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D E C I S I O N
of 22 June 2005

Case Number: T 0985/04 - 3.4.1

Application Number: 96945633.4

Publication Number: 0870202

IPC: G01R 33/20

Language of the proceedings: EN

Title of invention:
Method and apparatus for detecting target species having quadrupolar nuclei by stochastic nuclear quadrupole resonance

Applicant:
THE GOVERNMENT OF THE UNITED STATES OF AMERICA, as represented by THE SECRETARY OF THE NAVY

Opponent:
-

Headword:
-

Relevant legal provisions:
EPC Art. 52(1), 54, 56

Keyword:
"Inventive step (no) - main request"
"Novelty (no) - auxiliary request"

Decisions cited:
-

Catchword:
-

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Case Number: T 0985/04 - 3.4.1

D E C I S I O N
of the Technical Board of Appeal 3.4.1
of 22 June 2005

Appellant: THE GOVERNMENT OF THE UNITED STATES
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Decision under appeal: **Decision of the Examining Division of the European Patent Office posted 10 February 2004 refusing European application No. 96945633.4 pursuant to Article 97(1) EPC.**

Composition of the Board:

Chairman: B. J. Schachenmann
Members: R. Q. Bekkering
H. K. Wolfrum

Summary of Facts and Submissions

I. European patent application 96 945 633.4 (publication nos. WO-A-97 24625 and EP-A-0 870 202) was refused pursuant to Article 97(1) EPC by a decision of the examining division dispatched on 10 February 2004, on the grounds of Article 123(2) EPC and Articles 52(1) and 56 EPC.

II. The applicant (appellant) lodged an appeal against the decision on 14 April 2004 and paid the appeal fee on the same day. The statement of the grounds of appeal was received on 18 June 2004.

III. Reference was made *inter alia* to the following documents:

D1: US-A-4 034 191

D5: WO-A-93 02365

D7: US-A-3 711 764

D8: US-A-3 581 191

IV. Oral proceedings, requested as an auxiliary measure by the appellant, were held on 22 June 2005.

V. The appellant requested that the decision under appeal be set aside and a patent be granted on the basis of the following documents:

Main request:

Claims: No. 1 to 22 filed in the oral proceedings on 22 June 2005;
Description: Pages 1, 5 to 7 as originally filed; Pages 2 to 4 filed with the letter of 12 November 2003;
Drawings: Sheets 1/5 to 5/5 as originally filed.

Auxiliary request:

Claims: No. 1 to 17 filed in the oral proceedings on 22 June 2005; Description and drawings as for the main request.

VI. Independent claims 1 and 11 according to the main request read as follows:

"*1. A device for detecting a class of target species containing quadrupolar nuclei in a specimen having an NQR frequency of an explosive or a narcotic by nuclear quadrupole resonance, comprising:*

(a) sequencer means (200) for generating a random or pseudo-random train of rf pulses;

(b) irradiating means (10) for irradiating said specimen with said train of rf pulses having a pulse frequency at least near to the NQR frequency;

(c) detecting means (10) for detecting an NQR signal in response to irradiating said specimen;

(d) coupling means (20) for transmitting said train of rf pulses to said irradiating means (10);

(e) coupling means (20) for receiving said NQR signal from said detecting means (10);

(f) cross-correlating means (70) for cross—correlating said received NQR signal with said random or pseudo—random train of rf pulses, thereby generating a free induction decay signal;

(g) transform means (70) for converting said free induction decay signal into a frequency domain signal."

"*11. A method of detecting a class of target species containing quadrupolar nuclei in a specimen having an NQR frequency of an explosive or a narcotic by nuclear quadrupole resonance, comprising:*

(a) generating a random or pseudo-random train of rf pulses produced by a sequencer means;

(b) irradiating said specimen with said train of rf pulses, said random or pseudo—random train of phase-shifted rf pulses having a pulse frequency at least near to the NQR frequency;

(c) detecting an NQR signal in response to irradiating said specimen;

(d) cross—correlating said NQR signal with said random or pseudo-random train of rf pulses, thereby generating a free induction decay signal;

(e) converting said free induction [sic] *signal into a frequency domain signal.*"

VII. Independent claims 1 and 11 according to the auxiliary request differ from those of the main request in that the features

"*having an NQR frequency of an explosive or a narcotic*"

and

"*(said random or pseudo—random train of phase-shifted rf pulses) having a pulse frequency at least near to the NQR frequency*"
have been omitted from the introductory part and feature b) of the claims and the feature
"*having equal amplitude and pseudo-randomly shifted phases of 0^0 and 180^0*"
has been introduced in feature a) of the claims.

Reasons for the Decision

1. The appeal complies with the requirements of Articles 106 to 108 and Rule 64 EPC and is, therefore, admissible.

2. Main request

2.1 Amendments

Independent claim 1 is based on original claim 1, the additional features which relate to the pulse frequency being at least near to the NQR frequency of an explosive or narcotic and to the sequencer means are derivable from the original description (see page 4, lines 3 to 6 and lines 18 to 21, respectively). Similarly, independent claim 11 is based on original claim 12 with the above additional features taken from the original description.

The Board is thus satisfied that the amendments to these claims comply with the requirements of Article 123(2) EPC.

2.2 Novelty, inventive step

2.2.1 The closest prior art is provided by document D7 (see figure 1 and corresponding description) disclosing a noise excited resonance apparatus applicable in general to spectrometers including nuclear quadrupole resonance (NQR) spectrometers (see column 9, lines 9 to 18).

In particular, document D7 discloses, using the terminology of claim 1 under consideration, a device for detecting a class of target species containing quadrupolar nuclei in a specimen having a given NQR frequency by nuclear quadrupole resonance, comprising:

(a) sequencer means (5) for generating a random or pseudo-random train of rf pulses;

(b) irradiating means (2) for irradiating said specimen with said train of rf pulses having a pulse frequency at least near to the NQR frequency;

(c) detecting means (2) for detecting an NQR signal in response to irradiating said specimen;

(d) coupling means for transmitting said train of rf pulses to said irradiating means (2) and

(e) coupling means for receiving said NQR signal from said detecting means (2) (implicit, see also column 2, line 54 to column 3, line 7 and column 3, lines 54 to 63);

(f) cross-correlating means (11) for cross—correlating said received NQR signal with said random or pseudo—random train of rf pulses, thereby generating a free induction decay signal;

(g) transform means (13) for converting said free induction decay-signal into a frequency domain signal.

2.2.2 The subject-matter of claim 1 under consideration differs from the apparatus known from document D7 in that the pulse frequency, ie the rf frequency of the pulses, is at least near to the NQR frequency of an explosive or a narcotic. Accordingly, the subject-matter of claim 1 is novel with respect to document D7. Novelty is also given having regard to the remaining cited, more remote prior art.

2.2.3 In view of the above identified difference of the subject-matter of claim 1 over the teaching of document D7, the objective problem to be solved could be seen as residing in the selection of a useful substance to be analysed in this known NQR spectrometer. The particular substance selected will, by way of its NQR resonance frequencies, dictate the rf frequency of the irradiating means of the spectrometer.

2.2.4 However, the suggested use in the application in suit for the detection of explosives and narcotics, requiring the rf pulses to be at least near to the NQR frequencies of theses substances, is rendered obvious by the teaching of document D5 (see page 1, lines 9 to 21), in which NQR detection of explosives and narcotics, in particular those being crystalline solids containing nitrogen, has already been addressed as being of particular interest. Examples of such substances include RDX which has resonance lines near 1.8, 3.4 and 5.2 MHz (see document D5, page 4, lines 20 to 21). It would accordingly be evident to set the apparatus known from D7 up so as to provide rf pulses with a frequency at least near the resonance frequencies of the substance to be detected, ie in the exemplary case of RDX near 1.8, 3.4 and 5.2 MHz.

2.2.5 The appellant has argued that because the sensitivity of stochastic NQR detectors had been shown to be very low, in particular at the relatively low frequencies being claimed, and because the trend in the art had been toward the use of more and more power, one of ordinary skills in the art would not have considered a stochastic NQR detector as a candidate for detecting explosives or narcotics. In particular, prior to the invention, applying a random or pseudo-random train of phase shifted rf pulses at the relatively low frequencies claimed was considered undesirable because the recovery times of the NQR detector apparatus, in particular as dictated by the ring-down time of the delivered pulse, would be insufficient to observe the resonance signal. The absence of any expectation of success in the present case would have kept the skilled person from considering the claimed subject-matter. Furthermore, the fact that, although both NQR and stochastic excitation as such had been available for a long time, a combination of both for the detection of explosives and narcotics had not been suggested previously, had to be considered as indicative of the inventiveness of the invention as claimed.

2.2.6 The appellant's argumentation, however, ignores the fact that stochastic excitation, also in the context of NQR spectrometers, has been developed well before the priority date of the application in suit specifically in order to overcome the excessive peak power requirements for non-stochastic excitation pulses, as disclosed in for instance document D8 (see column 1, lines 53 to 70 and column 2, lines 43 to 49) or D1 (see column 1, lines 44 to 51), both closely related to

document D7 referred to above. Evidently, the skilled person working in the technical field at issue of nuclear resonance spectroscopy, would have considered employing the available equipment, such as the one disclosed in document D7, for the spectroscopy of in principle any substance of interest showing a quadrupole resonance effect, including such substances like nitrogen containing explosives and narcotics, for which NQR spectroscopy has already proven to be a useful analytical tool (see eg document D5).

Furthermore, it should be borne in mind that document D7 in fact provides an apparatus permitting to achieve, as a result of the stochastic excitation, a high signal-to-noise ratio despite a reduction in rf excitation pulse power. Accordingly, should the skilled person indeed have had concerns regarding the detectability of the relatively weak NQR signals from explosives or narcotics, the spectrometer of D7 would rather appear promising in producing sufficiently strong NQR signals.

In this respect it is noted, that should the ring-down time of the pulses at the relevant NQR frequencies of explosives and narcotics indeed be such that the relatively weak resonance signals as a result of the stochastic excitation would not be detectable, the application in suit does not provide any indication as to how this particular problem is solved, so that it is to be assumed that at the priority date of the present application the skilled person already knew how to cope with this issue. Therefore, this issue cannot have been a deterrent.

Finally, as far as the time factor is concerned, it would appear that the arguably slow progress in the field of NQR, in particular as regards the detection of explosives and narcotics, in the past decades, rather than being brought about by any serious technical difficulties encountered, has been caused by an until recently fairly low scientific, commercial and political interest in this field.

2.2.7 For the reasons above, the subject-matter of claim 1 according to the main request lacks an inventive step (Articles 52(1) and 56 EPC).

2.3 The argumentation above applies, *mutatis mutandis*, to the subject-matter of independent claim 11 directed to a corresponding method of detecting by NQR. The subject-matter of claim 11 according to the main request, thus, also lacks an inventive step (Articles 52(1) and 56 EPC).

2.4 For the reasons above, the main request is not allowable.

3. Auxiliary request

Independent claims 1 and 11 of the auxiliary request omit the limiting features relating to the pulses having an rf frequency at least near to the NQR frequency of an explosive or a narcotic contained in the independent claims of the main request. Instead, the rf pulses are now specified to have equal amplitude and pseudo-randomly shifted phases of 0^0 and 180^0. This feature is, however, known from document D7 (see column 2, line 62 to column 3, line 2). Since all

remaining features of claims 1 and 11 of the auxiliary request are known from document D7 as well, as discussed above with respect to the main request, the subject-matter of these claims lacks novelty having regard to document D7 (Articles 52(1) and 54 (1) and (2) EPC).

Therefore, the auxiliary request is not allowable either.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

R. Schumacher B. Schachenmann