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Datasheet for the decision of 11 March 2016

Case Number: T 1284/12 - 3.4.02

Application Number: 07111135.5

Publication Number: 1879014

IPC: G01N5/04

Language of the proceedings: EN

Title of invention:
Loss-on-drying instrument with a microwave source and an infrared source

Applicant:
CEM Corporation

Headword:

Relevant legal provisions:
EPC 1973 Art. 56, 84

Keyword:
Claims - clarity - main request (yes)
Inventive step - main request (yes)

Decisions cited:

Catchword:

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Case Number: T 1284/12 - 3.4.02

D E C I S I O N
of Technical Board of Appeal 3.4.02
of 11 March 2016

Appellant: (Applicant)	CEM Corporation P.O. Box 200 3100 Smith Farm Road Matthews, NC 28106-0200 (US)
Representative:	Bankes, Stephen Charles Digby Baron Warren Redfern Cambridge House 100 Cambridge Grove Hammersmith London W6 0LE (GB)
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted on 12 December 2011 refusing European patent application No 07111135.5 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairwoman	T. Karamanli
Members:	H. von Gronau
	F. Maaswinkel

Summary of Facts and Submissions

I. The appeal of the applicant is directed against the decision to refuse the European patent application. The examining division had refused the application in particular on the ground that the subject-matter of the independent claim 1 of the main request, the first auxiliary request and the second auxiliary request did not involve an inventive step (Article 56 EPC).

II. With the grounds of appeal the appellant filed anew the claims according to the main request and the first and second auxiliary requests that were subject to the contested decision. It put forward arguments as to why the subject-matter of the independent claims involved an inventive step. The appellant also requested oral proceedings in the event that the board was not disposed to grant the main request.

III. In a communication pursuant to Article 15(1) of the Rules of Procedure of the Boards of Appeal (RPBA, OJ EPO 2007, 536), annexed to the summons to oral proceedings of 4 December 2015, the board raised objections with respect to lack of clarity and lack of inventive step. In accordance with Article 114(1) EPC the board introduced document D20, which had been cited with respect to the corresponding US family member of the present application.

IV. With letter dated 9 February 2016 the appellant filed amended documents (claims and description pages) according to a main request and first and second auxiliary requests to replace those previously on file.

V. In a further communication pursuant to Article 15(1) RPBA of 23 February 2016 the board raised objections to

independent claim 11 of the main request and the description.

VI. In a reply of 1 March 2016 the appellant filed amended application documents for the main, and first and second auxiliary requests.

VII. Oral proceedings to be held on 9 March 2016 were cancelled.

VIII. The application documents according to the main request consist of:

Description:
Pages 1 to 12 filed with letter of 1 March 2016,
Claims:
Nos. 1 to 9 and 13 to 24 according to the main request filed with letter of 9 February 2016,
Nos. 10 to 12 according to the main request filed with letter of 1 March 2016,
Drawings:
Sheet 1/2 filed with letter of 1 March 2016,
Sheet 2/2 as originally filed.

IX. The following documents are relevant for the present decision:

X1: JP10038783
Y3: WO00/16067
A5: DE3411495
A7: Tireki et al.: "Production of bread crumbs by infrared-assisted microwave drying"
A16: DE4322946
D20: US4964734.

X. The independent claims of the main request read as follows:

"1. An instrument for determining the volatile content of a sample, while monitoring and controlling the sample temperature, the instrument comprising:
a cavity (10) in which a sample (11) for which the volatile content is to be determined can be placed;
a first source of electromagnetic radiation (12) for introducing microwaves into said cavity that have frequencies substantially other than infrared frequencies;
a second source of electromagnetic radiation (14) for introducing electromagnetic radiation into said cavity at infrared frequencies different from the microwave frequencies introduced by said first source;
an analytical balance (16) for measuring the weight of a sample while the sample is in said cavity and on said balance;
a temperature sensor (20) capable of measuring and positioned to measure the temperature of a sample (11) in said cavity (10) and on said balance; and
a processor (21) in communication with said balance and each of said first and second sources and said temperature sensor for controlling the introduction of said frequencies of microwave energy and infrared frequencies into said cavity in response to said balance and in response to temperatures measured by said temperature sensor to thereby maintain the sample temperature below the temperature at which the sample would burn until the microwaves from said first source and the infrared frequencies from said second source dry the sample sufficiently for said processor to determine the volatile content of the sample based on the weight change of the sample on said balance."

"11. A method for determining the volatile content of a sample, the method comprising:
positioning a sample (11) to be analyzed on an analytical balance (16) in a microwave cavity (10);
applying microwave energy (13) that has a frequency substantially other than infrared frequencies to the sample to heat the sample and remove free moisture and polar volatiles from the sample;
applying electromagnetic radiation (15) that has infrared frequencies substantially different from the applied microwave frequencies to the sample to heat the sample and remove bound moisture and nonpolar volatiles from the sample;
monitoring the weight of the sample during the application of the microwave energy and the infrared frequencies with said analytical balance (16);
measuring the temperature of the sample (11) during application of the microwave energy and the infrared frequencies; and
moderating the microwave energy and the infrared frequencies applied to the sample in response to the monitored weight and measured temperature in a manner that maintains the temperature of the sample below the temperature at which the sample would burn and until the microwave energy and infrared frequencies dry the sample sufficiently to determine the volatile content of the sample based on the weight change of the sample on said analytical balance."

Claims 2 to 10 and 12 to 24 are dependent on claims 1 and 11 respectively.

XI. The appellant essentially argued that document X1 did not suggest the present invention because the structure of the device disclosed in document X1 was different from the claimed invention. X1 described a device for

analysing a change of weight caused by thermal cracking, adsorption or desorption. In particular, pyrolysis, thermogravimetric analysis or differential thermal analysis was described in paragraphs [0003] and [0010] of that document. Pyrolysis, thermogravimetric analysis and differential thermal analysis each differed from the loss-on-drying technique utilised by the claimed invention. In fact, X1 directed the person skilled in the art away from loss-on-drying (in which the goal was to avoid decomposition or chemical change in the sample) to specifically and intentionally change the sample material into a different composition.
The appellant further argued that starting from document Y3 the person skilled in the art would not consider document D20. Document D20 sought to determine the moisture content of large amounts of coal (e.g. 1 kg) that did not contain moisture in the chemical bonding sense or a heterogenous material sense. The hot wind heating was incompatible with the small samples and the analytical balance of the claimed invention.
Furthermore, D20 did not suggest the use of infrared radiation to remove moisture from a sample.

Reasons for the Decision

1. Main Request

1.1 Clarity - Article 84 EPC 1973

1.1.1 The clarity objections raised by the examining division (cf. decision, part III) and by the board (cf. communication pursuant to Article 15(1) RPBA, annexed to the summons to oral proceedings, point 4; communication

pursuant to Article 15(1) RPBA of 23 February 2016, point 3) have been overcome by amendment.

1.2 Claim 1, inventive step - Article 56 EPC 1973

1.2.1 The board shares the view of the appellant that document X1 cannot be regarded as the closest prior art. According to established practice in the procedures at the European Patent Office, the first consideration for the selection of the closest prior art is that it should be directed to a similar purpose or effect as the invention (cf. Guidelines G-VII, 5.1). The subject-matter of claim 1 of the present application is directed to an instrument for determining the volatile content of a sample without burning the sample. Document X1 however is directed to measuring a change in the weight of a microwave-irradiated sample caused by thermal cracking, adsorption or desorption. This treatment therefore aims at decomposing the sample under microwave irradiation with the involved weight change and not at determining the volatile content of the sample. There are other documents that deal with the purpose of determining the volatile content by drying the sample, e.g. Y3 or A5.

1.2.2 The board is of the opinion that document **Y3** is the closest prior art for the subject-matter of claim 1 according to the main request. This document discloses an apparatus that also allows the volatile content of a sample to be determined while monitoring the sample temperature. It also deals with the problem that the sample might burn and not dry.

Document Y3 discloses the following features:

an instrument for determining the volatile content of a sample by drying the sample, while monitoring and

controlling the sample temperature (cf. page 3, lines 12-14), the instrument comprising

a cavity 11 in which a sample 12 for which the volatile content is to be determined can be placed;

a first source of electromagnetic radiation 21 for introducing microwaves into said cavity that have frequencies substantially other than infrared frequencies;

an analytical balance 14 for measuring the weight of a sample while the sample is in said cavity and on said balance;

a temperature sensor 13 capable of measuring and positioned to measure the temperature of a sample in said cavity and on said balance (cf. page 4, lines 20-21);

a susceptor element in the cavity that converts microwave radiation into heat (cf. page 8, lines 3-19);

and

a processor 23 in communication with said balance and said first source and said temperature sensor for controlling the introduction of said frequencies of microwave energy into said cavity in response to temperatures measured by said temperature sensor to thereby maintain the sample temperature below the temperature at which the sample would burn until the microwaves from said first source (directly or via said susceptor element) dry the sample sufficiently for said processor to determine the volatile content of the

sample based on the weight change of the sample on said balance (cf. page 6, lines 25-31).

1.2.3 The subject-matter of claim 1 differs from the disclosure of document Y3 in that a second source of electromagnetic radiation (14) is provided for introducing electromagnetic radiation into said cavity at infrared frequencies different from the microwave frequencies introduced by said first source, instead of the susceptor element. The susceptor element has the purpose of converting the microwave energy to heat, which allows "*temperature-controlled treatment of materials that would normally be unresponsive to, or would suffer degradation under, the application of microwave radiation*" (cf. page 8, lines 15-19, of document Y3). The same purpose is described for infrared radiation in paragraph [0014] of the present application: *"Infrared radiation will, however, heat almost all materials to some extent, and thus it offers advantages for materials that do not couple with microwaves."* However, the heat generated by the susceptor element disclosed in document Y3 depends directly on the amount of microwave radiation, such that the heat generated by the susceptor element is linked to the energy introduced by the microwave radiation, whereas the subject-matter of claim 1 provides two independent sources of electromagnetic radiation.

1.2.4 The differing feature therefore provides the effect of better controlling the temperature of the sample by means of two independently controlled sources of energy.

1.2.5 In view of the device disclosed in document Y3 the problem appears to be better control of the heat in the sample during the drying process.

1.2.6 In order to solve the above problem, the person skilled in the art would look for documents that deal with the problem of controlling the heat in the sample during the drying process.

Document **D20** appears to be such a document. This document addresses the above problem and discloses a method for measuring moisture content by combining microwaves with hot wind. "*According to a principal feature of the present invention, there is provided a moisture content measuring system, in which as heat for heating a sample such as coal, microwave irradiation and a stream of hot gases are employed in combination. Thus, by reducing a load of microwaves the sample is dried at a temperature lower than a decomposition temperature of coal, and therefore, a moisture content measurement can be taken quickly and with a high degree of precision.*" (cf. column 2, lines 60-68). The temperature in the sample is measured and controlled to avoid decomposition: "*temperatures are measured by the thermometers 13a, 13b and 13c, and an adjustment is effected to maintain the temperature within the casing 20 at 140°-150° C. Furthermore, an output of the magnetron 1 is regulated so that the temperature of the sample may not rise up to about 200° C or higher. The operations during this period are all controlled by a sequence controller (not shown)*" (cf. column 4, lines 60-67).
From this disclosure the person skilled in the art learns that the heat in the sample can be better controlled to avoid decomposition of the sample by a further controlled source of heat in addition to microwave irradiation. However, document D20 does not suggest using infrared radiation instead of hot wind.

A5 concerns an apparatus for measuring the humidity content of a sample. The drying is performed under vacuum and can be supported with heating. The heating can be performed with infrared, ultrared, high-frequency radiation or microwave radiation. A combination of different radiations is possible (page 7, second paragraph). The document addresses the problem of overheating or degradation (cf. page 6, second paragraph) and proposes heating only to such a degree as to compensate for the temperature losses due to evaporation. However, the temperature of the sample is not measured or controlled.

A7 discloses an apparatus for drying bread crumbs, without determining the initial moisture content or the temperature of the bread crumbs. The document discloses infrared-assisted microwave drying methods with different combinations of infrared power and microwave power to reach optimum speed and the desired appearance of the bread crumbs (cf. Table 1, Figure 3). Document A7 does not address overheating and degradation as a problem. The temperature in the bread crumbs is not controlled, and the colour change ΔE of the crumbs after drying is determined.

A16 relates to a microwave oven with a heat radiating source 6 and a microwave source 2, 3, 4. Both sources can be driven independently. Document A16 does not address the problem of maintaining the temperature of a sample below the temperature at which the sample would burn. The infrared radiation in a microwave oven is in fact typically used to create a browning effect on the product.

1.2.7 In summary, none of the further cited prior-art documents suggests a drying method in which infrared

radiation is combined with microwave radiation in such a way that the temperature in the sample is monitored and controlled to achieve optimum drying without burning or degradation of the sample. Therefore the subject-matter of independent claim 1 involves an inventive step.

1.3 Independent claim 11 defines a corresponding method for determining the volatile content of a sample and therefore its subject-matter likewise involves an inventive step.

1.4 Claims 2 to 10 and 12 to 24 are dependent on claims 1 and 11, respectively. Their subject-matter therefore also involves an inventive step. Furthermore, the board does not see any other objections to the grant of a patent on the basis of the main request.

2. In view of the above, no decision on the auxiliary requests is needed. The appellant also requested oral proceedings in the event that the main request was not allowed. That not being the case, the request for oral proceedings has become moot.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the department of first instance with the order to grant a patent in the following version:

Description:
Pages 1 to 12 filed with letter of 1 March 2016,

Claims:
Nos. 1 to 9 and 13 to 24 according to the main request filed with letter of 9 February 2016,
Nos. 10 to 12 according to the main request filed with letter of 1 March 2016,

Drawings:
Sheet 1/2 filed with letter of 1 March 2016,
Sheet 2/2 as originally filed.

The Registrar: The Chairwoman:

M. Kiehl T. Karamanli

Decision electronically authenticated