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— with international search report (Art. 21(3))

[Continued on next page]

(54) Title: A METHOD AND APPARATUS FOR PARTICLE BEAM RANGE VERIFICATION

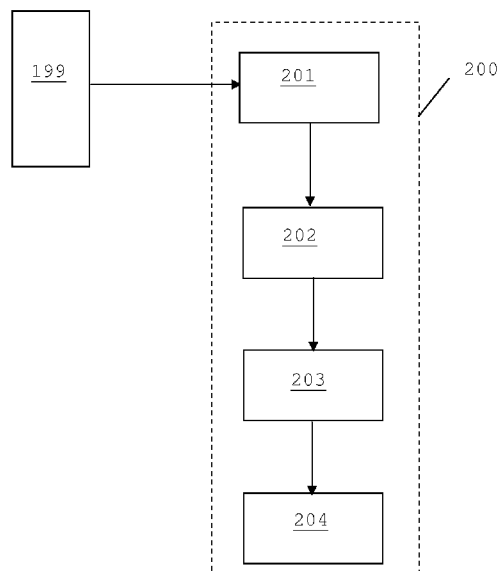


FIG. 4

(57) Abstract: The invention is related to a method and apparatus for verifying the beam range in a target irradiated with a charged hadron beam, such as a proton beam. The beam range is the location of the Bragg peak in the target, being the location where the largest portion of the dose is delivered. The method utilizes a prompt gamma camera provided with a slit-shaped opening, so as to be able to produced a 1-dimensional profile of the dose distribution along the beam line. The camera is mounted with the slit oriented perpendicularly to the beam line. The method comprises the steps of calculating a position of the camera with respect to a target, for a plurality of beam energies and spots to be irradiated. The method further comprises the steps of verifying the beam range for said plurality of spots, and delivering a value representative of the difference between the estimated beam range and the actual beam range. The apparatus of the invention is provided with a positioning module for positioning the camera.



— *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))*

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INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER
INV. A61N5/10
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)
A61N

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.
Y	EP 2 140 913 A1 (ION BEAM APPLIC SA [BE]) 6 January 2010 (2010-01-06) paragraph [0010] - paragraph [0015] paragraph [0086] - paragraph [0089] paragraph [0069] paragraph [0004]; claim 6 -----	1-8
Y	EP 0 779 081 A2 (HITACHI LTD [JP]) 18 June 1997 (1997-06-18) figures 3, 5 column 2, line 25 - line 34 ----- -/--	1-8



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

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Name and mailing address of the ISA/

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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2012/058836

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	MIN CHUL-HEE ET AL: "Prompt gamma measurements for locating the dose falloff region in the proton therapy", APPLIED PHYSICS LETTERS, AIP, AMERICAN INSTITUTE OF PHYSICS, MELVILLE, NY, US, vol. 89, no. 18, 2 November 2006 (2006-11-02), pages 183517-183517, XP012086792, ISSN: 0003-6951, DOI: 10.1063/1.2378561 abstract	1
A	----- MIN CHUL HEE ET AL: "Development of an Array-Type Prompt Gamma Detection System for the Online Measurement of the Range of the Proton Beam in a Patient: a Monte Carlo Feasibility Study", JOURNAL OF THE KOREAN PHYSICAL SOCIETY, SEOUL, KR, vol. 52, no. 3, 15 March 2008 (2008-03-15), pages 888-891, XP002509601, ISSN: 0374-4884 Section II. Materials and Methods; figure 1	1
A	----- POLF J C ET AL: "NOTE; Measurement and calculation of characteristic prompt gamma ray spectra emitted during proton irradiation; Measurement and calculation of prompt gamma spectra", PHYSICS IN MEDICINE AND BIOLOGY, TAYLOR AND FRANCIS LTD. LONDON, GB, vol. 54, no. 22, 21 November 2009 (2009-11-21), pages N519-N527, XP020167027, ISSN: 0031-9155 figure 1b	1
A	----- EP 2 116 277 A1 (ION BEAM APPLIC SA [BE]) 11 November 2009 (2009-11-11) paragraph [0015] - paragraph [0016]	1
Y	----- US 2011/057110 A1 (TESTA ETIENNE [FR] ET AL) 10 March 2011 (2011-03-10) paragraph [0059] - paragraph [0064]; figure 1 ----- -/--	1-8

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2012/058836

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A,P	VICTOR BOM ET AL: "Paper;Real-time prompt gamma monitoring in spot-scanning proton therapy using imaging through a knife-edge-shaped slit;Real-time prompt gamma monitoring in spot-scanning proton therapy using imaging through a knife-edge-shaped slit", PHYSICS IN MEDICINE AND BIOLOGY, INSTITUTE OF PHYSICS PUBLISHING, BRISTOL GB, vol. 57, no. 2, 9 December 2011 (2011-12-09), pages 297-308, XP020216223, ISSN: 0031-9155, DOI: 10.1088/0031-9155/57/2/297 abstract page 298, paragraph 3 page 299 figure 1 -----	1-8

INTERNATIONAL SEARCH REPORT

International application No.
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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.: 9-15
because they relate to subject matter not required to be searched by this Authority, namely:
see FURTHER INFORMATION sheet PCT/ISA/210
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:

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

Continuation of Box II.1

Claims Nos.: 9-15

As already explained for the parent application EP11165748, claim 9 explicitly discloses a step of "for each energy.....irradiating the target", which is unallowable because the target could be within a patient to treat for example tumours [0039]-[0040]. Moreover, since description also mentions the possibility of a feed back [0040] the treatment is dependent on the outcome of the measurement, which also makes the claim unallowable. Thus, Claim 9 refer to a method for treatment of the human body by surgery. Thus, according to Rule 39.1 (iv) PCT, no search is required to be carried out on claims 9-15. Further, according to Art 43bis.1 PCT and Rule 67.1 PCT, no international preliminary examination is required to be carried out on these claims.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2012/058836

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 2140913	A1	06-01-2010	EP 2140913 A1 06-01-2010
			EP 2313156 A1 27-04-2011
			JP 2011526504 A 13-10-2011
			US 2011186720 A1 04-08-2011
			WO 2010000857 A1 07-01-2010

EP 0779081	A2	18-06-1997	NONE

EP 2116277	A1	11-11-2009	EP 2116277 A1 11-11-2009
			EP 2313155 A1 27-04-2011
			US 2011248188 A1 13-10-2011
			WO 2009135879 A1 12-11-2009

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			FR 2930995 A1 13-11-2009
			JP 2011523568 A 18-08-2011
			US 2011057110 A1 10-03-2011
			WO 2009141570 A2 26-11-2009
