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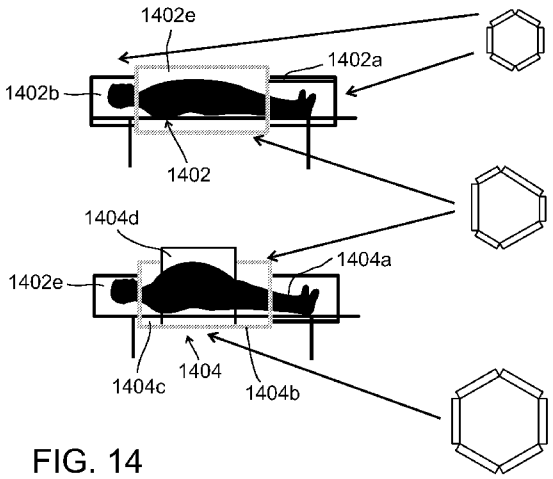

FIG. 14

(57) Abstract: An N-M tomography system comprising: a carrier for the subject of an examination procedure; a plurality of detector heads; a carrier for the detector heads; and a detector positioning arrangement operable to position the detector heads during performance of a scan without interference or collision between adjacent detector heads to establish a variable bore size and configuration for the examination. Additionally, collimated detectors providing variable spatial resolution for SPECT imaging and which can also be used for PET imaging, whereby one set of detectors can be selectably used for either modality, or for both simultaneously.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2013/053721

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - G01T 1/166 (2013.01)
USPC - 250/370.09
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC(8) - G01T 1/24, 1/29, 1/161, 1/166 (2013.01)
USPC - 250/363.04, 363.05, 363.1, 370.05, 370.08, 370.09

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
CPC - G01T 1/1635, 1/2914, 1/2978 (2013.01)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
PatBase, Orbit, Google Patents, Google

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 6,137,109 A (HAYES) 24 October 2000 (24.10.2000) entire document	1, 2, 4-7, 9-10, 12-16, 18-23, 30, 31, 35 ----- 3, 8, 11, 17, 32-34, 91, 93
Y -- A	US 7,498,582 B2 (JOUNG) 03 March 2009 (03.03.2009) entire document	8, 11 --- 92
Y	US 2012/0001077 A1 (INOUE et al) 05 January 2012 (05.01.2012) entire document	17
Y	US 2003/0001098 A1 (STODDART et al) 02 January 2003 (02.01.2003) entire document	32-34
Y	US 2009/0152471 A1 (ROUSSO et al) 18 June 2009 (18.06.2009) entire document	3, 91
Y	US 5,585,637 A (BERTELSEN et al) 17 December 1996 (17.12.1996) entire document	93

☒ Further documents are listed in the continuation of Box C. ☐

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
22 December 2013	10 JAN 2014
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Authorized officer: Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2013/053721

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☒ Claims Nos.: 83
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

See extra sheet.

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
1-23, 30-35, 91-93

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2013/053721

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 3,777,148 A (MIRALDI) 04 December 1973 (04.12.1973) entire document	92
A	US 2003/0111609 A1 (ZENG) 19 June 2003 (19.06.2003) entire document	92
A	US 2009/0304150 A1 (METZLER et al) 10 December 2009 (10.12.2009) entire document	1-23, 30-35, 91, 93

Continuation of Box III.

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I, claims 1-23, 30-35, 91-93, drawn to an N-M tomography system, method of using and method of imaging, comprising a detector positioning system operable to position the detector heads including rotation thereof to adjacent or radially or circumferentially or axially overlapping positions before and/or during performance of a scan without interference or collision between adjacent detector heads to establish a variable bore size and configuration for examination.
Group II, claims 24-28, drawn to drawn to an N-M tomography system, comprising a detector carrier which is configured to be populated by a variable number of detector heads.
Group III, claims 29, 36-39, drawn to an N-M tomography system and method of upgrading an existing N-M tomography system, comprising a detector carrier which is configured to be populated by detector heads of variable type and/or quality.
Group IV, claims 40-76, 81-82, 90, drawn to an N-M tomography system and collimator for attachment, comprising a detector unit for a Nuclear Medicine (NM) imaging system comprising: a collimator comprised of first and second sets of septa moveable to change the geometry of the collimator to increase and decrease the spatial resolution of the detector unit.
Group V, claim 77, drawn to a collimator for attachment to a N-M imaging system detector, having a thickness and/or height of the septa in one direction is different from a thickness and/or height in another direction.
Group VI, claims 78-82, 84-89, drawn to a detector unit, a method of imaging and a method of using a Nuclear Medicine (NM) imaging system comprising: a detector configured to permit use of the detector for both PET and SPECT imaging.

The inventions listed as Groups I-VI do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons: the special technical feature of the Group I invention: a detector positioning system operable to position the detector heads including rotation thereof to adjacent or radially or circumferentially or axially overlapping positions before and/or during performance of a scan without interference or collision between adjacent detector heads to establish a variable bore size and configuration as claimed therein is not present in the invention of Groups II-VI. The special technical feature of the Group II invention: a detector carrier which is configured to be populated by a variable number of detector heads as claimed therein is not present in the invention of Groups I, III-VI. The special technical feature of the Group III invention: a detector carrier which is configured to be populated by detector heads of variable type and/or quality as claimed therein is not present in the invention of Groups I, II, IV-VI. The special technical feature of the Group IV invention: first and second sets of septa extending in two directions that intersect to define an array of collimator cells, wherein the septa are moveable to change the geometry of the collimator to increase and decrease the spatial resolution of the detector unit as claimed therein is not present in the invention of Groups I, II, III or V-VI. The special technical feature of the Group V invention: a collimator having a thickness and/or height of the septa in one direction is different from a thickness and/or height in another direction as claimed therein is not present in the invention of Groups I-IV, VI-VI. The special technical feature of the Group VI invention: a detector configured to permit use of the detector for both PET and SPECT imaging as claimed therein is not present in the invention of Groups I-V.

Groups I, II, III, IV, V and VI lack unity of invention because even though the inventions of these groups require the technical feature of an N-M tomography system comprising: a support for a subject of an examination procedure; a plurality of detector heads; the detector element responsive to gamma ray photons to provide an electrical output signal; a carrier for the detector heads, the detector arrangement comprised of a plurality of SPECT detector heads or PET detector heads; this technical feature is not a special technical feature as it does not make a contribution over the prior art in view of US 6,137,109 A (HAYES) 24 October 2000 (24.10.2000), having an N-M tomography system (col. 1, lines 7-11) comprising: a support 10 for a subject of an examination procedure (patient on a support, col. 3, lines 56-57); a plurality of detector heads (22a, 22b, 22c, fig. 1; col. 3, line 65); the detector element responsive to gamma ray photons to provide an electrical output signal (col. 4, lines 10-22); a carrier 30 for the detector heads (face 30 of rotating gantry, fig. 1; col. 3, line 64); the detector arrangement comprised of a plurality of SPECT detector heads or PET detector heads (col. 1, lines 7-12).

Groups IV, V and VI lack unity of invention because even though the inventions of these groups require the technical feature of an N-M tomography system comprising: a collimator comprising a body defining first and second sets of septa extending in two directions, this technical feature is not a special technical feature as it does not make a contribution over the prior art in view of US 3,777,148 A (MIRALDI) 04 December 1973 (04.12.1973) having an N-M tomography system (radiation scanning system detecting gamma radiation (col. 2, lnes 30-36) comprising: a collimator 16 comprising a body defining first and second sets of septa (openings 50, 51, 52, 53) extending in two directions (fig. 4, showing two sets of openings on left and right, extending at an angle towards a focal line; col. 4, lines 43-55).

Groups I, II, III, and IV lack unity of invention because even though the inventions of these groups require the technical feature of an N-M tomography system comprising: a data processing unit responsive to signal outputs from the population of detector heads to reconstruct a tomographic image from the signals; performing SPECT or PET imaging using an algorithm that assumes a collection angle and a detection probability map, this technical feature is not a special technical feature as it does not make a contribution over the prior art in view of US 2009/0304150 A1 (METZLER et al) 10 December 2009 (10.12.2009), having an N-M tomography system (para. 0001) comprising: a data processing unit (computer reconstruction algorithms are used, para. 0243; thus a data processing unit is inherent) responsive to signal outputs from the population of detector heads (array of detector elements on a detector panel, including a collimator framework having septa, para. 0016) to reconstruct a tomographic image from the signals (para. 0007); performing SPECT imaging using an algorithm that assumes a collection angle (adjusting the acceptance angle by adjusting the septa, para. 0152) and a detection probability map according the adjustment of the collimator configuration (using the geometric resolution equation, para. 0154; calculating the sensitivity of the collimated geometry, para. 0168-0170, 0334; using detection probability and sensitivity for producing an attenuation map (image reconstruction), para. 0185),

Since none of the special technical features of the Group I, II, III, IV, V or VI inventions are found in more than one of the inventions, unity of invention is lacking.

Note: claims 81, 82 are multiple dependent claims, which depend from either Group IV or Group VI. These claims are included in both groups, and will be examined with the respective group, should it be selected.