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Datasheet for the decision of 16 March 2007

Case Number: T 0627/05 - 3.4.03

Application Number: 95911939.7

Publication Number: 0748249

IPC: B01D 59/44

Language of the proceedings: EN

Title of invention:
Multipole ion guide for mass spectrometry

Applicant:
ANALYTICA OF BRANFORD, INC

Opponent:
-

Headword:
Multipole ion guide/ANALYTICA

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

Keyword:
"Novelty - yes, after amendment"
"Inventive step - yes, after amendment"
"Added subject-matter - no"

Decisions cited:
-

Catchword:
-

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Case Number: T 0627/05 - 3.4.03

D E C I S I O N
of the Technical Board of Appeal 3.4.03
of 16 March 2007

Appellant: ANALYTICA OF BRANFORD, INC.
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Decision under appeal: **Decision of the Examining Division of the European Patent Office posted 30 December 2004 refusing European application No. 95911939.7 pursuant to Article 97(1) EPC.**

Composition of the Board:

Chairman: R. G. O'Connell
Members: G. Eliasson
T. Bokor

Summary of Facts and Submissions

I. This is an appeal against the refusal of European patent application 95 911 939.7 for lack of novelty (Article 52(1) and 54 EPC)(main request) and added subject matter (Article 123(2) EPC)(auxiliary request).

II. Prior art cited in the examination procedure included:

D3: US 4 746 794 A;
D4: US 4 535 235 A;
D9: US 4 328 420 A;
D11: Nuclear Instruments and Methods in Physics Research A, vol. 333, 1 September 1993, pages 274 to 281;
D15: Journal of Mass Spectrometry and Ion Processes, vol. 87, 1 January 1989, pages R7 to R13;
D16: International Journal of Mass Spectroscopy and Ion Processes, vol. 98, 1990, pages 35 to 50; and
D17: International Journal of Mass spectrometry and ion Processes, vol. 107, 15 June 1991, pages 91 to 102.

III. In a response dated 16 February 2007 to a summons to oral proceedings before the board the appellant applicant filed new claim requests.

IV. At the oral proceedings the appellant applicant filed amended application documents and requested that the decision under appeal be set aside and that a patent be granted in the following version:

Claims 1-45 filed as a main request with letter dated 16 February 2007, or alternatively,

Claims 1-45 of the first auxiliary request filed during oral proceedings before the board.

In view of the order below further auxiliary claim requests need not be considered.

V. Claim 1 of the main request reads as follows:

"1. An apparatus for analysing chemical species, comprising:

(a) an ion source for producing ions from a sample substance;

(b) at least two vacuum stages (53, 41, 42, 54), each of said vacuum stages (53, 41, 42, 54) having means for pumping away gas to produce a partial vacuum, said vacuum stages (53, 41, 42, 54) being in communication with each other such that the said ions can move through a sequence of vacuum stages (53, 41, 42, 54);

(c) a mass analyser (57) and detector, said mass analyser (57) and detector being located in at least one of the vacuum stages (54); and

(d) at least one multipole ion guide (40); and

(e) means for applying electrical voltages to said at least one multipole ion guide (40);

characterised in that:

said at least one multipole ion guide (40) extends continuously from one vacuum stage (41) into at least one subsequent vacuum stage (42) and wherein the background pressure in at least one of said vacuum pumping stages where said multipole ion guide is located is high enough to cause

cooling of ion kinetic energy resulting in a reduction of the ion energy spread for said ions of a given mass to charge transmitted through said multipole ion guide."

VI. Claim 1 of the first auxiliary request reads as follows:

"1. An apparatus for analysing chemical species, comprising:

(a) an ion source for producing ions from a sample substance;

(b) at least two vacuum stages (53, 41, 42, 54), each of said vacuum stages (53, 41, 42, 54) having means for pumping away gas to produce a partial vacuum, said vacuum stages (53, 41, 42, 54) being in communication with each other such that the said ions can move through a sequence of vacuum stages (53, 41, 42, 54) and wherein each successive vacuum stage in said sequence of vacuum stages has a lower background pressure than the previous vacuum stage;

(c) a mass analyser (57) and detector, said mass analyser (57) and detector being located in at least one of the vacuum stages (54); and

(d) at least one multipole ion guide (40); and

(e) means for applying electrical voltages to said at least one multipole ion guide (40);

wherein:

said at least one multipole ion guide (40) extends continuously from one vacuum stage (41) into at least one subsequent vacuum stage (42) and wherein the background pressure for a portion of the length of the

multipole ion guide is high enough to cause cooling of ion kinetic energy resulting in a reduction of the ion energy spread for said ions of a given mass to charge ratio transmitted through said multipole ion guide."

Claim 38 of the first auxiliary request relates to a method of analyzing chemical species using the apparatus of claim 1.

VII. The appellant applicant's arguments can be summarized as follows:

The apparatus of document D11 was developed for cooling and focusing an ion beam having a known composition and was not devised for mass spectroscopy of a sample with an unknown composition. In particular the low mass to charge ratio of O_2^+ ions used in the experiment reported in document D11 indicated that the multipole ion guide disclosed therein could not be used for larger ions. The skilled person would therefore not consider the apparatus of document D11 to be suitable for mass spectrometry.

Moreover, the glow-ion source used in the system of document D11 was unsuitable for biological molecules as it would induce unwanted fragmentation of the molecules. The high background pressure in the vacuum stages would likewise cause fragmentation of molecules.

Therefore, the skilled person faced with the task of producing an improved mass spectrometer would not consider document D11 as a feasible starting point.

Reasons for the Decision

1. The appeal is admissible.

2. *Amendments - first auxiliary request*

2.1 With respect to claim 1 as filed, the following amendments have been made to claim 1 of the first auxiliary request:

(i) the features "an ion source operated at or near atmospheric pressure which produces gaseous ions from analyte in solution and delivers said ions into a first vacuum pumping stage through an orifice" is replaced by "an ion source for producing ions from a sample substance";

(ii) the multipole ion guide is no longer specified to consist of "a multiple of equally spaced parallel poles extending the length of the ion guide";

(iii) the features "means for applying AC and DC voltages to said poles of said multipole ion guide" and "means for controlling the AC frequency and said AC and DC voltages" are replaced by "means for applying electrical voltages to said at least one multipole ion guide";

(iv) it is specified that each successive vacuum stage "in said sequence of vacuum stages has a lower background pressure than the previous vacuum stage"; and

(v) it is specified that "the background pressure for a portion of the length of the multipole ion guide is high enough to cause cooling of ion kinetic energy resulting in a reduction of the ion energy spread for said ions of a given mass to charge ratio transmitted through said multipole ion guide".

2.2 The deletion of "ion source which is operated at or near atmospheric pressure ion and delivers said ions into a first vacuum pumping stage through an orifice" (amendment (i)) is in the board's opinion justified in that the skilled person would understand that the invention as claimed is applicable to the transmission of ions regardless of the manner in which they are produced and introduced to the ion transmission system.

2.3 As to amendments (ii) and (iii), the term "multipole ion guide" is a generic term in the art. It is accordingly not necessary to specify in detail features of the multipole ion guide which are not modified in the invention as claimed (compare Guidelines, C-III, 4.7 relating to the long-standing practice of the EPO not to require features which are implied by a generic term used in the claim to be specified).

2.4 The basis for the additional features (iv) and (v) is found in claim 67 and on page 24, lines 15 to 17, respectively, of the application as published.

2.5 As to the basis for claims 2 to 45 in the application as filed, the board is satisfied that the comprehensive references given in Annex B of the applicant's letter

of 14 October 2004 indicate sufficient support in the application as filed for the amended claims.

2.6 For the above reasons, the claims of the first auxiliary request meet the requirements of Article 123(2) EPC.

3. *Novelty and inventive step - Main request*

3.1 Document D11 discloses an apparatus comprising an ion source producing ions from a sample substance, two vacuum stages, a multipole ion guide (Sextupole Ion beam Guide "SPIG"), means for applying electrical voltages to the multipole ion guide, and a detector (Faraday cup) (see Figure 1, section 3.1). In each vacuum stage, gas is pumped away to produce a partial vacuum. The multipole ion guide extends continuously from one vacuum stage to another (page 278, second paragraph). The background pressure in the second stage is lower (13 Pa) than that in the first stage (80 Pa) (see paragraph bridging pages 278 and 279) and is high enough in both vacuum stages to cause cooling of the ion kinetic energy resulting in a reduction or the spread in ion energy (page 277, paragraph bridging left and right hand columns; section 3.2, last paragraph).

3.1.1 The apparatus of claim 1 of the main request differs from that of document D11 in that (I) it comprises a mass analyser.

The apparatus of document D11 on the other hand does not comprise a mass analyser, as it is intended for applications where ions with a known mass are injected from the ion source to an ion trap system for

performing high resolution laser spectroscopy of unstable nuclei (D11, section 3.3, last paragraph).

3.2 Document D10 discloses a mass spectrometer having two vacuum chambers 30, 38 where a multipole ion guide 32 is located in a first vacuum chamber 30 (see Figure 1; column 4, lines 4 to 65). The ions of the chemical species to be analysed are introduced into the first vacuum chamber 30 from an ion source 16. After passing through the multipole ion guide 32 in the first vacuum chamber 30, the ions are detected by a mass analyser 40 in form of a second multipole ion guide located in the second vacuum chamber 38. The pressure of the second vacuum chamber 38 is less than that of the first vacuum chamber 40 (column 4, lines 53 to 68). The pressure in the first chamber is sufficiently high to cause cooling of ion kinetic energy so that the ion energy spread is reduced (column 8, lines 49 to 59). The result is an increased transmission of ions into the mass analyzer (Figure 3 with accompanying text).

3.2.1 The subject matter of claim 1 of the main request differs from the apparatus of document D10 in that a multipole ion guide extends continuously from one vacuum stage into at least one subsequent vacuum stage, whereas in document D10, each multipole ion guide 32, 40 is contained in its respective vacuum chamber.

3.3 Document D16 discloses a mass spectrometer with a single quadrupole ion guide extending through at least two different vacuum stages (see Figure 1). The background pressure at the mass analyser is "in the 10^{-10} torr range" and a pressure gradient of 40000:1 is

maintained between the ion source region and the ion detection region (see page R9).

3.3.1 According to document D10, the product of pressure and length should be at least 2.25×10^{-2} torr·cm in order to enable cooling of ion kinetic energy (see D10, column 13, lines 33 and 34; abstract). The appellant applicant has convincingly shown that the background pressures and dimensions of the apparatus of document D16 are such that the condition for kinetic cooling of ion kinetic energy is not met in this apparatus.

3.3.2 The subject matter of claim 1 of the main request thus differs from that of document D16 in that the background pressure in at least one vacuum stage is high enough to cause cooling of ion kinetic energy.

3.4 The subject matter of claim 1 of the main request is thus new within the meaning of Article 54 EPC.

3.5 As to the question of closest prior art, the appellant applicant argued that the apparatus of document D11 was not suitable for mass spectroscopy applications, and therefore, the skilled person in the field of mass spectroscopy would not consider document D11 as a starting point for designing an improved mass spectroscopy apparatus (see item VII above).

The board is not persuaded by the above argument, since the skilled person would be well aware that multipole ion guides are used not only in mass spectroscopy applications, but also as mass filters. The skilled person looking for possible improvements of the ion guide system in a mass spectrometer would also take

note of improvements of ion guide systems used as mass filters and the like. The skilled person would therefore not only appreciate that the same type of multipole ion guide as disclosed in document D11 could be used as a component in mass spectroscopy applications, but would also be aware of that operational parameters, such as background gas pressure and type of ion source, would have to be adjusted accordingly.

3.6 Starting from document D11, the objective technical problem relates to applying the teaching of document D11 to mass spectroscopy.

3.7 The skilled person faced with the task of applying the teaching of document D11 to mass spectroscopy would know that a mass analyser, for example in form of a further multipole ion guide followed by an ion detector, would have to be introduced in a stage following the multipole ion guide.

3.8 As to the argument that the background pressures disclosed in document D11 were too high for mass spectroscopy applications, it is noted that the background pressure where the mass analyser is located has to be low. Since the skilled person would as a matter of routine place the mass analyser in a separate vacuum stage following the two vacuum stages containing the multipole ion guide of the device of document D11, it would be possible to keep the mass analyser at a considerably lower background pressure than the pressures in the previous stages.

3.9 Regarding the argument that the ion source disclosed in document D11 was not suitable for large molecules, the board consider it to be within the competence of a skilled person to select the type of ion source suitable for the chemical species to be analysed. It is furthermore noted that claim 1 does not specify the ion source beyond the feature that it is "for producing ions from a sample substance".

For the above reasons, in the board's judgement, the subject matter of claim 1 of the main request does not involve an inventive step within the meaning of Article 56 EPC.

4. *Inventive step - First auxiliary request*

4.1 The subject matter of claim 1 of the first auxiliary request differs from the apparatus of document D11 in addition to feature (I) mentioned above (mass analyzer) in that (II) the background pressure for a portion of the length of the multipole ion guide is high enough to cause cooling of ion kinetic energy, whereas in the apparatus of document D11, the background pressure for the entire length of the multipole ion guide is high enough for the kinetic cooling effect to occur.

4.2 Document D11 does not contain any hint to the skilled person that a sufficient kinetic cooling of the ion beam could be achieved also when only a portion of the length of the multipole ion guide is maintained at the higher pressure. Since the apparatus of document D10 discloses a multipole ion guide fully enclosed in a vacuum stage, the claimed feature cannot be derivable from document D10. Therefore, absent any indication in

the prior art as to the possibility of subjecting only a portion of the multipole ion guide to background pressures sufficiently high for kinetic cooling, the skilled person would not be able to arrive at the claimed apparatus without employing inventive skills.

4.3 For the above reasons, the subject matter of claim 1 of the first auxiliary request involves an inventive step within the meaning of Article 56 EPC.

4.4 Since claims 2 to 45 of the first auxiliary request all refer directly or indirectly to the apparatus of claim 1, the subject matters of claims 2 to 45 likewise involve an inventive step.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The main request is refused.

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

   - Claims 1-45 of the first auxiliary request as filed at the oral proceedings before the board

   - Description:
     pages 1-4, 6, 12, 16-19, 21, 23, 26-35, 37-38 as published
     pages 5, 7-11, 13-15, 20, 22, 24, 25, 36, 39, 40 as filed during oral proceedings

   - Drawings: Sheets 1 to 14 as published.

Registrar Chair

S. Sánchez Chiquero R. G. O'Connell