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Datasheet for the decision of 15 May 2007

Case Number: T 0443/06 - 3.5.03

Application Number: 92912298.4

Publication Number: 0589974

IPC: H04R 29/00

Language of the proceedings: EN

Title of invention:
A method and a system for testing capacitive acoustic transducers

Patentee:
A/S BRÜEL & KJAER

Opponent I:
Müller-BBM GmbH

Headword:
Testing capacitive transducers/BRÜEL & KJAER

Relevant legal provisions:
EPC Art. 56

Keyword:
"Inventive step - no"

Decisions cited:
-

Catchword:
-

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Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T 0443/06 **-** 3.5.03

D E C I S I O N
of the Technical Board of Appeal 3.5.03
of 15 May 2007

Appellant: (Patent Proprietor)
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Decision under appeal:
Decision of the opposition division of the European Patent Office posted 12 January 2006 revoking European patent No. 0589974 pursuant to Article 102(1) EPC.

Composition of the Board:

Chairman: A. S. Clelland
Members: F. van der Voort
R. Moufang

Summary of Facts and Submissions

I. This appeal is against the decision of the opposition division revoking European patent No. 0 589 974 which is based on European patent application 92 912 298.4 which was originally filed as international application PCT/DK92/00173 (publication number WO 92/21982 A). Two notices of opposition had been filed.

II. The opposition division revoked the patent on the grounds that claim 1 of a main request included amendments which did not comply with the requirements of Article 123(2) EPC and that the subject-matter of claim 1 of an auxiliary request did not involve an inventive step, Articles 56 and 100(a) EPC.

III. In the course of the opposition proceedings the opponents referred, *inter alia*, to the following prior art document:

E2: US 4 648 078 A.

IV. The proprietor (appellant) lodged an appeal against the above-mentioned decision and implicitly requested that it be set aside and that the patent be maintained in amended form on the basis of claims of a main request or, in the alternative, on the basis of claims of an auxiliary request, both requests as filed with a statement of grounds of appeal dated 10 May 2006.

V. The respondents (opponents I and II) each filed a reply to the statement of grounds of appeal and argued that the appeal should be dismissed. Both respondents conditionally requested oral proceedings.

VI. The parties were summoned by the board to oral proceedings. In a communication accompanying the summons and in a further communication the board drew attention to issues to be discussed at the oral proceedings and gave a preliminary opinion on the allowability of the claims of the main and auxiliary requests.

VII. In preparation for the oral proceedings the appellant filed further claims of a second and a third auxiliary request. No arguments in support of these requests were given.

VIII. With letter of 19 February 2007 respondent II (opponent II) withdrew its opposition.

IX. Oral proceedings were held on 15 Mai 2007.

In the course of the oral proceedings the appellant withdrew the main and first auxiliary requests. The appellant requested that the decision be set aside and that the patent be maintained in amended form on the basis of claims 1 to 4 of the second auxiliary request as filed with letter of 6 March 2007 or, failing that, on the basis of claims 1 to 4 of the third auxiliary request as filed with letter of 13 April 2007, claim 1 of each request being amended by the replacement of "capacitive" by "capacitor" at line 1.

The respondent (opponent I) requested that the appeal be dismissed.

At the end of the oral proceedings the board's decision was announced.

X. Claim 1 of the second auxiliary request reads as follows:

"A system of testing one or more capacitor microphones from a central control unit, where the microphones are individually connected to an inlet of a preamplifier (4) having a relatively high input resistance (6), and where a test conduit (8') from the central control unit is connected to each of the microphones, the testing of each microphone being performed by means of a test signal transmitted through the test conduit (8') connected to the joint between the microphone and the inlet of the preamplifier (4) through a relatively small capacitor for measuring the frequency characteristics at discrete frequencies via the test conduit (8') and comparing the measured frequency characteristics with previously determined characteristics so as to indicate errors, if any, in the microphone, **characterised** by the relatively small capacitor in the test conduit (8') having a very high equivalent parallel resistance or leakage resistance, said equivalent parallel resistance of the capacior *[sic]* being of the magnitude 10^7 M Ω in order to allow the leakage current to be 100 times smaller than the capacitive current of the capacitor (10) at a low cut-off frequency of 20 Hz and by the test conduit (8') in the control unit communicating with a change-over switch (1) connected to either a chassis or a test AC voltage."

Claim 1 of the third auxiliary request differs from claim 1 of the second auxiliary request in that the first characterising feature, i.e. "the relatively small capacitor in the test conduit (8') having a very high equivalent parallel resistance or leakage resistance, said equivalent parallel resistance of the capacior *[sic]* being of the magnitude 10^7 M Ω", is replaced by:

"the relatively small capacitor in the test conduit (8') having a stable value, the stability being so good that neither the temperature nor the times result in changes exceeding 1%, and a very high equivalent parallel resistance or leakage resistance of the magnitude 10^7 M Ω".

Reasons for the Decision

1. *Novelty - second and third auxiliary requests*

1.1 At the oral proceedings the respondent argued that the subject-matter of claim 1 of the second auxiliary request lacked novelty having regard to the disclosure of E2.

1.2 E2 (see the figure) discloses a system for testing an array of acousto-electric transducers 10 from a central control unit (col. 2, lines 17 to 39). The transducers 10 are, using the language of claim 1, individually connected to an inlet of a preamplifier 12 and a test conduit 17 is connected from the central control unit to each of the transducers 10. The testing of each transducer is performed by means of a test signal which

is generated by an oscillator 18 and transmitted through the test conduit 17. The output signal is measured so as to determine any faults or deterioration in performance, if any, in the transducer (E2, col. 1, lines 13 to 15 and 34 to 37). The test conduit 17 is connected to a joint between the transducer 10 and the inlet of the preamplifier 12 through a capacitor formed by the inherent capacitances of insulated lead-throughs 15, 16 (see the abstract). The insulated lead-throughs 15, 16 will have an equivalent parallel resistance or leakage resistance. The test conduit 17 in the control unit communicates with a change-over switch 19 connected to either a chassis, i.e. ground, or the oscillator 18. The oscillator 18, see the figure, generates an AC voltage. The test signal is therefore suitable for measuring at the output of the preamplifier 12 the frequency characteristics at discrete frequencies of the output signal and for comparing the measured frequency characteristics with previously determined characteristics so as to indicate errors, if any, in the transducer.

Further, since the preamplifier 12 is a high gain charge amplifier and includes an operational amplifier (see col. 2, line 4, and the figure) it is implicit from E2 that the preamplifier 12 also has "a relatively high input resistance".

The board understands the expression "a relatively small capacitor" as used in present claim 1 as referring to the capacity of the capacitor and not to its physical size. This understanding is in accordance with the description, see the patent specification as published, col. 5, line 55, and col. 6, lines 1 and 2

and 25 and 26 ("0.1 pF or lower"). The term "relatively small", as used in present claim 1, has no precise meaning and in the board's view the lead-throughs 15, 16 in E2 also have a "relatively small" capacity. The board notes that in the statement of grounds of appeal the appellant acknowledged that E2 disclosed that the insulating lead-throughs each form a relatively small capacity and have an equivalent parallel resistance.

1.3 The subject-matter of claim 1 therefore differs from the system disclosed in E2 in that, according to claim 1:

i) the transducers are capacitor microphones; and

ii) the equivalent parallel resistance of the capacitor in the test conduit is of the magnitude 10^7 MΩ such that the leakage current can be hundred times smaller than the capacitive current of the capacitor at a test signal frequency of 20 Hz.

The board notes that in claim 1 the test signal frequency is referred to as "a low cut-off frequency of 20 Hz". In the board's view, however, since it has not been specified to which, if any, of the system components the low cut-off relates, the term "low cut-off" does not imply any limiting constructional features of the claimed system and may therefore be ignored.

1.4 The respondent argued that on implementing the system of E2 all features of claim 1 would necessarily have been arrived at. In other words, all features were

either explicitly or implicitly disclosed in E2. The board is however not convinced that the transducers as described in E2 are necessarily capacitor microphones. The board notes that in E2 (col. 1, lines 9 to 12) reference is made to "acousto-electric transducers, or microphones, ...". It was well-known at the publication date of E2 that different types of microphones suitable for use in the system of E2 existed, e.g. capacitive or condenser microphones and piezo-electric microphones. Since the system as described in E2 is not limited to the use of a particular type of microphone, it follows that at least the above-mentioned feature i) is not known from E2.

1.5 The board therefore concludes that the subject-matter of claim 1 of the second auxiliary request is novel having regard to the disclosure of E2. Since claim 1 of the third auxiliary request includes all features of claim 1 of the second auxiliary request, the same applies to the subject-matter of that claim.

2. *Inventive step - claim 1 of the second auxiliary request*

2.1 At the oral proceedings the appellant argued that, starting out from E2, the problem underlying the claimed subject-matter was how to measure variations in the performance of the transducers when used in the open air, for example at airports in order to register noise caused by airplanes, in which variations in performance could be caused by, e.g., water drops in the microphones. Since E2 exclusively related to hydrophones, a person skilled in the art facing this problem would not consider E2. A further aim of the

invention was to perform testing at very low frequencies, which also was not relevant to hydrophones as disclosed in E2.

The board does not find these arguments convincing, since present claim 1 does not exclude that the microphones are part of an underwater array such as the one disclosed in E2. Further, in the patent in suit (see col. 6, lines 50 to 54 of the patent as published) it is explicitly stated that "other capacitive transducers, such as piezoelectric hydrophones and accelerometers," may be used. Hence, in the board's view, having regard to the above-mentioned distinguishing features i) and ii), see point 1.3 above, the problem underlying the claimed subject-matter starting out from E2 is rather that of implementing, and therefore dimensioning the different components of, the system as disclosed in E2.

2.2 Even though E2 does not explicitly disclose the use of a capacitor microphone for the acousto-electric transducer 10, it does hint at the use of a capacitive transducer or microphone, i.e. one having the property of creating electric charges in response to receiving sound waves, since the preamplifiers 12 are high gain charge amplifiers (col. 2, line 4). At the priority date of the patent in suit, capacitor microphones were well-known examples of this type of microphone. Hence, the use of capacitor microphones in the system disclosed in E2 in order to implement the system would have been one of the obvious choices available to the skilled person. Feature i), see point 1.3 above, does not therefore contribute to an inventive step.

2.3 Further, the board notes that E2 (see col. 1, line 52 to col. 2, line 23) particularly relates to the testing of an array of hydrophones towed by a ship. Each hydrophone includes one of the acousto-electric transducers 10. Towed hydrophone arrays are commonly used in detecting seismic energy underwater and must therefore be capable of detecting sound waves over a low range of frequencies, e.g. 1 to 100 Hz. It follows that it would have been obvious to carry out the test as described in E2 at various low test frequencies in order to fully cover the frequency range of the transducers for a complete test.

2.4 As in the patent in suit, the testing according to E2 involves the measurement of the transducer response to a given test input signal. In the board's view, it is part of the common general knowledge of the person skilled in the art that, in order to accurately measure the response of a device, the measurement should be carried out in such a manner as not to affect the response to be measured. Hence, a person skilled in the art would have realized that the test system of E2 should be configured so that the output signal of the transducer is, as much as possible, dependent on the transducer characteristics only, i.e. independent of the way the measurement is carried out, e.g. the test frequency used.

In the case of a capacitive transducer it follows from elementary circuit theory that a purely capacitive coupling of the test signal to the capacitive transducer results in a linear output signal which is independent of the test frequency, since a purely capacitive voltage divider is thereby achieved. In line

with this, E2 explicitly refers to the test signal being "capacitively coupled" to the transducer (E2, the abstract, col. 1, lines 48 to 51, and col. 2, lines 24 to 28).

2.5 It would therefore have been obvious to the skilled person to design the capacitor consisting of the capacitances of the lead-throughs 15, 16 of the system of E2 such that it has a high leakage resistance compared to its reactance in order to achieve, as much as possible, a linear response over the whole range of frequencies. Whether or not a factor of 100 as specified in the claim would be sufficient depends on the specific circumstances, e.g. the input impedance of the particular preamplifier, the nominal capacity of the transducer to be tested and the desired linearity of the measurement as a function of the test frequency ω. For example, if a non-linearity within 1% were tolerable, the leakage current must be at least 100 times smaller than the capacitive current or, using Ohm's law, the leakage resistance R_L must be 100 times larger than the reactance ($1/\omega C_c$) of the capacitor i.e. $\omega R_L C_c = 100$. The specific value of R_L being "of the magnitude 10^7 MΩ", as claimed in claim 1, is therefore one of several possibilities to satisfy this equation and, moreover, does not result in any unexpected technical effect which could contribute to an inventive step. Nor did the appellant allege or submit evidence in support of such an effect. A person skilled in the art faced with the problem of implementing the test system of E2 would therefore, using his common general knowledge including normal workshop experimentation, have arrived at the claimed subject-matter including

feature ii), see point 1.3 above, without the exercise of inventive skill.

2.6 The appellant argued that the system of E2 would not provide the same accuracy as could be obtained with the present system, since the capacity of the insulated lead-throughs was strongly affected by, e.g., the surrounding water and stray capacitances and was therefore subject to changes. The board notes however that claim 1 does not define any features relating to the accuracy of the measurements and/or the stability of the different components of the system. The argument is therefore not convincing.

2.7 The board concludes that the subject-matter of claim 1 of the second auxiliary request lacks an inventive step, Articles 52(1) and 56 EPC.

3. *Inventive step - claim 1 of the third auxiliary request*

3.1 Claim 1 of the third auxiliary request differs from claim 1 of the second auxiliary request in that it additionally specifies that the above-mentioned capacitor has "a stable value, the stability being so good that neither the temperature nor the times result in changes exceeding 1%".

3.2 The claim thus attempts to define the subject-matter by a result to be achieved. However, in the present case, the result to be achieved is indeterminate, since the ranges of temperature and time within which the 1% stability is to be achieved have not been specified. For small ranges of time and temperature any capacitor would meet the claimed stability. Hence, in effect, the

additional feature of claim 1 of the third auxiliary request does not imply any constructional features of the claimed system and, in particular, of the capacitor.

3.3 It follows that, for the same reasons as set out at point 2 above in respect of claim 1 of the second auxiliary request, the subject-matter of claim 1 of the third auxiliary request lacks an inventive step (Articles 52(1) and 56 EPC).

4. The board concludes that neither of the requests is allowable.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

D. Magliano A. S. Clelland