



- (51) **International Patent Classification:**
G01T 1/02 (2006.01)
- (21) **International Application Number:**
PCT/US2015/037550
- (22) **International Filing Date:**
24 June 2015 (24.06.2015)
- (25) **Filing Language:** English
- (26) **Publication Language:** English
- (30) **Priority Data:**
62/018,030 27 June 2014 (27.06.2014) US
62/025,776 17 July 2014 (17.07.2014) US
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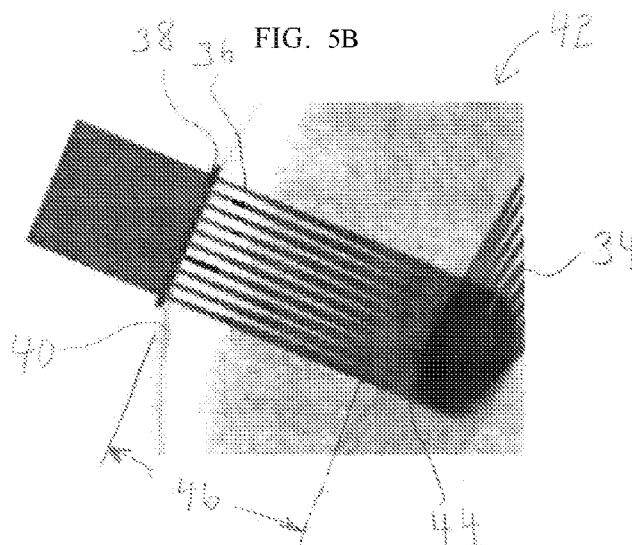
- (81) **Designated States** (*unless otherwise indicated, for every kind of national protection available*): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, 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, 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))

- (88) **Date of publication of the international search report:**
3 November 2016

(54) **Title:** RADIATION THERAPY WITH SEGMENTED BEAMS OF PROTONS AND OTHER IONS



(57) **Abstract:** A method for delivering therapeutic light ion radiation to a target volume of a subject, wherein the target volume is located at a predetermined depth from the skin, includes irradiating a surface of the skin with an array of light ion minibeam comprising parallel, spatially distinct minibeam at the surface in an amount and spatially arranged and sized to maintain a tissue-sparing effect from the skin to a proximal side of the target volume, and to merge into a solid beam at a proximal side of the target volume. A gap between the parallel, spatially distinct minibeam at the surface and a species of light ions forming the minibeam are selected such that the array merges into a solid beam at a predetermined beam energy, and across all energies for Bragg-peak spreading, at a proximal side of the target volume.



INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 15/37550

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - G01T 1/02 (2015.01)

CPC - A61N 5/1075; A61N 2005/1087; A61N 5/1071; A61N 5/1065

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 1/02 (2015.01)

CPC: A61N 5/1075; A61N 2005/1087; A61N 5/1071; A61N 5/1065

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

IPC(8): G01T 1/02 (2015.01)

CPC: A61N 5/1075; A61N 2005/1087; A61N 5/1071; A61N 5/1065; USPC: 250/393, 395; 600/1

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
 Patbase, Google Scholar, Google Web; Search terms used: Radiation, ion, proton, therapy, target, cancer, tumor, select, choose, choice, pick, species, type, bragg, beam, beamlet, minibeam, microbeam, array, parallel, control, spacing, gap, adjust, pencil, 1d, 2d, 1 dimensional, 2 dimensional, one dimensional, two dimensional

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2010/0187446 A1 (DILMANIAN et al.) 29 July 2010 (29.07.2010), para [0005], [0016]-[0017], [0020], [0022]-[0024], [0034], [0039]-[0040], [0042], [0044], [0047], [0050], [0053]-[0055], [0060]-[0061], [0065], [0068], [0069]	1, 2, 7, 9-18 ----- 3-6, 8, 19, 20
Y	US 2010/0327188 A1 (BERT et al.) 30 December 2010 (30.12.2010), para [0025]	3, 19, 20
Y	US 2012/0330086 A1 (LIDESTRI) 27 Decemer 2012 (27.12.2012), para [0026]-[0027], [0031]	4, 5
Y	US 2007/0034812 A1 (MA et al.) 15 February 2007 (15.02.2007), para [0140]-[0141]	6
Y	US 2010/0034357 A1 (SVESSON et al.) 11 February 2010 (11.02.2010), para [0019]-[0023], [0074], [0076]	8
A	US 2008/0192892 A1 (DILMANIAN et al.) 14 August 2008 (14.08.2008), para [0018], [0205], [0208]	1-20
A	DILINGHAM et al, "Interleaved Carbon Minibeams: An Experimental Radiosurgery Method With Clinical Potential." International Journal of Radiation Oncology Biology Physics Vol 84, Issue 2, 01 October 2012, (01.10.2012), pp. 1-2 [online] <URL: http://www.sciencedirect.com/science/article/pii/S0360301611037126 >	1-20

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* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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"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

31 December 2015 (31.12.2015)

Date of mailing of the international search report

08 AUG 2016

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 PCT OSP: 571-272-7774