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Datasheet for the decision of 15 September 2010

Case Number: T 0470/07 - 3.4.01

Application Number: 97114481.1

Publication Number: 0826394

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Language of the proceedings: EN

Title of invention:
Charged particle beam apparatus

Patentee:
Hitachi, Ltd.

Opponent:
Varian Medical Systems Particle Therapy GmbH

Headword:
-

Relevant legal provisions:
RPBA Art. 13(1)

Relevant legal provisions (EPC 1973):
EPC Art. 54(1)(2), 56

Keyword:
-

Decisions cited:
-

Catchword:
-

Case Number: T 0470/07 - 3.4.01

D E C I S I O N
of the Technical Board of Appeal 3.4.01
of 15 September 2010

Appellant: (Opponent)	Varian Medical Systems Particle Therapy GmbH Friedrich-Ebert-Strasse 1 D-51429 Bergisch Gladbach (DE)
Representative:	Kirchner, Veit Lorenz Seidler Gossel Widenmayerstrasse 23 D-80538 München (DE)
Respondent: (Patent Proprietor)	Hitachi, Ltd. 6, Kanda Surugadai 4-chome Chiyoda-ku Tokyo 101 (JP)
Representative:	Strehl Schübel-Hopf & Partner Maximilianstrasse 54 D-80538 München (DE)
Decision under appeal:	**Interlocutory decision of the Opposition Division of the European Patent Office posted 30 January 2007 concerning maintenance of European patent No. 0826394 in amended form.**

Composition of the Board:

Chairman: B. Schachenmann
Members: G. Assi
P. Fontenay

Summary of Facts and Submissions

I. An opposition was filed against the European patent No. 0 826 394 (application No. 97114481.1) as a whole. The opposition was based on the grounds pursuant to Article 100(a) EPC 1973 that the subject-matter of the patent was not patentable within the terms of Articles 52(1), 54 and 56 EPC 1973 with regard to the following documents inter alia:

(E5) E. Pedroni et al., "*The 200-MeV proton therapy project at the Paul Scherrer Institute: Conceptual design and practical realization*", Med. Phys. 22(1), Am. Assoc. Phys. Med., January 1995, pages 37-53;

(E6) W. T. Chu et al., "*Instrumentation for treatment of cancer using proton and light-ion beams*", Rev. Sci. Instrum. 64(8), American Institute of Physics, August 1993, pages 2055-2122.

In its interlocutory decision, dispatched on 30 January 2007, the opposition division held that, taking into consideration the amendments made by the patent proprietor during the opposition proceedings, the patent and the invention to which it relates met the requirements of the EPC. The maintenance of the patent was based on a set of claims 1-11 filed at the oral proceedings before the opposition division on 17 January 2007 as a main request.

II. On 14 March 2007 the opponent (appellant) lodged a notice of appeal against the decision of the opposition division and paid the appeal fee. A statement setting out the grounds of appeal was filed on 29 May 2007.

III. With the statement of grounds of appeal, the appellant filed the following further documents inter alia:

(E13) "*Design, Construction and First Experiments of a Magnetic Scanning System for Therapy*", "*Radiobiological Experiments on the Radiobiological Action of Carbon, Oxygen and Neon*", Final Report for the EULIMA Collaboration, Biophysics Group, GSI Darmstadt, 12 April 1991;

(E14) E. Pedroni, "*Accelerators for Charged Particle Therapy: Performance Criteria from the User Point of View*", Cyclotrons and their Applications, 13^{th} International Conference (1993), ISBN 981-02-1130-9, 1993, pages 226-233.

With regard to E13, document E13a, filed by the appellant with a letter of 27 June 2008, is an exhibit providing evidence for the public availability of E13 before the filing date of the contested patent.

IV. On 14 April 2010 the parties were summoned to oral proceedings scheduled to take place on 12 July 2010 and then postponed until 15 September 2010. On 21 April 2010 a communication of the Board was sent.

V. In reply to the Board's communication, with a letter of 13 August 2010 the patent proprietor (respondent) filed auxiliary requests 1-6 replacing an earlier auxiliary request filed with a letter of 15 February 2008 in response to the statement setting out the grounds of appeal.

VI. Oral proceedings before the Board were held on 15 September 2010.

The appellant requested that the interlocutory decision of the opposition division be set aside and that the patent be revoked in its entirety.

The respondent requested that the appeal be dismissed, as a main request, or, alternatively, that the patent be maintained in amended form on the basis of one of the sets of claims filed with the letter of 13 August 2010 as auxiliary requests 1-6.

VII. The wording of claim 1 of the respondent's main request reads as follows:

"*A charged particle beam apparatus, comprising:*
a charged particle accelerator (100, 172) for supplying a charged particle beam,
an extraction switching means (120, 121, 166, 174, 175) for switching extraction of said charged particle beam from said charged particle accelerator on and off,
electromagnets (220, 231) for setting an irradiation position where to irradiate an irradiation target with said charged particle beam,
a scatterer (300) for enlarging the size of the charged particle beam, and
a control unit (132) for controlling said extraction switching means to switch extraction of said charged particle beam off, changing said irradiation position

by controlling said electromagnets while extraction of said charged particle beam is switched off, and then controlling said extraction switching means to resume extraction of said charged particle beam."

The wording of claim 1 of the respondent's auxiliary request 1 differs from that of claim 1 of the main request in that the "*control unit*" is further defined by the following underlined additions:

"*a control unit (132) for controlling said electromagnets to scan the charged particle beam in a first direction while extraction of the charged particle beam is switched on, controlling said extraction switching means to switch extraction of said charged particle beam off after said scan in said first direction, changing said irradiation position in a second direction different from said first direction by controlling said electromagnets while extraction of said charged particle beam is switched off, and then controlling said extraction switching means to resume extraction of said charged particle beam.*"

The wording of claim 1 of the respondent's auxiliary request 2 differs from that of claim 1 of the auxiliary request 1 in that the "*control unit*" is further defined by the following underlined additions:

"*a control unit (132) for controlling said electromagnets to scan the charged particle beam in a first direction while extraction of the charged particle beam is switched on, controlling said extraction switching means to switch extraction of said charged particle beam off when an irradiation dose* *measured by am [sic] irradiation dose monitor (301) has reached a target dose, changing said irradiation position in a second direction different from said first direction by controlling said electromagnets while extraction of said charged particle beam is switched off, and then controlling said extraction switching means to resume extraction of said charged particle beam.*"

The wording of claim 1 of the respondent's auxiliary request 3 differs from that of claim 1 of the auxiliary request 2 in that the "*control unit*" is further defined by the following underlined additions:

"*a control unit (132) for controlling said electromagnets to scan the charged particle beam in a first direction over an irradiation region (Aij) while extraction of the charged particle beam is switched on, controlling said extraction switching means to switch extraction of said charged particle beam off when an irradiation dose measured by am [sic] irradiation dose monitor (301) has reached a target dose, changing said irradiation position in a second direction different from said first direction by controlling said electromagnets while extraction of said charged particle beam is switched off, and then controlling said extraction switching means to resume extraction of said charged particle beam and controlling said electromagnets to scan the charged particle beam in the first direction over another irradiation region (Aij+1)*."

The wording of claim 1 of the respondent's auxiliary request 4 differs from that of claim 1 of the auxiliary request 3 by the following underlined additions concerning an "*operation unit*" and the "*control unit*":

"*an operation unit (131) for determining, for each of a plurality of irradiation regions (Aij) of the irradiation target, the central position (Pij) of the irradiation region and a current magnitude (ΔIXij) necessary for changing the magnetic field strength of the electromagnets so as to scan the charged particle beam in a first direction over the extent of the irradiation region, and*
a control unit (132) for controlling said electromagnets to scan the charged particle beam in the first direction over an irradiation region (Aij) based on the current magnitude (ΔIXij) and while extraction of the charged particle beam is switched on, controlling said extraction switching means to switch extraction of said charged particle beam off when an irradiation dose measured by am [sic] irradiation dose monitor (301) has reached a target dose, changing said irradiation position in a second direction different from said first direction by controlling said electromagnets while extraction of said charged particle beam is switched off, and then controlling said extraction switching means to resume extraction of said charged particle beam and controlling said electromagnets to scan the charged particle beam in the first direction over another irradiation region (Aij+1) based on the respective current magnitude."

The wording of claim 1 of the respondent's auxiliary request 5 differs from that of claim 1 of the auxiliary request 4 in that the "*control unit*" is further defined by the following underlined additions:

"*a control unit (132) for controlling said electromagnets to scan the charged particle beam in the first direction over an irradiation region (Aij) based on the current magnitude (ΔIXij) and while extraction of the charged particle beam is switched on, controlling said extraction switching means to switch extraction of said charged particle beam off when an irradiation dose measured by am [sic] irradiation dose monitor (301) has reached a target dose, changing said irradiation position in a second direction different from said first direction by controlling said electromagnets while extraction of said charged particle beam is switched off, and then controlling said extraction switching means to resume extraction of said charged particle beam and controlling said electromagnets to scan the charged particle beam in the first direction over another irradiation region (Aij+1) based on the respective current magnitude <u>wherein the variation range of the magnetic field strength of the electromagnets is changed based on the size of the charged particle beam enlarged by the scatterer</u>.*"

The wording of claim 1 of the respondent's auxiliary request 6 differs from that of claim 1 of the main request by the following underlined amendments:

"*A charged particle beam apparatus, comprising:*
<u>a synchrotron as</u> a charged particle accelerator (100, 172) for supplying a charged particle beam,

an extraction switching means (120, 121, 166, 174, 175) for switching extraction of said charged particle beam from said synchrotron on and off,
electromagnets (220, 231) for setting an irradiation position where to irradiate an irradiation target with said charged particle beam,
a scatterer (300) for enlarging the size of the charged particle beam, and
a control unit (132) for controlling said extraction switching means to switch extraction of said charged particle beam off, changing said irradiation position by controlling said electromagnets while extraction of said charged particle beam is switched off, and then controlling said extraction switching means to resume extraction of said charged particle beam."

The remaining claims 2-11 according to all the requests are dependent claims.

VIII. In the present decision, reference will be made to "*EPC 1973*" or "*EPC*" for EPC 2000 (EPC, 13th edition, July 2007, Citation practice, pages 4-6) depending on the version to be applied according to Article 7(1) of the Revision Act dated 29 November 2000 (Special Edition No. 1 OJ EPO 2007, 196) and the decisions of the Administrative Council dated 28 June 2001 (Special Edition No. 1 OJ EPO 2007, 197) and 7 December 2006 (Special Edition No. 1 OJ EPO 2007, 89).

Reasons for the Decision

1. The appeal is admissible.

2. Respondent's main request

2.1 A skilled person, when reading claim 1 of the respondent's main request in the context of the whole patent, will notice that the claimed charged particle beam apparatus may be understood as comprising either a synchrotron (Figures 3, 15 and 17 of the patent as maintained) or, alternatively, a cyclotron (Figure 10 and paragraph [0057] of the patent as maintained) as a charged particle accelerator. Such an understanding of the term "*accelerator*" recited in the claim has a direct effect on the interpretation to be given to the feature concerning the "*extraction switching means*" and, more in particular, to the term "*extraction*". Indeed, according to the patent as maintained, extraction of the beam from a synchrotron is carried out by the provision of a radio frequency applying unit 120 increasing the betatron oscillation of the beam (paragraphs [0033] and [0034]; Figures 3 and 15) or by the provision of a kicker electromagnet 121 (paragraph [0076] and Figure 17), both the radio frequency applying unit 120 and the kicker electromagnet 121 being arranged in the synchrotron ring. In the case of a cyclotron, extraction of the beam is achieved by a deflector 175 in the low-energy line connecting the cyclotron with an ion source (paragraph [0057] and Figure 10 of the patent as maintained). In both cases, when the extraction of the beam is switched off, as claimed, no beam leaves the accelerator.

2.2 Document E5 discloses a proton therapy facility assembled at the Paul Scherrer Institute (PSI) in Villigen (CH). The PSI cyclotron was originally designed for the production of a proton beam used for basic research in nuclear and elementary particle physics. Since 1980 it has been possible to split a fraction of the proton beam delivered by the cyclotron by means of an electrostatic splitter. The split beam was then used for medical applications simultaneously with the physics experiments. Since 1989 the split beam has been deflected into a new hall, where it can be used for proton therapy (E5, page 39, point B).

In particular, the split beam is transported into a gantry, where it is guided to a patient using a spot scanning technique. According to this technique, a sequence of elementary static irradiation doses is deposited by scanning the focused beam spot in three dimensions inside a target volume, wherein the displacement of the beam spot position in the target volume is always performed when the beam is switched off. Through the superposition of a large number of such elementary static dose applications, a total conformation of the irradiation dose to the target volume can be achieved (E5, pages 39-41, point A).

With regard to the scanning components, a fast kicker magnet is placed in the high-energy beam transportation line for beam switching. When the fast kicker magnet is not energized, the beam is let through a small vertical slit of a slit system; when it is energized, the beam is deflected away from the slit and hits the plates of the slit system. In this way, the beam extracted from

the cyclotron can be switched on and off (E5, page 41, point 2).
A deflecting magnet (sweeper magnet) is also placed in the high-energy beam transportation line downstream of the fast kicker magnet for performing the most frequent displacements of the beam spot in a first direction.
The patient table is moved for performing the slower and less frequent displacements of the beam spot in a second direction orthogonal to the first one. However, a double magnetic scanning system can also be used (E5, pages 41 and 42, point 3; page 42, point 5).
A range shifter is placed immediately in front of the patient for controlling the position of the Bragg peak in depth in the target volume (E5, page 42, point 4).
Three thin lead foils can also be moved into the beam as an option to enlarge the size of the beam spot, if desired (E5, page 42, point 4).

Moreover, a safety system controls the beam delivery. It is based on redundancy and comprises two separated computers used independently of each other. A first computer (active steering system) performs the scanning operation by directly controlling the fast kicker magnet and the beam scanning devices. The time sequence is executed on the basis of the dose information delivered by a beam flux monitor. A second computer (dose controller) checks the status of each scanning device. In case of a device failure or some other error detection, the beam is immediately switched off by using the fast kicker magnet (E5, pages 42 and 43, point D).

2.3 In summary, with regard to the wording of claim 1 of the respondent's main request, E5 discloses a "*charged particle beam apparatus*" comprising:

an "*accelerator*" consisting of a cyclotron for supplying a proton beam,

an "*extraction switching means*" consisting of the fast kicker magnet in the high-energy beam transportation line for switching the beam on and off,

"*electromagnets*" consisting of sweeper magnets for setting the irradiation position of the beam,

a "*scatterer*" consisting of thin lead foils for enlarging the size of the beam spot, and

a "*control unit*" for controlling the fast kicker magnet to switch the beam off, changing the irradiation position by controlling the sweeper magnets while the beam is switched off, and then controlling the fast kicker magnet to switch the beam on.

2.4 The claimed charged particle beam apparatus is now understood, for the present argumentation, as comprising a cyclotron as a charged particle accelerator. With such understanding, the claimed apparatus would differ from the PSI proton therapy facility according to E5 in that the extraction switching means switches the "*extraction*" (in the narrow sense of the term) of the beam from the cyclotron on and off and in that the control unit controls the extraction switching means for switching said "*extraction*" of the beam on and off, whenever required. In other words, the PSI therapy facility according to E5 is designed so that the beam is extracted from the cyclotron and is then switched off by the fast kicker magnet in the high-energy beam transportation line when it is not required for irradiation. Conversely, the claimed apparatus is understood as avoiding that the beam be extracted from the accelerator (cyclotron) when it is not required. This may be obtained by means of a deflector in the low-energy line connecting the cyclotron with an ion source, as already explained.

It follows from the foregoing that the subject-matter of claim 1 of the respondent's main request, understood as stated above, is new over E5 (Article 54(1),(2) EPC 1973). The advantage achieved by the identified differences would consist in a higher safety, which is essential for a therapy facility to be used in a hospital environment.

2.5 The appellant did not acknowledge the differences mentioned above and held that claim 1 of the respondent's main request lacked novelty over E5. In its view, the feature concerning the "*extraction switching means*" should be broadly understood as comprising any means for switching not only the extraction of the beam from the cyclotron but also the extracted beam itself on and off.
The Board, however, does not find this view convincing because it is based on an interpretation of the claim which clearly disregards the context of the whole patent.

The respondent, on the other hand, held that the three thin lead foils, which could be moved into the beam according to E5, did not represent a "*scatterer*" as claimed. In particular, E5 failed to disclose a scatterer in connection with a spot scanning technique. The Board, however, disagrees with this view for the following reasons. First, the three thin lead foils according to E5 are described as an option "*to enlarge the size of the spot*". Thus, they achieve exactly the same effect as the claimed scatterer "*for enlarging the size of the charged particle beam*". Second, the option concerning the three thin lead foils is clearly disclosed in the context of the PSI spot scanning technique (E5, pages 39-45, chapter III concerning the PSI spot scanning technique, to which chapter point 4 on page 42 belongs).

2.6 Turning now to the issue of inventive step, the following is to be considered. With regard to the historical development of the PSI facility, as mentioned above, the Board would agree with the appellant's view (letter of 20 August 2010, pages 14 and 15, paragraph 4.2) that the PSI facility, as a matter of fact, imposed the arrangement of a fast kicker magnet in the high-energy beam transportation line for switching the split beam for medical applications on and off. The skilled person, however, knows that such a solution has the disadvantages mentioned by the respondent (letter of 15 February 2008, paragraph bridging pages 2 and 3), i.e. waste of beam energy while the beam hits the plates of the slit system, irradiation of the plates with the proton beam which may cause the emission of undesired secondary radiation and, moreover, an asymmetric dose distribution across the slit and thus at the beam spot in the target volume.

Starting from the disclosure according to E5, the skilled person would thus look for solutions permitting to avoid the said disadvantages which are inherent to the use of a fast kicker magnet for switching the beam on and off in the high-energy beam transportation line. The cause of the problem clearly resides in the fact that the PSI cyclotron is simultaneously used for different aims. A trivial solution would then consist in replacing the PSI cyclotron with a dedicated medical proton cyclotron. In such a case, the skilled person would know how to achieve the full control of the extraction of the proton beam from the cyclotron, for example by means of a deflector in the low-energy line connecting the cyclotron with its ion source (Figure 10 of the patent as maintained). Evidence for the skilled person's knowledge that the switching of the beam could indeed be realised at the ion source is given by E14 (paragraph bridging pages 232 and 233), should this be necessary. Moreover, since the fast kicker magnet known from E5 could be avoided by the provision of a dedicated medical cyclotron, safety would be increased and overall complexity would be reduced, both these aspects being essential for a facility to be installed in a hospital environment.

2.7 In conclusion, the subject-matter of claim 1 of the respondent's main request does not involve an inventive step (Article 56 EPC 1973) with regard to E5 and the skilled person's knowledge as evidenced by E14, if necessary. Hence, the respondent's main request is not allowable.

3. Admission into the procedure of the respondent's auxiliary requests 1-6 of 13 August 2010

3.1 Pursuant to Article 13(1) RPBA, any amendment to a party's case after it has filed its grounds of appeal or reply may be admitted and considered at the Board's discretion. The discretion shall be exercised in view of inter alia the complexity of the new subject-matter submitted, the current state of the proceedings and the need for procedural economy.

In the present case, the respondent did not file the auxiliary requests 1-6 with the reply of 15 February 2008 to the grounds of appeal, but later on with the letter of 13 August 2010. Therefore, it lies within the Board's discretion to admit them or not.

According to the jurisprudence of the boards of appeal, a party, when filing a new request during the procedure of second instance, should be expected to make a fair attempt to meet the objections raised against the requests on file, if these were not considered to be allowable. Moreover, if a new request gives cause for further objections, independently of whether or not the former objections are met, a board, in the exercise of the discretionary power conferred by Article 13(1) RPBA, may refuse its admission.

3.2 Concerning the admissibility of the respondent's auxiliary request 1 of 13 August 2010, the wording of claim 1 of this request differs from that of claim 1 of an earlier auxiliary request already filed with a letter of 15 February 2008 in response to the statement of grounds of appeal in that the control unit has been further defined by the addition of the following underlined expression:

"*a control unit (132) for controlling said electromagnets to scan the charged particle beam in a first direction while extraction of the charged particle beam is switched on, controlling said extraction switching means to switch extraction of said charged particle beam off after said scan in said first direction, changing said irradiation position in a second direction different from said first direction by controlling said electromagnets while extraction of said charged particle beam is switched off, and then controlling said extraction switching means to resume extraction of said charged particle beam.*"

Both the control unit as claimed in the auxiliary request of 15 February 2008 and the control unit as claimed in the auxiliary request 1 of 13 August 2010 are based on the second embodiment of the present invention, as described in paragraphs [0058] to [0064] together with Figures 11 and 12 of the contested patent. When reading claim 1 of the auxiliary request of 15 February 2008 in the context of this second embodiment, the feature that the control unit controls the electromagnets to scan the beam in a first direction is based on the condition that the beam is switched on. This understanding is indeed confirmed by the subsequent feature that the control unit controls the extraction switching means to switch the extraction of said charged particle beam off after said scan in said first direction.

Claim 1 of the auxiliary request 1 of 13 August 2010 thus differs from claim 1 of the auxiliary request of 15 February 2008 simply in that a feature has been explicitly mentioned, which was already contained, although implicitly, in claim 1 of the earlier auxiliary request.

Therefore, having regard to the fact that the two requests at issue do not differ in a substantial way and, moreover, that the auxiliary request of 15 February 2008 was duly filed in reply to the grounds of appeal, the respondent's auxiliary request 1 of 13 August 2010 is admitted into the procedure.

3.3 With regard to claims 1 of the respondent's auxiliary requests 2-5 of 13 August 2010, the appellant held (letter of 3 September 2010, point 2) that they were not based on the dependent claims of the patent as maintained. Rather, a large number of features taken in isolation from the description and the dependent claims were combined together so as to form new constellations. The new requests thus gave cause for a number of additional objections under Article 123(2) EPC and Article 84 EPC 1973, which could have been avoided by claiming the entire technical teaching of the disclosed second embodiment instead of inadmissibly isolating and generalising single features.
For example, claims 1 of all the auxiliary requests 2-5 recited a "*first direction*" and "*a second direction*", whereas two orthogonal directions x and y were disclosed in the context of the second embodiment.
Claim 1 of the auxiliary request 2 arbitrarily recited only a part of claim 5 of the patent as maintained.

Claim 1 of the auxiliary request 3 did not recite essential features like the definitions of the layers Li and the central points Pij, which definitions were functionally closely linked to those of the irradiation regions Aij.
Claim 1 of the auxiliary request 4 did not recite the definitions of the layers Li which were necessary for scanning the target volume.
Claim 1 of the auxiliary request 5 recited the feature that "*the variation range of the magnetic field strength of the electromagnets is changed based on the size of the charged particle beam enlarged by the scatterer*", which lacked clarity.
Moreover, even though claims 1 of all the auxiliary requests 2-5 were directed to the so-called semi-continuous scanning technique of the second embodiment of the present invention, features of the dependent claims relating to the spot scanning of the first embodiment had not been deleted. This caused a lack of clarity.

The respondent disagreed with the appellant's view. The extent of protection conferred by claims 1 of the auxiliary requests 2-5 was narrower the lower the rank of a request was. The amendments were either explicitly disclosed or derived by generalisations which, however, the skilled person would not consider as extending beyond the content of the application as filed. They lead to a progressively better definition of the semi-continuous scanning technique according to the disclosed second embodiment. Moreover, from a procedural point of view, the auxiliary requests 2-5 did not cause any delay and the appellant could not state to have been taken by surprise.

The Board, on the basis of a prima facie examination which according to the jurisprudence of the boards of appeal is sufficient for assessing the procedural issue of the admissibility of the respondent's auxiliary requests 2-5, holds that the appellant's concerns about disclosure and clarity are not unfounded. Indeed, the auxiliary requests 2-5 are not based on simple combinations of the claims of the patent as maintained, as it should be expected at a late stage of the appeal proceedings. Rather, features of a particular embodiment or of dependent claims have been isolated from their context and introduced in the independent claims. It is likely that the amendments generate fresh subject-matter and, moreover, that they cause contradictions among the claims. Last, it is doubtful, at least prima facie, whether the performed amendments relating to the semi-continuous scanning technique would be sufficient for meeting the objection of lack of inventive step which renders unallowable claim 1 of the respondent's main request.

Under these circumstances, the respondent's auxiliary requests 2-5 of 13 August 2010 are not admitted into the procedure.

3.4 As regards the respondent's auxiliary request 6 of 13 August 2010, the appellant held that it was not at all in line with the higher-ranking auxiliary requests. Indeed, the auxiliary request 6 introduced the amendment that the accelerator was a synchrotron, whereas the auxiliary requests 2-5 related to the semi-continuous scanning technique according to the second embodiment of the present invention.

The respondent submitted that the amendment concerning the synchrotron represented the direct reaction to the appellant's objection that claim 1 of the main request was very broad. With the exception of this amendment, claims 1 of the main request and of the auxiliary request 6 were identical.

The Board finds the respondent's argument more convincing than the appellant's objection. Moreover, the auxiliary request 6 did not give cause for further objections. Therefore, the respondent's auxiliary request 6 of 13 August 2010 is admitted into the procedure.

4. Respondent's auxiliary request 1

4.1 In the appellant's view, claim 1 of the respondent's auxiliary request 1 corresponded to claim 1 of the respondent's main request with the addition of quite general features functionally defining the control unit as controlling the semi-continuous beam scanning according to the second embodiment (Figures 11 and 12) of the patent as maintained. These amendments, however, could not render the claimed subject-matter inventive because such a technique was already known in the art (letter of 20 August 2010, paragraph 5.2). In particular, E5 (page 42, right-hand column) mentioned in the context of the discrete spot scanning that a "*semicontinuous scan, with a continuous motion of the sweeper magnet*" could be realized, i.e. a continuous motion of the beam spot in the x-direction while the control in the y-direction was still stepwise. Moreover, E6 (sentence bridging pages 2086 and 2087; Figure 47;

page 2089, right-hand column, first full sentence) described such a technique as comprising a continuous scan in the x-direction while the scan in the y-direction was carried out stepwise in such a way that adjacent scan lines overlapped.

The respondent submitted at the oral proceedings that the appellant's interpretation of the expression "*semicontinuous scan*" in E5 (page 42) was not correct. This expression rather implied that the irradiation position in the x-direction was controlled by a stepwise increase of the current in the sweeper magnet so that a discrete deposition of radiation still took place. Conversely, the control unit of claim 1 of the auxiliary request 1 operated in a substantially different way by providing a continuous scan in a first direction.
With regard to the disclosure of E6 cited by the appellant, it did not concern an operation as achieved by the claimed control unit which provided for a continuous scan in a first direction followed by a change of the irradiation position in a second direction while the extraction of the beam was switched off. E6 rather related to the case of a continuous raster scanning of a beam in a plane leading, for example, to the zigzag pattern of Figure 47(b) which did not require that the beam be switched off.

4.2 According to the amended claim 1 of the respondent's auxiliary request 1, the control unit is defined as controlling the electromagnets and the extraction switching means so as to scan the beam in a first direction while the extraction of the beam is switched on, to switch the extraction of the beam off, to change the irradiation position in a second direction while the extraction of the beam is switched off, and to resume the extraction of the beam. Thus, the amended claim defines the semi-continuous scanning technique in which the beam spot is moved continuously along the first direction and stepwise along the second direction, the extraction of the beam being switched off when the irradiation position is moved in the second direction.

4.3 Such a technique is known in the art, as the appellant convincingly submitted.

E6 is a review article concerning the instrumentation for cancer treatment using proton and light-ion beams. In the context of beam preparation for clinical use (pages 2068-2096, chapter II), dynamic beam delivery systems are disclosed which produce a desired dose distribution when a controlled extraction of the beam from the accelerator is coupled with strictly prescribed patterns of the motion of the beam spot (page 2084, point 2, first paragraph). In general, a scanner consists of two dipole magnets, one for the fast scan in a first direction and the other for the slow scan in a second orthogonal direction. Range modulation controls the Bragg peak in a third orthogonal direction (pages 2086 and 2087, point e; Figure 45).

Dynamic beam delivery systems are classified according to the way in which the beam spot is scanned (page 2087, right-hand column, last full paragraph).
Raster scanning in based on a smooth motion of the beam spot while keeping a constant beam extraction (pages 2087-2089, point f). Examples of raster scanning

techniques are shown in Figure 47. What is common to all the examples is the fact that an entire plane is scanned once during a beam spill.
In spot scanning and pixel scanning the beam spot is moved in discrete steps. The spot is positioned at a given location in which a radiation dose is deposited. The spot is then moved to the next location while the beam is switched off, and the process is repeated. Thereby, in the spot scanning the adjacent spots overlap in part, whereas in the pixel scanning the spots overlap only at their edges (pages 2089 and 2090, points g and h).

The sentence bridging pages 2086 and 2087, cited by the appellant, refers to the raster scanner of the Lawrence Berkeley Laboratory (LBL) of California (US). This scanner performs a continuous fast scan in the x-direction and a slow scan in the y-direction. In particular, the beam spot is moved in a zigzag raster as shown in Figures 46 and 47(b) with a constant sweep speed while holding the beam extraction level constant. However, according to page 2089 (full paragraph bridging the two columns) only a small central part of the scanned field exhibits an approximately flat-dose area. A scheme for enlarging the useful flat-dose area would then consist in clamping the beam off while it is outside this useful area. In the Board's view, although the teaching of clamping the beam off is disclosed in connection with the LBL zigzag raster scanning, the skilled person would immediately understand that it also applies to the case of a parallel raster scanning as shown in Figure 47(a), for example. In such a case, the beam would be clamped off in those regions where the slow y-scans are carried out.

4.4 It thus results from the foregoing that E6 discloses a scanning method including the steps of scanning the beam in a first direction (x), switching the beam off after the scan in the first direction, changing the irradiation position in a second direction (y) different from the first direction while the beam is switched off, and then switching the beam on.

4.5 It should be noted that claim 1 of the respondent's main request covers both a spot scanning and a semi-continuous scanning, whereas claim 1 of the respondent's auxiliary request 1 is limited to the case of the semi-continuous scanning.

As already stated above, the subject-matter of claim 1 of the respondent's main request does not involve an inventive step with regard to E5, which discloses the PSI spot scanning technique, and the skilled person's knowledge. Thus, when assessing the limitation underlying claim 1 of the auxiliary request 1, the issue arises whether, in the context of the PSI proton therapy facility according to E5, it would be obvious to rely on the semi-continuous scanning technique, as known from E6, rather than on the spot scanning technique.

The skilled person knows that there are different dynamic beam delivery systems, in particular the spot scanning and semi-continuous scanning techniques (E6, pages 2084-2090, point 2). Moreover, the skilled person is aware of the advantages that can be achieved by the semi-continuous scanning technique as compared to the spot scanning technique. In particular, the loss of beam during therapy could be decreased, which is an aim of the present invention (patent as maintained, paragraph [0005]). Moreover, a simplification of the scan in the first direction would result from the fact that a fast switching of the extraction of the beam from the accelerator can be avoided. In view of these advantages, the skilled person would then consider, without any inventive activity, to apply the semi-continuous scanning technique according to E6 to the PSI therapy facility known from E5. A hint at this approach may indeed be found in E5 itself (page 42, point C, last sentence) which envisages the use of a "*semicontinuous*" scan if desired, as submitted by the appellant. In this respect, the term "*semicontinuous*" appears to have a well-defined meaning in the art which can be inferred from the review article E6, so that the interpretation of this term given by the respondent is not convincing or supported by any evidence.

4.6 In conclusion, the subject-matter of claim 1 of the respondent's auxiliary request 1 does not involve an inventive step with regard to E5 and E6, both documents being read in the light of the knowledge of the skilled person. Hence, the respondent's auxiliary request 1 is not allowable.

5. Respondent's auxiliary request 6

5.1 The appellant held that it was common knowledge of the skilled person that a synchrotron could be used as an accelerator for medical purposes, for example instead of the PSI cyclotron mentioned in E5. Evidence in this respect was given by E13 (paragraphs 2.3.1 and 2.3.2) and E14 (page 231, left-hand column, first paragraph).

Moreover, the skilled person was aware of the technical characteristics of both a cyclotron and a synchrotron. Thus, the slower beam extraction from a synchrotron could be compensated by the use of a semi-continuous scanning technique or of a scatterer. Anyhow, a cyclotron and a synchrotron were disclosed as equivalents in the patent as maintained.

The respondent submitted that the essential question was not the use of a synchrotron per se but the operation of the synchrotron together with the claimed beam scanning technique. No prior art provided a hint at switching the extraction of the beam from a synchrotron off during the lateral movement of the irradiation position in one direction achieved by a deflecting electromagnet.
With regard to E13 cited by the appellant, there was no evidence for the fact that this document was publicly available before the filing date of the patent in suit. This document rather seemed to be an internal document for the EULIMA collaboration. Anyhow, paragraph 2.3.1 of E13 did not disclose that a beam was extracted from a synchrotron. Moreover, Figure 10 of the patent as maintained should not be considered as prior art.

5.2 The issue of the alleged public availability of E13, raised by the respondent with the letter of 15 February 2008 (paragraph bridging pages 1 and 2), was dealt with by the appellant by filing the exhibit E13a with the letter of 27 June 2008.

With this exhibit, the "*Technische Informationsbibliothek und Universitätsbibliothek Hannover*" (TIB/UB) declared that E13 had been registered on 1 November 1991 under the reference number RA 3692(91-18) and that, as a consequence, E13 was made available to the public as from this date. In the Board's view, this declaration thus proves beyond doubt that E13 was indeed publicly available before the filing date of the patent in suit.

Therefore, E13 belongs to the state of the art pursuant to Article 54(2) EPC 1973.

5.3 The review article E6 (pages 2059 and 2060, point 2) provides evidence for the fact that at the filing date of the patent in suit both a cyclotron and a synchrotron were considered to be suitable for a medical proton facility. This would be consistent with the disclosure in paragraphs [0032] and [0057] of the patent as maintained, according to which both a synchrotron or a cyclotron could be used as the accelerator. In this respect, it should be noted that the patent in suit, although it discloses differences related to the way of extracting the beam (extraction unit 120 in Figures 3 and 15; kicker magnet 121 in Figure 17; deflector 175 in Figure 10), does not give any indication for preferring one accelerator type over the other. In particular, the combination of the type of accelerator and the beam scanning technique is not presented as being decisive for the invention. The skilled person would rather understand from the whole disclosure of the patent in suit that both types of accelerator mentioned could be used with the spot scanning technique or the semi-continuous scanning technique.

5.4 E13 (point 2.3.1) teaches in the context of a pixel scanning technique that a fast beam switch is needed to turn the beam on and off very frequently. In principle, this could be done in the injection-line of a cyclotron. "*But a cyclotron is a fixed-energy machine and therefore less flexible than a synchrotron.*" With regard to this disclosure, the respondent is correct in drawing attention to the fact the combination of a synchrotron with a pixel scanning technique is not explicitly mentioned. However, the sentence reported above in cursive would be meaningless if a synchrotron would be unsuitable for delivering the beam for pixel scanning. The Board thus holds that the disclosure of E13 should be understood as giving a hint at the possibility of replacing a cyclotron with a synchrotron in a proton therapy facility with a pixel scanning technique.

5.5 In conclusion, the subject-matter of claim 1 of the respondent's auxiliary request 6 does not involve an inventive step with regard to E5 and E13, both documents being read in the light of the knowledge of the skilled person. Hence, the respondent's auxiliary request 6 is not allowable.

Order

For these reasons it is decided that:

The decision under appeal is set aside.

The patent is revoked.

The Registrar: The Chairman:

R. Schumacher B. Schachenmann