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Bezeichnung der Erfindung:
Title of invention:
Titre de l'invention : Computerized tomographic scanner with shaped radiation filter

Klassifikation / Classification / Classement : A61B 6/02, A61B 6/06

ENTSCHEIDUNG / DECISION

vom / of / du 24 November 1988

Anmelder / Applicant / Demandeur :

Patentinhaber / Proprietor of the patent / Titulaire du brevet : Technicare Corporation

Einsprechender / Opponent / Opposant : Siemens Aktiengesellschaft

Stichwort / Headword / Référence :

EPÜ / EPC / CBE Article 56 EPC

Schlagwort / Keyword / Mot clé : Inventive step (yes)

Leitsatz / Headnote / Sommaire

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Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number : T 3/87 - 3.4.1

D E C I S I O N
of the Technical Board of Appeal 3.4.1
of 24 November 1988

Appellant : (Opponent)	Siemens Aktiengesellschaft Berlin und München Postfach 22 16 34 D-8000 München 22
Representative :	
Respondent : (Proprietor of the patent)	TECHNICARE CORPORATION 29100 Aurora Road Solon, Ohio 44139 (US)
Representative :	Jones, Alan John et al. CARPMAELS & RANSFORD 43 Bloomsbury Square London, WC1A 2RA (GB)
Decision under appeal :	**Decision of the Opposition Division of the European Patent Office dated 7 October 1986 rejecting the opposition filed against European patent No. 0 018 181 pursuant to Article 102(2) EPC.**

Composition of the Board :

Chairman : K. Lederer
Members : E. Turrini
R. Schulte

Summary of Facts and Submissions

I. European patent No. 0 018 181 was granted on the basis of European patent application No. 80 301 169.1.

II. The Appellant filed notice of opposition against the European patent, requesting its revocation on the ground of non-patentability because of lack of inventive step in view of the prior art disclosed, inter alia, in document DE-A-2 525 270, which corresponds to US-A-4 118 629 (D1).

III. The Opposition Division rejected the opposition.

IV. The Appellant lodged an appeal requesting that the decision be set aside and that the patent be revoked in its entirety.

V. Oral proceedings were held before the Board, at the end of which the Respondent (Proprietor of the patent) requested that the appeal be dismissed and that the patent be maintained on the basis of amended claims, description and drawings as filed during the oral proceedings. The amended set of claims comprises fourteen claims, of which Claims 1 and 12, the only independent claims, read as follows:

"1. An apparatus for reconstructing an image of at least a region of an object (12) positioned in a scan circle (A) comprising:

a source of radiation (B) having a polychromatic spectrum for irradiating the scan circle with a fan-beam radiation from a plurality of directions;

at least one radiation detector (C) positioned to receive radiation from said source, which beam of

radiation has traversed the scan circle along a plurality of paths through the scan circle;

radiation filter means positioned between the source of radiation (B) and the at least one detector (C) comprising a block of filter material (D) having at one side a symmetric cutout with a center axis;

data collection means (E) for collecting data which are indicative of the intensity of radiation received by said at least one radiation detector (C) along the plurality of paths;

beam hardness correction means (F) for adjusting said data for non-linearities introduced by the polychromatic spectrum of radiation from the source of polychromatic radiation;

filter correction means (G) for adjusting said data for non-linearities introduced by alterations to the polychromatic spectrum of the radiation caused by said radiation filter means;

said beam hardness correction means and said filter correction means being operatively connected with said data collection means; and

reconstruction means (H) for reconstructing the data into a representation of an image of said region, said reconstruction means being operatively connected with the data collection means, the beam hardness correction means, the filter correction means, and characterised in that:

said data collection means is arranged to organise the collected data into data lines;

said radiation filter means comprises a single block of filter material (D) positioned such that the radiation from the source of radiation (B) passes through said single block of material (D) before it passes through said scan circle (A); and

said cutout (204) in said single block of filter material (D) is generally parabolic such that radiation after passing through the block of filter material (D) and a water phantom emerges with a generally constant intensity across the fan-beam or with a lower intensity adjacent its edges."

"10. A radiation filter (D), for use in an apparatus according to Claim 1, comprising a block (200) of filter material having at one side a symmetric cutout (204) with a center axis (206), characterised in that, said cutout (204) is generally parabolic such that radiation after passing through the filter body and a water phantom emerges with a generally constant intensity across the fan beam or with a lower intensity adjacent its edges."

VI. The Appellant, who was duly summoned, did not appear at the oral proceedings, nor was he represented. In his written submissions, he argued that the subject-matter of the then valid independent claims, which do not differ in substance from the present claims, did not involve an inventive step having regard to the disclosure of D1 and of the document Biomedizinische Technik, volume 24, No. 3, March 1979, Berlin, G. Kowalski and W. Wagner: "Patient dose rate: An ultimate limit for spatial and density resolution of scanning systems", pages 38 to 42 (D4), as cited in the European search report. In his view, when replacing the filter configuration disclosed in document D1, which

comprises two distinct radiation filters having part circular cutouts located on opposite sides of the scan circle, by a single radiation filter as taught by document D4 without changing the substantially constant radiation intensity profile at the input of the radiation detectors, each beam path in the single radiation filter should be equal in length to the sum of the lengths of the corresponding beam paths in the respective filters of document D1. This condition would, however, lead to the claimed shape of the filter cutout, as shown on a schematic drawing filed on 6 July 1988.

VII. This argument was contested by the Respondent, who submitted that the skilled person contemplating the use of a single filter only would not, without the benefit of hindsight, proceed to the shape correction set out by the Appellant. In particular, applying the same design principle to the filter configurations shown in Figures 2 or 4 of document D1 instead of the Figure 1 configuration, or even to that illustrated in the latter Figure but for offset source positions such as the one actually represented therein, would not lead to a cutout of a generally parabolic shape. Neither can the claimed shape in his view be considered as the mere result of an obvious optimisation of the filter shape by trial and error since there is no hint in the prior art that such shape optimisation would be required. To the contrary, document D1 explicitly teaches that the disclosed apparatus does not call for exact filter shaping by virtue of its electronic compensation capability.

Reasons for the Decision

1. The appeal is admissible.

2. There is no formal objection under Article 123(2) or (3) EPC to the current version of the claims, specification and drawings. Neither did the Appellant allege any deficiency in this respect.

3. Novelty.

3.1 Document D1 discloses, with reference to its Figure 1, an apparatus as defined in the preamble of present Claim 1 for reconstructing an image of at least a region of an object (3) positioned in a scan circle (2) comprising:

- a source of radiation (19) having a polychromatic spectrum (column 6, lines 22 and 23) for irradiating the scan circle with a fan-beam radiation from a plurality of directions;

- at least one radiation detector (25) positioned to receive radiation from said source which beam of radiation has traversed the scan circle (2) along a plurality of paths through the scan circle;

- radiation filter means (11, 12) positioned between the source of radiation (19) and the at least one detector (25) comprising a block of filter material (14) having at one side a symmetric cutout with a center axis;

- data collection means provided for collecting data which are indicative of the intensity of radiation received by said at least one radiation detector (25) along the plurality of paths (the output signals indicative of the intensity of radiation are collected through the lines S_r of Figure 3);

- beam hardness correction means (39r, 40r, 41r) for adjusting said data for non-linearities introduced by the

polychromatic spectrum of radiation from the source (19) of polychromatic radiation (column 5, last paragraph);

- filter correction means (column 7, lines 61 to 66) for adjusting said data for non-linearities introduced by alterations to the polychromatic spectrum of the radiation caused by said radiation filter means (11, 12); said beam hardness correction means and said filter correction means being operatively connected with said data collection means; and

- reconstruction means (43, 44) for reconstructing the data into a representation of an image of said region, said reconstruction means being operatively connected with the beam hardness correction means and the filter correction means (Figure 3).

Document D1 does not specify in which way the data indicative of the intensity of radiation received by the radiation detectors are organised by the data collection means, and the radiation filter means according to D1 comprises two separate blocks (11, 12) of filter material positioned on the radiation path at opposite sides of the scan circle, each having a part circular cutout. The radiation filter means (11, 12) are said to cause all the detectors to work with substantially equal amounts of radiation, but the document further states that "it is not necessary for the shaping of the compensating members to be such as to give exact compensation, i.e. so that when the aperture 1 is occupied by water all detector readings are equal. Approximate compensation is sufficient" (column 4, lines 36 to 40). Precise compensation is performed by electronically processing the non-equalised detection signals obtained when a homogeneous mass of water is placed in the scan circle (column 4, line 67 to column 5, line 16; column 5, lines 41 to 54).

Thus, the subject-matter of Claim 1 is distinguished from the apparatus known from document D1 in that

(a) the collected data are organised into data lines; and

(b) the radiation filter means comprise a single block of filter material positioned between the radiation source and the scan circle, the cutout further being of generally parabolic shape such that radiation after passing through the filter block and a water phantom emerges with generally constant intensity across the fan beam or with a lower intensity adjacent its edges

as set out in the characterising portion of the claim.

3.2 Document D4 discloses an X-ray tomographic scanning system comprising a radiation filter means ("intensity equalizer"; Figures 1 and 8) comprising a single block of filter material having a cutout of part circular shape as illustrated in the Figures and positioned between the radiation source and the object to be imaged. This intensity equalizer is said to be an "important means to reduce the patient dose rate", and it "should be shaped in such a way that the intensities impinging on the detectors are of the same order of magnitude for all detector positions" (paragraph bridging pages 38 and 39).

Document D4 neither discloses the data collection, beam hardness correction and filter correction means, nor the generally parabolic shape of the filter cutout as defined in present Claim 1.

3.3 Document GB-A-2 005 517 (D2) as cited in the European search report discloses a computer tomographic apparatus comprising data collection means (32; Figure 1) arranged in

such a way as to organise the data collected by radiation detectors 12 into data lines (page 4, lines 7 to 9) as set out in above defined feature (a) of the characterising portion of Claim 1.

This known apparatus, however, does not comprise any radiation filter means.

3.4 The remaining prior art documents on file do not come closer to the claimed subject-matter.

3.5 For the above reasons, the subject-matter of Claim 1 is considered to be novel within the meaning of Article 54 EPC.

4. Inventive step.

4.1 Not only is the first feature of the characterising portion of Claim 1 relating to the line organisation of the data by the data collecting means known per se in the field of computer tomography for the processing of the detector signals, as evidenced for instance by document D2 (see point 3.3 above), but it is also structurally and functionally independent from the remaining characterising features, which are directed to the shape and effect of the filter cutout. Neither did the Respondent prevail himself of any positive contribution to inventive step by the former feature, be it considered alone or in combination with other features of the claim.

This first feature therefore need not to be considered further.

4.2 Starting from the nearest prior art as disclosed in document D1, the technical problem to which the remaining features of the characterising portion of Claim 1 (feature (b) as identified in paragraph 3.1 above) afford a solution

is to reduce the dose of radiation received by the patient during tomographic examination while simultaneously further improving the intensity distribution of radiation impinging upon the detectors across the fan beam.

4.3 Document D4 indeed teaches that the use of a single radiation filter located between radiation source and patient permits patient dose reduction, while document D1 discloses the effect of filter shaping on the intensity distribution of radiation across the fan beam. In the Board's view, however, the skilled person could not find in these documents any actual encouragement to provide a generally parabolic cutout in a single radiation filter for simultaneously solving both aspects of the above defined composite technical problem.

In particular, the explicit admission in document D4 that the described single radiation filter achieves intensity distribution such that radiation intensities across the fan beam are "of the same order of magnitude" only (page 38, right hand column, last line) and that it "can only be approximately matched" to the patient's cross-section (page 39, left hand column, first paragraph, last sentence), and the statements in document D1 that exact equalization of the amounts of radiation impinging on the detectors by adequate shaping of the radiation filters is neither necessary (column 4, lines 36 to 40), nor achieved (column 5, lines 3 to 6) can hardly be considered to suggest that further refining of the filter shape could still serve any useful purpose capable of balancing the drawbacks of an expectable increase in complexity of the required radiation filter means. Attention is drawn in this respect to the further disclosure in document D1 of a radiation filter comprising four separate blocks, each having a double concave arcuate cutout, by means of which

the intensities are specified to be "better equalised than with the simpler form of member such as shown in Figure 1", which comprises two blocks only (column 7, lines 59 to 61). This disclosure as a matter of fact suggests that improving the equalization capability of radiation filter means calls for increasing the number and complexity of the radiation filters and, accordingly, it also teaches away from the idea of testing a single filter configuration of relatively simple shape.

Furthermore, even if it were admitted that the skilled person would indeed contemplate using a single filter arrangement for solving the composite technical problem, it is not seen either why he would, without the benefit of hindsight, provide it with a cutout of generally parabolic shape.

The sole Appellant's argument in this respect as set out in point VI above is not considered to be convincing since, in particular, there is no evidence that the skilled person would actually and as a matter of pure routine work proceed to the geometrical construction described in Appellant's letter filed on 6 July 1988 for designing a single filter member intended to replace the two-member configuration illustrated in Figure 1 of document D1. The more so since this design method is based on a straightforward addition of the radiation paths in a given direction in the respective filter elements for determining the thickness of the calculated single filter in the same direction, which obviously cannot account for the fact that due to the well known non-linearity of X-ray absorption and to the occurrence of X-ray scattering along the beam path, the effect on radiation of a given thickness of filter material located in front of a water phantom cannot be expected to be identical to that of the same thickness of filter material located downstream thereof. In addition, the

skilled person had no obvious reason either to start precisely from the filter configuration illustrated in Figure 1 of document D1 for implementing the described geometrical construction rather than e.g. from the better intensity equalising filter structure shown in Figure 4, which would clearly not result in a generally parabolic shape of the cutout. Even the choice of the former filter configuration would not necessarily lead to such parabolic shape, since the shape of the resulting profile also depends upon the apparatus geometry, as may be readily ascertained by proceeding to the proposed filter construction for radiation source positions closer to the scan circle than the one illustrated on the Figure filed by the Appellant. Eventually, the resulting profile depends on the relative positions of radiation source, filter and detector as can be seen when Appellant's way of construction is applied to an arrangement where source, filter and detector are positioned as shown in Figure 1 of document D1.

4.4 For the above reasons, the subject-matter of Claim 1 is considered to involve an inventive step within the meaning of Article 56 EPC.

5. Accordingly, independent Claim 1 is allowable (Article 52 EPC).

The same conclusion applies to independent Claim 10, since it defines a radiation filter which embodies all the features supporting the patentability of the apparatus in accordance with Claim 1, and to dependent Claims 2 to 9 and 11 to 14, by virtue of their dependency upon allowable independent claims.

6. Therefore, the grounds for opposition set out in Article 100 EPC do not prejudice maintenance of the

European patent in amended form as requested by the Respondent.

7. The Appellant chose not to prevail himself of the opportunity opened to him to take part at the oral proceedings and to present his comments on the current set of amended patent documents. There was no need to inform the parties in accordance with Rule 58(4) EPC (T 219/83; OJ EPO 1986, 211), because the parties had had an adequate opportunity to comment on the proposal to maintain the European patent in the amended form.

A party deliberately deciding not to participate in an oral proceedings abandons its right to be heard.

Order

For these reasons, it is decided that:

1. The appeal is dismissed.

2. The patent is maintained on the basis of the claims, description and the drawings filed during the oral proceedings.

The Registrar: The Chairman:

F. Klein K. Lederer

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