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Datasheet for the decision of 9 February 2007

Case Number: T 0389/05 - 3.4.02

Application Number: 00102884.4

Publication Number: 1035409

IPC: G01N 21/64

Language of the proceedings: EN

Title of invention:
Method and apparatus for measurement of light from illuminated specimen eliminating influence of background light

Applicant:
FUJIFILM Corporation

Opponent:
-

Headword:
-

Relevant legal provisions:
EPC Art. 54, 56

Keyword:
-

Decisions cited:
-

Catchword:
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Case Number: T 0389/05 - 3.4.02

D E C I S I O N
of the Technical Board of Appeal 3.4.02
of 9 February 2007

Appellant: FUJIFILM Corporation
26-30, Nishiazabu 2-chome
Minato-ku
Tokyo (JP)

Representative: Klunker . Schmitt-Nilson . Hirsch
Winzererstraße 106
D-80797 München (DE)

Decision under appeal: **Decision of the Examining Division of the European Patent Office posted 22 November 2004 refusing European application No. 00102884.4 pursuant to Article 97(1) EPC.**

Composition of the Board:

Chairman: A. Klein
Members: A. Maaswinkel
C. Rennie-Smith

Summary of Facts and Submissions

I. This appeal, received on 21 January 2005, is against the decision of the examining division, dispatched on 22 November 2004, refusing the European patent application 00102884.4. The fee for the appeal was paid on 21 January 2005 and the statement setting out the grounds of appeal was received on 9 March 2005. In its decision the examining division had objected to the set of claims then on file because the subject-matter of independent claims 1 and 3 was anticipated by the disclosure of document D1 (WO-A-97/08523) and the subject-matter of the independent claims 5 and 15 did not involve an inventive step (Articles 52(1), 54 and 56 EPC).

II. In the statement setting out the grounds of appeal the appellant argued that the passage in document D1 considered by the examining division related to the prior art acknowledged in this document and that this passage did not discloses, neither implicitly nor explicitly, the feature concerning the starting of the second measurement which, according to claim 1, should be different from the first time by an integer multiple of the period of the cyclically varying background radiation.

III. In a Communication annexed to the summons to oral proceedings the board observed that while it tended to concur with the appellant's interpretation of the passage in D1 considered in the decision under appeal, a further passage on pp. 11 and 12 in D1 appeared to disclose subject-matter relevant to the question of patentability.

IV. Oral proceedings took place on 9 February 2007. At the oral proceedings the appellant filed amended claims 1 and 3 replacing the respective claims of the main request filed with the letter of 7 October 2004 and to be considered together with the further claims of this main request. The board gave its decision at the end of the oral proceedings.

V. Independent claim 1 filed at the oral proceedings reads as follows:

"An optical measurement method for performing measurement of first light, which has been emitted from or reflected by a specimen, or has penetrated through the specimen, under background light having intensity which varies cyclically with a period, said method comprising steps of:

(a) performing a first operation of measuring the first light for a first duration having a certain length and beginning at a first time, while illuminating the specimen with second light, to obtain a first measurement result;

(b) performing a second operation of measuring the first light for a second duration having the same length as the first duration, while illumination of the specimen is stopped, to obtain a second measurement result; and

(c) subtracting said second measurement result from said first measurement result, to obtain a third measurement result which is not affected by said background light

characterized in that the second operation of measurement begins at a second time which is different

from said first time by an integer multiple of said period, wherein said second time is determined by a timing difference value (TK) obtained by multiplying said period by an integer".

Independent claim 3 filed at the oral proceedings reads as follows:

"An optical measurement apparatus adapted for performing measurement of first light, which has been emitted from or reflected by a specimen (10), or has penetrated through the specimen (10), under background light having intensity which varies cyclically with a period, said apparatus comprising:

a first measurement unit adapted for performing a first operation of measuring the first light while illuminating the specimen with second light, to obtain a first measurement result;

a second measurement unit adapted for performing a second operation of measuring the first light while illumination of the specimen is stopped, to obtain a second measurement result;

a control unit (100) specifically adapted for controlling timing of the operations of the first and second measurement units so that said first operation is performed for a first duration having a certain length and beginning at a first time, and said second operation is performed for a second duration having the same length as the first duration; and

a calculation unit (120) for obtaining a third measurement result, which is not affected by said background light, by subtracting said second measurement result from said first measurement result,

characterized in that said control unit comprises a period calculation unit (110) adapted to obtain a timing difference value (TK) by multiplying said period by an integer for determining a at a [*sic*] second time at which the second operation begins and which is different from said first time by an integer multiple of said period".

The wording of independent claim 5 reads as follows:

"An optical measurement method for performing measurement of first light, which has been emitted from or reflected by a specimen, or has penetrated through the specimen, under a plurality of types of background light respectively having a plurality of different periods with which intensities of the plurality of types of background light vary cyclically, said method comprising steps of:

(a) performing a first operation of measuring the first light for a first duration having a certain length and beginning at a first time while illuminating the specimen with second light, to obtain a first measurement result;

(b) performing a second operation of measuring the first light for a second duration having the same length as the first duration and beginning at a second time which is different from said first time by an integer multiple of a least common multiple of said plurality of different periods, while illumination of the specimen is stopped, to obtain a second measurement result; and

(c) subtracting said second measurement result from said first measurement result, to obtain a third

measurement result which is not affected by said plurality of types of background light.

The wording of independent claim 15 reads as follows:

"An optical measurement apparatus adapted for performing measurement of first light, which has been emitted from or reflected by a specimen, or has penetrated through the specimen, under a plurality of types of background light respectively having a plurality of different periods with which intensities of the plurality of types of background light vary cyclically, said apparatus comprising:

a first measurement unit adapted for performing a first operation of measuring the first light while illuminating the specimen with second light, to obtain a first measurement result;

a second measurement unit adapted for performing a second operation of measuring the first light while illumination of the specimen is stopped, to obtain a second measurement result;

a control unit adapted for controlling timing of the operations of the first and second measurement units so that said first operation is performed for a first duration having a certain length and beginning at a first time, and said second operation is performed for a second duration having the same length as the first duration and beginning at a second time which is different from said first time by an integer multiple of a least common multiple of said plurality of different periods; and

a calculation unit adapted for obtaining a third measurement result, which is not affected by said plurality of types of background light, by subtracting

said second measurement result from said first measurement result".

Claims 2, 4, 6 to 14 and 16 to 24 are dependent claims.

VI. The arguments of the appellant can be summarised as follows:

Claims 1 and 3 have been amended by adding the feature that the second time which defines the beginning of the second operation of measurement is determined by a timing difference value TK obtained by multiplying the value of the period S of the cyclically varying background illumination by an integer. This feature is disclosed, for instance, in paragraph [0035] of the published patent application. Selecting this value for the time difference between the two measurements ensures that both measurements are performed in the same phase interval in the cyclic variation of the intensity of the background light. This offers the advantage that the respective measurement time durations for the first and second measurements can be selected arbitrarily as long as they are equally long, as can be concluded from Figure 2, where the measurement time TS is shorter than one period S of the background illumination. The prior art documents do not disclose or suggest this feature. In particular the passage on page 4, lines 4 to 14 of document D1 considered by the examining division only discloses that a second measurement, wherein the sample is only illuminated by ambient light, may be subtracted from the first measurement during which the sample is illuminated with the impinging light source and ambient light. In fact, this passage even emphasises that such

a subtraction, while providing fair results if the ambient light is constant, may, in case of sinusoidally varying ambient light sources, provide different results at different times and different phases. In order to overcome this problem document D1 provides four different solutions, namely a lock-in amplifier and three types of filters. The further passage on page 11 and 12 of this document merely discloses that the time periods should last an integral multiple of 1/60 of a second, which implies that an integral number of time periods of the cyclically varying ambient light is always collected. Since, because of this requirement, the respective integration times are fixed to include an integral number of periods, there is no incentive to put a restriction on the time difference between the first and second measurements. Therefore document D1 does not suggest the step of determining the timing difference as defined in claim 1, and similarly in claim 3.

Independent claims 5 and 15 define an optical measurement method and apparatus for measuring light from a specimen under conditions of a plurality of types of cyclically varying background light sources Fa(t) and Fb(t)respectively having a plurality of different periods fa, fb. By selection of the time difference between the two measurements as defined in claims 5 and 15, both measurements are performed in the same phase interval in the cyclic variation of the intensity of the background light. This is illustrated in Figure 8, where the selection value for the time difference ensures that both measurements are carried out at the same phase of the cyclically varying sources Fa(t) and Fb(t) and also shown in Figure 11, where the

period of the measurements is shorter than that of the RGB background illumination. Since none of the prior art documents discloses the problem of measurement of light of a specimen under illumination of plural cyclically varying background sources and does not point to the solutions defined in claims 5 and 15 these claims should also define patentable subject-matter.

Reasons for the Decision

1. The appeal is admissible.

2. *Amendments*

2.1 With respect to the expressions introduced in independent claims 1 and 3 the board is satisfied they are supported by paragraph [0035] of the published application and the corresponding passage in the application documents as filed indicated by the appellant, therefore the amendments are not objectionable under Article 123(2) EPC.

2.2 Apart from one obvious error in claim 3 ("for determining a at a second time") the amendments are also allowable under Article 84 EPC.

3. *Patentability - Claim 1*

3.1 The board shares the view of the appellant and of the examining division that the closest prior art is disclosed in document D1, since this document also discloses an optical measurement of light from a sample in the presence of background light. In its decision

the examining division had reasoned that the passage on page 4, lines 4 - 14 of D1 discloses the method steps (a) to (c), defining the first and the second measurements of equal time length and the subtraction step, which steps form the preamble of claim 1. In addition it was argued that in this passage in D1 it was disclosed that in case of periodically varying background light "the subtraction provides different results at different times and different phases", which implied that in order to obtain comparable results of the first and second measurements these should be carried out at the same phase of the background radiation. This was tantamount to the requirement in claim 1 that the second measurement begins at a second time which is different from the first time by an integer multiple of the period (of the cyclically varying background light). The subject-matter of the former claim 1 was therefore held to be not novel.

3.2 The board does not concur with this interpretation of the disclosure on page 4 of document D1. Rather, as pointed out by the appellant, this part of D1 is concerned with the acknowledgement of the prior art. In the first paragraph on this page it is explained that a simple subtraction of a second measurement of ambient light from the first measurement as in the prior art only provides good results if the ambient light intensity is constant and that, for instance in the case of fluorescent or incandescent lighting with sinusoidally varying intensity, the subtraction would provide different results at different times and different phases. In the next paragraph (lines 16 to 26 on page 4) it is furthermore disclosed that part of the problem might be relieved by carrying out measurements

over extended time periods, thereby integrating the effect of noise, but that this was not appropriate for removing the ac component associated with standard ac power sources. Therefore, apart from the steps (a) to (c) of claim 1, this part of the document D1 does not disclose the further step of the characterising portion that the second operation measurement begins at a second time which is different from the first time by an integer multiple of the period of the background light. Nor is there a disclosure of the added feature that the second time is determined by a timing difference value TK obtained by multiplying the period by an integer.

3.3 In its Communication the board also referred to the further passage on pp. 11 and 12 of D1 in the context of the embodiment in Figure 4 in which two sets of measurements are carried out: a first measurement with LED 61 biased OFF (page 12, line 1), to measure the contributions of ambient light, and a second measurement with LED 61 biased ON, to measure the combined effects of ambient light and light from LED 61 passing through sample 22 (page 12, lines 2 - 4). According to page 11, lines 33 and 34, in both measurements the light signal is integrated (viz. a number of pulses is counted) "over a period that lasts for an integral multiple of a 1/60 of a second". Since the ambient light varies with a frequency of 60 Hz (see page 5, lines 28 and 28; and page 12, lines 17 and 18), this implies that both measurements are carried out over a time period which includes an integer multiple of periods of the cyclically varying background signal. Therefore in this embodiment of D1 it is the respective first and second measurement times and not the time

difference between the two measurements which are an integral multiple of the background light period. Furthermore, since document D1 is silent about the time difference between the first and second measurements, there is also no disclosure of the method step of determining the second time by multiplying the background light period by an integer. Therefore the method defined in claim 1 is novel over the disclosure in document D1. As to the further documents cited in the European Search Report these had been considered to disclose merely technological background art without a particular relevance to the claimed subject-matter. Indeed the board does not find that these disclosures are more relevant than that of document D1. The subject-matter of claim 1 is therefore novel (Article 52(1) and 54 EPC).

3.4 The subject-matter of claim 1 also involves an inventive step for the following reasons. The optical measurement method of claim 1 differs from the embodiment in Figure 4 of document D1 by the calculation of the time difference between the first and second measurement and the carrying out of this second measurement after this predetermined time. The technical problem solved by these features from the characterising portion of claim 1 can be seen in performing the illuminated and the unilluminated measurements in the same phase interval of the cyclic variation of the intensity of the background light, as explained in the context of the embodiment of Figure 2 in paragraphs [0047] and [0048] of the published patent application. Indeed, as convincingly argued by the appellant, this allows selecting measurement integration times for the illuminated and the

unilluminated measurements which may be freely chosen, as illustrated in Figure 2. In contrast, in the embodiment of Figure 4 of document D1, the measurement times are fixed and cannot be freely chosen. Finally document D1 offers no suggestion of the claimed solution, since, according to this document, signal processing techniques should be used to filter out the effects of ambient light and for that it proposes high-pass filtering (page 12, line 28), notch-type filtering (page 13, line 7) and low-pass filtering (page 13, line 18).

3.5 It follows that the subject-matter of claim 1 involves an inventive step (Article 52(1) and 56 EPC).

4. *Claim 3*

4.1 Claim 3 defines an optical measurement apparatus comprising first and second measurement units adapted for carrying out the respective measurements on the illuminated and unilluminated sample; a control unit; and a calculation unit for subtracting the results of the first and second measurements. The apparatus differs from the apparatus shown in Figure 4 of document D1 by the presence of a period calculation unit for calculating the timing difference between the first and second measurements. As is set out above, document D1 does not suggest carrying out the illuminate and unilluminated measurements with a particular time delay: rather, according to this document, it is the measurement or integration times themselves which are fixed, all remaining (high, low or ac power) frequency noise to be suppressed by

subsequent filtering. Therefore claim 3 also defines patentable subject-matter.

5. *Claims 5 and 15*

5.1 These claims define an optical measurement method and a respective apparatus for performing measurements on a specimen in the presence of a plurality of background light sources having a plurality of different cyclically varying periods. In order to effectively subtract the second (unilluminated) measurement from the first (illuminated) measurement, the time difference between the beginnings of these measurements should be selected as an integer multiple of a least common multiple of the different periods of the background sources.

5.2 Since, as discussed before, document D1 only teaches to select the durations of the respective measurements, it is silent about the time difference between the measurements and, furthermore, only discloses in the context of plural time-varying signals to suppress these by filtering methods, the solutions in claims 6 and 15 also define new and non-obvious subject-matter.

5.3 It is furthermore pointed out that the independent claims share the same inventive concept of selecting the timing difference between the illuminated and the unilluminated measurements to be an integer multiple of the background period or, as the case may be, a least common multiple of the plurality of different background periods. As is illustrated in Figures 2, 8 and 11, by selecting the timing difference in the claimed manner both measurements are carried out in the

same phase interval and the duration of the respective measurements can be freely selected.

6. *Further prosecution*

6.1 The dependent claims have not yet been addressed. Since it appears that some of the embodiments in the original patent application no longer fall within the scope of independent claims 1, 3, 5 or 15, the dependent claims appended thereto need further careful consideration, in particular with regard to the requirements of Article 84 and 123(2) EPC. This similarly applies to the adaptation of the description and drawings.

6.2 Therefore in the present case the board considers it appropriate to remit the case for further prosecution to the department of first instance.

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 for further prosecution on the basis of claims 1 and 3 of the amended main request and claims 5 and 15 of the main request filed on 7 October 2004 and dependent claims and a description and drawings to be adapted thereto.

The Registrar: The Chairman:

M. Kiehl A. Klein