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Datasheet for the decision of 20 October 2014

Case Number: T 0490/11 - 3.4.02

Application Number: 06789871.8

Publication Number: 1922540

IPC: G01N21/35, G01N21/85

Language of the proceedings: EN

Title of invention:
METHOD AND SYSTEM FOR MONITORING PLANT OPERATING CAPACITY

Applicant:
Nuvo Ventures, LLC

Headword:

Relevant legal provisions:
EPC Art. 56

Keyword:
Inventive step - (yes)

Decisions cited:

Catchword:

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Case Number: T 0490/11 - 3.4.02

D E C I S I O N
of Technical Board of Appeal 3.4.02
of 20 October 2014

Appellant: (Applicant)	Nuvo Ventures, LLC 7503 Moondance Lane Houston, TX 77071 (US)
Representative:	Wilkinson, Stephen John Stevens, Hewlett & Perkins 1 St. Augustine's Place Bristol BS1 4UD (GB)
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted on 11 October 2010 refusing European patent application No. 06789871.8 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman	A. Klein
Members:	F. Maaswinkel
	D. Rogers

Summary of Facts and Submissions

I. The appellant lodged an appeal against the decision of the examining division, refusing the European patent application 06789871.8. This patent application relates to a system and a method for monitoring plant output activity.

According to the decision, the subject-matter of the claims according to the respective Main, First Auxiliary and Second Auxiliary Requests did not involve an inventive step within the meaning of Article 56 EPC having regard to the disclosure in document D5 (WO-A-98/48260). In particular it was argued that this document disclosed a system for monitoring and determining plant output activity with an imaging subsystem comprising linear array detectors and imaging units having one or a plurality of infrared cameras. In the opinion of the examining division, the features in the independent claims not explicitly disclosed in document D5 were obvious to the skilled person upon the basis of common general knowledge alone, or were known from document D4 (US-A-5 726 450), which was a document from the same technical field and solving a similar problem.

II. With the letter containing the grounds of appeal the appellant requested to set aside the decision and to grant a patent on the basis of the sets of claims according to the Main or the First or Second Auxiliary Requests filed with this letter. The appellant also filed a request for oral proceedings.

III. In a phone conversation with the appellant's representative the rapporteur pointed out formal deficiencies in the application documents and also made

reference to document D6 which discloses a spectrometer of the type referred to in document D5:

D6: SPIE, vol. 2820, pp. 72 - 77;
D.M. Rider et al.: "Airborne emission spectrometer: a testbed for the EOS TES".

IV. With a letter dated 8 September 2014 the appellant filed amended description pages.

The appellant requests that a patent be granted based on the following documents:

Claims: 1 to 9 of the Main Request, filed with the letter dated 21 February 2011;
Description: pages 12 to 22 as published;
page 7, filed with telefax on 12 March 2010;
pages 1 to 6, 8 to 11, 11a, 11b, 23, filed with the letter dated 8 September 2014;
Drawings: sheets 1/16 to 16/16, as published.

V. The wording of independent claim 1 of the Main Request reads as follows:

" A system for monitoring and determining plant output activity comprising:

an imaging subsystem (100, 150, 200, 250, 300, 400, 500, 600) capable of imaging effluent plumes for thermal output with or without effluent compositional data from one or a plurality of stacks (114a-d, 164a-d, 214a-d), at an industrial facility and capturing image data associated therewith, said imaging subsystem comprising,

one or a plurality of imaging units (110, 160a-d, 210, 260a-d) having one or a plurality of infrared

detector cameras (404, 506a-d, 606a-d, 704) that are a thermal detector adapted to capture thermal data, with or without one or a plurality of effluent composition detectors adapted to capture data corresponding to the production of a given atomic species, molecular species, and/or class of molecular species from the effluent plumes and with a detector capable of converting incident light into an electronic signal for analysis;

an analysis subsystem (802) for processing (900, 1000, 1100) the thermal image data into plant output data comprising plant output activity and capacity utilisation with or without effluent compositional data of the industrial facility;

characterised in that the one or plurality of imaging units are capable of imaging at a distance of between 25 metres to 10 kilometres within a clear line of sight to the one or plurality of stacks of the industrial facility,

said system further comprising a data processing subsystem (1200) capable of performing the steps to

i) extract pixels associated with an active region in the captured image,

ii) determine which of the extracted pixels are on and have an intensity greater than a background or set threshold intensity and

iii) apply correction factors for weather conditions to the active region on pixels after extraction, said correction factors determined from acquired effluent plume images accumulated over time or acquired under different weather conditions at constant plant output;

wherein the corrected on pixels are processed into the plant output data prior to analysis ".

The wording of independent claim 5 reads as follows:

" A method for monitoring and determining plant output activity in real time with the monitoring system of any of claims 1 to 4, comprising:

positioning the imaging subsystem within a clear line of site with the industrial facility at a distance of between 25 metres to 10 kilometres;

acquiring one or a plurality of thermal images with or without images of one or a plurality of effluent plume composition from one or a plurality of stacks at the industrial facility with the imaging subsystem;

producing thermal image output data, with or without effluent plume composition output data, from the acquired one or a plurality of images;

extracting pixels associated with an active region of the acquired image(s);

determining which of the extracted pixels are on and have an intensity greater than a background or set threshold intensity and applying correction factors for weather conditions to the active region on pixels after extraction thereby producing a corrected image; wherein said correction factors are determined from acquired effluent plume images accumulated over time or acquired images under different weather conditions at constant plant output; and

processing the corrected image output data in real time into plant output data that comprises plant output activity and capacity utilisation with or without effluent compositional data of the industrial facility ".

Claims 2 to 4 and claims 6 to 9 are dependent claims.

The claims of the Auxiliary Requests are not relevant for the purpose of the present decision.

VI. The appellant's arguments may be summarised as follows:

In its decision the examining division considered that document D5 describes a system for monitoring and determining plant output activity comprising an imaging system including one or a plurality of infrared detector cameras and an analysis subsystem as defined in claim 1; and that only the last feature (iii) in claim 1 defining the application of correction factors was not explicitly disclosed in this document.

It is submitted that document D5 discloses a method for measuring trace gases in a gas plume and does not teach or suggest determining plant output activity and capacity utilisation. The disclosure in D5 rather relates to digital filters, and more particularly to a method for detecting and monitoring atmospheric gases, such as gases emitted from smoke stacks or tail pipes, through the use of a gas sensor and a digital filter constructed to correlate only with the spectrum of the gas of interest to yield the density of the gas (D5, page 1, lines 10-17). According to D5, one problem associated with detecting and measuring trace gases is that the spectral signal of interest associated with the trace gas is typically a small part of the overall signal measured by the sensor. It is often difficult for a basic correlation filter to detect this small target signal unless the background component of the measured spectrum is removed (D5, page 2, lines 5-11). D5 states that several conventional spectral measurement techniques exist and then discusses these (D5, page 2, line 12 to page 3, line 21). According to D5, a third known technique is known as an orthogonal background suppression (OBS) technique. OBS techniques are used to measure the column density/thermal radiance contrast product of a gas plume using a passive

thermal/infrared emission spectrometer. In particular the system described in D5, with reference to Fig. 2 includes a processor 22 which processes target pixel information measured by the sensor in accordance with the OBS technique of the invention (D5, page 6, lines 2-6). The sensor shown is a JPL Airborne Emission Spectrometer although ground based sensors, such as the Hughes Mobile FTS ground spectrometer, may be used (D5, page 6, lines 6-9). Therefore the technique disclosed in D5 makes use of a spectrometer. The present invention, however, makes use of one or more infrared detector cameras. Infrared detector cameras used in the present invention are distinct from the spectrometers used in D5.

A further key difference is the end result produced by thermal imaging in the present invention and the spectroscopy used in the technique described in D5. In the present invention, the infrared detector camera images the plume and the thermal environment around the plant producing the plume. To use a simple analogy, it is measuring a heated part of a cloud in a cloud and correlating that with activity in the heated part of the cloud. In distinct contrast, the results in D5 are compositional. To detect the presence and amount of a trace gas in a plume, the plume spectrum is digitally filtered via the equations provided in D5 to leave only the component spectrum of a trace gas comprising the plume. It is submitted that the method described in D5 is not applicable to infrared thermal imaging. Therefore the subject matter of the main request is novel over the contents of D5. It is further submitted that the subject matter of the main request involves an inventive step over the contents of D5.

The examining division also referred to document D4 as "...solving a similar problem". This document describes an unmanned integrated remote emissions sensor (RES) that measures emission levels from vehicle exhaust. The RES comprises, as a single unit, an IR source and receiver, a speed sensor, an automated license plate reader (ALPR), a calibration gas and container, computer and power supplies. The RES is positioned at the side of the road so that an infrared beam is directed across the road through the exhaust of a vehicle passing the RES where radiation is absorbed by various exhaust molecular species, and reflected back to the sensor by a reflector on the opposite side of the road where the reflected IR beam is compared to calibration curves of ambient air to determine concentration of the molecular species. This data is combined with the vehicle license plate number of the vehicle emitting the exhaust. The system in D4 does not obtain pixelated images of the exhaust, but measures the difference in IR intensity resulting from radiation absorption by the targeted molecular species, i.e. NO, H_20, $C0_2$, CO, and hydrocarbons, as the IR beam passes through the exhaust. Detectors for each molecular species pass the received radiation to a computer which calculates the concentrations of the molecular species in the exhaust. The system in D4 does not correct the emission data per se that it receives. D4 states that a CPU automates calibration of the remote emissions sensor. The RES uses reference curves based on ambient air to measure exhaust components. Ambient conditions can change during the day, i.e., carbon monoxide and hydrocarbon levels can increase which require constant checking to maintain calibration (D4, column 5, lines 55-59). A calibration gas is puffed in front of the sensor and its composition compared to reference samples to determine if the calibration curves need to

be recomputed. Rain destroys the IR signal and, therefore, the RES cannot obtain vehicle emissions data during inclement weather unlike the present invention which provides correction factors for effluent plume images obtained during various weather conditions.

Having regard to the above comments it is clear that D4 does not solve "a similar problem". It is also clear that the skilled person is not going to be able, by combining teachings from D5 and D4, to arrive at a system or a method according to the main request. It is further clear that neither D5 nor D4 contains any suggestion why a person skilled in the art would even consider trying to combine D5 and D4 in any way at all.

It is, thus, submitted that the subject matter claimed in the main request involves an inventive step over D5 and D4.

Reasons for the Decision

1. The appeal is admissible.

1.1 Amendments

The board is satisfied that in the set of claims according to the present Main Request the formal objections raised in the decision have been overcome. With the adapted description pages filed with the letter of 8 September 2014 also the further formal deficiencies under the EPC have been overcome. The application documents also comply with the provisions of Article 123(2) EPC.

2. Patentability

2.1 Novelty - Claim 1

In the decision under appeal no objections pertaining to lack of novelty based on the disclosure in document D5 were raised. The board also does not see a basis for such an objection.

2.2 Inventive step - document D5

2.2.1 According to point 1.1 at page 3 of the decision, document D5 discloses a "system for monitoring and determining plant output activity". Indeed, this document relates to the measurement of trace gases in a gas plume, in particular emitted from smoke stacks (see Figure 2, stack 14), which, in a general sense, may be a stack in a plant.

2.2.2 In the opinion of the examining division, the system disclosed in document D5 comprises an "imaging subsystem". This opinion was based on the following passages in document D5:

- the expression "The system provides a sensor that measures target pixel information" (page 4, lines 20-21);
- the expressions "The sensor is a linear array of 4 detectors" and "...image" (page 17, lines 7 and 18).

The examining division also identified the features in claim 1 "one or a plurality of imaging units having one or a plurality of infrared detector cameras" by the same expressions in D5 "linear array of 4 detectors" (page 17) and "target pixel information" (at page 4).

2.2.3 In contrast the appellant has argued in the grounds of appeal that document D5 relates to a spectrometer. In order to clarify this issue the board makes reference to document D6, which discloses the Airborne emission spectrometer (AES) referred to in D5 at page 6, line 7; and at page 17, line 12. As is readily understood from Figure 2 of this document D6, the AES optical system is not an imaging system but comprises an array of four detectors as part of a moving mirror Michelson FTS ("push-broomed"), see also document D5, page 17, lines 11 - 26. Since the four detectors are arranged to receive the same input beam (Figure 2 of D6) and only detect different spectral bands (via the dichroic beam splitters) the AES is not an instrument providing spatial resolution but rather spectral resolution, i.e. it is not an imaging instrument.

2.2.4 With respect to the passages in document D5 referred to by the examining division to support its belief that the instrument in this document would include an imaging subsystem or imaging units, it is observed:

- in document D5, the term "pixel" in the expression "The system provides a sensor that measures target pixel information" (page 4, lines 20-21) appears to be used in a rather uncommon sense: the expression "pixels" would normally be used for the picture elements in an imaging system (e.g. a CCD). However, in document D5 this term "pixel" is a synonym for "target scene", see page 6, lines 19 and 20. See also the penultimate line of this page, where the expression "f is the fraction of the pixel filled by the plume" clearly reveals that here "pixel" is not used in the sense of picture element of an imaging sensor (because such an element would not have a "fraction").

- the expression at page 17, line 17 and 18 ("linear array of 4 detectors .... 4xm ultra-special image") describes the AES Michelson interferometer with 4 detectors, each having a different spectral wavelength band and the interferometer being scanned with m steps per scan. In this context it is presumed that the expression "ultra-special image" is erroneous and should in fact read "ultra-spectral image" (to indicate the high spectral resolution obtained by the four detectors).

2.2.5 For this reason the board concurs with the appellant that document D5 does not relate to a system including an imaging subsystem and imaging units comprising infrared detector cameras. In fact, this document does not disclose a system of the type as defined in the preamble of claim 1, therefore this document is not a suitable starting point for the discussion of inventive step.

2.3 Inventive step - the further documents

2.3.1 In the decision document D4 had been cited as a document which would solve the problem of recalibration of a remote emission sensor ("RES") if the ambient (weather) conditions change. The system described in this document is rather different from the claimed system, because it employs an infrared emitting beam source and a receiver sampling the transmitted and reflected beam after passing through an exhaust plume of a passing vehicle. Apart from a video camera which may take a picture of the vehicle licence plate the system does not comprise an imaging subsystem within the meaning of the preamble of claim 1, therefore also

document D4 is not a suitable starting document for discussing inventive step.

2.3.2 Since neither document D4 nor D5 disclose the use of infrared cameras also the combination of their teachings would not result in the subject-matter of claim 1.

2.3.3 The only further document which had been cited during the examining proceedings against original claim 1 is document D1 (US-A-5 794 549). According to the applicant in its letter of 19 December 2008, that document discloses a method for monitoring conditions in a fossil-fueled utility boiler using at least one imaging camera and is considered to represent the closest prior art.

2.3.4 Unlike the system defined in present claim 1 the device of document D1 does not teach or suggest the use of imaging units positionable and operational at a distance of between 25 metres to 10 kilometres nor a monitoring system as defined in the characteristic portion of claim 1.

2.4 Therefore the board concludes that the subject-matter of this claim is novel and involves an inventive step.

2.5 The same conclusion can be drawn for independent claim 5, which defines a method for monitoring and determining plant activity in real time with the monitoring system according to independent claim 1.

2.6 Claims 2 to 4 and claims 6 to 9 are dependent claims and are equally allowable.

3. For the above reasons, the board finds that the appellant's Main Request meets the requirements of the EPC and that a patent can be granted on the basis thereof.

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 based on the following documents:

Claims: 1 to 9 of the Main Request, filed with the letter dated 21 February 2011;
Description: pages 12 to 22 as published;
page 7, filed with telefax on 12 March 2010;
pages 1 to 6, 8 to 11, 11a, 11b, 23, filed with the letter dated 8 September 2014;
Drawings: sheets 1/16 to 16/16, as published.

The Registrar: The Chairman:

M. Kiehl A. Klein

Decision electronically authenticated