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D E C I S I O N
of 27 June 2005

Case Number: T 0710/03 - 3.2.2

Application Number: 96905953.4

Publication Number: 0957769

IPC: A61B 8/08

Language of the proceedings: EN

Title of invention:
Apparatus for ultrasonic tissue investigation

Applicant:
Quality Medical Instruments Limited

Opponent:

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Headword:

-

Relevant legal provisions:

EPC Art. 52(1), 56

Keyword:

"Inventive step (yes) "

Decisions cited:

-

Catchword:

-



Case Number: T 0710/03 - 3.2.2

D E C I S I O N
of the Technical Board of Appeal 3.2.2
of 27 June 2005

Appellant: Quality Medical Instruments Limited
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Representative: Gregory, Timothy Mark
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Decision under appeal: Decision of the Examining Division of the
European Patent Office posted 13 January 2003
refusing European application No. 96905953.4
pursuant to Article 97(1) EPC.

Composition of the Board:

Chairman: T. K. H. Kriner
Members: S. S. Chowdhury
U. J. Tronser

Summary of Facts and Submissions

I. This appeal is against the decision of the examining division dated 13 January 2003 to refuse European patent application No. 96 905 953.4.

The application was refused on the grounds that claim 1 did not meet the inventive step requirement of Article 52 (1) EPC.

The following documents cited during the examination procedure are of interest in the appeal procedure:

D1: Proceedings of the Ultrasonics Symposium, Baltimore, Oct. 31 - Nov. 3, 1993, Vol. 2, 31 Oct. 1993; pages 985-988: Turnbull D. H. et al.: "Ultrasound Backscatter Microscope For Skin Imaging"

D2: L'onde Electrique, Vol. 72, No. 2, 1 March 1992, pages 31-35; Berson M. et al.: "Imagerie acoustique à haute resolution - Applications dermatologie".

II. On 7 March 2003 the appellant (applicant) lodged an appeal against the decision and paid the prescribed fee on 10 March 2003. On 23 May 2003 a statement of grounds of appeal was filed.

The appellant requests that the decision under appeal be set aside and that the application be allowed on the basis of on the basis of the following documents:

- Description pages 1 and 3 to 6 as published in WO-A-96/28096
- Description page 2 filed with the letter dated 29 November 2002
- Claims 1 to 7 filed with the letter dated 29 November 2002 (main request), or the first to fourth conditional set of claims filed with the grounds of appeal.
- Figures 1 to 6 as published in WO-A-96/28096.

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

"An apparatus for ultrasonic tissue investigation comprising ultrasonic transducer means adapted to emit pulsed emissions into tissue, means so to move said transducer means as to scan an area of tissue to be investigated, means to receive signals reflected from interfaces between tissue components, means to convert said received signals into a visual image of the tissue, and means to display said visual image, characterised in that said emissions of ultrasonic radiation are each activated by an electrical pulse having a fall back period during which the fall back rate is greater than 30 kV/ μ s."

Reasons for the Decision

1. The appeal is admissible.

2. The impugned decision refused claim 1 for lack of inventive step of its subject-matter, based on the argument that document D1 disclosed activating the emission of ultrasounds with mono-cycle pulses of 200 V amplitude by a pulse generator operating at frequencies of up to 100 MHz, leading to the conclusion that the fall time of the pulses must be well above $220 \text{ V} \times 100 \text{ MHz}$, ie well above $20 \text{ kV}/\mu\text{s}$, over which the claimed rate for the fall time of the pulses of $30 \text{ kV}/\mu\text{s}$ was not inventive.
 - 2.1 This argument appears to be based on a misunderstanding of the different parameters that contribute to the shape of electrical pulses. Therefore, a brief review of these parameters and their relationship to the pulse properties is in order.

3. Every pulse has at least a leading edge and a trailing edge, which are connected by a middle portion to define the shape of the pulse, i.e. its amplitude versus time profile. For example, a pulse may be triangular, rectangular, etc in profile. A triangular pulse has sloping, leading, and trailing edges meeting at an apex, while a rectangular pulse has sharp leading and trailing edges connected by a flat middle portion. The application places importance on the trailing edge only, and claim 1 uses the expression "fall back period" to refer to this edge, and requires the fall back rate to be greater than $30 \text{ kV}/\mu\text{s}$.

A pulse sequence is characterised by the pulse repetition frequency (prf), which is the number of pulses emitted per second, the pulse width, and other parameters such as pulse spacing, height, etc. The application states that the prf is 1 KHz (corresponding to a 1 ms prf) and has a duration of less than 50 ns (page 2, sixth paragraph).

- 3.1 The application also states that the transducer is capable of emitting a single cycle pulse at a frequency of between 10 and 50 MHz (page 3, fourth paragraph). This frequency, however, does not refer to the prf, but to the frequencies that contribute to making up the pulse as explained below.

There is generally an inverse relationship between the width of a pulse in the time domain and the width of the spectrum of frequencies in the frequency domain that go into making up the pulse. A narrow pulse in the time domain will have a broad spectrum of frequencies in the frequency domain, and if a pulse has sharp edges, then it will have a large bandwidth and very high frequencies in the frequency domain. It is the latter that are referred to on page 3 fourth paragraph of the application, the frequencies and bandwidth being high in order to produce the sharp trailing pulse edge required by claim 1.

- 3.2 However, the existence of high frequencies and a large bandwidth, while indicative of the fact that the pulse will have a sharp feature to it, does not necessarily mean that it is the trailing edge that is sharp, it could equally have a sharp leading edge and a gently falling trailing edge (see point 4.3 below).

4. *The prior art*

4.1 Document D1 mentions the use of high frequencies of up to 100 MHz (Abstract) which, as indicated above, refers to the frequencies in the frequency domain that go into making up the pulses. D1 does not mention the pulse shape. Therefore, while the very high frequencies and bandwidth used suggest that the pulses are sharp, there is no indication in D1 as to whether this refers to the leading edge or trailing edge or both. The approximate fall rate may, however, be derived as follows:

4.2 On page 986, first paragraph, it is said that the transducer moves at a rate of 5-10 Hz over an 8mm path length, which corresponds to a speed of 80 mm/s. The encoder emits pulses every 4 μm of its path length, which gives a prf of 20 KHz.

Neither the pulse shape nor the pulse spacing are given in D1. Figure 2 shows the pulse echo response of transducers excited by electrical pulses at different frequencies, but it is not possible to re-construct the electrical pulse shape from the shape of the response. If anything, the ringing of the pulse echo responses shown in Figure 2 points to a slow decay of the activating electrical pulses as in the case of D2 (see below). However, even assuming that the applied electrical pulses are symmetrical and triangular and have a mark to space ratio of one, and given that the pulses have an amplitude of 200 V (page 986, right column, line 4), this gives a rise and fall time of 16 kV/ μs which is well below the claimed rate.

4.3 Document D2 describes a high resolution acoustic imaging system in which it is desired to achieve high axial and lateral resolution, which implies the use of very short pulses (page 31, Introduction, second paragraph). This requires a very broad band system centred about a very high frequency. The first paragraph on page 33 says that the pulses should have a rise time of the order of 10 ns for an amplitude of 150V, which gives a rise rate of 15 kV/ μ s. There is no explicit mention of the fall rate, but in Figure 5 of D2 the trailing edge of the pulse resembles the natural exponential decay of the capacitor C in Figure 4 discharging through a resistor, so the fall rate is well below 15 kV/ μ s.

5. *Novelty*

From the foregoing it is evident that neither of D1 and D2 discloses the emission of ultrasonic radiation which is activated by an electrical pulse having a fall back period during which the fall back rate is greater than 30 kV/ μ s. The subject-matter of claim 1 is novel, accordingly.

6. *Inventive Step*

6.1 The application states that the technical effect of a fast fall time pulse is that it enables a better reception of the reflected signals (page 3, penultimate paragraph). This is because the driving signal is then shorter than the duration of a single cycle of the ultrasound produced so that only a single ultrasonic pulse is emitted, which gives improved imaging as compared with pulses having a slower fall rate.

6.2 The apparatus of D1 employs high frequency ultrasound waves in order to improve the resolution of images. Equation (1) on page 986 states that the resolution is proportional to the pulse width which, as indicated above, depends on the frequencies that make up the pulse. The implication here is that for good resolution high frequencies are necessary, for which reason frequencies of 40-100 MHz are employed.

However, D1 is silent as regards the shape of the trailing edges of the pulses, in particular that this must have a very rapid fall rate of greater than 30 kV/ μ s. No importance is placed in D1 on the rise or fall time of the pulses, these are governed only by the desired prf.

D2 also discusses high resolution acoustical imaging and discloses the use of high frequency transducers to produce a very sharp leading edge (Figure 5), but the document places no importance on the fall rate, and in particular that this must be greater than 30 kV/ μ s.

6.3 From the foregoing it is evident that the prior art does not suggest the emission of ultrasonic radiation pulses which are each activated by electrical pulses having a fall back period during which the fall back rate is greater than 30 kV/ μ s. For this reason claim 1 involves an inventive step.

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 on the basis of the following documents:
 - Description pages 1 and 3 to 6 as published in WO-A-96/28096

 - Description page 2 filed with the letter dated 29 November 2002

 - Claims 1 to 7 filed with the letter dated 29 November 2002

 - Figures 1 to 6 as published in WO-A-96/28096.

The Registrar

The Chairman

V. Commare

T. K. H. Kriner