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BOARDS OF APPEAL OF THE EUROPEAN PATENT OFFICE

CHAMBRES DE RECOURS DE L'OFFICE EUROPEEN DES BREVETS

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File Number: T 368/90 - 3.4.1

Application No.: 83 108 391.0

Publication No.: 0 102 592

Title of invention: X-ray image producing system

Classification: A61B 6/00

DECISION
of 16 January 1992

Proprietor of the patent: SHIMADZU CORPORATION

Opponent: N.V. Philips' Gloeilampenfabrieken

Headword:

EPC Article 56

Keyword: "Inventive step - yes (after amendments)" - prior art concerned with a different problem and a different solution

Headnote

Europäisches Patentamt | European Patent Office | Office européen des brevets

Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number : T 368/90 - 3.4.1

D E C I S I O N
of the Technical Board of Appeal 3.4.1
of 16 January 1992

Appellant : (Opponent)
N.V. Philips' Gloeilampenfabrieken
Groenewoudseweg 1
NL - 5621 BA Eindhoven (NL)

Representative :
Veenstra, Gustaaf
INTERNATIONAL OCTOOIBUREAU B.V.
Prof. Holstlaan 6
NL 5656 AA Eindhoven (NL)

Respondent : (Proprietor of the patent)
SHIMADZU CORPORATION
378, Ichinofunairi-cho
Kawaramachi-dori
Nijo Sagaru
Nakagyo-ku
Kyoto 604 (JP)

Representative :
Roth, Ronald
Patentanwaltsbüro
Tiedtke-Bühling-Kinne-Grupe-
Pellmann-Grams-Struif
Bavariaring 4
W - 8000 München 2 (DE)

Decision under appeal :
Interlocutory decision of the Opposition Division of the European Patent Office dated 16 March 1990 concerning maintenance of European patent No. 0 102 592 in amended form.

Composition of the Board :

Chairman : G.D. Paterson
Members : U.G.O.M. Himmler
H.J. Reich

Summary of Facts and Submissions

I. The present appeal lies from a decision of the Opposition Division maintaining European patent No. 0 102 592 in amended form. This European patent had been granted with two sets of claims; a first set of Claims 1 to 6 for DE and a second set of Claims 1 and 2 for FR, GB and NL having regard to the document EP-A-0 082 771 which is comprised in the state of the art according to Article 54(3) and (4) EPC.

II. The Opponent lodged an appeal against the decision of the Opposition Division and requested cancellation of the decision and revocation of the patent for lack of inventive step having regard to the prior art cited during the opposition procedure:

D1: GB-A-2 018 100,
D2: GB-A-2 062 403, and
D3: FR-A-1 541 671.

In order to remove any doubt that quantum noise and its effects were well known several years before the priority date, with respect to a particular statement in the decision of the Opposition Division, reference was also made to:

D5: Principles of Diagnostic X-Ray Apparatus, published by Philips Medical Systems Ltd., London, First Edition 1973, pages P6 and P7, and
D6: DE-C-3 018 129.

III. The Patentee (Respondent) requested rejection of the appeal and maintenance of the patent in the amended form. As an auxiliary request the Respondent requested to maintain the patent for all Contracting States (including

DE) on the basis of the Claims 1 and 2 which are valid, at present, only for FR, GB, and NL.

IV. Oral proceedings took place on 16 January 1992.

V. The Appellant essentially presented the following arguments in support of his request:

The Respondent's argumentation always brings forward that the problem of quantum noise reduction - even if the problem is known per se - is not mentioned in any of the documents D1 to D3 and therefore none of these documents should be relevant. However, none of the independent claims of the impugned patent is restricted to the reduction of quantum noise. On the contrary, the description explicitly mentions that also other kinds of noises, e.g. originating from the electronic circuits, are to be eliminated; cf. column 3, lines 35 to 44. Therefore the documents D1 to D3 are relevant because it is in all three documents the general aim to suppress undesired information and such undesired information is nothing else but noise.

As the Respondent cannot contest that the preamble of Claim 1 (DE) corresponds to the state of the art known from D1, and because the skilled reader of D1 is explicitly invited by D1 (see page 3, lines 12 to 14) to combine the corresponding image segment density information "in any desired way", the skilled person would not restrict himself to addition or averaging but would look for further possibilities to reduce undesired information. Therefore he would necessarily find documents D2 and D3 which provide him with means according to the characterising part of Claim 1 (DE). There is no doubt that D2 and D3 make available means for comparing plural (document D2 is not restricted to the comparison of

two images; cf. page 4, lines 25 to 28) successive frames in each picture element, in particular comparing the level of a video signal stored in storing means and the level of a succeeding video signal which forms a frame succeeding the frame formed by the stored digital video signal. Both these frames are compared pixel by pixel and only the lowest value of each pixel is retained in the storing means in order to extinguish the undesired parts of the two (or more) images. These undesired parts can be considered as noise.

D1 is concerned with the same problem as the patent in suit and gives the basic idea for solving this problem by suppressing undesired information. Documents D2 and D3 disclose the ideal concept for suppressing the undesired information. In both documents there are provided according to the wording of the characterising part of Claim 1

- means for comparing (the TV-cameras 30/31 for the line-wise scanning of images 10 and 11 in connection with the comparing means 32 in Figure 6 of document D2; the TV-cameras 4A/4B for scanning of images 20A/20B in connection with the discriminator M in Figure 3 of document D3) repeatedly for plural successive frames (the first frame being the first image, i.e. 10 in D2 and 20A in D3 respectively; the second frame being the second image, i.e. 11 in D2 and 20B in D3) in each picture element the level of the signal stored in the storing means (i.e. the record carrier/X-ray film 6 delivering the image 10 in D2 and the X-ray film A delivering the image 20A in D3) and the level of the succeeding signal which forms a frame (image 11 in D2 and image 20B in D3) succeeding the frame formed by the first stored signal;

- causing the signal with the lower value to be stored (if in both images there is not a corresponding signal value from a pixel having the same coordinates then the signal is suppressed and the signal value "zero" is stored, e.g. in the memory 34/Figure 6 of D2, because those pixels having the same coordinates and originating from the same layer have in both images corresponding signal values).

The subject-matter of Claim 1 lacks inventive step because the skilled person would arrive at this subject-matter by simply putting together D1 with D2 or D3. The subject-matter of this combination would fulfil the same object as the subject-matter of Claim 1 (DE) by essentially using the same means.

VI. The arguments of the Respondent can be summarised as follows:

Up to now the principle of every noise reduction concept was to approach the "true" value by averaging, and exactly this principle is applied in D1 (see the title). The teaching of D1 is to store the values of all picture elements of a frame (image) and then to combine all values for averaging; cf. page 1, lines 31 and 37, and page 3, line 14. Therefore the suggestion that the skilled person would replace this generally acknowledged principle by the very different means disclosed in D2 or D3 is as theoretical as the remark "in any desired way" in D1.

D2 and D3 do not refer to noise reduction but to tomography. There are used two different images of the same object which are taken from different points and under different angles with respect to the object. The reason for taking these two different images is to distinguish between different layers within the viewed

object. Only after the two different images have been obtained, the two images are compared in order to suppress the unwanted picture parts. But neither D2 nor D3 discloses a comparison of successive frames of the same X-ray shadow image.

Therefore a person skilled in the art would not try to combine the teaching of D1 with that of D2 or D3.

In order to emphasise the differences between the subject-matter of the patent and the cited state of the art the Respondent filed further amended independent claims which read as follows:

For DE:

"1. X-ray image producing apparatus comprising: means (11) for producing a beam of X-rays to irradiate an object (12) to be examined; means (13) for producing an X-ray shadow image of said object (12) caused by said X-rays that have passed through said object (12); means (14) for converting said X-ray shadow image to a corresponding analog video signal; means (23) for converting said analog video signal to a corresponding digital video signal; memory means (26) for storing the level of said digital video signal in each of the picture elements which constitute an image frame; means (27) for converting said stored digital video signal to a corresponding analog video signal; and means (16) for displaying the image formed by said analog video signal; characterized by: means (25) for comparing repeatedly for plural successive frames of said X-ray shadow image in each of said picture elements the level of said digital video signal stored in said storing means (26) and the level of a succeeding digital video signal from said converting means (14,23) which forms a frame succeeding the frame formed by said stored digital video signal and

causing the signal with either the higher or lower value to be stored in each of the memory sections of said storing means (26) corresponding to said picture elements in place of the data previously recorded therein.

5. An X-ray image producing system comprising: means (11) for producing a beam of X-rays to irradiate an object (12) to be examined; means (13) for producing an X-ray shadow image of said object (12) caused by said X-rays that have passed through said object (12); means (14) for converting said X-ray image to a corresponding analog video signal; means (23) for digitizing said analog video signal; means for forming a mask image by processing the values of said digital video signal obtained during a predetermined period of time in each of the picture elements of said X-ray image produced before injection of contrast material into said object (12), memory means (26M) for storing said mask image; means for forming a live image by processing the values of said digital video signal obtained during a predetermined period of time in each of the picture elements of said X-ray image produced after injection of contrast material into said object (12); memory means (26L) for storing said live image; means (40) for subtracting the digital video signals of said mask image from the digital video signals of said live image; memory means (41) for storing said subtraction image; means (27) for converting the digital video signal resulting from said subtraction to a corresponding analog video signal; and means (16) for displaying said converted analog video signal as a subtraction image; characterized by means (25) for comparing repeatedly for plural successive frames of said X-ray shadow image in each of the picture elements the level of said digital video signal stored in said mask image memory means (26M) and the level of a succeeding digital video signal from said converting means (15,23) which forms a succeeding frame before injection of

contrast material into said object, and causing either the higher or lower one of said video signals to be stored in each of the memory sections of said mask image storing means (26M) corresponding to said picture elements in place of the data previously recorded therein and the said means (25) also comparing repeatedly for plural successive frames of said X-ray shadow image in each of the picture elements the level of said digital video signal stored in said live image memory means (26L) and the level of a succeeding digital video signal from said converting means (15,23) which forms a succeeding frame after injection of contrast material into said object, and causing either the higher or lower one of said video signals to be stored in each of the memory sections of said live image storing means (26L) corresponding to said picture elements in place of the data previously recorded therein."

The only independent Claim 1 for FR, GB and NL is identical with Claim 5 for DE.

The Respondent finally requested that the appeal be dismissed and that the patent be maintained with the description and drawings as granted and with amended Claims 1 and 5 (DE) and amended Claim 1 (FR, GB and NL) as filed during the oral proceedings, together with all subsidiary claims as granted.

VII. At the conclusion of the oral proceedings, the Board announced its decision to set aside the decision of the Opposition Division and to remit the case to the first instance with the order to maintain the patent in amended form as set out above.

Reasons for the Decision

1. Allowability of the amendments and clarity

Claim 1 (DE) differs from the originally filed Claim 1 in that it comprises the following additional features

- means (23) for converting the analog video signal to a corresponding digital video signal; originally disclosed by Claim 4; page 4, line 29; page 5, lines 23 to 24;

- means (27) for converting said stored digital video signal to a corresponding analog video signal; originally disclosed on page 5, line 1; page 6, lines 17 to 18;

- means (16) for displaying the image formed by said analog video signal; originally disclosed by Claim 5; page 4, line 15; page 6, lines 18 to 20;

- means (25) for comparing "repeatedly for plural successive frames of said X-rax shadow image" in each of the picture elements the level of the digital video signal stored in the storing means (26) and the level of a succeeding digital video signal ...; originally disclosed on page 5, line 25 to page 6, line 10;

- causing the signal "with either the higher or lower value" to be stored in the memory sections ...; originally disclosed on page 3, lines 20 to 23 in connection with Figure 3.

The only amendment of the claims after grant - "repeatedly for plural successive frames of said X-ray shadow image" -

comprises a clarification as well as a restriction of the scope of protection.

The amendments to the claims therefore satisfy the requirements of Article 123(2) and (3) EPC.

2. Inventive step

The only issue to be examined in the present appeal is the question of inventive step having regard to the disclosures in documents D1, D2 and D3. These are summarised as follows:

2.1 D1: GB-A-2 018 100

The relevant features of this document essentially correspond to the preamble of Claim 1 (DE version). The essential difference in comparison with the subject-matter of Claim 1 is that this document does not mention any comparing means for selecting either the higher or lower signal value of corresponding picture elements of successive frames and in D1 there are not mentioned any means for storing the selected (either higher or lower) signal value in the memory section corresponding to the relevant picture element instead of the previously stored signal value.

This document is considered to be the closest prior art because it is concerned with the same technical problem: reducing the influence of noise (in the broadest sense) on the signal value; even if it is not stated explicitly that the aim of the document is the reduction of noise, it is indirectly disclosed that the aim of the document is the enhancement of the available information and the improvement of the resolution of an image information by

registering multiple images so that the density image information from each image can be combined into a single composite image having a more clearly defined information than any of the multiple images; cf. page 2, lines 24 to 26 and 44 to 45, page 3, lines 14 to 21.

The solution of the above stated problem according to D1 is either to amplify a signal by adding the signal values of corresponding picture elements of successive frames or to build the average of the signal values of corresponding picture elements of successive frames of the same image obtained with identical distance between object and X-ray source and under the same X-ray angle. The main objective in this document is to accentuate the object structures by enhancing the contrast of these image structures. This is achieved by constructing a single composite image from information contained in multiple, serially obtained images.

The Board does not agree with the interpretation of D1 given by the Appellant that the disclosure of the passage on page 3, lines 13 to 14,

"..... the computer can combine the corresponding image segment density information in any desired way ..."

is not restricted to adding or averaging the signal values of corresponding picture elements of successive frames but comprises any other method by which a "true value" is approximated, e.g. selecting either the highest or the lowest value of a set of measured values. Such a disclosure cannot be derived from D1.

D2: GB-A-2 062 403

This document describes an apparatus and a method for using this apparatus in order to achieve sectional X-ray

layer images. According to this document corresponding picture elements of two or more different images taken with a different local position of the irradiating source are compared. Contrary to the subject-matter of Claim 1, signal values having the same image information in each image for corresponding picture elements are stored whereas signal values having different image information for corresponding picture elements are suppressed; cf. page 1, lines 67 to 78. Figure 6 shows an electronic system for the point-wise comparison of individual layer images or perspective images, also called planar tomograms.

For producing such images several views are taken from different X-ray source directions and at the same time the image taking record carrier is shifted into an inversely correspondent direction. Thus, only those image points which are not blurred are taken into account because these are the only image points originating from the same plane of the object.

D3: FR-A-1 541 671

This document describes a planar tomographic method according to which two symmetrical shadow images (film F-A and film F-B) are taken from a body by moving the X-ray tube from a first position A to a second position B symmetrically situated to the axis of symmetry X. During a second step of the method both pictures are simultaneously scanned by two synchronised and symmetrically to the X-axis arranged television cameras. As opaque objects in the same layer of the examined object appear on the two pictures with the same coordinates whereas opaque objects in different layers of the examined object have on the two pictures different coordinates, the shadows of the opaque objects in the same layer are scanned at the same time. If both TV cameras produce analogue values for corresponding

picture elements then this value is passed by the discriminator M (Figure 3) via an amplifier to the screen C (Figure 6). If corresponding picture elements have not analogue values then these values are suppressed by the discriminator because they do not originate from the same layer of the examined object.

2.2 The Board does not accept the submissions of the Appellant set out in paragraph V above for the following reasons:

- The Respondent has clearly indicated that an apparatus or a system for producing or evaluating planar tomograms does not fall within the scope of the claims by inserting the amendment

  "repeatedly for plural successive frames"

  which was supplemented during oral proceedings by the further amendment

  "of said X-ray shadow image".

  Consequently, a planar tomogram-producing system is clearly distinguished from the system defined in the present claims because the comparing means of a planar tomogram-producing system refer to at least two different images.

- Even accepting that the skilled person for the design of a planar tomogram-producing system is the same person as the designer of an X-ray image producing system according to the present claims, the Board finds that the above two kinds of X-ray image producing system have completely different functions.

The claims of the patent in suit define an X-ray shadow image producing system which is designed to minimise statistically appearing noise in a single X-ray image, whereas each of the documents D2 and D3 refers to an X-ray image producing system which uses the image information of two different and separately taken X-ray images by combining the two images and eliminating the undesired information by comparison.

In the Board's view, the objective problem underlying the claimed invention and the concept of solving it in accordance with the claims has very little in common with the principles used in the systems disclosed in documents D2 or D3, even though a number of structural features are identical.

Consequently, the question whether the means disclosed in D2 or D3 for comparing and for selecting the lower (or higher) value (to be stored in the storing means in place of the data previously recorded therein) are applicable also in the system of the claimed invention need not to be considered. In the absence of any indication in D2 or D3 of a system which, in combination with the arrangement according to the preamble of Claim 1 (as disclosed in D1), would reduce noise in one and the same shadow picture, in the Board's view such disclosures do not establish lack of inventive step in the claimed invention.

2.3 In the Board's judgment, therefore, the subject-matter of Claim 1 in its version for DE as well as the subject-matter of the independent Claim 5 for DE (which is the twofold materialisation of the concept of Claim 1 in an X-ray image system for producing a subtraction image after injection of contrast material) was not obvious having regard to the state of the art.

As the only independent Claim 1 for FR, GB and NL is identical with Claim 5 for DE the same reasoning applies to this claim, too.

Hence, Article 56 EPC is satisfied and the independent claims are allowable having regard to Article 52(1) EPC.

Order

For these reasons, it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the first instance with the order to maintain the patent in amended form on the basis of amended Claims 1 and 5 (DE) and amended Claim 1 (FR, GB and NL) filed during oral proceedings and with all subsidiary claims, description and drawings as granted.

The Registrar: The Chairman:

M. Beer G.D. Paterson

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