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**Datasheet for the decision
of 19 November 2024**

Case Number: T 0687/22 - 3.5.05

Application Number: 16206073.5

Publication Number: 3340653

IPC: H04R25/00

Language of the proceedings: EN

Title of invention:
Active occlusion cancellation

Patent Proprietor:
GN Hearing A/S

Opponent:
Oticon A/S

Headword:
Active occlusion cancellation/GN HEARING

Relevant legal provision:
EPC Art. 56

Keywords:
Inventive step - all claim requests (no): no objective
technical problem credibly solved over the whole scope claimed

Decisions cited:

G 0001/19, G 0002/21



Beschwerdekammern

Boards of Appeal

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Case Number: T 0687/22 - 3.5.05

D E C I S I O N
of Technical Board of Appeal 3.5.05
of 19 November 2024

Appellant: Oticon A/S
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Decision under appeal: **Interlocutory decision of the Opposition
Division of the European Patent Office posted on
4 January 2022 concerning maintenance of the
European Patent No. 3340653 in amended form.**

Composition of the Board:

Chair K. Bengi-Akyürek
Members: K. Peirs
F. Bostedt

Summary of Facts and Submissions

I. The appeal lies from the decision of the opposition division to maintain the opposed patent in amended form based on the patent proprietor's main request (Article 101(3)(a) EPC). The opposition division deemed in particular that the main request complied with Articles 54, 56, 83, 84 and 123(2) EPC. The appealed decision had regard to the following prior-art document:

D2: WO 2014/075195 A1.

II. Oral proceedings before the board were held on 19 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 respondent (patent proprietor) requested that the appeal be dismissed (**main request**) or, in the alternative, that the patent be maintained in amended form on the basis of one of three auxiliary requests (**first to third auxiliary requests**).

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) "A hearing device comprising

- (b) a microphone (12) for provision of an audio signal in response to ambient sound received at the microphone (12),
- (c) a signal processor (16) that is adapted to process the audio signal in accordance with a predetermined signal processing algorithm to generate a processed audio signal (20),
- (d) a first subtractor (24) having a first input (22) that is connected for reception of the processed audio signal (20) and a second input (26) and an output for provision of a first combined audio signal (40) that is equal to the signal received at the first input (22) minus the signal received at the second input (26) of the first subtractor (24),
- (e) a receiver (44) connected for reception of the first combined audio signal (40) for converting the combined audio signal (40) into an output sound signal for emission towards an eardrum of a user,
- (f) a housing that is adapted to be positioned in an ear canal of a user of the hearing device and accommodating an ear canal microphone (28) that is positioned in the housing for provision of an ear canal audio signal (30) in response to an ear canal sound pressure, when the housing is positioned in its intended operating position in the ear canal,
- (g) a second subtractor (50) having a first input that is connected for reception of the ear canal audio signal (30) and a second input and an output for provision of a second combined audio signal that is equal to the difference between the signal (30) received at the first input and the signal received at the second input of the second subtractor (50),
- (h) a first filter (36) having an input that is connected for reception of the second combined audio signal for provision of a filtered second

combined audio signal (38) to the second input (26) of the first subtractor (24), and

- (i) a second and adaptive filter (48) having an input that is connected for reception of the processed audio signal (20) generated by the signal processor (16) and an output for provision of a filtered processed audio signal to the second input of the second subtractor (50) characterized in that
- (j) the signal processor (16) and the second and adaptive filter (48) is adapted for operation in blocks of samples,
- (k) the first filter (36) is adapted to perform filtering sequentially sample by sample, and
- (l) the second and adaptive filter (48) has filter coefficients which are adapted so that the difference between the ear canal audio signal (30) and the output of the second and adaptive filter (48) is minimized."

IV. Claim 1 of the **first auxiliary request** differs from claim 1 of the main request in that the word "and" is removed at the end of feature (h) and in that features (f) and (i) are replaced by the following features respectively (board's feature labelling and underlining, the latter reflecting amendments vis-à-vis features (f) and (i)):

- (m) "a housing that is adapted to be positioned in an ear canal of a user of the hearing device and accommodating an ear canal microphone (28) that is positioned in the housing for provision of an ear canal audio signal (30) in response to an ear canal sound pressure that is a superposition of body conducted sound (46, t) and receiver emitted sound (r), when the housing is positioned in its

intended operating position in the ear canal,"

(n) "a second and adaptive filter (48) having an input that is connected for reception of the processed audio signal (20) generated by the signal processor (16) and an output for provision of a filtered processed audio signal to the second input of the second subtractor (50), and an active occlusion cancellation circuit comprising the first subtractor (24), the second subtractor (50), the first filter (36), the second and adaptive filter (48) and the ear canal microphone (28), characterized in that".

V. Claim 1 of the **second auxiliary request** differs from claim 1 of the first auxiliary request in that feature (h), with the word "and" removed at the end as set out in point IV above, is replaced by the following feature (board's feature labelling and underlining, the latter reflecting amendments vis-à-vis feature (h)):

(o) "a first filter (36) having an input that is connected for reception of the second combined audio signal for provision of a filtered second combined audio signal (38) to the second input (26) of the first subtractor (24) wherein the filtered second combined audio signal (38) is suitable for suppression of an occlusion effect,".

VI. Claim 1 of the **third auxiliary request** differs from claim 1 of the second auxiliary request in that the phrase "characterized in that" is replaced by the wording "wherein:" and in that it comprises, at the end, the following feature (board's feature labelling):

", characterized in that

- (p) the hearing device further comprises:
- a third subtractor inserted between the first subtractor (24) and the receiver (44) and having a first input that is connected for reception of the first combined audio signal (40) and a second input and an output for provision of a third combined audio signal that is equal to the signal received at the first input minus the signal received at the second input of the third subtractor,
 - a fourth subtractor having a first input that is connected for reception of the ear canal audio signal (30) and a second input and an output for provision of a fourth combined audio signal that is equal to the difference between the signal received at the first input and the signal received at the second input of the fourth subtractor,
 - a third filter having a transfer function B_2 and an input that is connected for reception of the fourth combined audio signal for provision of a filtered fourth combined audio signal to the second input of the third subtractor, and
 - a fourth filter having a transfer function A_2 and an input that is connected for reception of the third combined audio signal and an output for provision of a third combined audio signal to the second input of the fourth subtractor".

Reasons for the Decision

1. *Technical background*

- 1.1 The opposed patent addresses the problem of the occlusion effect in hearing devices. The occlusion effect is the unnatural perception of a user's own voice when a hearing device is inserted into the ear

2. *Main request: claim 1 - inventive step*

2.1 The board concurs with the parties that document **D2** is an appropriate starting point for assessing inventive step.

2.2 The appellant opined that D2 did not disclose features "F1.3.1" and "F1.9" as labelled in the appealed decision, i.e. **features (d) and (j)** in the board's labelling. The respondent acknowledged that these were the distinguishing features of claim 1 with respect to D2. The board notes in particular that the "signal processor" identified by the appellant (i.e. the combination of elements G, G_v and summer 53 as shown in Figure 4 of D2) is not at the same place in the processing chain according to claim 1 because this signal processor receives an input from the first subtractor, whereas, according to claim 1, the first subtractor 51 mentioned in feature (d) receives an input from the "signal processor" according to feature (c). In the board's view, this difference amounts to the signal paths labelled "l)" to "o)" by the respondent (cf. page 19 of its written reply to the statement of grounds of appeal).

2.3 The board cannot identify any technical effect that can be credibly associated with features (d) and (j) over the whole scope claimed. In particular, the board holds that the objective technical problems considered in the appealed decision and by the parties in appeal proceedings cannot be derived from technical effects directly and causally related to the technical features of the claimed invention:

2.3.1 In Reasons 14.2.4 of the appealed decision, the opposition division accepted the "technical problem

posed by the opponent" but, other than referring to "the above objective technical problem (OTP2)" in Reasons 14.2.2 of the appealed decision, did actually not define this "technical problem". The board assumes this "objective technical problem" to be the one formulated by the opponent as recited in Reasons 14.1.4 of the appealed decision, in the context of the features "F1.3.1", "F1.9" and "F1.10" following the labelling adopted in the appealed decision, namely "to improve the energy efficiency and signal processing of the fearing[*sic*] device of D2". This is in line with the "objective technical problem (OTP2)" mentioned on page 21 of the statement of grounds of appeal, which reads "improving the energy efficiency of the signal processing of the hearing aid".

The board is not convinced that features (d) and (j) could bring about, in a credible way, any improvement of the energy efficiency of the hearing device's signal processing. Quite the opposite, the block-wise processing mentioned in feature (j) necessitates the presence of one or more additional process steps or components, such as "un-buffer" circuits 18 and 52 shown in Figure 3 of the opposed patent (cf. point 1 above), to convert the blocks of samples as per feature (j) into a sequence of individual samples for use in feature (k). These additional process steps or components may accommodate the different timescales at which different parts of the claimed "hearing device" operate, but do so at the cost of a small increase in energy consumption. The board fails to see how this small *increase* is compensated for by other features of the claimed "hearing device".

2.3.2 The board is also not satisfied that any of the technical effects invoked on page 24 of the written

reply to the statement of grounds of appeal, namely that

- "the hearing device circuit can be made more stable",
- the second and adaptive filter has "an improved efficiency" or
- the "active occlusion cancelling" would be enabled,

is credibly achieved by features (d) and (j) over the whole scope claimed. In particular, these features do not necessarily contribute to the claimed hearing device's "circuit stability" or "efficiency" (whatever the latter term's meaning). Moreover, claim 1 is silent as to any "occlusion".

2.3.3 The respondent highlighted the "feedback loop" within the hearing-device circuit and argued that relocating the "second and adaptive filter" *outside* this feedback loop, as per the claimed invention, simplified control. This simplification arose from the second and adaptive filter's transfer function no longer influencing the denominator in Equation (5) mentioned in the opposed patent, thus preventing instability. It thus resulted in an enhanced flexibility. The respondent also argued that, according to claim 1, the "second and adaptive filter" should minimise the difference irrespective of any AOC. It concluded therefore that the following technical effect was credibly achieved: "regardless of its objective, the hearing device according to claim 1 of the main request provides for more flexibility".

The board first concurs with the respondent that the "ear-canal microphone" according to feature (f), the "second subtractor" as per feature (g), the "first filter" in accordance with feature (h) together with

the "first subtractor" mentioned in feature (d) can be regarded to constitute a "feedback loop" (cf. point 1.3 above). However, claim 1 does not require the "second and adaptive filter" according to feature (i) to be necessarily *outside* this feedback loop. This is because the second and adaptive filter is not limited to a *single* input. An adaptive filter can accommodate *multiple* input signals, combined in various ways before signal processing. In the claimed "hearing device", additional inputs could provide information on user movements or the surrounding acoustic environment. For instance, if the hearing device is assumed to perform AOC, data on chewing or yawning could enhance accuracy, as these actions impact the occlusion effect by altering the ear canal's shape and volume. Given the feedback loop's sensitivity to residual errors in the AOC process and given that user movements influence these errors, analysing the feedback signal (particularly from the ear-canal microphone) could reveal movement-related patterns. As a result, and contrary to the respondent's dismissal of this as a technically non-viable interpretation without providing any further explanation, it would indeed make technical sense to the skilled reader that the "second and adaptive filter" as per feature (i) could have additional inputs, e.g. from *inside* the feedback loop. Therefore, the board concurs with the appellant that the wording of claim 1 does not guarantee that the second and adaptive filter is *outside* the feedback loop. Correspondingly, the respondent's argument that the features of claim 1 would bring about an "increased flexibility" must fail.

2.3.4 In a further refinement, the respondent formulated the objective technical problem as "providing for an alternative modification of the resulting signal based

on the signal from the ear-canal microphone".

Regardless of the extreme breadth of that problem which alone happens to render it invalid, a modification introduced solely for the sake of differentiation from the prior art simply means that, at most, the novelty requirement of Article 54 EPC is met. This does however not guarantee compliance with Article 56 EPC. To be considered "not obvious to a person skilled in the art", such a modification must, as a prerequisite, yield a discernible technical effect that credibly solves a technical problem. This is at least the case for electronic circuits, as in the case in hand, where a change in the processing chain might simply alter the way in which information is physically manipulated, without necessarily affecting a tangible, technical outcome. Without such a discernible technical effect, it is thus not possible for the board to formulate an objective technical problem that is credibly solved. In other words, when following the problem-solution approach to assess inventive step in the case in hand, a technical effect associated with the distinguishing feature(s) of the invention must be identified on the basis of the claim wording to establish a credible objective technical problem (see e.g. **G 1/19**, Reasons 82 and 124 as well as **G 2/21**, Reasons 25). If no such technical effect can be identified, there is not necessarily any technical problem to be solved (see e.g. **G 1/19**, Reasons 49).

2.3.5 The respondent further suggested that, within the "alternative modification" considered in its objective technical problem, technical modifications like adding an echo based on user preferences were possible. The board notes however that such modifications are not addressed in the respondent's problem formulation and

lack a direct, causal link with the claimed features (a) to (l).

2.4 Consequently, features (d) and (j) cannot contribute to inventive step. The main request is therefore not allowable under Article 56 EPC.

3. *First to third auxiliary requests: claim 1 - inventive step*

The amendments underlying the **first to third auxiliary requests** do not provide a remedy for the deficiency mentioned in point 2 above as regards the main request, for the reasons set out below.

3.1 As to claim 1 of the **first and second auxiliary requests**, the respondent formulated the objective technical problem as "how to provide for a hearing device that provides AOC or at least suppression (without the need for additional gain adjustments to avoid instabilities)". The part between brackets in this objective technical problem was intended for the case where the board regarded document D2 to rely on an AOC circuit.

3.1.1 While the board does consider the circuitry shown in Figure 4 of D2 to be part of a device for occlusion-effect minimisation (cf. D2: page 1, first paragraph), it notes that, concerning **feature (m)**, the "ear-canal microphone" mentioned in feature (f), i.e. microphone 11 in Figure 4 of D2, will typically pick up sounds from the receiver in accordance with feature (e), i.e. receiver 5 in Figure 4 of D2, as well as sounds that are conducted through the body of the user (e.g. from the vocal cords to the auditory system). The board can therefore not see how

feature (m) could possibly contribute to inventive step.

3.1.2 Regarding **feature (n)**, assuming that it is a distinguishing feature over D2 for the sake of argument, the board shares the appellant's doubt regarding the technical effect caused by this feature. While feature (n) designates the combination of features (d) and (g) to (l) as part of an "active occlusion-cancellation circuit", their precise role within this circuit remains unspecified in claim 1. The appellant rightfully questioned whether this combination is limited to a specific type of occlusion cancellation capable of removing bone-conducted sound. The board observes in this regard that the minimisation in relation to the "second and adaptive filter" in accordance with feature (l) does not inherently necessitate an AOC circuit. Labelling a circuit within the hearing device as an "active occlusion-cancellation circuit" does not alter this fact either. Moreover, the board notes that the functionality of features (d) and (g) to (l) within the "active occlusion-cancellation circuit" as mentioned in feature (n) could be to merely *measure* if the housing becomes clogged, for instance due to cerumen build-up. The opposed patent itself addresses "wax build-up" in paragraphs [0034] and [0105], supporting a construction where a part of the circuit monitors the need for AOC. If the need arises, other components, which are not mentioned in claim 1 but constitute further parts of the AOC circuit according to feature (n), could then provide for the actual cancellation signal.

3.1.3 Regarding **feature (o)**, the board concurs with the appellant's view that the suitability of a signal for occlusion-effect suppression is not solely determined

by the hearing device's component structure. Instead, a signal generated by the device's circuitry can well be suitable for suppression simply due to the inherent properties of the signal received by the microphone in accordance with feature (b) and/or the one mentioned in feature (f). These inherent properties may arise from prevailing circumstances beyond the influence of the claimed "hearing device".

The respondent also argued that the objective technical problem could overall be formulated as "to provide an alternative for the system disclosed in D2" but, for the reasons set out in point 2.3.4 above, the board does not consider the mere provision of an alternative measure without any underlying technical effect to enable the formulation of an objective technical problem that is credibly solved. This means that features (m) to (o) do not necessarily provide "AOC or at least suppression", regardless of any "need for additional gain adjustments to avoid instabilities", contrary to what the respondent considered.

3.2 As to claim 1 of the **third auxiliary request**, the respondent formulated the objective technical problem as how "to add flexibility in tuning the AOC circuit". It referred to paragraphs [0086] to [0089] of the opposed patent in this context.

3.2.1 The board acknowledges that **feature (p)** adds further processing components to the claimed "hearing device", but it is not apparent to the board which technical effect these further processing components would credibly achieve. In particular, simply adding two subtractors and two arbitrary filters, without further requirements, might not necessarily impart any flexibility in tuning the AOC circuit. Quite the

opposite: they may introduce instability in the resulting circuit, making it more difficult to tune. The board acknowledges that paragraph [0089] of the opposed patent states that the "active occlusion cancellation circuits of Figs, [sic] 4(a) and 4(b) offer more flexibility than the active occlusion cancellation circuits of Figs, [sic] 2 and 3, respectively". While paragraph [0088] of the opposed patent attempts to elucidate this aspect by highlighting the "ability to tune both the (non-recursive) head and the (recursive) tail of the impulse response independently", the board has reservations as to the feasibility of achieving this independent tuning ability with arbitrary "filters" such as those mentioned in features (h) and (p). In particular, the patent description implicitly assumes in paragraph [0088] that

- the filter "B1", i.e. the "first filter" in accordance with feature (h),

and

- the filter "B2", i.e. the "third filter" in accordance with feature (p),

can be categorised as "recursive" and "non-recursive" filters respectively. This implies that they cannot be *arbitrary* filters but should have *specific* characteristics as to their transfer functions to enable this independent tuning. Moreover, paragraph [0088] of the opposed patent explicitly mentions "under optimal conditions (R=A)". This in turn suggests that the filters are designed to operate in a specific configuration where the transfer function (A) of the "second and adaptive filter" in accordance with feature (i) and/or of the "fourth filter" according to

feature (p) closely matches the transfer function (R) of the signal path from the receiver to the ear-canal microphone.

3.2.2 Furthermore, the analogy to "general direct form IIR filters" apparent in paragraph [0088] of the opposed patent reinforces the assumption that the filters "B1" and "B2" are actually not arbitrary. Rather, these filters are likely designed to have characteristics similar to the poles and zeros of an IIR filter, thereby enabling the independent tuning of the head and tail of the impulse response. Therefore, it appears that the "additional flexibility" is, at most, only achieved within the *specific* setup of Figures 4(a) and 4(b) of the opposed patent. The board, however, is not convinced that this can also be achieved with the *general* filters according to claim 1 of the third auxiliary request.

3.3 In conclusion, the first to third auxiliary requests are not allowable under Article 56 EPC either.

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