Internal distribution code:

(A) [-] Publication in OJ
(B) [-] To Chairmen and Members
(C) [-] To Chairmen
(D) [X] No distribution

Datasheet for the decision of 28 November 2024

Case Number: T 0737/22 - 3.5.05

Application Number: 13154317.5

Publication Number: 2765787

IPC: H04R3/00

Language of the proceedings: EN

Title of invention:
A method of reducing un-correlated noise in an audio processing device

Patent Proprietors:
(1) Sennheiser electronic GmbH & Co. KG
(2) EPOS Group A/S
(3) Oticon A/S

Opponent:
GN Hearing A/S

Headword:
Wind-noise reduction in a hearing device/SENNHEISER

Relevant legal provisions:
EPC Art. 54, 56
RPBA 2020 Art. 12(4), 13(2)

Keyword:

Novelty - main request (no)
Admittance of claim requests filed after Art. 15(1) RPBA communication - auxiliary requests 1 to 5 and 6a to 10a (no): no exceptional circumstances justified with cogent reasons
Inventive step - auxiliary requests 6 to 8 (no): no credible technical effect over the whole scope claimed
Admittance of claim requests filed on appeal - auxiliary requests 9 and 10 (no): contrary to procedural economy

Europäisches Patentamt
European Patent Office
Office européen des brevets

Beschwerdekammern

Boards of Appeal

Chambres de recours

Boards of Appeal of the
European Patent Office
Richard-Reitzner-Allee 8
85540 Haar
GERMANY
Tel. +49 (0)89 2399-0

Case Number: T 0737/22 - 3.5.05

D E C I S I O N
of Technical Board of Appeal 3.5.05
of 28 November 2024

Appellant: (Opponent)	GN Hearing A/S Lautrupbjerg 7 2750 Ballerup (DK)
Representative:	Guardian IP Consulting I/S Diplomvej, Building 381 2800 Kgs. Lyngby (DK)
Respondent 1: (Patent Proprietor 1)	Sennheiser electronic GmbH & Co. KG Am Labor 1 30900 Wedemark (DE)
Respondent 2: (Patent Proprietor 2)	EPOS Group A/S Industriparken 27 2750 Ballerup (DK)
Respondent 3: (Patent Proprietor 3)	Oticon A/S Kongebakken 9 2765 Smørum (DK)
Representative:	Cohausz & Florack Patent- & Rechtsanwälte Partnerschaftsgesellschaft mbB Bleichstraße 14 40211 Düsseldorf (DE)
Decision under appeal:	**Interlocutory decision of the Opposition Division of the European Patent Office posted on 10 January 2022 concerning maintenance of the European Patent No. 2765787 in amended form.**

Composition of the Board:

Chair	K. Bengi-Akyürek
Members:	K. Peirs
	R. Romandini

Summary of Facts and Submissions

I. The appeal lies from the interlocutory decision of the opposition division to maintain the opposed patent in amended form in accordance with the proprietor's "auxiliary request 1" (Article 101(3)(a) EPC). The decision of the opposition division had regard to the following prior-art document:

D3: US 2012/0284023 A1.

II. Oral proceedings before the board were held on 28 November 2024. The parties' final requests were as follows:

- The appellant (opponent) requested that the decision under appeal be set aside and that the patent be revoked.

- The joint respondents (proprietors, hereinafter "the respondent") requested, as a **main request**, that the appeal be dismissed. In the alternative, the respondent requested that the patent be maintained in amended form based on the set of claims according to one of fifteen auxiliary requests, with **auxiliary requests 1 to 5** and **6a to 10a** filed with the letter of 31 October 2024, while **auxiliary requests 6 to 10** were filed with the written reply to the appellant's statement of grounds of appeal (and originally labelled as auxiliary requests 1 to 5).

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

III. Claim 1 of the **main request** reads as follows (board's feature labelling):

(a) "An audio processing device (ADP) comprising

(b) • a multitude of electric input signals (X_1, ..., X_N), where N>=2, each electric input signal being provided in a digitized (I_1, ..., I_N) form in a time-frequency representation comprising a number of frequency bands *k* and a number of time instances *m*, and

(c) • a control unit (CTR; WNR) receiving said digitized electric input signals (I_1,...,I_N) and providing a resulting signal (Y(k,m)), wherein the control unit (CTR; WNR) is configured to determine the resulting signal from said digitized electric input signals (I_1,...,I_N), or signals derived therefrom, according to a predefined scheme CHARACTERIZED IN THAT the predefined scheme comprises:

(d) • a criterion resulting in the selection of the contents of a given time-frequency unit (k, m) of *one* of the respective electric input signals (X_1, ..., X_N), or a signal derived therefrom, for being used in the corresponding time-frequency unit (*k, m*) of the resulting signal (Y(k, m)); and

(e) • selecting the time frequency units (*k, m*) having the largest signal to noise ratio (SNR)."

IV. Claim 1 of **auxiliary request 1** differs from claim 1 of the main request in that feature (d) is replaced by the following feature (board's feature labelling and underlining, the latter reflecting amendments vis-à-vis feature (d)):

(f) "• applying a criterion resulting in the selection of the contents of a given time-frequency unit (k, m) of *one* of the respective electric input signals (X_1, ..., X_N), or a signal derived therefrom, for being used in the corresponding time-frequency unit (*k, m*) of the resulting signal (Y(k, m)); and".

V. Claim 1 of **auxiliary request 2** differs from claim 1 of the main request in that feature (d) is replaced by the following feature (board's feature labelling and underlining, the latter reflecting amendments vis-à-vis feature (d)):

(g) "• a criterion resulting in the selection of the contents of a given time-frequency unit (k, m) of precisely *one* of the respective electric input signals (X_1, ..., X_N), or a signal derived therefrom, for being used in the corresponding time-frequency unit (*k, m*) of the resulting signal (Y(k, m)); and".

VI. Claim 1 of **auxiliary request 3** differs from claim 1 of the main request in that feature (e) is replaced by the following feature (board's feature labelling and underlining, the latter reflecting amendments vis-à-vis feature (e)):

(h) "• selecting the time frequency units (*k, m*) of the electric input signals having the largest signal to noise ratio (SNR)."

VII. Claim 1 of **auxiliary request 4** differs from claim 1 of the main request in that feature (d) is replaced by the following feature (board's feature labelling and underlining, the latter reflecting amendments vis-à-vis

feature (d)):

(i) "• a criterion resulting in the selection of the contents, that is magnitude and phase, of a given time-frequency unit (k, m) of *one* of the respective electric input signals (X_1, ..., X_N), or a signal derived therefrom, for being used in the corresponding time-frequency unit (*k, m*) of the resulting signal (Y(k, m)); and".

VIII. Claim 1 of **auxiliary request 5** differs from claim 1 of auxiliary request 3 in that feature (d) is replaced by the following feature (board's feature labelling and underlining, the latter reflecting amendments vis-à-vis feature (d)):

(j) "• applying a criterion resulting in the selection of the contents, that is magnitude and phase, of a given time-frequency unit (k, m) of precisely *one* of the respective electric input signals (X_1, ..., X_N), or a signal derived therefrom, for being used in the corresponding time-frequency unit (*k, m*) of the resulting signal (Y(k, m)); and".

IX. Claim 1 of **auxiliary request 6** differs from claim 1 of the main request in that feature (b) is replaced by the following feature (board's feature labelling and underlining, the latter reflecting amendments vis-à-vis feature (b)):

(k) "• a multitude of electric input signals (X_1, ..., X_N), where N>=2, each electric input signal being provided in a digitized (I_1, ..., I_N) form in a time-frequency representation comprising a number of frequency bands *k* and a number of time instances *m*, wherein at least one electric input

signal (X_i) is an omni-directional input signal and wherein at least one electric input signal (X_i, ID) is a result of a combination of two or more signals, and".

X. Claim 1 of **auxiliary request 6a** differs from claim 1 of auxiliary request 6 in that features (d) and (e) are replaced by features (j) and (h) respectively.

XI. Claim 1 of **auxiliary request 7** differs from claim 1 of the main request in that feature (b) is replaced by the following feature (board's feature labelling and underlining, the latter reflecting amendments vis-à-vis feature (b)):

(l) "• a multitude of electric input signals (X_1, ..., X_N), where N>=2, each electric input signal being provided in a digitized (I_1, ..., I_N) form in a time-frequency representation comprising a number of frequency bands *k* and a number of time instances *m*, wherein at least one electric input signal (X_i) is an omni-directional input signal and wherein at least one electric input signal (X_i, ID) is a directional signal resulting from a combination of at least two omni-directional signals, and".

XII. Claim 1 of **auxiliary request 7a** differs from claim 1 of auxiliary request 7 in that features (d) and (e) are replaced by features (j) and (h) respectively.

XIII. Claim 1 of **auxiliary request 8** differs from claim 1 of auxiliary request 7 in that feature (e) is replaced by the following feature (board's feature labelling and underlining, the latter reflecting amendments vis-à-vis

feature (e)):

(m) "• for that selection, selecting the time frequency units (*k, m*) having the largest signal to noise ratio (SNR)."

XIV. Claim 1 of **auxiliary request 8a** differs from claim 1 of auxiliary request 7 in that feature (d) is replaced by feature (j) and in that feature (e) is replaced by the following feature (board's feature labelling and underlining, the latter reflecting amendments vis-à-vis feature (e)):

(n) "• for that selection, selecting the time frequency units (*k, m*) of the electric input signals having the largest signal to noise ratio (SNR)."

XV. Claim 1 of **auxiliary request 9** differs from claim 1 of auxiliary request 8 in that it comprises, at the end, the following feature (board's feature labelling):

(o) ";
• wherein the audio processing device further comprises a wind noise detector for providing an estimate of the amount of wind noise or any other un-correlated noise present at a specific point in time, wherein a weighting factor $P_i(f)$ of the i^{th} electric input signal or a signal derived therefrom, i=1, 2, ..., N, is modified in dependence of the estimated amount of wind noise".

XVI. Claim 1 of **auxiliary request 9a** differs from claim 1 of auxiliary request 9 in that features (d) and (m) are replaced by features (j) and (n) respectively.

XVII. Claim 1 of **auxiliary request 10** differs from claim 1 of auxiliary request 9 in that it comprises, at the end, the following feature (board's feature labelling):

(p) ", wherein a weighting factor $P_i(f)$ of an electric input signal that is a directional signal is different at different frequencies".

XVIII. Claim 1 of **auxiliary request 10a** differs from claim 1 of auxiliary request 10 in that features (d) and (m) are replaced by features (j) and (n) respectively.

Reasons for the Decision

1. *Technical background*

1.1 The invention describes an audio-processing device and a method for reducing uncorrelated noise in an audio signal, particularly in applications like hearing aids and headsets. The patent focuses on minimising noise components that are not correlated across multiple input signals, such as wind noise or microphone noise.

1.2 According to the opposed patent, traditional noise-reduction techniques typically rely on identifying and cancelling out correlated noise present in multiple input signals. When noise sources are uncorrelated, these methods become less effective. The opposed patent proposes a solution based on analysing the content of individual "time-frequency units" within multiple input signals. By applying a predefined scheme and criterion, the device then selects the "best" time-frequency unit from the available input signals to eventually construct a resulting signal with reduced

uncorrelated noise.

1.3 Figures 6a and 6b (reproduced below) of the opposed patent illustrate the invention's core concept.

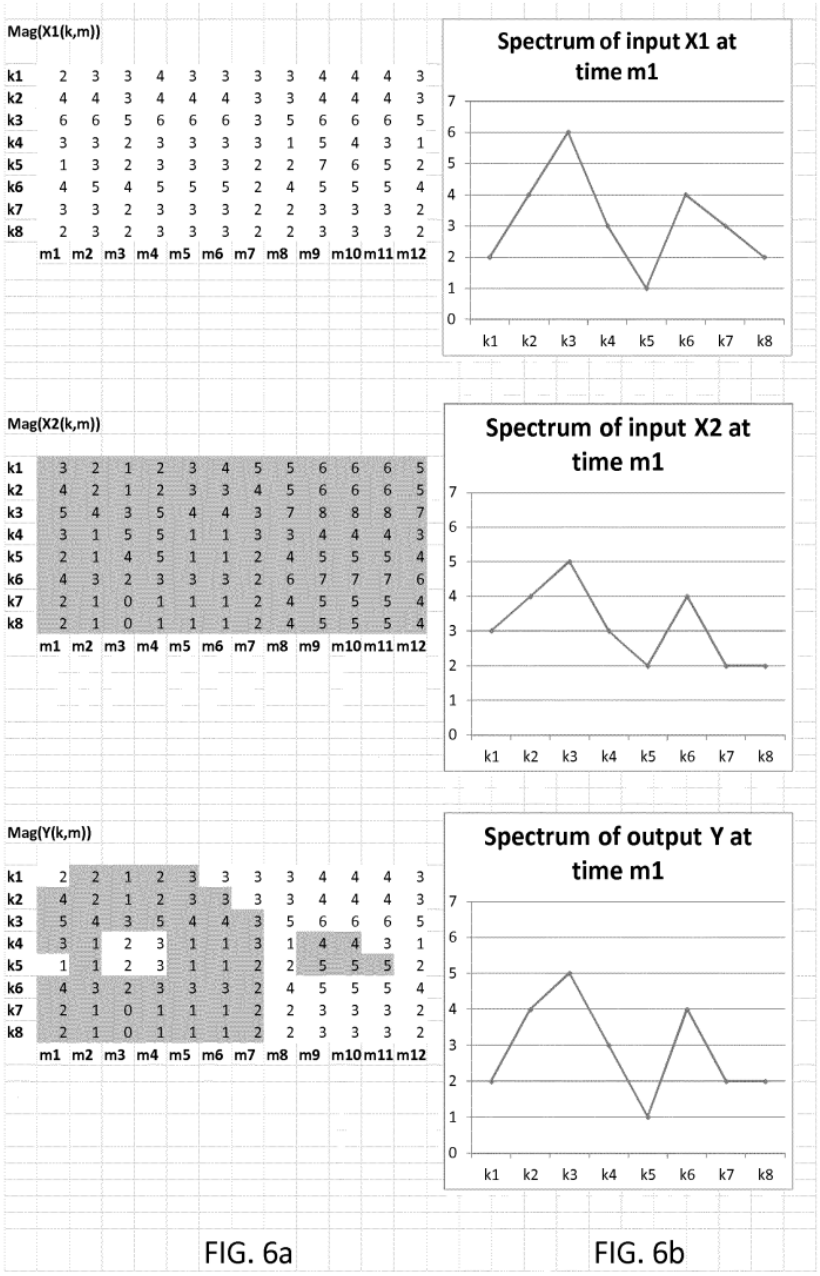

FIG. 6a FIG. 6b

Figure 6a shows how "time-frequency units" from different input signals are selected and combined like pieces of a mosaic to create an enhanced output signal.

The figure consists of three tables, each representing the magnitude of an audio signal across different frequency bands (*k1* to *k8*) and time frames (*m1* to *m12*). The top table shows the magnitude values of the first input signal (*X1*), the middle table shows the magnitude values of the second input signal (*X2*) and the bottom table shows the magnitude values of the resulting enhanced signal (*Y*). The shading in the bottom table indicates the origin of each time-frequency unit in the output signal: white shading signifies selection from *X1* while grey shading indicates selection from *X2*.

The top and middle graphs of Figure 6b show a specific example of this process, representing the frequency spectra of the two input signals *X1* and *X2* at time frame *m1*. Each input signal captures the same audio content but also contains different uncorrelated noise components. Each point on the frequency spectrum (*k1*, *k2*, *k3*, etc.) represents a time-frequency unit. The system compares the magnitude of corresponding time-frequency units in both input signals. For each unit, it selects the one with the lower magnitude, which indicates less noise content. The bottom graph of Figure 6b shows the frequency spectrum of the resulting enhanced signal (*Y*). It comprises the selected time-frequency units from the input signals, creating a composite signal with minimised uncorrelated noise.

2. *Main request: claim 1 - novelty*

2.1 The board concurs with the appellant that document **D3** discloses **features (a) to (e)**:

2.1.1 Paragraph [0011] of D3 concerns the processing of microphone signals originating from two or more microphones. Document D3 uses "short-term Fourier

transforms" of the microphone signals to perform this processing, which result in a plurality of "frequency bands" and "successive frames", as set out in paragraphs [0037], [0046] and [0047] of D3. Hence, D3 inherently involves a "time-frequency representation" and thereby discloses **features (a) and (b)**.

2.1.2 Additionally, the signal processing in the system of D3 requires the selection of that particular microphone signal which picked up a speech signal with the least noise (D3: paragraphs [0011] and [0070] to [0073]). It therefore discloses a "control unit" in accordance with **feature (c)** that determines (i.e. selects), by the application of a predefined scheme in the form of a "decision rule", the contents of the time-frequency units used in the "time-frequency representation" of the microphone signals as per **feature (d)**. Moreover, the selection of that particular microphone signal typically includes a selection of the signal's magnitude and phase.

The respondent could in this respect not convince that a "selection" in accordance with feature (d) would necessarily imply "making a choice" in the sense that only a subset of all available time-frequency units or even "a single one" is taken into account. This is simply not what claim 1 requires: it does not explicitly state that only a subset of the available time-frequency units, in particular merely a "single" one, is considered. The "selection" could well refer to the process of identifying and evaluating the contents of each time-frequency unit, irrespective of whether all or only a subset of the units are ultimately used in the resulting signal. Even with the respondent's interpretation of "one of the respective electric input signals" in feature (d) as "precisely one", the

addition of "precisely" does not inherently restrict the selection to a *single* electric input signal.

2.1.3 Furthermore, the board holds that the selection of the microphone signal with the least noise disclosed in paragraphs [0011] and [0070] to [0073] of D3 also means that, subsequent to this determination, the control unit actually selects those time-frequency units of the microphone signals with the largest signal-to-noise ratio in accordance with **feature (e)**. The respondent understood the "selecting" step according to feature (e) to imply that each of the time-frequency units must be looked at, but that only that particular time-frequency unit which has the largest SNR is then chosen to contribute to the "resulting signal". It emphasised, with reference to paragraphs [0043], [0069], [0071] and [0072] of D3, that document D3 relied on one of the two signals having been picked up by the microphones being the "better" one in terms of speech-to-noise ratio. It argued that D3 was bound to remain with its particular choice of microphone signal for a certain duration and for all frequencies. This was however in contrast to feature (e), which in fact allowed, in the respondent's view, for a selection on a finer granularity, i.e. at the level of individual time-frequency units.

However, in the board's view, claim 1 does not preclude such a coarse-grained microphone selection. In particular, claim 1 does not specify the time scale or the frequency based on which the "selecting" step as per feature (e) actually takes place. In fact, this selecting step needs to occur only once during the execution of the predefined scheme. This applies irrespective of any time scales which may be apparent from paragraph [0053] of the opposed patent and

regardless of paragraph [0022] suggesting that it was the very aim of the opposed patent to remove the need to prefer one source over another.

2.2 The subject-matter of claim 1 of the main request is therefore not novel (Article 54 EPC).

3. *Auxiliary requests 1 to 5, 6a, 7a, 8a, 9a and 10a: admittance*

3.1 The respondent filed **auxiliary requests 1 to 5, 6a, 7a, 8a, 9a and 10a** after notification of the board's communication under Article 15(1) RPBA. The respondent asserted that the filing was justified due to the board's introduction of claim-construction considerations that had not been previously raised, including the contestation of aspects upon which the parties had a common understanding. The respondent referred especially to the board's doubt regarding

- which signal the "time frequency units" mentioned in feature (e) actually belonged to,

- whether "the criterion according to feature (d) needed to be actually applied [by the control unit in accordance with feature (c)]"

and

- whether the "selecting" step as per feature (e) related to the "selection" in accordance with feature (d).

3.2 The board considers claim interpretation to be a question of law. Accordingly, the parties must take into account the possibility that the board may adopt

its own claim construction, which could certainly depart from the interpretation adopted in the decision under appeal or by the parties. This is particularly relevant when the patent proprietor enters the appeal proceedings with an overly broad claim, as is the case here. Therefore, the board does not consider the "new" claim construction performed in its communication under Article 15(1) RPBA to constitute *per se* an "exceptional circumstance" within the meaning of Article 13 RPBA.

3.3 The board therefore decided not to admit auxiliary requests 1 to 5, 6a, 7a, 8a, 9a and 10a into the appeal proceedings (Article 13(2) RPBA).

4. *Auxiliary requests 6 to 8: claim 1 - inventive step*

The board holds that **auxiliary requests 6 to 8**, referred to as auxiliary requests 3, 5 and 6 in point 6 of the "Summary of Facts and Submissions" of the appealed decision to "meet the requirements of the EPO's data processing systems", cannot form the basis for maintaining the patent in amended form. The reasons for this are as follows:

4.1 Concerning **feature (m)**, it is immediately apparent from the first paragraph of point 2.1.3 above that this feature is also directly and unambiguously disclosed in document D3. It can therefore not render the claimed subject-matter novel over D3 (Article 54 EPC).

4.2 Conversely, **features (k) and (l)** are not disclosed in document D3. This is so, however, only on account of the "omni-directional input signal" and the "directional signal resulting from a combination of at least two omni-directional signals". The appellant correctly observed in this regard that *any* electric

input signal could be considered to be the result of the combination of two or more signals. For the particular microphone signals mentioned in point 2.1.1 above, this could be a speech and noise signal.

4.3 The board can nevertheless not see how features (k) and (l) could contribute to inventive step. In relation to the technical effect that these features would bring about, the respondent argued, with reference to paragraph [0033] of the opposed patent, the potential benefits of using an "omnidirectional signal", especially in the presence of uncorrelated noise. It suggested that beamforming, which was used to create the "directional signal" in accordance with feature (l), might amplify undesired effects when applied to uncorrelated signals. This further assisted the technical effect underlying features (d) and (e) which already provided, in the respondent's view, for an improved method for reducing uncorrelated noise in the resulting signal. The respondent formulated the objective technical problem associated with features (k) and (l) accordingly as "to further improve the preventing and minimisation of noise in the output signal".

The board acknowledges that the directionality of a microphone indeed influences the sound it captures. However, the resulting *signal* does not inherently reveal this directionality: whether an input signal is *omnidirectional* or *directional* is not always determined solely by the audio-processing device's overall structure. Rather, the location of the sound source relative to the microphone significantly affects the recorded signal, irrespective of the microphone's directionality. In addition, reflections, reverberation and other acoustic characteristics of the environment

likewise influence the signal, thereby obfuscating the microphone's directional pattern. This makes it difficult for the board to identify any technical effect which the "omnidirectional and directional signals" in accordance with features (k) and (l) would credibly yield over the whole scope claimed. Focusing especially on the respondent's objective technical problem, the board notes that claim 1 of auxiliary requests 6 and 7 is in fact silent about any "presence of uncorrelated noise". This problem is thus not credibly solved over the whole scope claimed.

4.4 Consequently, auxiliary requests 6 to 8 are not allowable under Article 56 EPC.

5. *Auxiliary requests 9 and 10: admittance*

5.1 The appealed decision was not based on **auxiliary requests 9 and 10**. These auxiliary requests were filed as "auxiliary requests 4 and 5" for the first time with the written reply to the statement of grounds of appeal.

5.2 The respondent did not provide substantive arguments why these auxiliary requests would address the primary reasons for the higher-ranking claim requests' rejection, i.e. lack of novelty and inventive step over D3. During the oral proceedings before the board, no such arguments were presented either. From pages 27 to 30 of the written reply to the statement of grounds of appeal, it is apparent that the respondent filed those auxiliary requests in reaction to prior-art documents (labelled **D4** and **D7** in the statement of grounds of appeal) that were not taken into account in the board's assessment of the main request. Moreover, in its response to the board's communication under

Article 15(1) RPBA, the respondent focused merely on document D4 regarding these requests. The admittance of auxiliary requests 9 and 10 into the proceedings can therefore only be contrary to procedural economy (cf. Article 12(4), fifth sentence, RPBA).

5.3 Hence, the board decided not to admit these auxiliary requests into the proceedings (Article 12(4) RPBA).

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The patent is revoked.

The Registrar: The Chair:

B. Brückner K. Bengi-Akyürek

Decision electronically authenticated