in said given area on the photodetector provides confocal action "in one dimension". This apparent contradiction between the wording of claim 2 as appended to claim 1 and the description thus casts doubt on the intended meaning of the feature of the selective binning recited in claim 1.

The claims therefore in the opinion of the Board fail to meet the requirement of Article 84 EPC that they be clear and supported by the description.

2.3 For the above reasons, the respondent's main request cannot be allowed.

3. *Respondent's first and second auxiliary requests*

The respondent's first and second auxiliary requests respectively comprise claims corresponding to claim 2 as objected to above under Article 84 EPC and to claims 4 and 10 as objected to above under Article 123(2) EPC.

These auxiliary requests are not allowable either, accordingly.

4. *Respondent's third auxiliary request*

4.1 The set of claims in accordance with the respondent's third auxiliary request no longer comprises any claims corresponding to claims 2, 4 and 10 of the main request, as objected to above.

Claims 1, 2 and 7, the only independent claims, are respectively identical to claims 1, 3 and 9 of the main request.

No further objection under Article 84 or 123 EPC arises against the present claims, as was acknowledged also by the appellant at the oral proceedings of 15 May 2000.

Independent method claim 1 corresponds in substance to a combination of independent claim 1 as filed with dependent claim 2 as appended thereto. Present independent method claim 2 and present independent apparatus claim 7 correspond in substance to independent claims 1 and 7 as originally filed, with the additional limitation that the area in which light scattered from a given plane in the sample is brought to a tight focus is defined by a region extending between parallel lines across the detector and along which the spectrum is dispersed, as is described on page 5, lines 8 to 27 of the description as originally filed, and illustrated in Figure 3.

The scope of the present independent claims has also been restricted in comparison to the scope of the independent claims 1 and 9 as granted.

Finally, the description was merely adapted for consistency with the amended claims, and supplemented with a short summary of the relevant background art,

in compliance with the requirements of Rule 27(1)(b) and (c) EPC.

4.2 Independent claims 1, 2 and 7

4.2.1 Novelty

Document D1 relates to the analysis of a sample using the Raman effect. Two embodiments of a Raman microscope, passing onto an array of pixels 22 a 2-dimensional image of the scattering at a selected Raman frequency of the illuminated **surface** of a sample 14, are described with reference to Figures 2 and 3 (see page 5, lines 22 to 25 and page 6, lines 28 to 31). The document also refers to a modification of the described Raman microscope for use as a Raman microprobe. This is done by focusing an illuminating laser beam to a single point **on the sample** and focusing the resulting image onto a small group only of pixels on the CCD 22. The computer averages the outputs of these pixels (see page 10, line 34 to page 11, line 4). The document does not disclose that light scattered from other planes in the sample is brought to a more diffused focus on the photodetector, and that the binning of data from pixels is performed selectively, i.e. only on data from pixels receiving tightly focused light. The document does not even in the Board's opinion disclose that the sample transmits light from internal planes, located below the point on the sample on which the illuminating laser beam is focused. Indeed, the reference in lines 18 to 33 on page 11 to the possibility of using the described microprobe for contour scanning work, i.e. for determining the local heights of the illuminated portion of the object 14 so as to determine its shape

and contour, actually implies that only the surface of the object produces the scattered light as detected by the small group of pixels on the CCD.

The appellant in this respect submitted that document D1 in lines 12 to 15 of page 5 explicitly referred to examining the interior of a transparent sample. This only reference to a transparent sample in the whole document is however part of a brief preliminary explanation of the Raman effect as such given independently of the following description of specific embodiments (see in particular page 4, line 36). This brief explanation also primarily refers to identifying the composition of the **illuminated surface of the sample**, the option of examining the interior of a transparent sample being mentioned between parentheses only.

Thus, the subject-matter of claim 1 is distinguished from the analysis method as performed when using the Raman microprobe embodiment of document D1 mainly in that the binning together of data from pixels in a given area on the photodetector, on which light scattered from a given plane in the sample is brought to a tight focus, is performed selectively to detect the tightly focused light without or separately from light scattered from other planes in the sample as brought to a more diffused focus on the photodetector or on a plane thereof.

The subject-matter of independent claims 2 and 7 is distinguished from the method and apparatus disclosed in D1 by the detection of light only in an area defined by a region extending between parallel lines across the detector and along which the spectrum is

dispersed. Document D1 indeed does not suggest the definition of any such area on the detector, nor even does it call for any dispersing of the spectrum.

Document D2 relates to the technique of confocal Raman microspectroscopy, in which confocality is provided by a pin-hole. The document does not disclose any binning of data from pixels on the CCD detector, nor any preferential detection in a region extending between parallel lines along which the analysed spectrum is dispersed.

Document D3 discloses a solid state microscope using a CCD detector, which in the embodiment illustrated in Figure 5 is able to generate spectral scan lines of various wavelengths of a specimen, as passed through a very narrow slit provided across the otherwise light absorbing surface of a prism element positioned in the primary image plane.

The document does not disclose the rejection of more diffusely focused light on the photodetector, nor does it in any way refer to confocal action.

Document D4 discloses a confocal scanning microscope using a single point detector to achieve confocal action, for the three-dimensional measurement of a surface.

Document D5 discloses a scanning microscope for the spectral analysis of an object, with a linear or 2-dimensional detector array. The detector array comprises a plurality of individual detectors, of which each receives light from a different point of the analysed sample (see column 13, lines 26 to 41 or

column 16, lines 12 to 16). There is no reference in the document to any confocal action, nor to any preferential detection of tightly focused light over light brought to a more diffused focus.

Finally, document D6, which is part of the prior art under Article 54(3) and (4) EPC only, discloses a spectroscopy apparatus adapted for confocal discrimination between planes in a sample. The apparatus, like the one of document D5, comprises a 2-dimensional area of point detectors each receiving light focused from a different point on the sample. Thus the document neither discloses the selective binning together of data from pixels in an area of tight focusing, nor the preferential detection in a region extending between parallel lines along which an analysed spectrum is dispersed.

For these reasons, the subject-matter of independent claims 1, 2 and 7 is novel within the meaning of Article 54 EPC.

4.2.2 Inventive step

4.2.2.1 Closest prior art

Apart from document D6 which is part of the prior art only for the purpose of assessing novelty within the meaning of Article 54(3) and (4) EPC, document D2 is the only citation relied upon by the appellant to address the question of the spatial, in particular depth resolution in the spectroscopic analysis of a sample, and to disclose means for eliminating the contribution to the detector signal of radiation issued from planes within the sample others than the

plane of the point under examination (see the analysis of these documents in paragraph 4.2.1 above).

This citation, which is correctly acknowledged in the introductory portion of the present specification, thus in the Board's view represents the closest prior art.

4.2.2.2 The apparatus of document D2 and the method of operating it involve the use of a pin-hole through which light scattered by the object is coupled into the spectrometer, so as to provide confocal detection by eliminating radiation scattered from planes others than the object plane (see Figure 1 on page 302 and its legend).

In contrast, the methods and apparatus of independent claims 1, 2 and 7 do not involve any pin-hole arrangement, since light scattered from other planes in the sample is explicitly specified there to be brought onto the photodetector. Light brought to a tight focus in a given area on the photodetector is however detected without or separately from light outside said given area either by selectively binning together the data from pixels in said given area (independent claim 1), or by restricting detection of light to a region extending between parallel lines across the detector and along which the analysed spectrum is dispersed (independent claims 2 and 7).

The claimed subject-matter no longer requires any pin-hole arrangement, which needs careful alignment of its optical components - this is particularly difficult to achieve in systems where only very low levels of

scattered light are available for analysis - and is susceptible to vibration (see column 1, line 49 to column 2, line 2 of the present patent specification).

Accordingly, the technical problem solved by the claimed invention is to simplify the initial setting up and maintenance of the optical arrangement of document D2.

4.2.2.3 Whilst it is certainly a common endeavour of the skilled person to strive at simplifying or facilitating the alignment of optical arrangements, the Board cannot share the appellant's view that, having recognised that the pin-hole of the apparatus of document D2 constitutes an important source of alignment difficulties, he would as a matter of mere routine consideration contemplate suppressing it altogether. The pin-hole is indeed presented in document D2 as an essential element of the arrangement described there, which allows for a depth resolution of 1.3 micrometers. This arrangement already uses a CCD carmera for signal detection, and there is no evidence on the file that the skilled person's general knowledge or any prior art document could have suggested that proper controlling of the CCD device could compensate for the missing pin-hole. It is noticed in this respect that the only other citation of the effective prior art to disclose a technique achieving high depth discrimination without using a pin-hole, albeit not in conjunction with the spectroscopic analysis of a sample, is document D4. The technique taught there in the context of high-resolution surface profilometry however uses a point detector, which obviously cannot replace the CCD required in the arrangement of document D2 for

detecting the extended Raman spectrum as dispersed by the grating. Moreover, in the absence of any information in document D2 as to the degree of focusing of the dispersed spectrum on the CCD as achieved by the concave mirror M as shown in Figure 1, and as to the area of the CCD actually covered by the spectrum, there is no evidence either that removal of the pin-hole would necessarily result in a peripheral area of the CCD clearly receiving additional, more diffusely focused radiation which it would be obvious to eliminate by adequately controlling the CCD detector, as was further alleged by the appellant.

The remaining documents on the file, including document D1, do not address the technical problem underlying the invention, nor do they disclose the claimed discrimination between areas on the detector receiving either tightly focused radiation as scattered from a given plane in the sample, or more diffusely focused radiation as originating from other planes.

For these reasons, the subject-matter of independent claims 1, 2 and 7 is considered to involve an inventive step within the meaning of Article 56 EPC.

4.3 The same conclusion applies to the subject-matter of dependent claims 3 to 6 and 8 to 11, by virtue of their appendency to independent claims 2 and 7, respectively.

4.4 Since, taking into consideration the amendments made by the respondent, the patent and the invention to which it relates meet the requirements of the Convention, maintenance of the patent as so amended

can be decided (Article 102(3) EPC).

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 maintain the patent as amended in the following version:

Claims: 1 to 11 filed during the oral proceedings of 15 May 2000 as the third auxiliary request;

Description: pages 2 to 5 with the paragraph on page 2a to be inserted line 3 of column 2, all filed during the oral proceedings of 15 May 2000 as the third auxiliary request;

Drawings: as granted.

The Registrar: The Chairman:

P. Martorana E. Turrini