



(51) International Patent Classification:
G21K 1/02 (2006.01)

(21) International Application Number:
PCT/US2017/019174

(22) International Filing Date:
23 February 2017 (23.02.2017)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
62/299,888 25 February 2016 (25.02.2016) US

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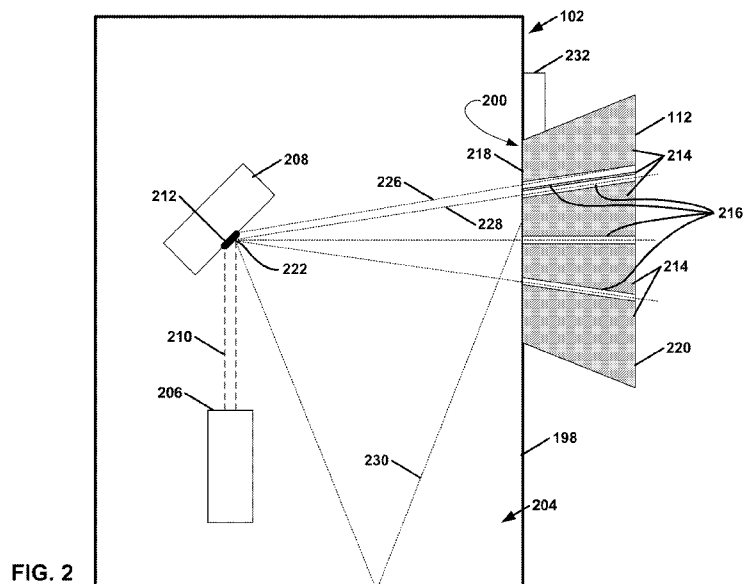
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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM,

(54) Title: X-RAY TUBE AND GAMMA SOURCE FOCAL SPOT TUNING APPARATUS AND METHOD



(57) Abstract: An apparatus (112) provides for tuning of an effective focal spot size of a radiation source. The apparatus may comprise a plurality of inter-channel structures (214) defining a plurality of channels (216) passing through the apparatus from a first surface (218) to a second surface (220). The inter-channel structures comprise a first substance and the channels contains a second substance. The first substance attenuates radiation more than the second substance. The inter-channel structures may define the channels such that lines passing through the channels converge at a location on or near the surface of a focal spot (212).

TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,
KM, ML, MR, NE, SN, TD, TG).

Published:

- *with international search report (Art. 21(3))*
- *before the expiration of the time limit for amending the
claims and to be republished in the event of receipt of
amendments (Rule 48.2(h))*

(88) Date of publication of the international search report:

02 November 2017 (02.11.2017)

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2017/019174

A. CLASSIFICATION OF SUBJECT MATTER
INV. G21K1/02
ADD.

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)
G21K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2005 241381 A (HAMAMATSU PHOTONICS KK) 8 September 2005 (2005-09-08) abstract; figures 1-5,8 paragraphs [0014], [0022] - [0026], [0030], [0038], [0039], [0044], [0049] - [0051] -----	1-3,6,7, 9,11,13, 16-18, 22,23, 25,28-30
X	US 2016/045767 A1 (BENDER EDWARD T [US] ET AL) 18 February 2016 (2016-02-18) figures 2,4,5 paragraphs [0002], [0005] - [0007], [0017], [0018], [0032] - [0035], [0041] ----- -/--	1,6,7



Further documents are listed in the continuation of Box C.



See patent family annex.

* 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

15 September 2017

Date of mailing of the international search report

26/09/2017

Name and mailing address of the ISA/

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INTERNATIONAL SEARCH REPORT

International application No

PCT/US2017/019174

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2014/112451 A1 (FIGUEROA SAAVEDRA RODOLFO [CL] ET AL) 24 April 2014 (2014-04-24) figures 11,12 paragraphs [0039], [0040], [0043] -----	1-3,7
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X	WO 2014/131173 A1 (OUR NEW MEDICAL TECHNOLOGIES [CN]; WU ZHONGHUA [CN]) 4 September 2014 (2014-09-04) abstract; figures 1-3 -----	1-3,7,8
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X	JP 2013 195407 A (DOBASHI KATSUHIRO) 30 September 2013 (2013-09-30) figures 2,4,5,14,16,18 paragraphs [0001], [0004], [0005], [0017], [0018], [0033], [0038], [0041], [0042] paragraphs [0047], [0064], [0103], [0110] - [0112], [0117], [0123], [0124] -----	1,4,7,9, 14,17, 22,26, 29,34
X	US 6 353 227 B1 (BOXEN IZZIE [CA]) 5 March 2002 (2002-03-05) figures 1a,5a,5b column 1, lines 36-63 column 4, line 40 - column 5, line 10 column 8, line 55 - column 9, line 10 column 10, lines 30-63 column 13, lines 6-10 ----- -/--	1-3,6-9, 11-13, 17, 20-25, 28,29, 32,33

INTERNATIONAL SEARCH REPORT

International application No

PCT/US2017/019174

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2008/170664 A1 (KALMAN ZWI HEINRICH [IL]) 17 July 2008 (2008-07-17) figures 2,3 paragraphs [0007] - [0014], [0049] - [0055], [0060] - [0063], [0080], [0081] -----	1,6,7, 22,28, 29,32,33
X	US 2014/105361 A1 (VOGTMEIER GEREON [DE] ET AL) 17 April 2014 (2014-04-17) figures 1-19 paragraphs [0041], [0042], [0046] - [0050], [0054], [0061], [0074], [0079], [0080] paragraphs [0087] - [0094], [0098] - [0101] paragraphs [0107] - [0113], [0129], [0130] -----	1-4,7-9, 11-14, 17, 22-26, 29,34 19,31
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X	JP 2012 181111 A (RIKAGAKU KENKYUSHO) 20 September 2012 (2012-09-20) figure 17 paragraphs [0006], [0007], [0057] - [0059] -----	1,6,7,9, 10,16, 17,19,31

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2017/019174

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.:
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 additional 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 an 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.:

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.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-4, 6-14, 16-18, 22-26, 28-30, 34

Apparatus comprising a plurality of inter-channel structures and a plurality of channels, wherein the inter-channel structures attenuate a radiation more than the channels and lines passing through the channels converge, wherein the inter-channel structures define the channels such that diameters of the channels vary to compensate for non-uniformity of a focal spot of an electron beam.

2. claims: 5, 15, 27

Apparatus comprising a plurality of inter-channel structures and a plurality of channels, wherein the inter-channel structures attenuate a radiation more than the channels and lines passing through the channels converge, wherein the inter-channel structures define the channels such that a first segment of an inner surface of the channel is smoother than a second segment of the inner surface of the channel

3. claims: 19-21, 31-33

Apparatus comprising a plurality of inter-channel structures and a plurality of channels, wherein the inter-channel structures attenuate a radiation more than the channels and lines passing through the channels converge, wherein a motion system is configured to move the apparatus.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2017/019174

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