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Datasheet for the decision of 9 December 2020

Case Number: T 2222/15 - 3.4.01

Application Number: 08708714.4

Publication Number: 2238592

IPC: G10L21/02, H04R3/00

Language of the proceedings: EN

Title of invention:
METHOD FOR REDUCING NOISE IN AN INPUT SIGNAL OF A HEARING DEVICE AS WELL AS A HEARING DEVICE

Patent Proprietor:
Sonova AG

Opponent:
Sivantos Pte. Ltd.

Headword:
Noise reduction / SONOVA

Relevant legal provisions:
EPC Art. 54, 84
RPBA 2020 Art. 13(1)

Keyword:
Novelty - (no)

Decisions cited:
T 1480/16

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Case Number: T 2222/15 - 3.4.01

D E C I S I O N
of Technical Board of Appeal 3.4.01
of 9 December 2020

Appellant: (Opponent)	Sivantos Pte. Ltd. 18 Tai Seng Street No. 08-08 18 Tai Seng Singapore 539775 (SG)
Representative:	FDST Patentanwälte Nordostpark 16 90411 Nürnberg (DE)
Respondent: (Patent Proprietor)	Sonova AG Laubisrütistrasse 28 8712 Stäfa (CH)
Representative:	Schwan Schorer & Partner mbB Patentanwälte Bauerstrasse 22 80796 München (DE)
Decision under appeal:	**Interlocutory decision of the Opposition Division of the European Patent Office posted on 29 October 2015 concerning maintenance of the European Patent No. 2238592 in amended form.**

Composition of the Board:

Chairman	P. Scriven
Members:	B. Noll
	D. Rogers

Summary of Facts and Submissions

I. The opponent appealed the interlocutory decision of the Opposition Division by which European Patent 2238592, in amended form, was found to meet the requirements of the Convention.

II. In the decision, it was held that the subject-matter of independent claims 1 and 8, in amended form, was novel and involved an inventive step.

III. In a communication issued in preparation of oral proceedings, the Board addressed the issues raised and indicated that the method of claim 1 (as considered allowable in the impugned decision) lacked novelty over the disclosure of

D7 (WO2007/106399 A2).

IV. The appellant's request, as formulated at the end of oral proceedings before the Board, was that the decision under appeal be set aside and that the patent be revoked.

V. The respondent's requests at the end of oral proceedings were, as a main request, that the appeal be dismissed or, alternatively, that the decision under appeal be set aside and the patent maintained on the basis of one of auxiliary requests 1, 2, 2.2, 3.1, 3.2, 3.3, 4.1, 4.2, 5.1, 5.2, 6.1 or 6.2.

VI. Auxiliary request 1 is identical to the patent as granted. Auxiliary requests 2, 3.1, 3.2, 4.1, 4.2, 5.1, 5.2, 6.1 and 6.2 were filed with a letter dated 14 July

2016 and auxiliary requests 2.2 and 3.3 were filed under with a letter dated 3 December 2020.

VII. Claim 1 according to the main request reads as follows:

A method for reducing noise in an input signal (110) of a monaural hearing device comprising a transfer function (H), the method comprising the steps of:
- capturing first and second acoustic signals by first and second acoustic-electric converters (1, 2),
- providing first and second input signals (110, 311) by the first and the second acoustic-electric converters (1, 2),
- deriving an information signal (410) by using the first and the second input signals (110, 311),
- deriving an information signal estimate (S) from the information signal (410),
- deriving a noise signal (411) by using the first and the second input signals (110, 311),
- deriving a noise signal estimate (N) from the noise signal (411),
- generating instantaneous coefficients (412, 312) for the transfer function (H) by using the information signal estimate (S) and the noise signal estimate (N),
- applying the transfer function (H) to the first input signal (110) or to a processed first input signal (410) generating an output signal (111), and
- feeding the output signal (111) to an electro-acoustic converter (5) of the

hearing device.

VIII. Claim 1 according to auxiliary request 1 (as granted) reads identically, except that it does not contain the word "monaural".

IX. Claim 1 according to auxiliary request 2 reads as claim 1 of the main request except for the beginning, which read as follows:

A method for reducing noise in an input signal (110) of a behind-the-ear hearing device to be worn behind an ear of a hearing device user, comprising a transfer function (H), the method comprising the steps of:
- capturing first and second acoustic signals by first and second acoustic-electric converters (1, 2), the first acoustic-electric converter (1) being an omni-directional front microphone, the second acoustic-electric converter (1) being an omni-directional back microphone,
[- providing first and second
...
hearing device.]

X. Claim 1 according to auxiliary request 2.2 reads as follows:

A behind-the-ear hearing device to be worn behind an ear of a hearing device user, comprising
- at least two acoustic-electric converters (1, 2) providing at least first and second input signals (110, 311), the first

acoustic-electric converter being an omni-directional front microphone, and the second acoustic-electric converter being an omni-directional back microphone,
- a receiver (5);
- a filter unit (101) having a transfer function (H), the filter unit (101) being operatively connected in-between the at least two acoustic-electric converters (1, 2) and the receiver (5),
***characterized by** further comprising*
- a computing unit (302) which is, on its input side, operatively connected to the at least two acoustic-electric converters (1, 2), and, on its output side, operatively connected to the filter unit (101), the computing unit (302) comprising
- means for deriving an information signal (410) by using at least the first and the second input signals (HO[sic], 311),
- means for deriving an information signal estimate (S) from the information signal (410),
- means for deriving a noise signal (411) by using the first and the second input signals (110, 311),
- means for deriving a noise signal estimate (N) from the noise signal (411), and
- means for generating instantaneous coefficients (412, 312) for the transfer function (H) by using the information signal estimate (S) and the noise signal estimate (N).

XI. Claim 1 according to auxiliary request 3.1 adds, at the end of claim 1 of the main request, the following:

[A method
...
hearing device],
wherein the information signal (410) is generated by first spatial filtering with a front facing cardioid in relation to a hearing device user, and the noise signal (411) is generated by second spatial filtering with a back facing cardioid in relation to a hearing device user.

XII. Claim 1 of auxiliary request 3.3 adds, to the end of claim 1 of auxiliary request 2.2, the following:

[A behind-the-ear hearing device
...
and the noise signal estimate (N)],
wherein the means for deriving information signal (410) comprises a first fixed beamformer (401) with a front facing cardioid in relation to a hearing device user, the means for deriving the noise signal (411) comprise a second fixed beamformer (402) having a back facing cardioid in relation to a hearing device user.

XIII. Claim 1 of auxiliary request 4.1 adds, to the end of claim 1 of auxiliary request 3.1, the following:

...,
and wherein *the step of generating instantaneous coefficients (412, 312) for*

the transfer function (H) is performed by using a Wiener filter using the information signal estimate (S) and the noise signal estimate (N).

XIV. Claim 1 of auxiliary request 5.1 adds, to the end of claim 1 of auxiliary request 3.1:

...,
and wherein the method further comprises the step of averaging the generated instantaneous coefficients (412), the averaging in particular being performed by first order IIR filtering with an IIR filtering parameter ß, preferably with ß = 0.05 or with a time constant of 30 ms.

XV. Claim 1 of auxiliary request 6.1 removes, from the applying step, the first alternative "*the first input signal (110)*" and adds, to the end of claim 1 of auxiliary request 3.1 the following:

...
and wherein equalizing is applied as part of the processing to generate the processed first input signal (410) with a transfer function equal to an inverse transfer function of the first/second spatial filtering, in particular with a transfer function of the equalizing given by the following formula:

$$1/(1-\alpha z^{-2}),$$

with a factor α, preferably set to α = 0.965.

XVI. Claim 1 of auxiliary requests 3.2, 4.2, 5.2 and 6.2 reads as claim 1 of auxiliary requests 3.1, 4.1. 5.1 and 6.1, respectively, except the beginning, which read as in auxiliary request 2.

Reasons for the Decision

The patent

1. The patent relates to noise filtering in a hearing aid. Noise, in the sense of the patent, is an unwanted background acoustic signal; the user of the hearing aid wants to filter this out from the acoustic signal from a source he or she wants to focus on. Acoustic noise may be sound reaching the hearing aid from a direction different from the direction of the desired source. Also, acoustic noise may be sound which has spectral components other than those of the signal from the desired source. The patent addresses, as the representative pointed out during oral proceedings, noise filtering for both these scenarios.

Claim 1 of the main request, construction

2. The *information signal* in claim 1 represents (see the description, paragraph 33) sound mainly originating from the front hemisphere, relative to the user, which he or she wants to focus on. The *noise signal* represents sound mainly originating from the back hemisphere which the user wants to be suppressed.

3. The *information signal estimate* and *noise signal estimate* limit claim 1 insofar as they designate some magnitude obtained from the information (or noise) signal, which is able to serve for calculating coefficients of a transmission function. Examples are given in paragraph 34 of the patent specification: *... the power of the front signals 410 and the power of the back signal 411 are computed resulting in an information signal estimate S and in a noise signal estimate N*. Further examples of estimates are given in paragraph 35: *absolute value*, or *squared absolute value* or *logarithm*. Paragraphs 21, 48, 50, and claim 5 add *power spectrum [sic] density*. However, claim 1 is not limited to any of these or to any particular calculation that only takes into account the information signal or the noise signal.

4. A *processed first input signal* is any signal that contains the first input signal as a component; or any magnitude that is derived from the first input signal.

Claim 1 of the main request, novelty

5. D7 discloses a method of reducing wind-induced noise in a directional microphone system. A hearing aid is mentioned in the first paragraph of page 1 as one of the applications of this noise reduction. D7, therefore, is in the same technical field and relates to the same general problem as the patent in suit. Figure 6 of D7 illustrates a block diagram for noise suppression as follows:

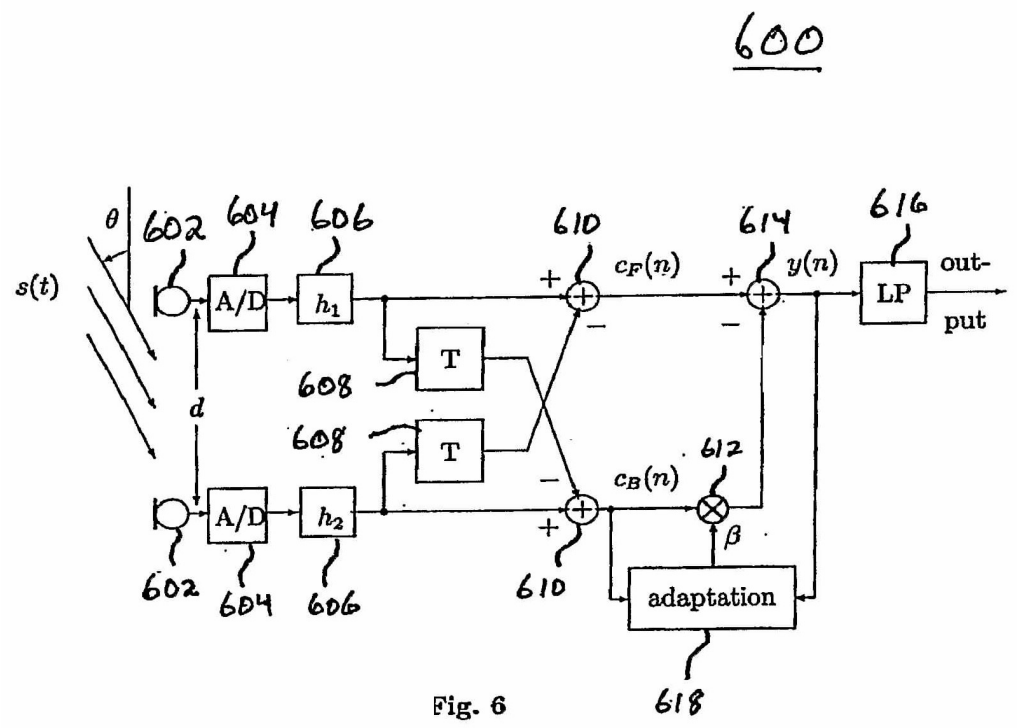

Fig. 6

6. Incident sound, *s(t)*, is captured by first and second omnidirectional microphones 602. The signals output by microphones, after A/D-conversion 604 and anti-aliasing filtering 606, are first and second input signals, in the wording of the patent. Forward and backward cardioid signals, $c_F(n)$ and $c_B(n)$, are, in the wording of the patent, an information signal and a noise signal, respectively. They both contain the first input signal; each is, therefore, also a processed first input signal, in the wording of claim 1.

7. Therefore, D1 discloses steps of capturing first and second acoustic signals by first and second acoustic-electric converters, providing first and second input signals by the first and the second acoustic-electric converters, deriving an information signal by using the first and the second input signals, and deriving a noise signal by using the first and the second input

signals.

8. Equation 13 of D7 defines the output of adder 614, $y(n)$, as a linear combination of $c_F(n)$ and $c_B(n)$. There is, therefore, a transfer function in the sense that the first input signal is modified and contributes to the output signal. The transfer function is determined by a parameter β, which is iteratively calculated as a sequence β_i with respect to a changing sound field, as explained at page 7, line 10 to page 8, line 4. Accordingly, the sequence of parameters β_i is a set of instantaneous coefficients for the transfer function, in the wording of the patent. In this respect it is stated in D7, at page 7, lines 10 to 12, that *it is of interest to allow the first-order microphone to adaptively compute a response that minimizes the output under a constraint that signals arriving from a selected range of direction are not impacted*. The skilled reader understands the purpose of this minimization process as maintaining the signal representing sound from the desired source while hiding unwanted sound as far as possible. This is the same kind of noise filtering as aimed at in the contested patent.

9. This minimization process aims at minimizing the expected value $E[y^2(t)]$, by using the instantaneous estimate $y^2(t)$ in equation 15 instead of $E[y^2(t)]$ itself (page 7, line 26, to page 8, line 1). $y^2(t)$ is given in equation 14 as a sum, including terms $c^2_F(t)$ and $c^2_B(t)$, which are estimates of the information signal $c_F(t)$ and the noise signal $c_B(t)$, in the wording of the patent. Therefore, by defining an instantaneous estimate $y^2(t)$ in terms of estimates $c^2_F(t)$ and $c^2_B(t)$ of the information signal $c_F(t)$ and the noise signal $c_B(t)$, and recursively calculating the sequence of

parameters β_i as a function of $y^2(t)$, D7 discloses that information signal estimates are derived from the information signal, that noise signal estimates are derived from the noise signal, and that both are used for generating instantaneous coefficients for the transfer function.

10. Therefore, D7 discloses, at page 7, line 10 to page 8, line 4, steps of deriving an information signal estimate from the information signal, deriving a noise signal estimate from the noise signal and generating instantaneous coefficients for the transfer function by using the information signal estimate and the noise signal estimate.

11. As set out above, $c_F(n)$ and $c_B(n)$ both contain the first input signal; each is, therefore, a processed first input signal, in the wording of claim 1. $y(n)$ is provided, after being low-pass filtered at block 616, as the audio output signal.

12. Therefore, D7 discloses further steps of applying the transfer function to the processed first input signal generating an output signal, and feeding the output signal to an electro-acoustic converter of the hearing device. In conclusion, D7 discloses a method that falls within the definition of claim 1.

13. The respondent argued that the claimed method differed from D7 in that, in the invention, information and noise signal estimates were derived from the information signal and the noise signal, respectively, and that a transfer function was applied to the (processed) first input signal.

14. The Board does not agree. The claim is not so limited that the coefficients for the transfer function need be calculated directly or exclusively from the information and noise signal estimates, or that the latter need be derived directly or exclusively from the information signal and the noise signal. The claimed method defines only a *use* of the information and noise signal estimates in determining the filter coefficients. How the estimates are used, however, is undefined.

15. The Board does not agree with the opposition division's view, in point 10 of its decision, that the method according to the patent has two separate steps whereas the method disclosed in D7 does not; the claimed method is not limited to a specific two-step calculation rule for obtaining the filter coefficients. In contrast, D7 describes a specific calculation rule, in which information and noise signal estimates $c^2_F(t)$ and $c^2_B(t)$ are used for defining the quantity $y^2(t)$ in equation 14, and in subsequent calculation steps, for obtaining the coefficients β_{i+1} in equations 15 to 18. The fact that both $c^2_F(t)$ and $c^2_B(t)$ are used, in D7, for generating the coefficients β_i, is not precluded by the appearance, in equations 17 and 18 of only a product of the quantities $y(t)$ and $c_B(t)$. The mathematical representation in equations 17 and 18 is particularly advantageous, in view of accessing such signal quantities for calculating the filter coefficients β_{i+1} which are actually available within the filter and can be directly accessed in a simple manner. It cannot be concluded, from the absence of any detail, in the patent, of how filter coefficients are calculated, that the claimed method is different from the method described in D7.

16. Further, the claimed method is not defined by specific properties of a transfer function but only by the generation of instantaneous coefficients for it. The transfer function, in the claim, thus only indicates that there is a relationship between the input signal and the output signal, irrespective of what kind the relationship is. In contrast, a concrete relationship is defined in D7 by equation 13, that falls within the claim's vague definition. It cannot be concluded that a transfer function within the meaning of the patent is different from the specific relationship in equation 13 of D7.

17. For the above reasons, the main request is not allowable (Article 54 EPC).

Auxiliary requests 1, 2, 3.1, 3.2

18. The reasons given in points 5 to 16 above apply equally to claim 1 of auxiliary request 1, which is broader than claim 1 of the main request.

19. The above reasons also apply to claim 1 of auxiliary request 2; the wording added does not further restrict the claimed method.

20. The above reasons also apply to the versions of claim 1 in auxiliary requests 3.1 and 3.2. The generation of the information and noise signals by front and back facing cardioids does not further distinguish the method from D7, since c_F and c_B are explicitly designated as forward and backward cardioid signals (see page 6, lines 22 to 25).

21. Auxiliary requests requests 1, 2, 3.1 and 3.2 are not allowable for the same reasons as the main request.

Auxiliary requests 4.1 and 4.2

22. The wording, *by using a Wiener filter using the information signal estimate (S) and the noise signal estimate (N)* in claims 1 of auxiliary requests 4.1 and 4.2, fails to comply with Article 84 EPC. This is because it has been taken out of its context in claim 6 as granted, in which the use of the information and signal estimates is defined by a specific mathematical equation. Merely defining that the Wiener filter "uses" the information and noise signal estimates renders the claim vague.

Auxiliary requests 5.1, 5.2, 6.1 and 6.2

23. In the oral proceedings, the appellant argued that, by using the terms "in particular" and "preferably" it was left open whether the features so designated were mandatory or optional. Consequently claims 1 of auxiliary requests 5.1, 5.2, 6.1 and 6.2 were rendered unclear and did not comply with Article 84 EPC.

24. This objection has merit and was not opposed by the respondent. Therefore, the Board concludes that auxiliary requests 5.1, 5.2, 6.1 and 6.2 do not comply with Article 84 EPC, and are not allowable.

Auxiliary requests 2.2 and 3.3 - admissibility

25. Auxiliary requests 2.2 and 3.3 differ from auxiliary requests 2 and 3.2 by the deletion of the claims directed to methods, so that only the claims directed to a hearing device remain.

26. The appellant argued, citing decision T 1480/16, that the deletion of the method claims did not constitute an amendment of the case, so these requests should be admitted.

27. At oral proceedings, the appellant further submitted that D7 did not disclose that the transfer function belonged to a filter unit or that the filter coefficients were determined in a calculation unit.

28. In the versions of claim 1 in auxiliary requests 2 and 3.2, the hearing aid is, essentially, defined by the filtering method. The objection of lack of novelty against the method is, therefore, equally relevant to the hearing aid, even if this was not explicitly mentioned in the statement of grounds of appeal or the Board's communication.

29. However, if the subject-matter of the claims directed to the hearing aid is patentable on grounds different from those that apply to the method claims, these separate grounds would have to be submitted, as a justification for the amendment, sufficiently in advance of oral proceedings, so that all parties can adequately prepare.

30. The submission of a set of claims directed only to a hearing aid only one week before the oral proceedings, and without supporting reasons, and the mention of

other reasons only during the oral proceedings, is not the sort of justification required by Article 13(1) RPBA.

31. T 1480/16 concerns a case in which the patentability of the apparatus and method claims had already been considered separately in the first instance proceedings and had been decided differently. These circumstances do not apply to the present case.

32. For these reasons, the Board declined to consider (did not admit) auxiliary requests 2.2 and 3.3.

Conclusion

33. As there is no request on which the patent can be maintained, the patent has to be revoked.

Order

For these reasons it is decided that:

The decision under appeal is set aside.

The patent is revoked.

H.

The Registrar: The Chairman:

H. Jenney P. Scriven

Decision electronically authenticated