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BOARDS OF APPEAL OF THE EUROPEAN PATENT OFFICE

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Title of invention: X-ray diagnostic apparatus

Classification: H05G 1/64

D E C I S I O N
of 27 February 1992

Proprietor of the patent: KABUSHIKI KAISHA TOSHIBA

Opponent: Siemens Aktiengesellschaft, Berlin and München

Headword:

EPC Article 56

Keyword: "Inventive step (no)"

Headnote

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Case Number : T 915/90 - 3.4.1

D E C I S I O N
of the Technical Board of Appeal 3.4.1
of 27 February 1992

Appellant : (Opponent)
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Decision under appeal :
Decision of the Opposition Division of the European Patent Office dated 25 September 1990 rejecting the opposition filed against European patent No. 0 088 356 pursuant to Article 102(2) EPC.

Composition of the Board :

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

Summary of Facts and Submissions

I. The Respondent is owner of European patent No. 0 088 356.

Claim 1 as granted reads as follows:

"1. An X-ray diagnostic apparatus for alternately projecting X-rays toward an object under X-ray examination at first and second projection angles for obtaining, on a TV monitor, stereoscopic X-ray angiographic images of said object, wherein a contrast medium is injected into said object and penetrates to a region of interest in said object, comprising:

means for (a) producing a plurality of first X-ray images of said region of interest taken from said first angle before propagation of said contrast medium into said region of interest and during propagation of said contrast medium through said same region of interest, (b) producing a plurality of second X-ray images of said region of interest taken from said second angle before propagation of said contrast medium into said region of interest and during propagation of said contrast medium through said same region of interest, and (c) generating a plurality of first and second analog video signals from said first and second X-ray images, respectively,

means for separately producing (d) first subtraction images by performing first digital subtractions among said plurality of first analog video signals before injection and during propagation of said contrast medium, respectively, and (e) second subtraction images by performing second digital subtractions among said plurality of second analog video signals before injection and during propagation of said contrast medium, respectively, and

means for combining said first and said second subtraction images within one frame period of said TV

monitor, whereby both of said subtraction images are displayed on said TV monitor at the same instant so that a stereoscopic view of said region of interest is displayed."

Claims 2 and 3 are dependent on Claim 1.

II. The grant of this patent was opposed by the Appellant on the ground of lack of inventive step, citing in view of the subject-matter of Claim 1 documents:

D1: EP-A-0 041 752,
D2: DE-C-2 157 843, and
D3: DE-A-2 919 425;

and in view of Claims 2 and 3 additionally documents:

D4: "Fortschr. Röntgenstr." Bd. 117, Heft 5, 1972, pp. 587-593,
D5: DE-A-1 489 114, and
D6: "Radiology", Vol. 79, No. 1, July 1962, pp. 30-34.

The Opposition Division rejected the opposition. It took in particular the view that the subject-matter of Claim 1 of the opposed patent involved an inventive step, because document D2 describes how to get stereo images and document D3 describes how a progress can be shown on a monitor. Combining documents D2 and D3 there would still be no incitation for the skilled person to generate first and second analog video signals from the first and second X-ray images and to perform digital subtraction among said analog video signals. The skilled person does not even obtain from document D1 any hint to do so, because in the apparatus described there scanograms are subtracted from each other.

III. The Appellant lodged an appeal against the decision of the Opposition Division.

IV. In a communication accompanying a summons to oral proceedings the Board notified the parties of its preliminary view that the subject-matter of Claim 1 might be regarded as the obvious analogous use of the conventional angiographic subtraction image technique known from document D3 in both of the conventional electronic imaging circuits for the stereoscopic image pair known from document D2. Moreover, document D1 would hint to a skilled person to form subsequent stereoscopic image pairs and to subtract them from each other for producing a stereoscopic angiogram. The subject-matter of Claims 2 and 3 would only comprise more specific definitions of apparatus components of functional means claimed in Claim 1, which are known from documents D4, D5 or D6 respectively.

V. In response to this communication of the Board, the Respondent filed on 31 January 1992 a new auxiliary request, the only claim of which comprises the subject-matter of granted Claims 1 to 3 and features of the X-ray switching means disclosed in the description of Figure 3 of the patent under appeal, and reads as follows:

"1. An X-ray diagnostic apparatus for alternately projecting X-rays toward an object under X-ray examination at first and second projection angles for obtaining, on a TV monitor, stereoscopic X-ray angiographic images of said object, wherein a contrast medium is injected into said object and penetrates to a region of interest in said object, comprising:

means for (a) producing a plurality of first X-ray images of said region of interest taken from said first angle before propagation of said contrast medium into said

region of interest and during propagation of said contrast medium through said same region of interest, (b) producing a plurality of second X-ray images of said region of interest taken from said second angle before propagation of said contrast medium into said region of interest and during propagation of said contrast medium through said same region of interest, and (c) generating a plurality of first and second analog video signals from said first and second X-ray images, respectively,

means for separately producing (d) first subtraction images by performing first digital subtractions among said plurality of first analog video signals before injection and during propagation of said contrast medium, respectively, and (e) second subtraction images by performing second digital subtractions among said plurality of second analog video signals before injection and during propagation of said contrast medium, respectively, and

means for combining said first and said second subtraction images within one frame period of said TV monitor, whereby both of said subtraction images are displayed on said TV monitor at the same instant so that a stereoscopic view of said region of interest is displayed wherein:

(1) X-ray projecting means comprises an X-ray radiation source including a one-target and two focus stereoscopic X-ray tube (1) having first and second grids (Gl, Gr), and X-ray switching means (12) for alternately applying bias voltages to said first and second grids (Gl, Gr) in order to switch the first and second X-ray projection angles, said X-ray switching means (12) comprising two photocouplers (1291, 129r) responsive to X-ray projection switching control signals and two tetrodes (1241, 124r) which alternately turn on and off in response to the output signals from the photocoupler (1291, 129r) in order

to control the bias voltage applied to each of the first and second grids (Gl, Gr) of said X-ray tube (1),

(2) said X-ray images producing means comprises an X-ray image converter (3-8) which includes:

an image intensifier device (3) to receive X-ray projection images taken in turn at said two different projection angles, and

first and second TV camera video circuits equipped with pick up tubes (5, 6) to receive the relative X-ray images from said image intensifier device (3), and to produce said first and second analogue video signals corresponding to one-viewed and other-viewed X-ray images of the object (2), respectively; and

a signal processor (13) which includes:

first and second A/D converters (132r, 132) for converting the first and second analogue video signals, obtained before and after injection of the contrast medium, into first and second digital video signals, respectively;

first and second digital memory means (134r, 134l) for storing said first and second digital video signals obtained before injection of the contrast medium as first and second mask images digital video signals, respectively; and

third and fourth digital memory means (135r, 135l) for storing first and second digital video signals, obtained after injection of the contrast medium respectively;

(3) said subtraction images producing means comprises:

processing means (133r, 133l) for performing the digital subtraction between said first and second mask images digital video signals and in said third and fourth digital memory means (135r, 135l) so as to

produce separately said first and second subtraction images and digital video signals, and

first and second D/A converters (140r, 140l) for converting said first and second subtraction image digital video signals into the corresponding analogue video signals; and

(4) said combining means comprises:

gate means comprising first and second gate circuits (153, 154) for gating said first and second subtraction images analogue video signals during predetermined period so as to leave necessary diagnostic information of the examined object (2) on said first and second subtraction images analogue video signals, respectively, and

a video mixer (155, 156) for mixing said gated first subtraction image's analogue video signal obtained in the first projection angle with said gated second subtraction image's analogue video signal, obtained in the second projection angle to provide a composite video signal."

VI. Oral proceedings were held on 27 February 1992, at the beginning of which the Appellant (Opponent) cited (in response to the subject-matter claimed for the first time in Claim 1 according to the auxiliary request filed on 31 January 1992) documents:

D7: DE-A-2 926 394, and
D8: GB-A-1 077 742.

The relevance of these documents to the subject-matter of the auxiliary request was not contested by the Respondent. At the end of the oral proceedings the Appellant requested that the decision under appeal be set aside and that European patent No. 0 088 356 be revoked.

The Respondent (Patentee) requested that the appeal be dismissed and that the patent be maintained:

as main request, with text as granted;

as auxiliary request, on the basis of Claim 1 as filed on 31 January 1992.

VII. In support of his request, the Appellant made essentially the following submissions:

(a) Claim 1 of the main request consists of an aggregation of means for producing a stereoscopic image as known from document D2 and means for producing an angiographic subtraction image as known from document D3. The double use of the teaching of document D3 in the device disclosed in document D2, i.e. in the channel for the lefthand image and in the channel for the righthand image of the stereoscopic image pair, would be obvious.

(b) Claim 1 of the auxiliary request only specifies that some of the functional means claimed in Claim 1 of the main request shall be realised by structural means, which are part of old technologies and known in the relevant art of X-ray diagnostic apparatus since long:

The X-ray projecting means such as claimed in paragraph (1) of alternative Claim 1 are known from document D5; minor details, such as a photocoupler for introducing with galvanic separation a control signal into an X-ray control unit, are described in document D7 (see units 7, 8 and 9 in Figure 1), and tetrodes for switching an X-ray radiation source are disclosed in document D8; see 23 to 26 in Figure 1.

The image producing means with image intensifier device and first and second TV camera circuits such as claimed in paragraph (2) of alternative Claim 1 are known from document D6.

The signal process or as defined by the further wording of paragraph (2) of alternative Claim 1 and the subtraction images producing means as claimed in paragraph (3) of alternative Claim 1 are known from document D3.

The combining means with gate means and video mixer as claimed in paragraph 4 of alternative Claim 1 are disclosed in Figure 1 of document D4.

Hence, a skilled person arrives at the subject-matter of alternative Claim 1 by simply aggregating a variety of per se known constructional elements in order to use their respectively known properties without producing any surprising synergistic effect of the apparatus claimed in total.

(c) The transformer coupling 44, 44a for the input of the control signal in the X-ray projecting means of document D5 is known to produce disadvantageous phase shifts and delays, whereas photocouplers and tetrodes are generally known to allow quick switching processes.

VIII. The above submissions were contested by the Respondent who argued essentially as follows:

(a) The starting point of the patent under appeal, document D2, was published 10 years before the filing date of the patent under appeal, and document D3

4 years before. Hence, it took 4 years before the combination was made, which period indicates the presence of an inventive step.

(b) Document D4 was published in 1972, document D5 in 1969, document D6 in 1962, document D7 in 1981 and document D8 in 1967. The priority date of the patent under appeal is 5 March 1982. The prior art gives no hint to combine all the mostly very old technical teachings of these documents in order to achieve advantages for a medical user.

(c) Neither document D5 nor document D7 mention the problem of quick X-ray emission switching. Thus, it is not obvious why a skilled person should replace the transformer 44 in the device of document D5 by a photocoupler and a tetrode, in order to form a switching means, which allows to control the right and left X-ray emissions at a high speed with certainty and safety.

IX. At the conclusion of the oral proceedings, the decision was announced that the decision of the Opposition Division is set aside and European patent No. 0 088 356 is revoked.

Reasons for the Decision

1. Inventive step - Claim 1 of the main request

1.1 From document D2 there is known in accordance with the wording of Claim 1:

"An X-ray diagnostic apparatus (see D2, Fig. 1) for alternately (D2, 13 in Fig. 1, col. 5, lines 3-8)

projecting X-rays toward an object under X-ray examination at first and second projection angles (2, 3 in Fig. 1) for obtaining, on a TV-monitor (7), stereoscopic images of said object (11, 12 in Fig. 1; col. 5, lines 48-52), comprising: means for (a) producing a plurality of first X-ray images of said region of interest taken from said first angle (2, 10, 4, 14), and (b) producing a plurality of second X-ray images of said region of interest taken from said second angle (3, 10, 4, 14), and (c) generating a plurality of first and second analog video-signals from said first and second X-ray images, respectively (5, 6, Fig. 2), and means (17, 8) for combining said first and second images within one frame period of said TV monitor (col. 5, lines 14-47), whereby both of said images (11, 12) are displayed on said TV monitor (7) at the same time so that a stereoscopic view of said region of interest is displayed."

1.2 Starting from the conventional stereoscopic X-ray imaging technique according to document D2 the objective problem underlying Claim 1 reduces to the provision of an X-ray diagnostic apparatus which allows stereoscopic TV-visualisation of not only mask images but also of angiographic subtraction images; see also the patent under appeal; column 2, lines 44 to 50.

The advantage of injecting a contrast medium only once and of ensuring thus the safety of the patient, only exists with regard to the long sampling time of a stereoscopic image pair in the computer tomography technique such as known from document D1 (see also the patent under appeal, column 2, lines 21 to 30) but not with regard to the short sampling times in the television technology of document D2, in the order of 10^{-2} seconds (see D2, column 3, line 61 to 64). Therefore this advantage, in the Board's

present view, cannot be included into the formulation of the objective problem.

The advantages of a diagnosis on the basis of a stereoscopic angiogram are known from document D1. These advantages, in the Board's view, will incite a skilled person to produce such stereoscopic angiograms also on a TV screen. Thus, the formulation of the technical problem does not contribute to an inventive step underlying the subject-matter of Claim 1.

1.3 The technical means for solving the above problem consist basically in means for producing an angiographic subtraction image on a TV monitor, and are known from document D3, i.e. the following features in the wording of Claim 1 are known from document D3:

an X-ray diagnostic apparatus for obtaining, on a TV monitor "angiographic" images of an object "wherein a contrast medium is injected into said object and penetrates to a region of interest in said object" (D3, page 25, lines 1 to 10); means for producing a plurality of ... X-ray images of said region of interest before propagation of said contrast medium into said region of interest (D3, 21 in Figure 2, page 26, paragraph 1) and during propagation of said contrast medium through said same region of interest (22 in Figure 2) and means for separately producing ... subtraction images by performing ... digital (20 in Figure 1) subtraction (24 and 142a in Figure 2) among said plurality of .. analog video signals before injection and during propagation of said contrast medium, respectively (page 27, lines 5 to 9 and 21 to 24)".

1.4 In order to arrive at the subject-matter claimed in Claim 1 the angiographic subtraction image technique as

performed by means 21, 22 and 24 of Figure 2 of document D3 has to be provided twice in the apparatus of document D2, i.e. in the electronic circuit of the "first" X-ray images (see lefthand image 11 in Figure 1 of D2) and in that of the "second" X-ray images (see righthand image 12 in Figure 1 of D2). Such a double parallel use of these known digital subtraction means in both stereoscopic image channels represents a mere logical adaptation measure in the aggregation of the known stereoscopic and angiographic subtraction techniques, which measure, in the Board's view, can be expected from a skilled person.

1.5 The subtraction technique for planar TV images as disclosed in document D2 was published 3 years before the priority of the patent under appeal; see paragraph VIII(a) above. However, the incorporation of angiographic subtraction into tomographic sampling of stereoscopic images as taught by document D1 was only published one year before. Since the publication of document D1 the public is aware of the advantages of stereoscopic angiograms for X-ray diagnosis and started to be interested in such stereoscopic angiograms visualised on a TV screen. Filing the priority documents of the patent under appeal about one year after a practical demand arose among users, appears to the Board a normal technological development time and no indication of inventive step.

1.6 For these reasons, the Board considers that the subject-matter of Claim 1 of the main request is the result of an obvious use of the conventional angiographic subtraction technique disclosed in document D3 in the conventional stereoscopic TV imaging technique disclosed in document D2. Therefore, in the Board's judgment, Claim 1 lacks an inventive step within the meaning of Article 56 EPC.

2. Claims 2 and 3 of the main request fall because of their dependency on Claim 1.

3. Inventive step - Claim 1 of the auxiliary request

3.1 The closest prior art and the objective problem underlying Claim 1 of the auxiliary request are identical to those of Claim 1 of the main request as set out in paragraphs 1.1 and 1.2 above.

3.2 The solution of the objective problem according to Claim 1 of the auxiliary request adds to that claimed in Claim 1 of the main request a more specific apparatus definition of technical means used in device units which in Claim 1 of the main request are only defined by functional terms, i.e. (1) the X-ray projecting means, (2) the X-ray images producing means, (3) the subtraction images producing means and (4) the combining means. The wording of Claim 1 of the auxiliary request begins with an identical repetition of the more functionally defined solution of Claim 1 of the main request, which does not involve an inventive step as set out in paragraphs 1.3 to 1.5 above. Hence, it remains to be investigated, whether the claimed more concrete apparatus definition of said device units (1), (2), (3) or (4) was obvious to the skilled person.

3.3 An "X-ray projecting means" which "comprises an X-ray radiation source including a one-target and two-focus stereoscopic X-ray tube" is known from document D5, in particular Figure 7. These means have first and second blocks (41, 41a) and "X-ray switching means (44, 44a) in order to switch the first and second X-ray projection angles". Replacing the blocks by grids represents a use of known equivalents.

The use of photocouplers in X-ray switching means is known from document D7; see units 7, 8 and 9 in the figure. X-ray tubes switched via tetrodes are disclosed in document D8; see tetrodes 23, 24, 25 and 26 in Figure 1. Though the property of photocouplers and tetrodes concerning their short switching speed is not explicitly mentioned in documents D7 and D8 (see also paragraph VIII-(c) above), this fact, in the Board's view, is generally known to a skilled person, and will incite him, "in order to control the bias voltage applied to each of the first and second grids of said X-ray tube" to replace the transformer couplings 44 and 44a in Figure 7 of document D5 by "two photocouplers responsive to X-ray projection switching control signals and two tetrodes which alternately turn on and off in response to the output signals from the photocoupler". In the Board's view, the use of the known advantageous properties of the recently developed or conventional circuit means of documents D7 and D8 in the X-ray projecting means of document D5, published in 1969, lies within the normal technical development and should be expected from a normally skilled person, whenever the observable delays and phase-shifts of the transformers 44 and 44a in document D5 are no longer in line with his practical needs.

3.4 The prior art according to Figures 1 and 3 of document D6 shows "X-ray images producing means" which "comprises an X-ray image converter which includes: an image intensifier device to receive X-ray projection images taken in turn at said two different projection angles (image tube in Figure 1), and first and second TV camera video circuits equipped with pick-up tubes to receive the relative X-ray images from said image intensifier device (see the optical path from "image tube output phosphor" to photocathodes No. 1 and No. 2 in Figure 3 and the "orthicons" in Figure 1), and to produce said first and second analogue

video signals corresponding to one-viewed and other-viewed X-ray images of the object respectively (Figure 1).

3.5 From document D3, there is known in the wording of Claim 1 the following technical features of the "X-ray producing means": "a signal processor which includes: a first ... A/D converter (D3, 20 in Figure 1) for converting the first ... analogue video signals, obtained before and after injection of the contrast medium, into first ... digital video signals, respectively; first ... digital memory means (104a in Figure 2) for storing said first ... digital video signals obtained before injection of the contrast medium as first ... mask digital video signals, respectively (page 27, lines 10 and 11); third ... digital memory means (104b in Figure 2) for storing first ... digital video signals, obtained after injection of the contrast medium respectively (page 27, lines 11 to 15); **said subtraction images producing means** comprises: processing means for performing the digital subtraction between said first .. mask images digital video signals and said first digital video signals stored in said third ... digital memory means (138a, 140a; 138b, 148b, 146b, 144a; 142a) so as to produce separately said first ... subtraction images and digital video signals, and a first ... D/A converter (2b in Figure 2) for converting said first ... subtraction image digital video signals into the corresponding analogue video signals;".

Providing the above means twice is obvious in order to create a "stereoscopic" subtraction image; see paragraph 1.4 above.

3.6 Figure 1 of document D4 and the corresponding description discloses: a "**combining means**" which "comprises: gate means (see "Bild-Umschaltung" in Figure 1) comprising first and second gate circuits for gating said first and

second ... images analogue video signals during predetermined period so as to leave necessary diagnostic information of the examined object on said first and second ... images analogue video signals, respectively, and a video mixer ("Bildmischung" in Figure 1) for mixing said gated first ... image's analogue video signal obtained in the first projection angle with said gated second ... image's analogue video signal, obtained in the second projection angle to provide a composite video signal (see "Monitor" in Figure 1)".

3.7 The multitude of known technologies applied at the same time - i.e. starting from the closest prior art according to document D2, additional individual technical means separately disclosed in documents D3, D4, D5, D6, D7 and D8 - in the Board's view can be no indication of inventive step in spite of the very complex structure of the device claimed in Claim 1 of the auxiliary request incorporating various constructional units. Each of the applied, known technical means mentioned above in paragraphs 3.3 to 3.6 is exclusively used to produce independently its own known effects. In complex technologies, such as here in the case of an X-ray diagnostic apparatus for producing stereoscopy angiograms on a TV-screen, the Board considers a skilled person as acting in the frame of his routine work, when he aggregates arbitrarily a variety of technically independent analogous uses of conventional technologies which are all known in the identical relevant technical field, and thus only integrates a plurality of known technical results into the same device. No unexpected synergistic effect was suggested by the Respondent.

3.8 For the reasons stated above, the Board finds that the subject-matter of Claim 1 of the auxiliary request is the result of a series of independent analogous uses which alone and in aggregation with each other are obvious to a

skilled person. Therefore, Claim 1 of the auxiliary request is considered to lack an inventive step within the meaning of Article 56 EPC.

Order

For these reasons, it is decided that:

1. The decision of the Opposition Division is set aside.

2. European patent No. 0 088 356 is revoked.

The Registrar: The Chairman:

M. Beer G.D. Paterson