UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Agilent Technologies, Inc.,
Petitioner

v.

Thermo Fisher Scientific Inc. and
Thermo Fisher Scientific (Bremen) GmbH,
Patent Owner.

Case No. Unassigned

U.S. Patent No. RE45,553

Petition for *Inter Partes* Review of U.S. Patent No. RE45,553

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TABLE OF CONTENTS

Page

TABLE OF CONTENTS
(continued)

Page

TABLE OF CONTENTS
(continued)

Page

TABLE OF CONTENTS
(continued)

Page

TABLE OF AUTHORITIES

Cases

TABLE OF AUTHORITIES (Cont'd.)

Page(s)

Statutes

Regulations

TABLE OF EXHIBITS

Petitioner's Exhibit No.	**Document**
1001	U.S. Patent No. RE45553E1 ("the '553 Patent")
1002	Prosecution History of U.S. Patent No. 7,211,788 ("'788 Patent"), May 8, 2006 Non-Final Rejection.
1003	Prosecution History of the '788 Patent, September 11, 2006 Amendment and Remarks.
1004	Declaration of Richard Yost, Ph.D.
1005	The Complaint (served copy)
1006	Tanner, Scott D., and Vladimir I. Baranov. "A dynamic reaction cell for inductively coupled plasma mass spectrometry (ICP-DRC-MS). II. Reduction of interferences produced within the cell." *Journal of the American Society for Mass Spectrometry* 10.11 (1999): 1083-1094. ("Tanner")
1007	U.S. Patent No. 6,191,417 ("Douglas")
1008	Declaration of Sylvia Hall-Ellis, Ph.D.
1009	JPH10214591A ("Saito")
1010	Certified Translation of JPH10214591A ("Saito")
1011	Baranov, Vladimir, and Scott D. Tanner. "A dynamic reaction cell for inductively coupled plasma mass spectrometry (ICP-DRC-MS). Part 1. The rf-field energy contribution in thermodynamics of ion-molecule reactions." *Journal of Analytical Atomic Spectrometry* 14, no. 8 (1999): 1133-1142. ("Baranov")
1012	PCT International Application – International Publication Number WO 00/16375 ("PCT375")
1013	U.S. Patent No. 6,340,814 ("Vandermey")
1014	McLafferty, Fred W. "Tandem mass spectrometry." *Science* (1981): 280-287.
1015	Yost, Richard A., and Dean D. Fetterolf. "Tandem mass spectrometry (MS/MS) instrumentation." *Mass Spectrometry Reviews* 2, no. 1 (1983): 1-45.

Petitioner's Exhibit No.	**Document**
1016	Miller, Philip E., and M. Bonner Denton. "The quadrupole mass filter: basic operating concepts." *J. Chem. Educ.* 63, no. 7 (1986): 617-623.
1017	Yost, R. A., and C. G. Enke. "Triple quadrupole mass spectrometry for direct mixture analysis and structure elucidation." *Analytical Chemistry* 51, no. 12 (1979): 1251-1264.
1018	European Patent Application Publication No. EP0237259A2
1019	U.S. Patent No. 4,234,791 ("Enke")
1020	U.S. Patent No. 6,093,929 ("Javahery")
1021	Dawson, P. H., J. B. French, J. A. Buckley, D. J. Douglas, and D. Simmons. "The use of triple quadrupoles for sequential mass spectrometry: 1—The instrument parameters." *Journal of Mass Spectrometry* 17, no. 5 (1982): 205-211.
1022	Johnston, M., "Energy Filtering in Triple Quadrupole MS/MS," *Finnigan MAT*, San Jose, California, USA, no. 203, 1984.
1023	Eiden, Gregory C., Charles J. Barinaga, and David W. Koppenaal. "Beneficial ion/molecule reactions in elemental mass spectrometry." *Rapid Communications in Mass Spectrometry* 11, no. 1 (1997): 37-42.
1024	U.S. Patent No. 6,222,185 ("Speakman")
1025	U.S. Patent No. 6,011,259 ("Whitehouse")
1026	Koppenaal, David W. "Atomic mass spectrometry." *Analytical Chemistry* 64, no. 12 (1992): 320R-342R.
1027	Sass, Samuel, and Timothy L. Fisher. "Chemical ionization and electron impact mass spectrometry of some organophosphonate compounds." *Journal of Mass Spectrometry* 14, no. 5 (1979): 257-264.
1028	King, F. L., and W. W. Harrison. "Glow discharge mass spectrometry: an introduction to the technique and its utility." *Mass Spectrometry Reviews* 9, no. 3 (1990): 285-317.

Petitioner's Exhibit No.	**Document**
1029	Douglas, D. J. "Some current perspectives on ICP-MS." *Canadian Journal of Spectroscopy* 34, no. 2 (1989): 38-49. ("Douglas-1989")
1030	Louris, John N., Larry G. Wright, R. Graham Cooks, and Alan E. Schoen. "New scan modes accessed with a hybrid mass spectrometer." *Analytical Chemistry* 57, no. 14 (1985): 2918-2924.
1031	Houk, R. S. "Elemental and isotopic analysis by inductively coupled plasma mass spectrometry." *Accounts of Chemical Research* 27, no. 11 (1994): 333-339.
1032	Tanner, Scott D., Vladimir I. Baranov, and Dmitry R. Bandura. "Reaction cells and collision cells for ICP-MS: a tutorial review." *Spectrochimica Acta Part B: Atomic Spectroscopy* 57, no. 9 (2002): 1361-1452.
1033	Rowan, John T., and R. S. Houk. "Attenuation of polyatomic ion interferences in inductively coupled plasma mass spectrometry by gas-phase collisions." *Applied Spectroscopy* 43, no. 6 (1989): 976-980.
1034	Kishi, Yoko. "A benchtop inductively coupled plasma mass spectrometer." HEWLETT PACKARD JOURNAL 48 (1997): 72-79. ("Kishi")
1035	Montaser, Akbar et al., *An Introduction to ICP Spectrometries for Elemental Analysis* 1 in Inductively Coupled Plasma Mass Spectrometry (Akbar Montaser, ed. 1998).
1036	U.S. Patent No. 6,140,638 ("Tanner-Patent")
1037	King, F.L., et al., "Collision-Induced Dissociation of Polyatomic Ions in Glow Discharge Mass Spectrometry," *International Journal of Mass Spectrometry and Ion Processes*, 1989, vol. 89, pp. 171-185.
1038	Turner, Patrick, et al., "Instrumentation For Low and High-Resolution ICP/MS": Inductively Coupled Plasma Mass Spectrometry, Publication Wiley-VCH, edited by A. Montaser, 1998, p. 421-501. ("Turner")

Petitioner's Exhibit No.	**Document**
1039	Terzić, I., and D. Ćirić. "The double cylindrical electrostatic sector as an ion energy analyzer." *Nuclear Instruments and Methods* 166, no. 3 (1979): 419-423. ("Terzic")
1040	1992 Pittcon (The Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy) "Practical MS/MS Analysis" Short Course, Lecture 7

I. INTRODUCTION

Pursuant to 35 U.S.C. § 311, Agilent Technologies, Inc. ("Agilent" or "Petitioner") submits this petition for *inter partes* review ("IPR"), seeking cancellation of Claims 1–66 of U.S. Patent No. RE45,553 ("the '553 Patent," Ex. 1001). These claims are unpatentable under 35 U.S.C. §§ 102 and 103 over the prior art references identified and applied in this petition.

II. MANDATORY NOTICES

Pursuant to 37 C.F.R. § 42.8, Petitioner provides the following mandatory disclosures:

A. REAL PARTIES IN INTEREST

Agilent Technologies, Inc. ("Agilent") is the real party in interest.

B. RELATED MATTERS

Pursuant to 37 C.F.R. § 42.8(b)(2), the '553 Patent is the subject of a patent litigation suit brought by the Patent-Owner (see Ex. 1005). Petitioner is also filing three petitions for IPR of two other patents asserted in that litigation: U.S. Patent Nos. 7,230,232 and RE45,386.

C. LEAD AND BACK-UP COUNSEL

Petitioner provides the following designation of counsel:

Lead Counsel	Back-up Counsel
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A Power of Attorney accompanies this petition in accordance with 37 C.F.R. § 42.10(b). Service via hand delivery or postal mail may be made at the addresses of the lead and back-up counsel above. Petitioner hereby consents to electronic service, and service via electronic mail may be made at the email addresses provided above for the lead and back-up counsel.

III. PAYMENT OF FEES

Pursuant to 37 C.F.R. §§ 42.103 and 42.15(a), $52,600 is being paid via deposit account 501408. Any additional fees due in connection with this petition may be charged to the foregoing account.

IV. STANDING

Pursuant to 37 C.F.R. § 42.104(a), Petitioner certifies that the '553 Patent is available for IPR and that Petitioner is not barred or estopped from requesting IPR of the claims on the grounds identified herein.

V. IDENTIFICATION OF CHALLENGE AND STATEMENT OF PRECISE RELIEF REQUESTED

Pursuant to 37 C.F.R. § 42.104(b), Petitioner requests that the Board institute *inter partes* review of Claims 1-66 of the '553 Patent on one or more grounds under pre-AIA 35 U.S.C. §§ 102 and/or 103.

VI. THRESHOLD REQUIREMENT FOR *INTER PARTES* REVIEW

Under 35 U.S.C. § 314(a), institution of *inter partes* review requires "a reasonable likelihood that the petitioner would prevail with respect to at least one of the claims challenged in the petition." This petition meets this threshold for each of the asserted grounds of unpatentability.

VII. STATEMENT OF REASONS FOR THE RELIEF REQUESTED

Petitioner predicates its challenge on five references. Collectively, these references render each claim of the '553 Patent unpatentable based on the following seven grounds.

A. GROUNDS

- GROUND 1: PCT375 anticipates claims 1–5, 8–10, 12–15, 18–21, 25–35, 38, 41, 43, 46, 48, 51, 53, 56, 58, 61, 63, 66 under § 102(b);
- GROUND 2: PCT375 renders obvious claim 11 under § 103;
- GROUND 3: Tanner anticipates claims 1, 4–6, 8–9, 12-13, 16, 18–19, 22, 24–25, 28, 31–32, 35, 38–41, 43–46, 48–51, 53–56, 58–61, 63–66 under § 102(b);
- GROUND 4: Douglas in combination with Tanner renders obvious claims 1–6, 8–9, 12–16, 18–22, 24–66 under § 103;
- GROUND 5: Vandermey in combination with Douglas and Tanner renders obvious claims 6–7, 16–17, 22–23, 37, 42, 47, 52, 57, 62 under § 103;
- GROUND 6: Saito anticipates claims 1, 4–6, 12, 28, 32, 57, and 62 under § 102(b);
- GROUND 7: Saito in combination with Douglas renders obvious claims 1–6, 12–16, 18, 20–22, 25–38, 42–43, 47–48, 52–53, 57–58, and 62–63 under § 103.

The Declaration of Richard Yost, Ph.D., a world-renowned expert in mass spectrometry, accompanies this petition. Ex. 1004.

B. PRIORITY DATE OF THE '553 PATENT

The '553 patent is a reissue from U.S. Patent No. 7,211,788 (the "'788 Patent"). The reissue application was filed on September 19, 2013 (Application Number 14/032,110). The '788 patent was filed on May 27, 2004 (Application Number 10/497,396), which ultimately claimed priority to a GB patent application 0210930.4, filed May 13, 2002.

For purposes of this petition, Agilent assumes that the claims are entitled to a priority date of May 13, 2002.

VIII. STATE OF THE ART

A. PERSON OF SKILL IN THE ART

A person of ordinary skill in the art in May 2002 would have a Ph.D. or a Master's degree, or an equivalent education or practical experience, in chemistry, physics, or a related field, and at least two to three years of experience in developing the instrumentation and/or the applications of tandem mass

spectrometry and/or quadrupole mass spectrometers (hereafter, "POSA"). Ex. 1004 ¶23.

B. SCOPE AND CONTENT OF THE ART BEFORE MAY 2002

1. Mass Spectrometry

Mass spectrometry ("MS") is an analytical technique used to identify and quantify chemical elements and compounds (*i.e.*, atoms and molecules, respectively) in a sample based on the atomic mass and charge state of the constituents in the composition. Ex. 1014, 281–82; Ex. 1004 ¶¶32-33. Typically, a sample containing atoms or molecules of interest is introduced into the ion source of a mass spectrometer. *Id*.; Ex. 1015, 6-9; Ex. 1004 ¶¶32-33. The ion source induces either a positive or a negative charge in the neutral atoms and molecules, typically by adding or removing electron(s), generating positive or negative ions. *Id*., 281-282; Ex. 1015, 6-9; Ex. 1004 ¶¶32-33. In most instruments, only the positive ions are electrostatically guided by ion optics into a portion of the mass spectrometer called a "mass analyzer." *Id*., 281-282; Ex. 1015, 9; Ex. 1004 ¶¶32-33. The mass analyzer allows ions of a specific mass-to-charge ratio (m/z or m/e) to pass through to a detector while preventing all other ions from reaching the

detector when the detector is measuring ions of a set m/z value. Ex. 1015,16; Ex. 1004 ¶¶32-33.

2. Quadrupole Mass Analyzer

A quadrupole is the most common mass analyzer used in modern mass spectrometry. Ex. 1016, 617; Ex. 1004 ¶35. It comprises four parallel rods arranged in a radial array at 90° intervals, with opposite pairs of rods electrically connected. *Id*., 618; Ex. 1004 ¶35. There are two main modes of operating a quadrupole: RF-only and RF-DC mode. *Id*., 621–22; Ex. 1004 ¶35. When only an RF voltage is applied between the rod pairs, the quadrupole would transmit all ions above a certain m/z cutoff, generally termed "total ion mode." *Id*.; Ex. 1004 ¶35. When a combination of RF and DC voltages is applied between the rod pairs, the quadrupole transmits ions between upper and lower m/z cutoffs, such that the mass analyzer acts as a "mass filter" for the purpose of passing selected ions. *Id*.; Ex. 1004 ¶35. As the DC-to-RF ratio increases, the quadrupole's transmission band narrows. *Id*.; Ex. 1004 ¶35. At a certain DC-to-RF ratio, this transmission band is so narrow as to allow only ions of a specific integer m/z to pass through, generally termed "unit mass resolution." *Id*.; Ex. 1004 ¶35. By selecting (typically under computer control) one or a series of DC and RF voltages (at constant DC/RF ratio),

one can select ions of one or a series of m/z ratios to be passed by the mass analyzer, generally referred to as "selected ion monitoring," or SIM mode. *Id*.; Ex. 1015, 3-5; Ex. 1017, 1251; Ex. 1004 ¶35. If the magnitude of the DC and RF voltages is continuously increased over time while keeping the DC/RF ratio constant, the mass filter will scan over a range of m/z ratios and generate a mass spectrum, generally termed "full-scan mode." Ex. 1016, 621; Ex. 1004 ¶35.

Quadrupole mass spectrometers may have two, three, or more quadrupoles arranged in tandem. Exs. 1018–20; Ex. 1004 ¶36. Each of the quadrupoles can be designed to operate independently and/or with one another. *Id.*; Ex. 1004 ¶¶36-49. For example, a triple-quadrupole instrument may be operated in one of several modes: normal mass spectrum, daughter scan, parent scan, neutral loss scan, and selected reaction monitoring. *Id.*; Ex. 1004 ¶¶36-49.

3. Photons and Neutral Species

Many ion sources inevitably generate some amount of neutral species and photons, including ICP, GD, chemical ionization, and electron ionization sources. Ex. 1012, 3:35–4:4; Ex. 1004 ¶58. In the absence of other means to divert their path (*e.g.*, vacuum systems), these neutral species and photons are assumed to

travel in a straight line from the ion source to the detector, increasing the background noise. Ex. 1012, 4:24–33; Ex. 1004 ¶58. To reduce such background noise, many mass spectrometers use ion optics to bend the path of the ions so that the ions would either travel around a photon stop or be sent off-axis towards a detector mounted off-axis. Ex. 1012, 6:15–21; Ex. 1004 ¶58. In contrast, the neutral species and the photons would still travel in a straight line and strike the photon stop or not be bent towards an off-axis detector. Ex. 1012, 6:15–21; Ex. 1004 ¶58.

IX. THE '553 PATENT

A. SUMMARY OF PROSECUTION AND REISSUE HISTORIES

During prosecution, the '788 patent was initially rejected under U.S.C. § 103(a) as being unpatentable over Douglas, in view of U.S. Patent Application Publication No. 2001/0038069 by Whitehouse. Ex. 1002, 2-3. The applicant overcame that combination by arguing that neither reference specifically taught a configuration wherein the first quadrupole selects a sub-range of mass/charge ratios, and the second quadrupole filters for "only ions of the said selected mass/charge ratio." Ex. 1003, 11-13. Instead, according to the applicant, the second quadrupole in Douglas, like the first quadrupole in the series, filtered for a

range of mass/charge ratios instead of a single, selected mass/charge ratio. *Id*. Likewise, the applicant argued that the multipole ion guides in Whitehouse did not select for a single mass/charge ratio. *Id*. Finally, the applicant contended that the examiner failed to demonstrate motivation to combine the references. *Id*. During reissue proceedings, no references were addressed in substantive communications from the examiner.

At no time in the prosecution of the '553 Patent or the underlying '788 Patent did the applicant or examiner distinguish the prior art based on the apparatus elements of the mass spectrometer. On the contrary, the only distinction ever offered during prosecution was the user's selection of the m/z ranges for which the first and second quadrupoles would filter. *Id*. This claimed operation of the mass spectrometer did not require any modification of the instrumentation, as described in the grounds below.

B. THE '553 PATENT CLAIMS

The alleged inventions claimed in the '553 Patent are directed to a mass filter apparatus comprised of an ion source and two mass filter stages in series, and methods of use thereof. Ex. 1004 ¶21. The first mass filter stage acts as the

"sacrificial filter," and the second mass filter stage serves as the "analysis filter." Ex. 1001, 5:44–47. The '533 Patent explains that "the sacrificial filter acts to pre-filter the beam before it enters the analysis filter." *Id.*, 5:48–53.

The '553 Patent has five independent claims: apparatus claim 1, and method claims 13, 18, 25, and 28.

X. CLAIM CONSTRUCTION

In *inter partes* review, claims receive the broadest reasonable interpretation ("BRI") supported by the specification. 37 C.F.R. § 42.100(b); *Cuozzo Speed Techs., LLC v. Lee*, 136 S.Ct. 2131, 2142 (2016). At least the following term requires construction:

Elements [1C], [13B], [18B], [32B] — "a sub-range of mass/charge ratios which includes a selected mass/charge ratio"

This term defines the range of m/z ratios of the ions transmitted through the first mass filter stage in Claims 1, 13, 18, 28, and 32. The BRI of this term is "one or more m/z ratios, including at least an m/z ratio selected by the second mass filter stage." The claims themselves support the BRI of this term.

First, the "sub-range" of m/z ratios describes a subset of the range of m/z ratios. And the m/z ratios within the sub-range do not have to be continuous.

Second, the "sub-range" of m/z ratios can be as narrow as a single selected m/z ratio. Notably, Claim 36 depends on Claim 1, and further requires that "the band pass width of the first filter stage being broader than the band pass width of the second filter stage." Accordingly, with respect to claim 1, the bandpass width of the first filter stage need not be broader than—and can be identical to—the bandpass width of the second filter stage, which selects only a single m/z ratio. *Sunrace Roots Enterprise Co., Ltd. v. SRAM Corp*., 336 F.3d 1298, 1303 (Fed. Cir. 2003) (finding the claim differentiation presumption "especially strong when the limitation in dispute is the only meaningful difference between an independent and dependent claim").

Similarly, Claim 28 recites an additional limitation for the term "sub-range," namely, "the sub-range being broader than the selected mass/charge ratio." But this additional limitation is not found in similar independent Claims 1, 13, 18, or 32. Without this additional limitation, the term "sub-range" does not have to be broader than the selected m/z ratio.

XI. GROUNDS FOR UNPATENTABILITY

A. GENERAL PRINCIPLES

Under 35 U.S.C. § 102, if a single prior art reference discloses each limitation of the claimed invention, a patent claim is anticipated and invalid. *Schering Corp. v. Geneva Pharms.*, 339 F.3d 1373, 1377 (Fed. Cir. 2003). Moreover, "a reference can anticipate a claim even if it 'd[oes] not expressly spell out' all the limitations arranged or combined as in the claim, if a person of skill in the art, reading the reference, would 'at once envisage' the claimed arrangement or combination." *Kennametal, Inc. v. Ingersoll Cutting Tool Co.*, 780 F.3d 1376, 1381 (Fed. Cir. 2015) (quoting *In re Petering*, 301 F.2d 676, 681 (1962)).

Under 35 USC § 103, a patent claim is obvious and invalid "if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains." Multiple pieces of prior art render the claims of the '553 Patent anticipated and/or obvious.

B. APPARATUS CLAIMS RECITING MANNERS OF OPERATION

"[A]pparatus claims cover what a device *is,* not what a device *does*." *Hewlett-Packard Co. v. Bausch & Lomb Inc.,* 909 F.2d 1464, 1469 (Fed. Cir. 1990) (emphasis in original). "[T]he patentability of apparatus or composition claims depends on the claimed structure, not on the use or purpose of that structure." *Catalina Marketing Int'l v. Coolsavings.Com.*, 289 F.3d 801, 809 (Fed. Cir. 2002); *In re Gardiner*, 171 F.2d 313, 315-16 (C.C.P.A. 1948) ("It is trite to state that the patentability of apparatus claims must be shown in the structure claimed and not merely upon a use, function, or result thereof."). Thus, a claim containing a "recitation with respect to the manner in which a claimed apparatus is intended to be employed does not differentiate the claimed apparatus from a prior art apparatus" if the prior art apparatus teaches all the structural limitations of the apparatus claim. *Ex parte Masham*, 2 U.S.P.Q. 2d 1647 (Bd. Pat. App. & Inter. 1987).

C. METHOD CLAIMS RECITING OPERATIONS OF AN APPARATUS

When a prior art apparatus is the same as the apparatus described in a claim for carrying out a claimed method, the prior art apparatus presumably will perform the claimed method in its normal and usual operation. *See In re King,* 801 F.2d

1324 (Fed. Cir. 1986). Moreover, when a prior art reference describes using a prior art apparatus towards a particular purpose, a claimed method is anticipated if the claim merely recites newly discovered results of using the same apparatus for the same purpose. *Bristol-Myers Squibb Co. v. Ben Venue Labs., Inc*., 246 F.3d 1368 (Fed. Cir. 2001).

D. CLAIM ELEMENTS DIRECTED TO THE INTENDED USE OF A COMPONENT

[1Pre.] — Mass filter apparatus for filtering a beam of ions having mass/charge ratios in a range of mass/charge ratios to transmit ions of a selected mass/charge ratio in the said range, comprising:

[13Pre.] — A method for filtering a beam of ions having mass/charge ratios within a range of mass/charge ratios to transmit ions of a selected mass/charge ratio in said range, the method comprising:

[18Pre.] — A method for producing a mass spectrum of an ion beam having mass/charge ratios within a range of mass/charge ratios, comprising:

[28Pre.] — A method of improving the resolving power of a mass spectrometer, comprising:

Element [32A.] — emitting an ion beam from a beam source into a first mass filter stage, the ions in the beam having mass/charge ratios within a range of mass/charge ratios,

Statements of an intended use or purpose of a component in a claimed structure or composition are not included in invalidity analysis under Sections 102

and 103. *Boehringer Ingelheim Vetmedica, Inc. v. Schering-Plough Corp.*, 320 F.3d 1339, 1345 (Fed. Cir. 2003) ("[A]n intended use or purpose usually will not limit the scope of the claim because such statements usually do no more than define a context in which the invention operates."). "Although such statements often appear in the claim's preamble, a statement of intended use or purpose can appear elsewhere in a claim." *Ex parte Mewherter*, Appeal No. 2012-007692, Decision on Appeal at 18–19 (P.T.A.B. May 8, 2013) (internal annotations omitted).

The preambles above merely state the intended purposes of the mass filter apparatus or the methods claimed therein, respectively. They do not limit the scopes of their respective claims in any way. Accordingly, prior art that discloses the claimed apparatus or method anticipates (or renders obvious) these claims regardless of whether the prior art explicitly teaches the stated purpose.

E. GROUND 1: PCT375 ANTICIPATES CLAIMS 1–5, 8–10, 12–15, 18–21, 25–35, 38, 41, 43, 46, 48, 51, 53, 56, 58, 61, 63, 66 UNDER § 102(B)

PCT375 (Ex. 1012) is an international patent application published under the patent cooperation treaty ("PCT") and listing the same inventor as the '553 patent. It has an international publication date of March 23, 2000, and thus qualifies as

prior art under 35 U.S.C. § 102(b). U.S. Patent 7,202,470 is the United States equivalent of PCT375, and was cited on the face of the '553 patent.

EP1114437 is the European equivalent of PCT375. The '553 Patent states that "EP1114437 discloses a method and apparatus for removing ions from an ion beam to reduce the gas load on the collision cell which serves to minimise the formation, or reformation, of unwanted artefact ions in the collision cell." Ex. 1001, 2:49-52. But the '533 Patent does not discuss the two mass filtering stages disclosed therein. PCT375 and/or any of its foreign equivalents were not discussed during the prosecution or reissue proceeding.

PCT375 discloses an ICP mass spectrometer with two quadrupoles in tandem. Ex. 1012, 5:13–23; Ex. 1004 ¶60. Both quadrupoles are operated preferably as mass selective ion optical devices. *Id.*, 8:11–31; Ex. 1004 ¶60. PCT375 further teaches vacuum pumps and pressure ranges for the respective chambers. *Id.*, 7:18–28; Ex. 1004 ¶60. Thus, PCT375 teaches all the structural limitations of the apparatus Claim 1 and many of its dependent Claims. *Id.*, 7:18–28, 8:11–31; Ex. 1004 ¶60.

Moreover, PCT375 discloses operation of a mass spectrometer according to the methods of claims 13, 18, 25, 28, and 32. *Id.*, 6:15–9:6; Ex. 1004 ¶61. Thus, PCT375 anticipates these claims and many of their respective dependent claims.

1. PCT375 Anticipates Claim 1

[1Pre.] — Mass filter apparatus for filtering a beam of ions having mass/charge ratios in a range of mass/charge ratios to transmit ions of a selected mass/charge ratio in the said range, comprising:

Although the preamble is nonlimiting (*supra*, XI.D.), PCT375 nevertheless discloses a mass filter apparatus that fulfills the recited purpose of filtering a beam of ions in a range of m/z ratios. Ex. 1012, 5:13–23.

Moreover, as discussed in Section XI.B., Claim 1 is an apparatus claim reciting a manner of operation. And PCT375 discloses an apparatus that meets all the structural limitations of Claim 1 and is capable of operating as described. *Id.*, 6:15–9:6. Thus, PCT375 anticipates Claim 1. To the extent that it is held to require transmitting only a selected range of ions, that Element is present as discussed in Elements 1C and 1D below.

Element [1A.] — an ion beam source for emitting the ion beam,

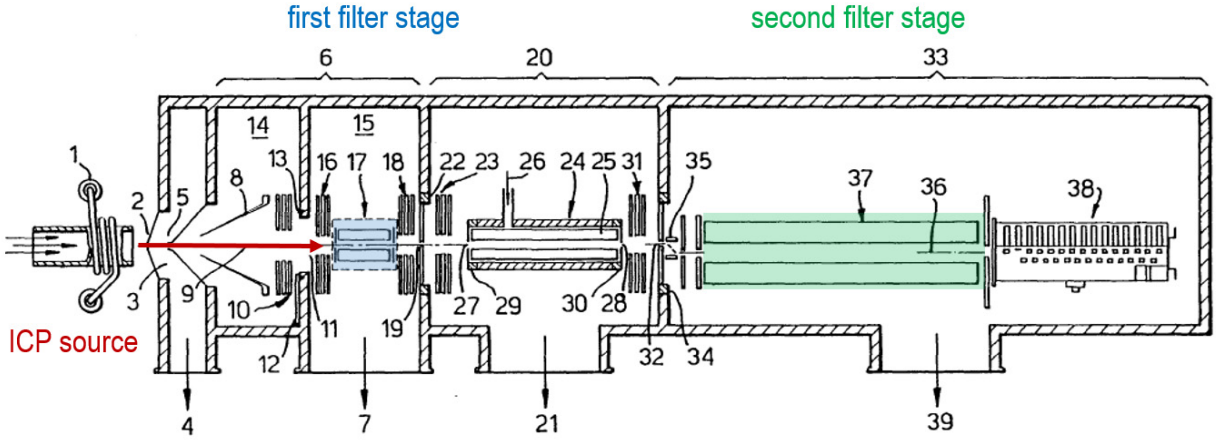
PCT375 discloses an "ion beam source" in the form of an inductively coupled plasma source that emits an ion beam. Ex. 1012, 1:18–30, 9:7–14; Ex. 1004 ¶64.

Element [1B.] — first and second mass filter stages in series to receive the beam from the beam source, and a vacuum system arranged to maintain both the first and second filter stages at operating pressures below 10^{-3} torr,

PCT375 discloses two quadrupoles that are the recited "first and second mass filter stages in series," as can be clearly seen in Figure 2. Ex. 1012, Fig. 2; Ex. 1004 ¶65. In PCT375, the ion beam passes from the beam source to a first ion optical device located in a first evacuated chamber and eventually to a mass analyzer located in a third evacuated chamber. *Id*., 5:3–29; Ex. 1004 ¶65. PCT375 discloses that the first ion optical device may be a "mass selective device" that "can be driven so as to transmit only ions of a specific mass to charge ratio (m/e) or a range of m/e" and "functions as an auxiliary mass filter." *Id*., 8:9–16; Ex. 1004 ¶65. Therefore, the first optical device, which PCT375 refers to as the "auxiliary mass filter," is a first mass filter stage. Ex. 1004 ¶65. PCT375's mass analyzer may "include[] a main mass filter." *Id*., 8:5–8; Ex. 1004 ¶65. Therefore, PCT375's main mass filter is a "second mass filter stage." Ex. 1004 ¶65. The

filter stages are in series, as the ion beam passes from the source to the auxiliary mass filter and then eventually to the main mass filter. *Id.*, 8:17–20; Ex. 1004 ¶65. Figure 2 (annotations added) shows ICP ion source 1 directing an ion beam into the first filter stage located in first evacuated chamber 6 and then, in series, to mass filter 37 (the second filter stage) in the third evacuated chamber 33. Ex. 1004 ¶65.

Fig.2.



PCT375 discloses a vacuum system that maintains both filters at a pressure below 10^{-3} torr. First, it discloses that the first evacuated chamber is maintained at a pressure of 10^{-2} to 10^{-4} mbar, which is 10^{-2} to 10^{-4} torr.[1] *Id.*, 5:30–32, 11:5–10;

[1] 1 mbar is equivalent to approximately 0.75 torr.

Ex. 1004 ¶66. Because the disclosed range overlaps with the claimed range of "below 10^{-3} torr," PCT375 discloses this limitation. *See Atlas Powder Co. v. Ireco, Inc.*, 190 F.3d 1342, 1345 (Fed. Cir. 1999) (finding anticipation because prior art references disclose compositions with ingredients identical to those of the claimed compositions in overlapping amounts). Second, PCT375 discloses that the third evacuated chamber 33 is maintained at a pressure "less than 10^{-4} mbar, typically about 10^{-6} mbar." *Id.*, 14:25–31; Ex. 1004 ¶66.

Element [1C.] — wherein the first mass filter stage is configured to select for transmission on to the second filter stage only ions having a sub-range of mass/charge ratios which includes the selected mass/charge ratio;

PCT375 discloses that the first filter stage is configured to select only a particular m/e or range of m/e, which is a sub-range of the range of ions emitted from the ion source. Ex. 1012, 8:9–16; Ex. 1004 ¶67. PCT375 further discloses that the second filter stage selects ions of the same m/e as the first filter stage. *Id.*, 8:17–23; Ex. 1004 ¶67. As the m/e ranges at the first and second filter stages are the same, the second range (the selected range) is necessarily included in the first range (the sub-range). Ex. 1004 ¶67.

Element [1D.] — the second mass filter stage is configured to select only ions of the said selected mass/charge ratio.

PCT375 discloses that the second filter stage only selects ions of the same m/e as the first filter stage for mass analysis. Ex. 1012, 8:9–23; Ex. 1004 ¶68. These ions correspond to the claimed selected mass/charge range. Ex. 1004 ¶68.

2. PCT375 Anticipates Claim 13

[13Pre.] — A method for filtering a beam of ions having mass/charge ratios within a range of mass/charge ratios to transmit ions of a selected mass/charge ratio in said range, the method comprising:

Even if the preamble of method Claim 13 were limiting (which it is not), PCT375 discloses a method of filtering a beam of ions. *Id.*, 5:13–23. Because claim 13's method tracks the purpose of the mass filter apparatus of Claim 1, claim 1 is anticipated for the same reasons as Claim 13. Ex. 1004 ¶78.

Element [13A.] — emitting the ion beam from a beam source into a first mass filter stage that is arranged in series with a second mass filter stage,

PCT375 discloses emitting an ion beam source from an "inductively coupled plasma" source. Ex. 1012, 1:18–30, 9:7–14; Ex. 1004 ¶79. The ion beam passes from the source to a first ion optical device located in a first evacuated chamber and eventually to a mass analyzing means located in a third evacuated chamber.

Id., 5:3–29; Ex. 1004 ¶79. PCT375 discloses that the first ion optical device is preferably a "mass selective device" that "can be driven so as to transmit only ions of a specific mass to charge ratio (m/e) or a range of m/e" and "functions as an auxiliary mass filter." *Id.*, 8:9–16; Ex. 1004 ¶79. The filter stages are in series, as the ion beam passes from the source to the auxiliary mass filter and then eventually to the main mass filter, as explained for element [1B] above. *Id.*, 8:17–20; Ex. 1004 ¶79.

Element [13B.] — selecting at the first mass filter stage for transmission on to the second mass filter stage only ions having a sub-range of mass/charge ratios which includes the selected mass/charge ratio, and

PCT375 discloses Element 13B for the same reasons as Element 1C. *Id.*, 8:9–23; Ex. 1004 ¶80.

Element [13C.] — selecting at the second mass filter stage only ions having the selected mass/charge ratio,

PCT375 discloses Element 13C for the same reasons as Element 1D. Ex. 1004 ¶81.

Element [13D.] — wherein the first and second filter stages operate at pressures below 10^{-3} torr.

PCT375 discloses Element 13D for the same reasons as Element 1B. *Id.*, Figure 2, 5:3–29, 8:5–8, 8:17–20; Ex. 1004 ¶82.

3. PCT375 Anticipates Claim 18

[18Pre.] — *supra*.

Although the preamble is nonlimiting (*see* Section XI.D.), PCT375 discloses a method for producing a mass spectrum of an ion beam. *Id*., 2:27-32, 5:13–23; Ex. 1004 ¶85.

Element [18A.] — emitting the ion beam from a beam source into a first mass filter stage,

Element [18B.] — selecting only ions having a sub-range of mass/charge ratios which includes a selected mass/charge ratio at the first mass filter stage for transmission on to a second mass filter stage arranged in series with the first mass filter stage,

Element [18C.] — selecting only ions having the selected mass/charge ratio at the second mass filter stage for transmission on to a detector for detecting any ions having the selected mass/charge ratio,

Element [18F.] — wherein the first and second filter stages operate at pressures below 10^{-3} torr.

These claim elements are substantively identical to Elements [13A.]–[13D.] and are thus disclosed in PCT375 for the reasons above. Ex. 1004 ¶¶87-90; *supra*, at XI.E.2.

Element [18D.] — controlling the second filter stage so that the selected mass/charge ratio is scanned over a scanned range, and

Element [18E.] — detecting the number of ions selected by the second filter stage at any given mass/charge ratio to provide a mass spectrum,

PCT375 discloses scanning the first and second mass filter stages. Ex. 1012, 8:36–9:4; Ex. 1004 ¶89. The result of scanning the mass filter stage at the mass analyzing means (*i.e.*, before the detector) is a mass spectrum. *Id.*, 5:24–29; Ex. 1004 ¶89. The detector detects the number of ions selected at any given moment. *Id.*; Ex. 1004 ¶89.

4. PCT375 Anticipates Claims 28 and 32

[28Pre.] — ***supra.***

[32Pre.] — A method for reducing the deposition of material on multipole elements of a primary resolving filter of a mass spectrometer, comprising:

PCT375 anticipates Claims 28 and 32 based on the same disclosures. As explained above in Section XI.D., the preambles of these claims are nonlimiting. Even if they were somehow limiting, PCT375's experiments are directed toward the same purpose and achieve the same results. *Id.*, 1:31–2:7; Ex. 1004 ¶¶99, 108.

Element [28A.] — emitting an ion beam from a beam source into a first mass filter stage that is in series with a second mass filter stage, the ions

in the beam having mass/charge ratios within a range of mass/charge ratios,

Element [32A.] — *supra*.

PCT375 discloses emitting an ion beam source from an "inductively coupled plasma" source. *Id.*, 1:18–30, 9:7–14; Ex. 1004 ¶¶100, 109. The ion beam passes from the source to a first ion optical device located in a first evacuated chamber and eventually to a mass analyzing means located in a third evacuated chamber. *Id.*, 5:3–29; Ex. 1004 ¶¶100, 109. PCT375 discloses that the first ion optical device is preferably a "mass selective device" that "can be driven so as to transmit only ions of a specific mass to charge ratio (m/e) or a range of m/e" and "functions as an auxiliary mass filter." *Id.*, 8:9–16; Ex. 1004 ¶¶100, 109. The filter stages are in series, as the ion beam passes from the source to the auxiliary mass filter and then, eventually, to the main mass filter, as explained for Element [1B.] above. *Id.*, 8:17–20; Ex. 1004 ¶¶100, 109.

Element [28B.] — selecting at the first mass filter stage only ions having a sub-range of mass/charge ratios which includes a selected mass/charge ratio, the range being broader than the sub-range, the sub-range being broader than the selected mass/charge ratio,

Element [28C.] — receiving only ions in said sub-range at the second mass filter stage,

Element [32B.] — *supra*.

Element [32C.] — receiving only ions in said sub-range at a second mass filter stage in series with said first mass filter stage, said second mass filter stage constituting said primary resolving filter, and

PCT375 discloses passing ions in the sub-range from the first filter stage to the second filter stage. *Id.*, 8:17–20; Ex. 1004 ¶¶101-102, 109-110. PCT375 discloses mass selecting at the second filter stage the ions of the same m/z as the first filter stage for analysis. *Id.*, 8:23–9:4; Ex. 1004 ¶¶101-102, 109-110. These ions correspond to the claimed "selected" mass/charge range. *Id.*; Ex. 1004 ¶¶101-102, 109-110. Furthermore, PCT375 discloses that the sub-range at the filter stage (the "auxiliary filter") can be a range of m/z, which is broader than the selected mass/charge range at the second filter stage. *Id.*, 8:9–16; Ex. 1004 ¶¶101-102, 109-110.

Element [28D.] — selecting at the second mass filter stage only ions having the selected mass/charge ratio,

Element [28E.] — whereby the second filter stage can operate with reduced ion beam current.

Element [32D.] — selecting at the second mass filter stage only ions having a selected mass/charge ratio within the sub-range,

Element [32E.] — thereby reducing the number of ions rejected in said primary resolving filter.

In the experiments described in Elements [28B.] and [32B.], the quadrupole mass filter selects analyte ions having a particular mass/charge ratio. Because the first mass filter removes ions having m/z ratios outside of the transmission bandpass, the downstream quadrupole mass filter operates with an ion current of reduced intensity. Ex. 1004 ¶¶103-104, 111-112. PCT375 describes an identical experiment. *Id.*, 8:36–9:4 ("The ion beam that leaves the devices is much less intense . . . .").

PCT375 also teaches filtering the range of ions at the auxiliary mass filter to a single mass-to-charge ratio or range, which would decrease the number of ions that reach the main mass filter, which corresponds to the claimed "primary resolving filter." Ex. 1012, 8:12-20; Ex. 1004 ¶112.

5. PCT375 Anticipates Claim 25

[25Pre.] — selecting at the second mass filter for transmission on to the detector or output only the filtered ions, the second mass filter being disposed between the first mass filter and the detector or output.

PCT375 discloses this limitation for the same reasons it discloses each limitation of Claim 1 and Element [13D]. *Id.*, Figure 2, 5:3–29, 8:5–8, 8:17–20; Ex. 1004 ¶94.

Element [25A.] — emitting the ion beam from a beam source into a first mass filter,

PCT375 discloses the limitation of Element [25A] for the same reasons it discloses Element [13A]. Ex. 1012, 8:9–23; Ex. 1004 ¶95.

Element [25B.] — selecting at the first mass filter for transmission on to a second mass filter only ions having a range of mass/charge ratios which includes the mass/charge ratio of the filtered ions, the range being broader than the mass/charge ratio and narrower than the array of mass/charge ratios of the ion beam, and

PCT375 discloses the limitation of Element [25B] for the same reasons it discloses Element [13B]. Ex. 1012, 8:9–23; Ex. 1004 ¶96.

Element [25C.] — selecting at the second mass filter for transmission on to the detector or output only the filtered ions, the second mass filter being disposed between the first mass filter and the detector or output.

PCT375 discloses the limitation of Element [25C] for the same reasons it discloses Element [13C]. *Id.*; Ex. 1004 ¶96.

6. PCT375 Anticipates Many Dependent Claims

Claim [2.] — An apparatus according to claim 1, wherein the ions within the sub-range comprise 1%, or less, of the ions within the beam.

Claim [3.] — An apparatus according to claim 1, wherein the ions within the sub-range comprise 0.01%, or less, of the ions within the beam.

Claim [14.] — A method according to claim 13, wherein the ions within the sub-range comprise 1%, or less, of the ions within the beam.

Claim [15.] — A method according to claim 13, wherein the ions within the sub-range comprise 0.01%, or less, of the ions within the beam.

Claim [20.] — A method according to claim 18, wherein the ions within the sub-range comprise 1%, or less, of the ions within the beam.

Claim [21.] — A method according to claim 18, wherein the ions within the sub-range comprise 0.01%, or less, of the ions within the beam.

Claim [26.] — A method according to claim 25, wherein the ions within the range comprise 1%, or less, of the ions within the beam.

Claim [27.] — A method according to claim 25, wherein the ions within the range comprise 0.01%, or less, of the ions within the beam.

Claim [29.] — A method according to claim 28, wherein the ions within the sub-range comprise 1%, or less, of the ions within the beam.

Claim [30.] — A method according to claim 28, wherein the ions within the sub-range comprise 0.01%, or less, of the ions within the beam.

Claim [33.] — A method according to claim 32, wherein the ions within the sub-range comprise 1%, or less, of the ions within the beam.

Claim [34.] — A method according to claim 32, wherein the ions within the sub-range comprise 0.01%, or less, of the ions within the beam.

Each of the dependent claims listed here requires that the ions within the sub-range comprise 1% or less, or 0.01% or less, of the ions within the beam. Ordinarily most of the ions that are produced in a mass spectrometer consist of the

plasma gas, not the sample. *Id.*, 1:37–2:4. Necessarily then, as explained in PCT375, "the most abundant ions in the plasma beam are rejected by the mass selective device." *Id.*, 9:7–11. Dr. Yost concurs, emphasizing that the actual ratio of sample to plasma ions in any particular experiment would depend on the sample used, as well as the sub-range selected by the user. Ex. 1004 ¶¶69-71. However, Dr. Yost attests that the selection of a sub-range of a single m/z would result in ions within the sub-range comprising less than 0.01% of the ions in the beam. *Id.*

Furthermore, PCT375 discloses synchronously scanning the auxiliary mass filter across a specific mass-to-charge ratio. Ex. 1012, 8:36–9:6; Ex. 1004 ¶70. A POSA would understand that when scanning through various particular mass-to-charge ratios, some will have effectively no ions present, which means that the percentage of the ions within the beam that are in the sub-range would be effectively zero. Ex. 1004 ¶70.

Claim [4.] — An apparatus according to claim 1, wherein each filter stage comprises a multi-pole analyzer.

Claim [5.] — An apparatus according to claim 4, wherein each filter stage comprises rods in a quadrupole arrangement

PCT375 explains that each of the filter stages is preferably a quadrupole arrangement, which is a multipole analyzer. Ex. 1012, 8:5–16; Ex. 1004 ¶¶72-73.

Claim [8.] — An apparatus according to claim 1, further comprising a scanner for controlling the second filter stage so that the mass/charge ratio of transmitted ions is scanned over a scanned range to provide a mass spectrum.

Claim [9.] — An apparatus according to claim 8, wherein the scanner is arranged to control also the first filter stage so that a center point of the sub-range of mass/charge ratios transmitted by said first filter stage substantially tracks the scanned mass/charge ratio transmitted by the second filter stage.

Claim [19.] — A method according to claim 18, further comprising controlling the mass/charge of ions selected by the first filter stage so that a center point of the sub-range of mass/charge ratios selected by said first filter stage substantially tracks the selected mass/charge ratio during scanning of the selected mass/charge ratio by the second filter stage.

Claim [38.] — An apparatus according to claim 1, further comprising a scanner configured to scan the first filter stage and the second filter stage together to provide a mass spectrum.

Claim [41.] — An apparatus according to claim 8, wherein the scanned range is the sub-range.

Claim [43.] — A method according to claim 13, further comprising: scanning the first mass filter stage and the second mass filter stage together to provide a mass spectrum.

Claim [46.] — A method according to claim 13, further comprising: scanning the second mass filter stage over a scanned range to provide a mass spectrum, wherein the scanned range is the sub-range.

Claim [48.] — A method according to claim 18, wherein the first mass filter stage and the second mass filter stage are scanned together to provide the mass spectrum.

Claim [51.] — A method according to claim 18, wherein the scanned range is the sub-range.

Claim [53.] — A method according to claim 25, further comprising: scanning the first mass filter and the second mass filter together to provide a mass spectrum.

Claim [56.] — A method according to claim 25, further comprising: scanning the second mass filter over a scanned range to provide a mass spectrum, wherein the scanned range is the range.

Claim [58.] — A method according to claim 28, further comprising: scanning the first mass filter stage and the second mass filter stage together to provide a mass spectrum.

Claim [61.] — A method according to claim 28, further comprising: scanning the second mass filter stage over a scanned range to provide a mass spectrum, wherein the scanned range is the sub-range.

Claim [63.] — The method of claim 32, wherein the first mass filter stage and the second mass filter stage are scanned together to provide a mass spectrum.

Claim [66.] — The method of claim 32, further comprising: scanning the second mass filter stage over a scanned range to provide a mass spectrum, wherein the scanned range is the sub-range.

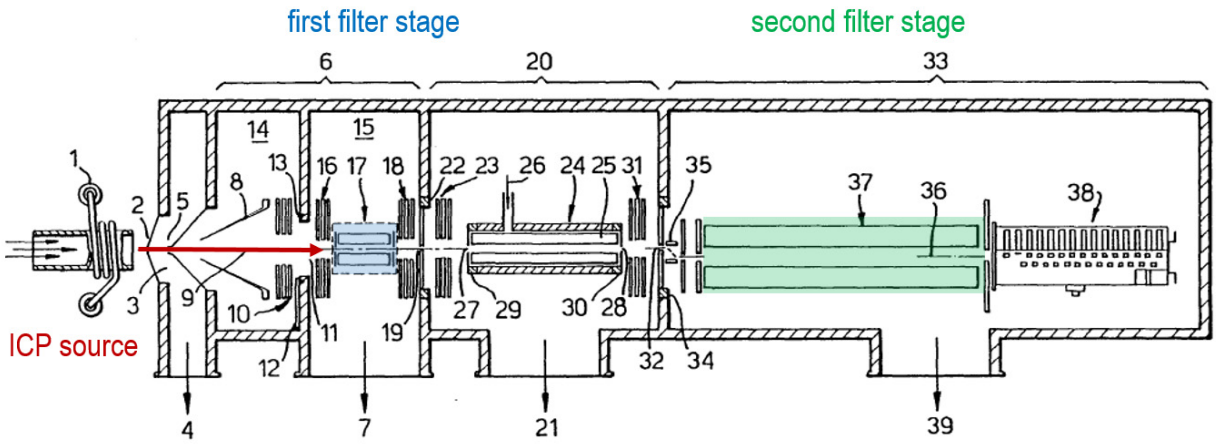
PCT375 discloses scanning the two filter stages (the "auxiliary mass filter" and the "main mass filter") synchronously, such that the same m/e is being filtered at each stage. *Id.*, 8:37–9:6; Ex. 1004 ¶¶74-75. The result of the synchronous scan is a mass spectrum. *Id.*; Ex. 1004 ¶¶74-75. The total range scanned for each of the two filters is the same, comprising the entire sub-range. *Id.*; Ex. 1004 ¶¶74-75. Furthermore, as the total range scanned for the two filters is the same, the center of the scan ranges for the two mass filters is substantially the same. *Id.*; Ex. 1004 ¶¶74-75. This method would necessarily mean that the center point of the sub-range of mass/charge ratios selected by said first filter stage would substantially track the selected mass/charge ratio during scanning. Ex. 1004 ¶91. Thus, each of the claims set forth above is disclosed in PCT375. Ex. 1004 ¶¶74-75, 91, 116-127.

Claim [10.] — An apparatus according to claim 1, wherein the first filter stage is arranged off axis with respect to the second filter stage.

PCT375 discloses that the axis of the mass analyzing means (which corresponds to the claimed second filter stage) is preferably offset from the first axis (which corresponds to the claimed first filter stage). *Id.*, 9:20–23; Ex. 1004 ¶76. In particular, PCT375 discloses that the first axis is the ion beam at element 9 in Figure 2 (annotation added), which continues through the first and second

evacuated chambers (6 and 20). The second axis, 36, is along the mass analyzing means 37 in chamber 33. *Id.*, 16:32–35.

Fig.2.



Claim [12.] — Mass spectrometer comprising a mass filter apparatus according to claim 1.

PCT375 discloses that the two-stage mass filter apparatus described in the independent claims above is incorporated into a mass spectrometer. *Id.*, 1:6–14, 5:1–25; Ex. 1004 ¶77.

Claims [31.] — A method according to claim 28, wherein the first and second filter stages operate at pressures below 10^{-3} torr.

Claim [35.] — A method according to claim 32, wherein the first and second filter stages operate at pressures below 10^{-3} torr.

PCT375 discloses maintaining the first evacuated chamber at a pressure of 10^{-2} to 10^{-4} mbar, which is 10^{-2} to 10^{-4} torr. *Id.*, 5:30–32; 11:5–10; Ex. 1004 ¶¶107, 115. PCT375 discloses maintaining the third evacuated chamber 33 at a pressure "less than 10^{-4} mbar, typically about 10^{-6} mbar." *Id.*, 14:25–31; Ex. 1004 ¶¶107, 115.

F. GROUND 2: PCT375 RENDERS OBVIOUS CLAIM 11

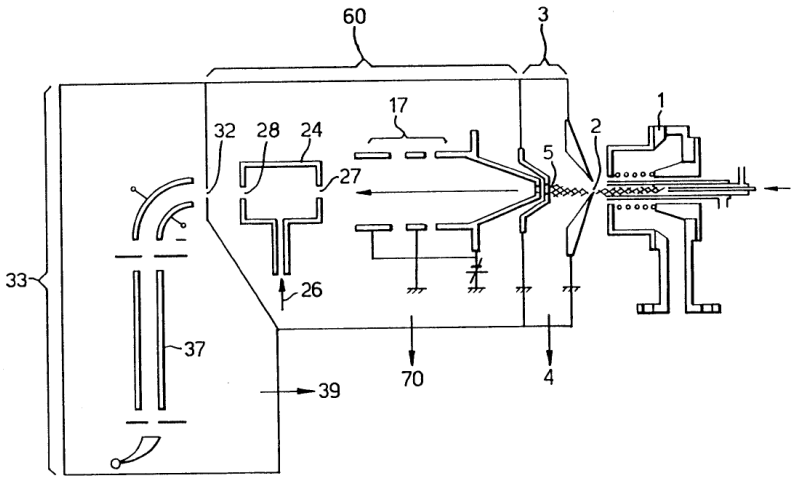
Claim [11.] — An apparatus according to claim 10, wherein the longitudinal axis of the first filter stage is arranged to intersect with the longitudinal axis of the second filter stage substantially at the end of the second filter stage nearest to the first filter stage.

Figures 1 and 2 of PCT375 together teach a mass filter apparatus "wherein the longitudinal axis of the first filter stage [an ion optical device (17)] is arranged to intersect with the longitudinal axis of the second filter stage [mass analyzer (37)] substantially at the end of the second filter stage nearest to the first filter stage." *Id.*, Figures 1 and 2; Ex. 1004 ¶¶128-130.

Specifically, PCT375 describes a prior art ICP mass spectrometer in Figure 1. *Id.*, 10:11–30; Ex. 1004 ¶¶128-130. In this earlier mass spectrometer, the ion optical device (17) is a lens stack in one evacuated chamber (60), and the mass analyzer (37) is in a separate evacuated chamber (33). *Id*. As shown in

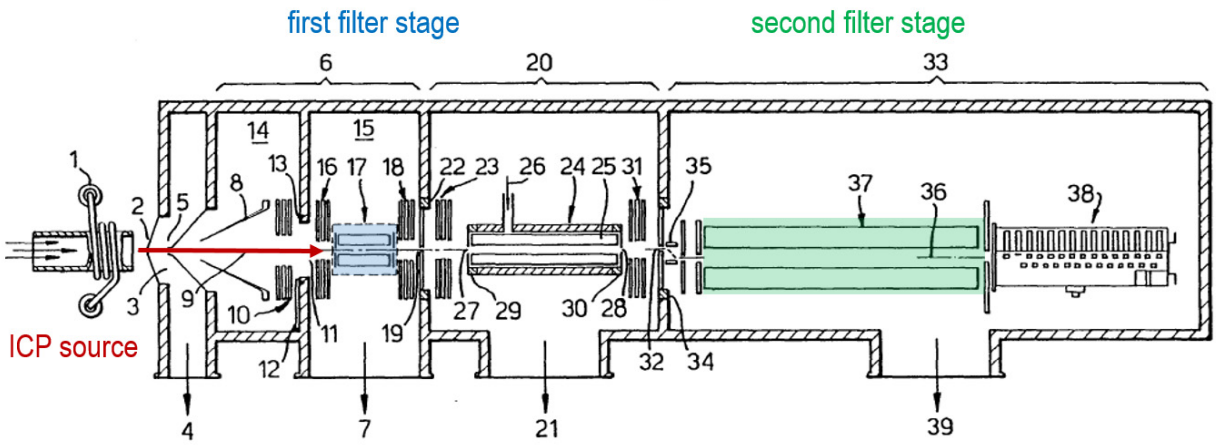
Figure 1, the longitudinal axis of the ion optical device intersects with the longitudinal axis of the mass analyzer substantially at the end of the mass analyzer nearest to the ion optical device. *Id.*; Ex. 1004 ¶¶128-130.

Fig.1.



PCT375 also describes an embodiment of the present invention in Figure 2. *Id*., 10:31–33, Figure 2 (annotations added); Ex. 1004 ¶¶128-130. It states that in this embodiment, the evacuated chamber (60) of the prior art is divided into two chambers, the first evacuated chamber (6) and a second evacuated chamber (20). *Id*., 11:3–5. The ion optical device (17) is the first filter stage in the first evacuated chamber. *Id*. at 12:8–9. The mass analyzer (37) is the second filter stage in the third evacuated chamber (33). *Id.*

Fig.2.



As explained above regarding Claim 10, PCT375 further states that preferably the second axis of the mass analyzer is offset from the first axis of the ion source (1) and the ion optical device (17). *Id*., 9:20–21. Based on this teaching and the two mass spectrometers in Figures 1 and 2, a POSA would have understood that one way for the two axes to be offset from each other is for the longitudinal axis of the first filter stage (the ion optical device) to intersect the longitudinal axis of the second filter stage (the mass analyzer). Ex. 1004 ¶¶128-130. A POSA would also have at once envisaged that the intersection could be placed substantially at the end of the second filter stage (the mass analyzer) nearest to the first filter stage (the ion optical device). *Id*.

G. GROUND 3: TANNER ANTICIPATES CLAIMS 1, 4–6, 8–9, 12–13, 16, 18–19, 22, 24–25, 28, 31–32, 35, 38–41, 43–46, 48–51, 53–56, 58–61, 63–66 UNDER § 102(B)

Tanner (Ex. 1006) was published in 1999 and thus qualifies as prior art under 35 U.S.C. § 102(b). Ex. 1008 ¶21. Tanner was not submitted or discussed during the prosecution and the reissue proceeding.

As detailed below, Tanner discloses an ICP mass spectrometer with two quadrupoles in tandem. Ex. 1006, 1086-87; Ex. 1004 ¶131. The first quadrupole is a bandpass filter,[2] and the second quadrupole is a mass analyzer. *Id.*; Ex. 1004 ¶131. Tanner further discloses vacuum pumps for their respective chambers. *Id.*; Ex. 1004 ¶131. As explained in Section XI.B, Tanner discloses all the structural limitations of apparatus Claim 1 and many of its dependent claims. *Id.*

Tanner states that "the basic configuration of these instruments has been described previously" in Baranov (Ex. 1011). *Id.*, 1087. For illustration purposes

[2] A mass filter that allows transmission of ions above a specified m/z ratio is commonly referred to a "highpass filter," passing all ions higher than the set value. Similarly, a quadrupole used as a "lowpass filter" transmits all ions lower than a high m/z threshold. Ex. 1004 ¶131 n.4. A "bandpass filter" transmits ions in a range, or band, spanning between high and low m/z cutoff values. *Id.*

only, a schematic of the instrumental configuration from Figure 11 of Baranov is shown below. Ex. 1011, 1139; Fig. 11 (annotations added).

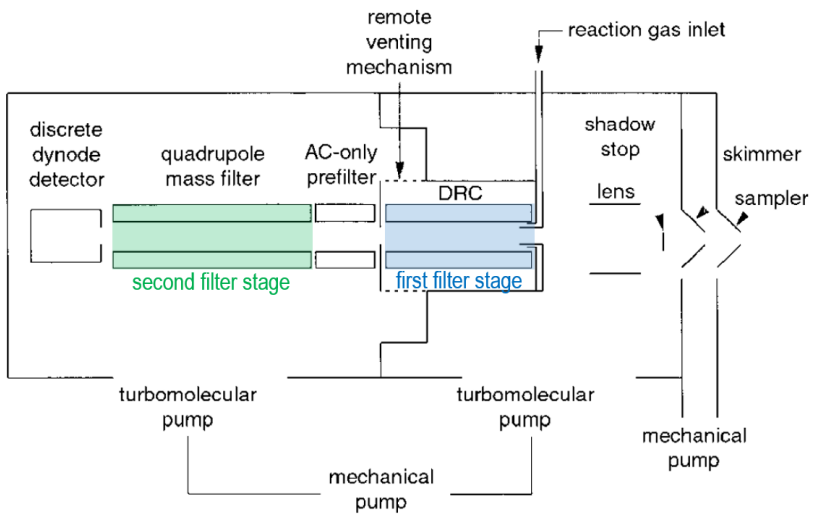


Fig. 11 Schematic of the instrumental configuration. The dynamic reaction cell (DRC) is described in the text. The dashed line indicates a remotely manipulated mechanism which vents the DRC into the high vacuum chamber when reaction gas is not required.

Moreover, as explained in Section XI.C, Tanner's instrument performs the methods of claims 13, 18, 25, 28, and 32 during normal operation. Ex. 1004 ¶133. Thus, Tanner anticipates these claims and many of their respective dependent claims.

1. Tanner Anticipates Claim 1

[1Pre.] — Although the preamble is nonlimiting (*see* Section XI.D), Tanner nevertheless discloses a mass filter apparatus that fulfills the recited purpose of filtering a beam of ions in a range of m/z ratios. *Id.*, 1085; Ex. 1004 ¶134.

Moreover, as discussed in Section XI.B., claim 1 is an apparatus claim reciting a manner of operation. And Tanner discloses an apparatus that meets all the structural limitations of claim 1 and is capable of operating as described. *Id.*, 1088; Ex. 1004 ¶135.

Element [1A.] — Tanner discloses an ion beam source, namely an inductively coupled plasma ion source. *Id.*, 1083; Ex. 1004 ¶136.

Element [1B.] — Tanner discloses two quadrupoles as the first and second mass filter stages in series. *Id.*, 1086; Ex. 1004 ¶137. The first mass filter stage is a mass filter stage, capable of operating in a bandpass mode which selects ions in a range of mass-to-charge ratios. *Id.*, 1083 (abstract), 1086; Ex. 1004 ¶137. The second mass filter stage is a "mass analyzer quadrupole." *Id.,* 1087; Ex. 1004 ¶137. Tanner discloses operating each filter stage at an operating pressure below 10^{-3} torr. *Id.* ("operating in the low 10^{-5} torr range").

Element [1C.] — Tanner discloses that "the quadrupole reaction cell offers the potential to define a mass bandpass window"; *i.e.*, it is configured to select only ions having a sub-range of m/z values between high and low m/z cutoff values. *Id.*, 1085; Ex. 1004 ¶138. Tanner discloses two types of bandpass filters: a fixed bandpass filter and a dynamic bandpass filter. *Id.*, 1086; Ex. 1004 ¶138.

In Tables 1 and 2, Tanner discloses experiments in which the bandpass filter selects ions having a sub-range of m/z ratios that includes a selected mass/charge ratio of an analyte ion. *Id.*, 1089–90; Ex. 1004 ¶139.

Element [1D.] — As discussed above in Elements [1B.] and [1C.], Tanner discloses that the quadrupole mass filter as the second mass filter stage is configured to select only ions of the said mass/charge ratio. Tanner discusses the "mass of the ion being analyzed in the downstream mass filter" and "the analyte mass being passed through the downstream mass filter." *Id.*, 1086, 1091; Ex. 1004 ¶140.

2. Tanner Anticipates Claim 13

[13Pre.] — Although the preamble is nonlimiting (*see* Section XI.D), Tanner nevertheless discloses a method of filtering a beam of ions in the experiment described for Figure 2. *Id.*, 1088, Tables 1-2; Ex. 1004 ¶147.

Element [13A.] — In Figure 2 experiment, a sample containing 18 trace elements is introduced to the ion source, which emits an ion beam into the bandpass reaction cell as the first mass filter stage. *Id.*, 1088; Ex. 1004 ¶148.

Element [13B.] — In Figure 2 experiment, Tanner sets the bandpass reaction cell such that only ions having a sub-range of mass/charge ratios are transmitted. *Id.*, Figure 2 (caption); Ex. 1004 ¶149. This sub-range of m/z ratios includes the "selected mass/charge ratio" of each of the 18 trace elements in the sample. *Id.*, Tables 1-2; Ex. 1004 ¶149. As Dr. Yost explains, in Tanner Figure 2 experiment, the quadrupole is operated in the bandpass filter mode, with RF and DC voltages that place the ion of interest (*i.e.*, the ion synchronously scanned in the following quadrupole mass filter, m_{set}) at Mathieu parameters of a = 0.005, q = 0.11. *Id.*, Figure 2 (caption); Ex. 1004 ¶149. Thus, there is a lower m/z limit (low mass cut-off or "LMCO") as well as an upper m/z limit (high mass cut-off or

"HMCO"). *Id.* For ^{11}B, for instance, the range of stable m/z values would be from ~m/z 2 to 20; for ^{208}Pb, the range of stable m/z values would be from ~m/z 28 to 375. *Id.*

Element [13C.] — Tanner sets the quadrupole mass analyzer to select only ions having a specific m/z ratio of each of the 18 trace elements. Ex. 1006, Tables 1-2, Figure 2; Ex. 1004 ¶150.

Element [13D.] — The operating pressures of first and second mass filter stages are "below 10^{-3} torr" or roughly 10^{-5} torr. *Id.*, 1088 ("[the spectra] were obtained with the dynamic reaction cell vented to the high vacuum chamber and without addition of reaction gas (cell pressure ~2 x 10^{-5} torr)"), Tables 1-2; Ex. 1004 ¶151.

3. Tanner Anticipates Claim 18

[18Pre.] — Although the preamble is nonlimiting (see Section XI.D), Tanner nevertheless discloses a method for producing a mass spectrum of an ion beam in Figure 2 experiment. *Id.*, 1088, Tables 1-2; Ex. 1004 ¶153.

Elements [18A.], [18B.], [18C.], [18F.] — These claim elements are substantively identical to Elements [13A.]-[13D.] and are thus disclosed in Tanner for the reasons above. *Id.*, 1088, Tables 1-2; Ex. 1004 ¶¶154-159.

Element [18D.] — As discussed above in Element [13C.], Tanner sets the quadrupole mass analyzer to scan at each specific m/z ratio of the 18 trace elements over a scanned range. *Id.*, 1087, Tables 1-2; Ex. 1004 ¶157.

Element [18E.] — Tanner detects the ions selected by the quadrupole at each of the m/z ratios. *Id.*, 1090; Ex. 1004 ¶158.

4. Tanner Anticipates Claim 25

[**25Pre.] —** Tanner discloses this limitation for the same reasons it discloses each limitation of Claim 1 and Element [13D.]. *Id.*, 1088, Tables 1-2; Ex. 1004 ¶¶163-164. Tanner discloses the limitation of Element [25A.] for the same reasons it discloses Element [13A.]. *Id.*; Ex. 1004 ¶165. Tanner discloses the limitation of Element [25B.] for the same reasons it discloses Element [13B.]. *Id.*, 1085; Ex. 1004 ¶166. Tanner discloses the limitation of Element [25C.] for the same reasons it discloses [13C.]. *Id.*, 1088, Tables 1-2; Ex. 1004 ¶167.

5. Tanner Anticipates Claims 28 and 32

[28Pre.], [32Pre.] — Tanner anticipates Claims 28 and 32 based on the same disclosures, and so the two are addressed simultaneously. Although the preamble is nonlimiting (*see* Section XI.D), Tanner nevertheless discloses methods that fulfill the recited purposes in these claims. Ex. 1004 ¶¶168, 178.

Elements [28A.], [32A.] — Tanner discloses emitting an ion beam into a first mass filter stage in series with a second mass filter stage. *Id.*, 1084–85; Ex. 1004 ¶¶169, 179. In the experiments described therein, Tanner introduces samples into an ICP mass spectrometer having a bandpass filter and a quadrupole mass filter. *Id.*, 1088 ("a 1-ppb mixed analyte sample"); Ex. 1004 ¶¶169, 179. Tanner further discloses that the ion beam contains ions within a range of mass/charge ratios. *Id.*, 1084–85 ("impurity gas"), Tables 1-2; Ex. 1004 ¶¶169, 179.

Elements [28B.], [32B.] — For the same reasons Tanner discloses Element [1C.], it discloses a sub-range at the first filter that is broader than the range and further discloses the second filter having a selected ratio within that sub-range. *Id.*, 1085–86, 1089–90.

The Tanner Figure 2 experiment discloses this limitation for the same reasons as Element [13B.]. Ex. 1004 ¶¶170, 180.

The Tanner Figure 6 experiment sets the reaction cell's bandpass to be between 30 and 86 amu, and mass analyzes analyte ions having mass/charge ratios of 39, 40, 48, 52, 55, 56, 58, 60, 63, 65, 64, and 66, respectively, at the quadrupole mass filter. *Id.*, 1091–92, Tables 1-2; Ex. 1004 ¶¶171, 181.

The Tanner Figure 8b experiment sets the reaction cell's bandpass to be between 19 and 55 amu, and mass analyzes analyte ions having a mass/charge ratio of 27 at the mass filter. *Id.*, 1092–93, Tables 1-2; Ex. 1004 ¶¶172, 182.

The Tanner Figure 9 experiment sets the reaction cell's bandpass to be between 6–16 amu, and mass analyzes analyte ions having mass/charge ratios of 6 and 7 amu, respectively, at the mass filter. *Id.*, 1093, Tables 1-2; Ex. 1004 ¶¶173, 183.

Elements [28C.], [32C.] — In the experiments described in Elements [28B.] and [32B.], the quadrupole mass filter as the primary resolving filter receives ions

within the transmission bandpass of the reaction cell. *Id*., 1091–93, Tables 1-2; Ex. 1004 ¶¶174, 184.

Elements [28D.], [28E.], [32D.], [32E.] — In the experiments described in Elements [28B.] and [32B.], the quadrupole mass filter selects analyte ions having a particular mass/charge ratio within the transmission bandpass of the reaction cell. *Id.*, Tables 1-2; Ex. 1004 ¶¶175, 185. Because the reaction cell filters out ions having m/z ratios outside of its transmission bandpass, the downstream quadrupole mass filter operates with a reduced number of ions (*i.e.,* a reduced ion beam current). Ex. 1004 ¶¶176, 186.

6. Tanner Anticipates Many Dependent Claims

Claims [4.], [5.], [6.], [16.], [22.] — Tanner discloses a quadrupole bandpass reaction cell as the first mass filter stage, and a quadrupole mass analyzer as the second mass filter stage. *Id.*, 1086–87; Ex. 1004 ¶¶141-142. Each of these quadrupoles has a DC and an AC voltage supply for applying driver voltages to the rods. *Id.*; Ex. 1004 ¶¶143, 152, 161.

Claims [8.], [9.], [19.], [24.], [38.] — In Tanner's dynamic bandpass cell instrument, "a center point of the sub-range of mass/charge ratios selected by said

first filter stage [the center point of the bandpass of the dynamic reaction cell] substantially tracks the selected mass/charge ratio during scanning of the selected mass/charge ratio by the second filter stage ['the mass bandpass window of the [dynamic reaction cell] was dynamically adjusted with the reference **q** and **a** defined for the mass being transmitted through the mass filter']." *Id.*, 1087; Ex. 1004 ¶145. A POSA would have understood that Tanner discloses a scanner for controlling the two filter stages as described in Claims 8, 9, 24, and 38. Ex. 1004 ¶¶144-145, 162, 188.

Claim [12.] — Tanner discloses a mass spectrometer comprising a two-stage mass filter apparatus. *Id.*; Ex. 1004 ¶146.

Claims [31.], [35.] — Tanner discloses the limitations of these claims for the same reasons as it discloses Element [13D.]. *Id.*, 1088, Tables 1-2; Ex. 1004 ¶¶177, 187.

Claims [39.], [43.], [44.], [48.], [49.], [53.], [54.], [58.], [59.], [63.], [64.] — With the dynamic reaction cell, Tanner discloses a method in which the first mass filter stage and the second mass filter stage are scanned together to provide a mass spectrum, and the scan is stepped from transmission peak to another peak (also

called a jump scan). *Id.*, 1087 ("The bandpass is adjusted on a per element basis; that is, a value of **q** and of **a** is defined for each analyte in the peak hopping mode and the bandpass is adjusted prior to measurement of each signal."); Ex. 1004 ¶¶189-192, 195-196, 199-200, 203-204, 207-208.

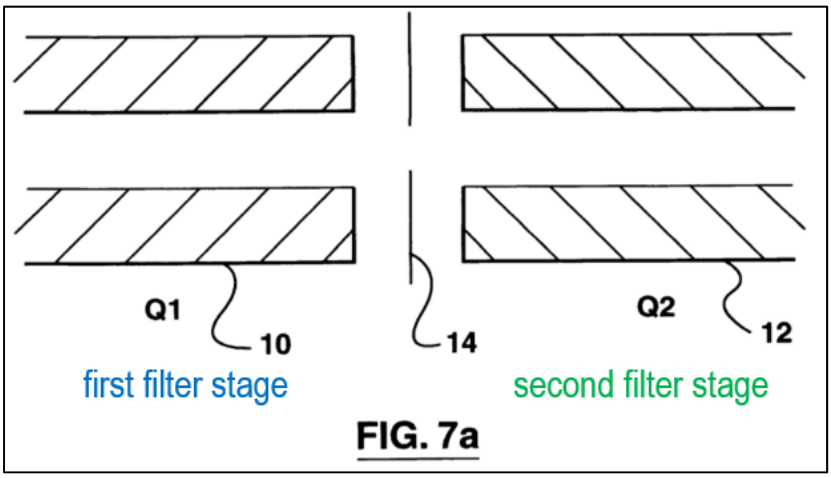
Claims [40.], [41.], [45.], [46.], [50.], [51.], [55.], [56.], [60.], [61.], [65.], [66.] — Tanner discloses a method wherein the scan is a smooth scan and the scanned range is the sub-range. *Id.*, 1086 ("the mass analyzer scanned through the bandpass of the reaction cell"); Figure 2 (showing a smooth scan across mass-to-charge ratios); Ex. 1004 ¶¶190, 193-194, 197-198, 201-202, 205-206, 209-210.

H. GROUND 4: DOUGLAS IN COMBINATION WITH TANNER RENDERS OBVIOUS CLAIMS 1-6, 8-9, 12-16, 18-22, AND 24-66 UNDER § 103

Douglas (Ex. 1007) qualifies as prior art under 35 U.S.C. § 102(b) because it was published on February 20, 2001. The '553 Patent specification states that Douglas "teaches a spectrometer comprising two filters operating with similar mass resolution to improve the resolution of the whole device." Ex. 1001, 2:43–48.

During the prosecution of the ’788 Patent, the applicant admitted that “Douglas teaches an apparatus having two mass filters arranged in series.” Ex. 1002, 11. The applicant argued that in Douglas, however, “both filters pass essentially the same range of mass/charge ratios (*i.e.*, at the same resolution), but typically with a mass offset between them.” *Id.* But that is wrong.

Douglas teaches a mass spectrometer with two quadrupoles, wherein each is operated in mass analyzing mode. Ex. 1007, 2:65–67; Ex. 1004 ¶212. Figure 7a of Douglas shows an embodiment of a double-quadrupole apparatus, which is reproduced below. *Id.*, 5:35–38, Figure 7a (annotations added); Ex. 1004 ¶212.



Douglas teaches that the two quadrupoles operate in tandem and mass select ions with the same m/z ratio. *Id.*, 9:13–17; Ex. 1004 ¶213. Their two peak shapes

can then be combined to give a single, enhanced, higher resolution peak. *Id.*; Ex. 1004 ¶213. The two quadrupoles can be scanned with no mass shift or offset between them, or with a mass offset between them. *Id.*, 12:2–6, 11:44–47, Figures 11C and 12D; Ex. 1004 ¶213.

Douglas teaches that each quadrupole may operate at the same constant resolution. *Id.*, 13:15–16; Ex. 1004 ¶214. Significantly, Douglas also teaches that the two quadrupoles may just as easily operate at different resolutions. *Id.* at 13:25–27; Ex. 1004 ¶214.

1. Douglas in Combination with Tanner Renders Obvious Claim 1

[1Pre.] — Although the preamble is nonlimiting (*see* Section XI.D), Douglas nevertheless teaches a mass filter apparatus that fulfills the recited purpose of filtering a beam of ions in a range of m/z ratios. *Id.*, 12:2–6, 11:44-47; Ex. 1004 ¶¶217-218.

As discussed in Section XI.B., Claim 1 is an apparatus claim reciting a manner of operation. *Id.* Douglas discloses an apparatus that meets all the

structural limitations of Claim 1 and is capable of operating as described. Ex. 1004 ¶217.

Element [1A.] — Douglas teaches "an inductively coupled plasma source" as an ion beam source for emitting the ion beam. *Id.*, 13:43.; Ex. 1004 ¶219.

Element [1B.] — Douglas teaches two quadrupoles in tandem as the first and second mass filter stages in series. *Id.*, 2:65–67; Ex. 1004 ¶220. Douglas also teaches that quadrupoles typically "require pressures as low as 10^{-5} torr," *id.*, 18:44–45, and the mass filter apparatus described therein may operate at "a pressure of $2\times10^{[-4]}$ Torr, *i.e.*, a factor of 10 higher than is conventional or common." *Id.* at 20:48–50; Ex. 1004 ¶220.

Elements [1C.], [1D.] — Douglas teaches two quadrupoles in series that are capable of operating in the manner described in Elements [1C.] and [1D.]. Ex. 1004 ¶221. Douglas also teaches that the two quadrupoles mass select ions with the same m/z ratio. *Id.*, 9:13–17; Ex. 1004 ¶221. To do so, they may operate at different resolutions at the same tip of a given stability region. *Id.*, 13:25–27; Ex. 1004 ¶221. In other words, the first quadrupole may operate at a lower resolution (*i.e.*, to select ions having a sub-range of m/z ratios that includes the selected m/z

ratio) as described in Element [1C.], and the second quadrupole may operate at a higher resolution (*i.e.*, to select only ions of the selected m/z ratio) as described in Element [1D]. *Id.*; Ex. 1004 ¶221.

To the extent that the Board finds that Douglas does not teach Elements [1C.] and [1D.], a POSA would have been motivated to operate the two mass filter stages as described in Elements [1C.] and [1D.] in light of Tanner's teaching.

2. Motivation to Combine Douglas and Tanner

As discussed in Ground 3, Tanner is directed to improving the detection of ICP-MS using two mass filter stages. Specifically, Tanner teaches the first mass filter stage is a bandpass reaction cell, and the second mass filter stage is a conventional quadrupole mass analyzer. Ex. 1006, 1088, Tables 1-2; Ex. 1004 ¶215. Tanner teaches that a bandpass filter as the first filter stage eliminates interfering ions and prevents the formation of new interfering ions before the ion beam enters into the second mass analyzing stage. *Id.*, 1086; Ex. 1004 ¶215.

Douglas is also directed to using two filter stages to improve the resolution of ICP-MS. Douglas discusses that the two filter stages may be in different resolution at the same tip of a given stability region. Ex. 1007, 13:25–27; Ex. 1004

¶216. A POSA would have understood Douglas's teaching to mean that the first filter stage may be a bandpass filter (*i.e.*, at a lower resolution), and the second filter stage may be a conventional mass analyzer (*i.e*., at a higher resolution). Ex. 1004 ¶216. In view of Tanner, a POSA would have been motivated to operate Douglas's instrument in a manner taught by Tanner—*i.e.*, having a bandpass filter as the first filter stage and a conventional mass analyzer as the second filter stage—to improve the resolution of ICP-MS. Ex. 1004 ¶216.

3. Douglas in Combination with Tanner Renders Obvious Several Additional Independent Claims

Claim [13.], [18.], [25.], [28.], [32.] — Douglas teaches experiments using an ICP source with two mass filter stages. Ex. 1007, 13:35–15:55. However, Douglas does not explicitly disclose an experiment with a first filter stage selecting ions having a sub-range of m/z ratios that includes a selected m/z ratio, and a second filter stage selecting ions having the selected m/z ratio in manners described in these claims.

As explained in Ground 3, Tanner teaches various methods of operating the two filter stages in manners as described in these claims. Ex. 1006, 1086–87, Tables 1-2. And as discussed in this Ground for Claim 1, in view of Tanner, a

POSA would have been motivated to operate the two filter stages in Douglas's instrument as described in these claims. These methods are normal operations of a double-quadrupole mass spectrometer, as set forth in Section XI.C., and as shown by Tanner.

4. Douglas in Combination with Tanner Renders Obvious Claim 13

[13Pre.] — Although the preamble is nonlimiting (s*ee* Section XI.D.), Douglas nevertheless teaches a method for filtering a beam of ions. Ex. 1004 ¶234.

Element [13A.] — Douglas teaches emitting an ion beam containing Co^+ ions (m/z =59) into a first mass filter stage in series with a second mass filter stage. Ex. 1007, 13:43–49 ("two quadrupoles operated in tandem"); Ex. 1004 ¶235.

Elements [13B.]-[13C.] — As described above in Ground 3 for Elements [13B.] and [13C.], Tanner teaches these two mass filter stages. Ex. 1006, 1086–87. A POSA would have been motivated to carry out Tanner's mass analysis on Douglas's instrument for the same reasons set forth above regarding Claim 1. Ex. 1004 ¶236.

Element [13D.] — Douglas also teaches operating the first and second filter stages at pressures below 10^{-3} torr. Ex. 1007, 18:44–45, 20:48–50; Ex. 1004 ¶237.

5. Douglas in Combination with Tanner Renders Obvious Claim 18

[18Pre.] — Although the preamble is nonlimiting (*supra*, Section XI.D.), Douglas nevertheless teaches a method for producing a mass spectrum of an ion beam. Ex. 1004 ¶241.

Element [18A.] — Douglas teaches emitting an ion beam containing Co^+ ions (m/z =59) into a first mass filter stage in series with a second mass filter stage. *Id.*, 13:43–49 ("two quadrupoles operated in tandem"); Ex. 1004 ¶242.

Elements [18B.]-[18E.] — As described above in Elements [18A.]-[18E.] in Ground 3, Tanner teaches such manner of operating these two mass filter stages. Ex. 1006, 1086–87; Ex. 1004 ¶243. A POSA would have been motivated to carry out Tanner's mass analysis on Douglas's instrument for the same reasons set forth above regarding claim 1.

Element [18F.] — Douglas teaches this element for the same reasons it teaches Element [1B.]. Ex. 1004 ¶244.

6. Douglas in Combination with Tanner Renders Obvious Claim 25

[25Pre.] — As discussed above in this Ground for Claim 1, Douglas teaches a mass spectrometer comprising an ion beam source for emitting the ion beam, a detector, and two mass filters disposed in series between the beam source and the detector (Ex. 1007, 3:17–18), the filters having the same operating pressures at or below 10^{-3} torr. *Id.*, 18:44–45, 20:48–50; Ex. 1004 ¶252.

Element [25A.] — Douglas teaches emitting an ion beam containing Co^{+} ions (m/z =59) into a first mass filter stage in series with a second mass filter stage. *Id.*, 13:43–49 ("two quadrupoles operated in tandem"); Ex. 1004 ¶253.

Elements [25B.]-[25C.] — As described above in Elements [25B.]-[25C.] in Ground 3, Tanner teaches such manner of operating these two mass filter stages. Ex. 1006, 1086–87, Tables 1-2; Ex. 1004 ¶254. A POSA would have been motivated to carry out Tanner's mass analysis on Douglas's instrument for the same reasons set forth above regarding claim 1. Ex. 1004 ¶254.

7. Douglas in Combination with Tanner Renders Obvious Claims 28 and 32

[28Pre.], [32Pre.] — Although the preamble is nonlimiting (*supra*, Section XI.D.), Douglas's methods nonetheless are used in part for the recited purpose. Ex. 1004 ¶¶257, 263.

Elements [28A.]-[32A.] — Douglas teaches emitting an ion beam containing Co^+ ions (m/z =59) into a first mass filter stage in series with a second mass filter stage. Ex. 1012, 13:43–49 ("two quadrupoles operated in tandem"); Ex. 1004 ¶¶258, 264. It was well known in the art as of 2002 that an ion beam generated from an ICP source would contain ions within a range of m/z ratios. Ex. 1004 ¶¶258, 264.

Elements [28B.],[28E.], [32B.], [32E.] — As described above in Elements [28B.]–[28E.] and [32B.]–[32E.] in Ground 3, Tanner teaches such manner of operating these two mass filter stages. Ex. 1006, 1086–87, Tables 1-2; Ex. 1004 ¶¶259, 265. A POSA would have been motivated to carry out Tanner's mass analysis on Douglas's instrument for the same reasons set forth above regarding claim 1. Ex. 1004 ¶¶259, 265.

8. Douglas in Combination with Tanner Renders Obvious Dependent Claims on Certain Sub-Ranges

Claims [2.], [14.], [20.], [26.], [29.], [33.] — These claims variously describe that "the ions within the sub-range comprise 1%, or less, of the ions within the beam." In the vast majority of situations, this reduction in ions occurs naturally whenever a mass filter is applied to the ion beam. Ex. 1012, 1:37–2:4; Ex. 1004 ¶¶223-225, 238-239, 247-248, 266-267.

Claims [3.], [15.], [21.], [27.], [30.], [34.] — These claims variously describe that "the ions within the sub-range comprise 0.01%, or less, of the ions within the beam." Again, in the vast majority of situations, this reduction in ions occurs naturally whenever a mass filter is applied to the ion beam. Ex. 1012, 1:37–2:4; Ex. 1004 ¶¶223-225, 238-239, 247-248, 266-267.

Notably, the '553 Patent does not explicitly teach how to obtain sub-ranges of 1% or less, or 0.01% or less, for the first mass filter stage (the sacrificial filter). Instead, it gives an example on a range of RF/DC ratios for the sacrificial filter to obtain a desired filter resolution. Ex. 1001, 7:29–35 ("[W]ilter resolution can be controlled by varying the RF to DC voltage ratio. . . . The ratio for the sacrificial

filter should lie between −5.983 to −6.00 [for ions having amu = 115 as an example].”); Ex. 1004 ¶¶223-225.

Before May 2002, it was routine in the art to adjust the RF/DC ratio to control the bandpass of a quadrupole. Ex. 1004 ¶¶223-225. After reviewing Douglas and Tanner, a POSA would have understood that the first quadrupole disclosed in Douglas can normally operate in certain RF/DC ratios when a specific result is desired, such as transmitting 0.01% of ions within the beam. *Id.* Thus, as discussed above in Sections XI.B. and XI.C., Douglas and Tanner anticipate these apparatus and the method claims. At the very least, these claims are rendered obvious in light of the combined teachings of Douglas and Tanner on adjusting RF/DC ratios to achieve certain resolution. Ex. 1007, 7:18–8:58; Ex. 1006, 1085–16; Ex. 1004 ¶¶223-225.

9. Douglas in Combination with Tanner Renders Obvious Other Dependent Claims

Claims [4.], [5.], [6.], [16.], [22.] — Douglas teaches a quadrupole analyzer, which is a multi-pole analyzer, for each mass filter stage. Ex. 1007, 2:65–67; Ex. 1004 ¶¶226-228. Each of these quadrupoles has a DC voltage supply and an AC

voltage supply for applying driver voltages to the rods. *Id.*, 3:9–14, 3:59–62; Ex. 1004 ¶¶228, 240, 249.

Claims [8.], [9.], [19.], [24.], [38.] — As explained above in Ground 3 for Claims 8, 9, 19, 24, and 38, Tanner teaches the use of a dynamic bandpass filter as the first filter stage, which teaches the elements of Claims 8, 9, 19, 24, and 38. Ex. 1006, 1086–87, Tables 1-2; Ex. 1004 ¶¶229-232, 245-246, 250-251, 271-272.

Likewise, Douglas discloses scanning the two mass filter stages synchronously over the same mass range, which would result in the center point of the sub-range substantially tracking the selected mass/charge ratio during scanning. Ex. 1007, 6:5–38, Figures 14–16; Ex. 1004 ¶¶229-232.

Claim [12.] — Douglas teaches a mass spectrometer comprising a two-stage mass filter apparatus. *Id.*, 1:7–10, 2:65–67; Ex. 1004 ¶233.

Claims [31.], [35.] — Douglas also teaches operating the first and second filter stages at pressures below 10^{-3} torr. Ex. 1007, 18:44–45, 20:48–50; Ex. 1004 ¶¶262, 268.

Claim [36] — Douglas in combination with Tanner discloses the limitations of this claim for the same reasons as Elements [1C.] and [1D.]. *Id.*, 13:25–27, 9:13–17; Ex. 1006, 1086–87, Tables 1-2; Ex. 1004 ¶269.

Claims [37.], [42.], [47.], [52.], [57.], [62.] — Douglas teaches experiments in which the first and second quadrupoles operate at the same stability region. *Id.*, 5:31–34 (third stability region), 5:43–53 (third stability region), 6:5–52, 14:30–43; Ex. 1004 ¶¶270, 275.

Claims [39.], [43.], [44.], [48.], [49.], [53.], [54.], [58.], [59.], [63.], [64.] — As described in Ground 3 for these claims, using the dynamic bandpass reaction cell, Tanner teaches a method in which the first mass filter stage and the second mass filter stage are scanned together to provide a mass spectrum and the scan is stepped from transmission peak to another peak. Ex. 1006, 1086–87, Tables 1-2; Ex. 1004 ¶¶273, 276-278.

Likewise, Douglas discloses scanning the two mass filter stages synchronously over the same mass range to provide a mass spectrum. Ex. 1007, 6:5–38, Figures 14-16; Ex. 1004 ¶¶273, 276-278.

Claims [40.], [41.], [45.], [46.], [50.], [51.], [55.], [56.], [60.], [61.], [65.], [66.] — As described in Ground 3 for these claims, using a fixed bandpass reaction cell, Tanner teaches a method wherein the scan is a smooth scan and the scanned range is the sub-range. Ex. 1006, 1086–87, Tables 1-2; Ex. 1004 ¶274.

I. GROUND 5: VANDERMEY IN COMBINATION WITH DOUGLAS AND TANNER RENDERS OBVIOUS CLAIMS 6–7, 16–17, 22–23, 37, 42, 47, 52, 57, AND 62

U.S. Patent No. 6,340,814 ("Vandermey," Ex. 1013) was issued on January 22, 2002 and thus qualifies as prior art under § 102(a).

A POSA would have been motivated to combine the teaching in Tanner and Douglas with the teaching in Vandermey. Ex. 1004 ¶306. Vandermey, like Douglas and Tanner, teaches improvements in the operation of mass spectrometers with multiple mass analysis stages. *Id*. Specifically, Vandermey teaches the operation of two quadrupole mass analyzers in order to have greater resolution of ion signals. Ex. 1013 at Abstract; Ex. 1004 ¶306. Similarly, Tanner teaches improvement in the removal of interferences to improve the resolution of ion signals. Ex. 1009 at 1:9–14; Ex. 1004 ¶306. Vandermey is cited on the face of the '553 patent.

Claims [6.], [16.], [22.] — Tanner and Douglas render obvious Claims [1], [13], and [18] as described above. Vandermey teaches the use of two quadrupole filter stages, configured to select certain mass to charge ratios. Ex. 1013, 4:56–60. Each quadrupole has a DC voltage supply and an AC voltage supply for applying a driver voltage [an RF voltage is applied] to the rods of each filter stage. *Id*., 3:9–25; Ex. 1004 ¶307.

Claims [7.], [17.], [23.] — Vandermey teaches that AC voltage supply is attached to one quadrupole filter stage, and that the two quadrupole filter stages are electronically coupled by an RF coupler. *Id*., 1:53–57; 3:9–25; 6:5–18; Ex. 1004 ¶308. The RF coupler in this case is the RF driver circuit that couple the two quadrupole filter stages in a controlled manner. *Id*., 1:53–57; Ex. 1004 ¶308.

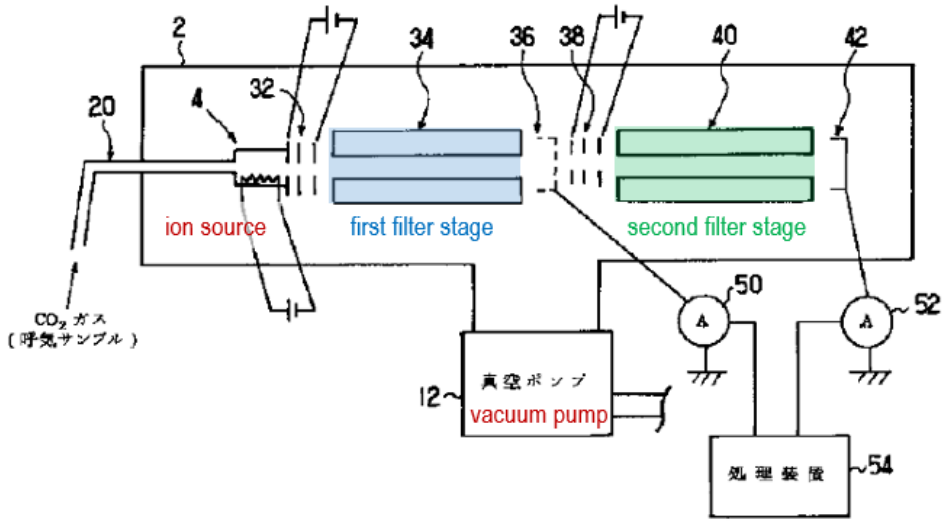
Claims [37.], [42.], [47.], [52.], [57.], [62.] — Tanner and Douglas render obvious Claims 1, 13, 18, 25, 38, and 32 as described above. Vandermey teaches operation of the first and second mass filter stages in the same stable operating system, specifically, the third stability region as shown in Figure 2. Ex. 1013, 3:51–4:14, Figure 2; Ex. 1004 ¶313.

J. GROUND 6: SAITO ANTICIPATES CLAIMS 1, 4–6, 12, 28, 32, 57, AND 62.

Saito is a Japanese Patent Application Publication published in January 1997 (Ex. 1009, and Ex. 1010 (a certified translation)). It thus qualifies as prior art under § 102(b). It is not cited in the '553 Patent, and was not discussed during the prosecution and reissue proceeding.

Saito discloses a double-quadrupole mass spectrometer for isotopic analysis. Ex. 1010, ¶¶[0048-0057], Figure 7 (annotations added). Ex. 1004 ¶315. The first quadrupole operates as a bandpass filter, and the second quadrupole operates as a mass analyzer. *Id*., ¶¶[0049-0065]; Ex. 1004 ¶315. Saito further discloses an experiment for determining the abundance ratio of $^{12}CO_2$ and $^{13}CO_2$ using this instrument. *Id*., ¶¶[0050-0065]; Ex. 1004 ¶315.

【図7】 Figure 7



1. Saito Anticipates Claim 1

[1Pre.] — Although the preamble is nonlimiting (*see* Section XI.D.), Saito nevertheless discloses a mass filter apparatus that fulfills the recited purpose of filtering a beam of ions in a range of m/z ratios. Ex. 1004 ¶316.

Moreover, as discussed in Section XI.B., Claim 1 is an apparatus claim reciting a manner of operation. Saito discloses an apparatus that meets all the structural limitations of Claim 1 and is capable of operating as described. Thus, Saito anticipates Claim 1.

Element [1A.] — Saito discloses "an ion beam source [an ionization device 4] for emitting the ion beam." *Id*., ¶¶[0011], [0057], Figure 7; Ex. 1004 ¶317.

Element [1B.] — Saito discloses "first and second mass filter stages in series" because it discloses the "front stage filter 34" and the "rear stage filter 40" in series. *Id*., ¶¶[0049], [0057]; Ex. 1004 ¶318. Saito further discloses "a vacuum system pump 12 in Figure 7," which can be arranged to "maintain both the first and second filter stages at operating pressures below 10^{-3} torr." *Id*.; Ex. 1004 ¶318.

Element [1C.] — Saito discloses that "the first mass filter stage [the front stage filter 34] is configured to select for transmission onto the second filter stage [the rear stage filter 40] only ions having a sub-range of mass/charge ratios [$^{12}CO_2$ (mass number 44) and $^{13}CO_2$ (mass number 45)] which includes the selected mass/charge ratio [$^{13}CO_2$ (mass number 45)]." *Id*., ¶¶[0050-0052], [0063-0065], Figure 6; Ex. 1004 ¶319.

Element [1D.] — Saito discloses that "the second mass filter stage [the second stage filter 40] is configured to select only ions of the said selected

mass/charge ratio [$^{13}CO_2$ (mass number 45)]." *Id*., ¶¶[0050-0052], [0063-0065], Figure 6; Ex. 1004 ¶320.

2. Saito Anticipates Claims 28 and 32

[28Pre.] and [32Pre.] — Saito anticipates Claims [28.] and [32.] based on the same disclosures, and so these two claims will be discussed together here. To the extent that the preambles of method Claims [28.] and [32.] are limiting (which they are not), Saito's experiment is performed toward the same purposes to achieve the same results. Ex. 1004 ¶¶325-332.

In addition, Saito discloses Elements [28A.] and [32A.] for the same reasons it discloses Element [1A.]. Ex. 1004 ¶¶325-332. Saito discloses Elements [28B.], [28C.], [32B.], [32C.] for the same reasons it discloses Elements [1B.] and [1C.]. Ex. 1004 ¶¶325-332. Saito discloses Elements [28D.], [28E.], [32D.], and [32E.] for the same reasons it discloses Element [1D.]. Ex. 1004 ¶¶325-332.

3. Saito Anticipates Several Dependent Claims

Claim [4.] — Saito discloses that "each filter stage comprises a multi-pole analyzer [quadrupole filter]." *Id*., ¶¶[0028], [0049]; Ex. 1004 ¶321.

Claim [5.] — Saito discloses that "each filter stage comprises rods in a quadrupole arrangement [quadrupole filter]." *Id*.; Ex. 1004 ¶322.

Claim [6.] — Saito discloses "a DC voltage supply [U1 for the first filter stage and U2 for the second filter stage] and an AC voltage supply [V1 for the first filter stage and V2 for the second filter stage] for applying driver voltages to rods of each filter stage." *Id*., ¶¶[0050-0051]; Ex. 1004 ¶323.

Claim [12.] — Saito discloses every limitation of this claim for the same reasons as it discloses Claim [1.].

Claims [57.], [62.] — Saito discloses "operating the first and second mass filters stages in a same stable operating region [the first stability region as shown in Figure 6]." *Id*., ¶¶[0050–0051], Figure 6; Ex. 1004 ¶¶333-334.

K. GROUND 7: SAITO IN COMBINATION WITH DOUGLAS RENDERS OBVIOUS CLAIMS 1–6, 12–16, 18, 20–22, 25–38, 42–43, 47–48, 52–53, 57–58, AND 62–63 UNDER § 103

A POSA would have viewed Saito in combination with Douglas as teaching each element of claims 1–6, 12–16, 18, 20–22, 25–38, 42–43, 47–48, 52–53, 57–58, and 62–63.

1. Motivation to Combine Saito and Douglas

A POSA would have been motivated to combine the teaching in Douglas with Saito. Ex. 1004 ¶¶336-337. As discussed in Ground 4, Douglas teaches the use of two filter stages to improve the resolution of ICP-MS. Douglas discusses that the two filter stages may be at different resolutions. Ex. 1007, 13:25–27. A POSA would have understood Douglas's teaching to mean that the first filter stage may be a bandpass filter (*i.e.*, at a lower resolution), and the second filter stage may be a conventional mass analyzer (*i.e.*, at a higher resolution), similar to the teaching in Saito. Ex. 1004 ¶¶336-337.

Douglas improves Saito by teaching that the double-quadrupole instrument can be operated at the conventional pressure of 2 x 10^{-5} torr for quadrupoles or at a slightly higher pressure. Ex. 1007, 18:38–45; Ex. 1004 ¶¶336-337. Specifically, Douglas teaches that the quadrupoles may be able to operate at a pressure of 2 x 10^{-4} torr, a factor of 10 higher than the conventional pressure. *Id*., 20:46–50; Ex. 1004 ¶¶336-337. Accordingly, lower speed and lower cost vacuum pumps can be used with these instruments. *Id*., 18:47–50; Ex. 1004 ¶¶336-337. Thus, a POSA

would have been motivated to use the teaching in Douglas to operate Saito's instrument at a pressure of 10^{-4} or 10^{-5} torr. Ex. 1004 ¶¶336-337.

2. Claim 1

As explained in Ground 6, Saito discloses every limitation of apparatus Claim 1. To the extent that Patent-Owner argues that Saito does not disclose a vacuum system arranged to maintain operating pressures below 10^{-3} torr in Element [1B.], Douglas teaches this limitation. As discussed above, in view of Douglas's teaching, a POSA would have been motivated to operate Saito's vacuum system to maintain a pressure of 10^{-4} or 10^{-5} torr. Ex. 1004 ¶338. Thus, Saito in combination with Douglas teaches every limitation of Claim 1.

3. Claim 13

As for **[13Pre.]**, to the extent that the preamble of method claim 13 is limiting (which it is not), Saito teaches a method of filter a beam of ions. Saito in view of Douglas teaches Element [13A.] for the same reasons it teaches Elements [1A.] and [1B.]. Saito in view of Douglas teaches Element [13B.] for the same reasons it teaches Element [1C.]. Saito in view of Douglas teaches Element [13C.] for the same reasons it teaches Element [1D.]. Saito in view of Douglas teaches Element [13D.] for the same reasons it teaches Element [1B.].

4. Claim 18

As for **[18Pre.]** to the extent that the preamble of method claim 18 is limiting (which it is not), Saito teaches a method of producing a mass spectrum of an ion beam because Saito's instrument has a detector and a processing device to produce such mass spectrum. Ex. 1004 ¶349.

Elements [18A.], [18B.], [18C.], [18F.] — These claim elements are substantively identical to Elements [13A.]-[13D.] and are thus taught by Saito in view of Douglas for the reasons above.

Element [18D.]: As discussed above in Element [13C.], Saito sets the quadrupole mass analyzer to scan at mass number 45. *Id*., ¶¶[0050-0052], [0063-0065], Figure 6; Ex. 1004 ¶351.

Element [18E.]: Saito detects the number of ion selected at mass number 45 to provide a mass spectrum. *Id*., ¶¶[0050-0052], [0063-0065], Figure 6; Ex. 1004 ¶352.

5. Claim 25

As for [25Pre.], Saito in view of Douglas teaches this limitation for the same reasons it teaches each limitation of Claim 1 and Element [13D.]. Saito in view of

Douglas teaches the limitation of Element [25A.] for the same reasons it teaches Element [13A.]. Saito in view of Douglas teaches the limitation of Element [25B.] for the same reasons it teaches Element [13B.]. Saito in view of Douglas teaches the limitation of Element [25C.] for the same reasons it teaches Element [13C.].

6. Claims 28 and 32

A POSA would have understood that Saito teaches each limitation of these claims for the same reasons discussed in Ground 6.

7. Dependent Claims on Certain Sub-ranges

Claims [2.], [14.], [20.], [26.], [29.], [33.] — These claims variously describe that "the ions within the sub-range comprise 1%, or less, of the ions within the beam," which is ordinarily achieved automatically in the operation of a multi-quadrupole mass filter. Ex. 1004 ¶¶339-340.

Claims [3.], [15.], [21.], [27.], [30.], [34.] — These claims variously describe that "the ions within the sub-range comprise 0.01%, or less, of the ions within the beam." Ex. 1004 ¶¶339-340.

As discussed in Ground 4, a POSA would have known how to adjust the RF/DC ratio to control the bandpass of a quadrupole. Ex. 1004 ¶¶339-340. After

reviewing Saito and Douglas, a POSA would have understood that the first quadrupole disclosed in Saito can normally operate in certain RF/DC ratios when a specific result is desired, such as transmitting 1% of ions within the beam. *Id.* Also, Saito teaches methods of determining the number of ions that passed through a filter stage. *Id*.; Ex. 1010, ¶¶[0053-0054]. Thus, these claims are rendered obvious in light of the combined teaching of Saito and Douglas.

8. Other Dependent Claims

Claims [4.], [5.], [6.], [12.] — As discussed in Ground 6 for these claims and in this ground for Element [1B.], Saito in view of Douglas teaches every limitation of these claims.

Claims [16.], [22.] — Saito in view of Douglas teaches every limitation of these claims for the same reason it teaches Claim 6. *Id*.

Claims [31.], [35.] — Saito in view of Douglas teaches every limitation of these claims for the same reason it teaches Element [1B.]. *Id*., ¶¶[0050-0052], [0063-0065], Figure 6.

Claim [36.] — Saito in combination with Douglas discloses the limitations of this claim for the same reasons as Elements [1C.] and [1D.] and Claim 6. *Id*.

Claims [37.], [42.], [47.], [52.], [57.], [62.] — Saito teaches experiments in which the first and second quadrupoles operate at the first stability region. Ex. 1010, ¶¶[0048]–[0052], Figure 6; Ex. 1004 ¶369.

Claims [38.], [43.], [48.], [53.], [58.], [63.] — Douglas teaches scanning the two mass filter stages synchronously to provide a mass spectrum. *Id*., 6:5–38, Figures 14–16; Ex. 1004 ¶370. A POSA would have understood that Douglas discloses a scanner for controlling the two filter stages as described in Claim 38. Ex. 1004 ¶370.

XII. CONCLUSION

For all of the reasons set forth above, there is a reasonable likelihood that the petitioner would prevail with respect to at least one of the sixty-six claims challenged in this petition.

XIII. CERTIFICATE OF WORD COUNT

Pursuant to 37 C.F.R. § 42.24, the undersigned attorney for the Petitioner declares that the argument section of this Petition (Section I, III-XII) has a total of 13,935 words, according to the word count tool in Microsoft Word™.

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CERTIFICATE OF SERVICE

The undersigned certifies service pursuant to 37 C.F.R. §§ 42.6(e) and 42.105(a), (b) on the Patent-Owner via UPS overnight mail of a copy of this Petition for *Inter Partes* Review and supporting materials at the Patent-Owner at the correspondence address of record for the '553 Patent:

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