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**D E C I S I O N**  
**of 9 March 2000**

**Case Number:** T 0256/97 - 3.5.1

**Application Number:** 91114462.4

**Publication Number:** 0477571

**IPC:** A61B 8/00

**Language of the proceedings:** EN

**Title of invention:**

Ultrasonic diagnostic apparatus capable of acquiring high quality image by correcting phase distortion contained in ultrasonic pulses

**Applicant:**

Kabushiki Kaisha Toshiba

**Opponent:**

-

**Headword:**

-

**Relevant legal provisions:**

EPC Art. 52(1), 56, 83, 84

**Keyword:**

"Clarity and support (yes)"  
"Inventive step (yes)"

**Decisions cited:**

-

**Catchword:**

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Boards of Appeal

Chambres de recours

**Case Number:** T 0256/97 - 3.5.1

**D E C I S I O N**  
**of the Technical Board of Appeal 3.5.1**  
**of 9 March 2000**

**Appellant:** KABUSHIKI KAISHA TOSHIBA  
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**Representative:** Blumbach, Kramer & Partner GbR  
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**Decision under appeal:** Decision of the Examining Division of the  
European Patent Office posted 11 October 1996  
refusing European patent application  
No. 91 114 462.4 pursuant to Article 97(1) EPC.

**Composition of the Board:**

**Chairman:** P. K. J. van den Berg  
**Members:** A. S. Clelland  
P. H. Muehlens

## Summary of Facts and Submissions

I. This appeal is against the decision of the examining division to refuse application No. 91 114 462.4 on the grounds that the subject-matter of claim 1 of the main request lacked an inventive step and that claim 1 of the auxiliary request was not clear. Inter alia the following documents were cited in the decision:

D1: EP-A-0 256 481

D2: DE-A-3 742 724

II. The appellant (applicant) lodged an appeal against the decision and paid the prescribed fee. The accompanying statement of grounds contained a new set of claims corresponding to the refused auxiliary request. The description was revised to delete subject-matter and an auxiliary request was made for oral proceedings.

III. In communications from the Board the clarity of claim 1 was discussed. In consequence, the appellant filed amendments to the claims and description.

IV. The appellant requests that the decision under appeal be set aside and a patent granted on the basis of the following documents:

**Claims:** claim 1 received 23 December 1999;  
claims 2 to 5, received 31 March 1999;

**Description:** pages 11 to 14 and 19 to 22, as originally filed;  
pages 1 to 5, 8 to 10 and 23, received with grounds of appeal on 11 December 1996;  
pages 15 to 18, received 23 December 1999;  
(there is no page 6 or page 7).

**Drawings:** Figures 1 to 17 as originally filed.

V. Claim 1 of the main request reads as follows:

"An ultrasonic diagnostic apparatus (2000) comprising:  
ultrasonic transducer means (2) having a plurality of ultrasonic transducer elements (V) for transmitting ultrasonic pulses to an object under medical examination in response to energizing signals, and for receiving echoes therefrom to produce echo signals (S),  
delay controlling means (11, 12, 13) supporting the energizing signals and the echo signals (S) with delay times determined according to the geometrical position information of the transducers elements,  
delay-time-correcting-value-calculating means (23) calculating delay-time correcting values, and  
delay-time-correcting means (24) correcting the delay time in said delay control means (13) by the delay-time correcting values to form a focal point without phase shifts,  
which is characterized by:  
quadrature-phases-detecting means (25, 130) for inputting the echo signals derived from the transducer means (2) and reference signals (S1, S2), and for obtaining phase data (ö) based on a quadrature signal

component and an in-phase signal component contained in the echo signals, discontinuity correcting means (121A) for correcting the phase data in such a manner that discontinuity points ( $f_1, f_2, \dots, f_n$ ) contained in the phase data are searched and, in response to identified discontinuity points, the corresponding discontinuities in the phase data are removed by adding bias values in the form  $\pm 2\delta$  so as to provide continuous phase data, temporal direction-averaging means (121B) for averaging the continuous phase data, and said delay-time-correcting-value-calculating means (23) calculating the delay-time correcting values based on the averaged continuous phase data."

VI. The appellant argued as follows:

The invention solved the problem of removing discontinuities in phase data derived from a quadrature phase detector means. This was achieved by searching the phase data for discontinuities and shifting the data by adding bias values to obtain continuous data as claimed in claim 1. None of the cited references contained any means for phase correction. Regarding clarity, the above described problem and solution were evident from claim 1 itself. The phases of the echo signals varied greatly depending on the apparatus setup, whereas the phase of the reference signal was fixed. Thus it was possible that the phase difference would exceed  $2\delta$  which could not be detected by the quadrature detecting means, leading to the problem of discontinuities in the output signal. This was corrected by a discontinuity correcting means, operating as described above. According to the

description at page 22, lines 19 to 24 calculation error was thereby reduced and image quality improved.

## **Reasons for the Decision**

### 1. *Amendments*

- 1.1 The description and claims have been subject to substantial amendment, primarily by deletion of subject-matter. Claim 1 is based on the subject-matter of originally filed claims 1, 3 (part) and 4 (part), whilst claims 2 to 4 are respectively based on original claims 2, 3(part) and 4 (part). New claim 5 is supported by the originally filed description relating to Figures 5 and 9. Original claims 5 to 21 have been deleted. Figures 18 to 40 and the associated description, relating to the "second basic idea" and the "third basic idea", have also been deleted.
- 1.2 In course of the appeal proceedings the feature "phase correcting means" in the characterising part of claim 1 was amended to "discontinuity correcting means", which correct the phase data by adding a bias value. The amendment is supported by page 20, lines 1 to 8 of the application as originally filed. The "temporal direction averaging means" now present in the characterising part is present in claim 4 as originally filed.
- 1.3 The Board is accordingly satisfied that the amendments do not contravene Article 123(2) EPC.

2. *Background to the invention*

2.1 Ultrasonic diagnostic apparatus can be used to acquire images of body organs. By means of a transducer array an image can be built up as the focal point is raster-scanned on a plane within the organ; the individual transducers are energised with differing and varying phase shifts to form the movable focal point.

2.2 However, a biological body is not a homogeneous medium. The velocity of sound in the surface fat layer of a body is different to that in muscle and it is difficult to maintain focus because the propagation delay will change as the angle of insonification, and thus the path length in different layers, changes. This has the result of widening the focal point of the beam and reducing image quality.

2.3 One answer to this problem, known from D1, is to add to the phase shifts determined by the geometry a corrective phase shift derived from the received signal. The delimitation of claim 1 is based on this document. The present application goes a step further by determining the required correction from in-phase and quadrature components of the echo signals, a technique acknowledged as known per se from D2. A difficulty which apparently arises with this technique is that the known phase detectors have a detection limit of  $\pm 2\delta$ ; the result of a phase shift outside these limits is a phase discontinuity. The application seeks to overcome this problem by detecting such discontinuities and adding a biasing phase value to smooth the signal.



3. *Clarity and Support (Article 84 EPC)*

3.1 Claim 1 corresponds in substance to claim 1 of the auxiliary request rejected by the examining division. This claim was considered unclear because "The nature and origin of the said phase distribution data having discontinuity points to be coupled is unclear. Not even in the light of the description could it be understood for what reasons any discontinuity points would occur...". It was surmised by the examining division that the discontinuity arose from the phase detector limiting the phase to the range  $\pm\delta$  but that in this case "the claim would obviously lack clarity". The division also stated that it seemed "to be of no practical significance whether a given phase is processed with or without the addition of an integer multiple of  $2\pi$ ". It was concluded that the advantage of the continuous phase distribution seemed to be "inexplicable".

3.2 The existence of phase discontinuities is discussed in a number of places in the application as filed, see for example page 12, lines 22 to 24, Figure 6 and page 15, lines 2 to 10, page 17, lines 13 to 18, Figure 10 and page 19, lines 13 to 23, and page 20, line 1 to page 22, line 24. It is indicated that the discontinuities occur at the output of the phase detector but no explanation is given as to why they occur. The Board has no reason to doubt the appellant's explanation - which corresponds to the examining division's surmise - that they are caused by the limitation of a conventional quadrature phase detector to an output range of  $\pm 2\delta$ . Such an understanding is in substantial agreement with Figures 13 to 15 of the

application as filed. It would seem self-evident that, as indicated at page 22, lines 19 to 24 of the description, a solution to this problem is desirable in order to ensure "less calculation error".

3.3 In essence, the examining division did not believe that the problem described in the application actually occurred or that the removal of phase discontinuities produced any useful effect. This amounts to an objection to the lack of a problem underlying the invention.

3.4 The Board does not agree that the claim is unclear merely because it does not mention the cause of the problem. Rule 29 EPC does not require a statement of the problem in the claim. The claim on the other hand identifies the solution to the problem, namely the feature of the discontinuity correcting means which corrects the phase data by adding bias values in the form  $\pm 2\delta$ . This solution is supported by the description at page 20 line 1 to page 22 line 24. Although as noted below the claim contains minor infelicities of language it is, in the Board's judgement, both clear and supported by the description.

4. *Sufficiency of Description (Article 83 EPC)*

4.1 Although not mentioned in the impugned decision it appears that an objection the examining division may have had in mind is one of insufficiency. Whilst it is clear that the discontinuity correcting means add bias values of  $\pm 2\delta$ , no specific means are disclosed for implementing this procedure. Nor does the application disclose how discontinuities are detected. The question

therefore arises as to whether the person skilled in the art would be able to carry out the invention.

- 4.2 The Board however takes the view that adding a phase shift to a signal is a fundamental requirement of any electronically scanning ultrasonic diagnostic apparatus, so that the skilled person would have no difficulty in implementing the specific phase shifts of  $\pm 2\delta$ . As regards the identification of discontinuities, the detection of sudden changes in the level of a signal is a fundamental part of the knowledge of a skilled person in the electronics art.

5. *Inventive step*

- 5.1 As is apparent from the above discussion, the Board considers that the invention solves the problem of removing phase discontinuities which occur at the output of the quadrature phase detector. The problem of phase discontinuities is not discussed in either D1 or D2, see point 2.3 above. Neither of the other two documents cited in the European Search Report suggests the problem. It is noted that this aspect of the application has apparently been searched since the European Search Report cites document D2 as technological background inter alia for the phase correcting means, now the discontinuity correcting means, of original claim 3.

- 5.2 The Board accordingly concludes that the subject-matter of claim 1 is not obvious in the light of the prior art at its disposal.

- 5.3 Claims 2 to 5, defining further aspects of the

invention, are directly or indirectly dependant on claim 1 and therefore also allowable.

6. The Board notes that claim 1 contains minor mistakes at line 12 (transducers elements) and line 18 (quadrature-phases-detecting - also found in claims 3 and 5). The description also contains a number of infelicities of language. The Board takes the view however that these are not of sufficient gravity to affect the clarity of either the claims or description.

## **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 grant a patent according to the appellant's request.

The Registrar:

The Chairman:

M. Kiehl

P. K. J. van den Berg