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Datasheet for the decision of 16 March 2026

Case Number: T 0572/24 - 3.5.05

Application Number: 18701656.3

Publication Number: 3586523

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Language of the proceedings: EN

Title of invention:
Off-head detection of in-ear headset

Patent Proprietor:
Bose Corporation

Opponent:
K/S HIMPP

Headword:
Off-head state detection in an in-ear headset/BOSE

Relevant legal provisions:
EPC Art. 83, 123(2)
RPBA 2020 Art. 12(4)

Keywords:

Sufficiency of disclosure - auxiliary requests 1 to 4 (no): claimed invention, construed by taking all technically sensible interpretations into account, not sufficiently disclosed over the whole scope claimed
Admittance of claim requests filed on appeal - auxiliary requests 5 to 7 (no): not all issues that led to the opposition division's decision are addressed
Added subject-matter - auxiliary request 8 (yes): unallowable intermediate generalisation

Decisions cited:

T 0149/21, T 0867/21, T 2027/23

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Case Number: T 0572/24 - 3.5.05

D E C I S I O N
of Technical Board of Appeal 3.5.05
of 16 March 2026

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Decision under appeal:	**Decision of the Opposition Division of the European Patent Office posted/electronically transmitted on 19 February 2024 revoking European patent No. 3586523 pursuant to Article 101(3)(b) EPC.**

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 revoke the present European patent (Article 101(2) and 101(3)(b) EPC).

The opposition division deemed the ground for opposition under Article 100(c) in combination with Article 123(2) EPC to prejudice the maintenance of the patent as granted (main request). Auxiliary requests 1, 1c, 1d and 2 to 5 were considered to be not allowable under Article 83 or 123(2) EPC. Auxiliary requests 1a, 1b and 1e were not admitted into the proceedings before the opposition division.

II. Oral proceedings before the board were held on 16 March 2026.

The appellant ("proprietor" henceforth) requested that the decision under appeal be set aside and that the patent be maintained in amended form on the basis of one of eight auxiliary requests (i.e. auxiliary requests 1 to 8), where

- **auxiliary requests 1 to 4** were re-filed with the statement of grounds of appeal and correspond, respectively, to auxiliary requests 1 to 4 underlying the appealed decision;

- **auxiliary requests 5 to 8** were filed for the first time with the statement of grounds of appeal.

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

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

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

(a) "An off-head detection system (114) for an in-ear headset (10) comprising an acoustic driver (106), the off-head detection system comprising:
(b) an input device that receives an audio signal, a feed-forward microphone signal, and a driver output signal provided to the acoustic driver;
(c) an expected-output computation circuit that predicts a value of the driver output signal provided to the acoustic driver based on a combination of the audio signal, the feed-forward microphone signal, and off-head data; and
(d) a comparison circuit that compares the received driver output signal and the predicted value of the driver output signal to determine an off-head state of the in-ear headset."

IV. Claim 1 of **auxiliary request 2** differs from claim 1 of auxiliary request 1 in that features (c) and (d) have been replaced by the following features respectively (board's feature labelling and underlining, the latter reflecting amendments vis-à-vis features (c) and (d)):

(e) "an expected-output computation circuit that predicts a value of the driver output signal provided to the acoustic driver based on a combination of the audio signal, the feed-forward microphone signal, and off-head data, <u>but without receiving a feedback microphone signal</u>; and"

(f) "a comparison circuit that compares the received driver output signal and the predicted value of the driver output signal to determine an off-head state of the in-ear headset,
wherein the input device includes an active noise reduction (ANR) circuit that processes the feedback microphone signal."

V. Claim 1 of **auxiliary request 3** differs from claim 1 of auxiliary request 2 in that features (b), (e) and (f) have been replaced by the following features, respectively (board's feature labelling and mark-up, the latter reflecting amendments vis-à-vis features (b), (e) and (f)):

(g) "an input device comprising an expected-output computation circuit (221) and a comparison circuit (223), wherein the input device ~~that~~ receives an audio signal, a feed-forward microphone signal, ~~and~~ a driver output signal provided to the acoustic driver, and a feedback microphone signal;"

(h) "wherein the ~~an~~ expected-output computation circuit ~~that~~ predicts a value of the driver output signal provided to the acoustic driver based on a combination of the audio signal, the feed-forward microphone signal, and off-head data, but without receiving the ~~a~~ feedback microphone signal; and"

(i) "wherein the ~~a~~ comparison circuit ~~that~~ compares the received driver output signal and the predicted value of the driver output signal to determine an off-head state of the in-ear headset,
wherein the input device includes an active noise reduction (ANR) circuit that processes the feedback

microphone signal."

VI. Claim 1 of **auxiliary request 4** differs from claim 1 of auxiliary request 2 in that features (b), (e) and (f) have been replaced by the following features respectively (board's feature labelling and mark-up, the latter reflecting amendments vis-à-vis features (b), (e) and (f)):

(j) "an input device that receives an audio signal, a feed-forward microphone signal, and a driver output signal provided to the acoustic driver, wherein the input device includes an active noise reduction (ANR) circuit that processes a feedback microphone signal and provides a feedback active noise reduction;"

(k) "an expected-output computation circuit that predicts a value of the driver output signal provided to the acoustic driver based on a combination of the audio signal, the feed-forward microphone signal, and off-head data, but without receiving the ~~a~~ feedback microphone signal; and"

(l) "a comparison circuit that compares the received driver output signal and the predicted value of the driver output signal to determine an off-head state of the in-ear headset,
wherein the off-head detection system (114) calculates a discrete Fourier transform (DFT) for each of the driver output signal, feed-forward microphone signal, and audio signal at select frequencies where a feedback ANR loop is active
~~wherein the input device includes an active noise reduction (ANR) circuit that processes the feedback~~

~~microphone signal~~."

VII. Claim 1 of **auxiliary request 5** differs from claim 1 of auxiliary request 1 in that it comprises, at the end, the following feature (board's feature labelling and underlining, the latter reflecting amendments vis-à-vis claim 1 of auxiliary request 5 underlying the appealed decision, see point 4.4 below):

(m) ", wherein the off-head data comprises values in the off-head state corresponding to i) a transfer function (N_{so}) between an external sound received at a feedback microphone (104) of the in-ear headset (10) as differing from that received at a feed-forward microphone (102) of the in-ear headset (10) and ii) a transfer function (G_{sd}) that is a physical transfer function from a voltage applied to the acoustic driver (106) to a voltage measured at the feedback microphone (104), wherein the values of the transfer functions in the off-head state are stored in an off-head model (222)".

VIII. Claim 1 of **auxiliary request 6** differs from claim 1 of auxiliary request 5 in that it now comprises, between features (b) and (c), the following feature (board's feature labelling):

(n) "wherein the driver output signal provided to the acoustic driver is a combination of i) the audio signal passed through a first digital filter (202) to equalize the audio signal, the first digital filter being represented by a known transfer function (K_{eq}), ii) the feed-forward microphone signal passed through a second digital filter (204) to provide a feed-forward active noise reduction,

ANR, the second digital filter being represented by a known transfer function (K_{ff}) for processing and filtering sound measured at a feed-forward microphone (102), and iii) a feedback microphone signal passed through a third digital filter (206) to provide a feedback ANR, the third digital filter being represented by a known transfer function (K_{fb}) for processing and filtering sound measured at a feedback microphone (104);".

IX. Claim 1 of **auxiliary request 7** differs from claim 1 of auxiliary request 6 in that features (c) and (m) have been replaced, respectively, by the following features (board's feature labelling and underlining, the latter reflecting amendments vis-à-vis features (c) and (m) above, which effectively implement the amendments underlying features (e) and (f)):

(o) "an expected-output computation circuit that predicts a value of the driver output signal provided to the acoustic driver based on a combination of the audio signal, the feed-forward microphone signal, and off-head data, <u>but without receiving the feedback microphone signal</u>; and"

(p) ", wherein the off-head data comprises values in the off-head state corresponding to i) a transfer function (N_{so}) between an external sound received at a feedback microphone (104) of the in-ear headset (10) as differing from that received at a feed-forward microphone (102) of the in-ear headset (10) and ii) a transfer function (G_{sd}) that is a physical transfer function from a voltage applied to the acoustic driver (106) to a voltage measured at the feedback microphone (104), wherein the values of the transfer functions in the

off-head state are stored in an off-head model (222), wherein the input device includes an active noise reduction (ANR) circuit that processes the feedback microphone signal".

X. Claim 1 of **auxiliary request 8** differs from claim 1 of auxiliary request 6 in that it further comprises, at the end, the following feature (board's feature labelling):

(q) "wherein the predicted value of the driver output signal provided to the acoustic driver in the off-head state is calculated as:

$d=o\ (N_{so}K_{fb}+K_{ff})/(1-G_{sd}\ K_{fb})+a\ K_{eq}/(1-G_{sd}K_{fb})$".

Reasons for the Decision

1. *Opposed patent - technical background*

1.1 The opposed patent relates to an "in-ear headset", in particular to a system that detects whether the in-ear headset is presently not worn (i.e. detecting an "off-head" state as it is phrased in the patent). As explained in the patent description, an in-ear headset can suffer from feedback oscillation between its acoustic driver and its external microphone when the in-ear headset is removed or improperly fitted, which in turn creates an acoustic leak.

1.2 To address this problem, the patent proposes a system that automatically detects an off-head state to enable a corrective action, such as reducing the system gain. The solution underlying the opposed patent involves predicting an expected "driver output signal" as a

target signal based on a combination of an input audio signal, a feed-forward microphone signal and specific "off-head data". A comparison circuit then compares this predicted value to the actually measured "driver output signal" to determine whether or not the in-ear headset is in an off-head state.

1.3 The board understands the underlying physical premise of this detection system to critically rely on the change in acoustic impedance between the *on-head* and *off-head* states (see also point 5.2.1 below). As can be derived from paragraphs [0021] and [0031] of the opposed patent, when an in-ear headset of the type considered therein is properly worn, it forms a seal within the user's ear canal, i.e. creating a "closed acoustic-pressure chamber" with a high acoustic impedance. This high acoustic impedance heavily reinforces the internal acoustic transfer functions of the headset. In particular, within the configuration described in paragraph [0031] of the opposed patent where the acoustic driver and an internal microphone share an acoustic volume, the transfer function between them (referred to as G_{sd}; see point 1.4 below) is substantially reinforced. Conversely, when the in-ear headset is removed, this seal is broken, the closed acoustic-pressure chamber is lost and the acoustic impedance drops drastically. The present patent exploits this substantial difference in acoustic impedance — and the resulting change in the magnitude of the internal acoustic transfer functions — to mathematically distinguish whether or not the in-ear headset is being worn.

1.4 Figure 2 (reproduced below) of the opposed patent is considered to be the patent's most illustrative figure. It depicts a signal-flow diagram of the relevant system

architecture and illustrates the specific arrangement of the input signals ((*a*), (*o*), (*s*)), the relevant digital filters (K_{eq}, K_{ff}, K_{fb}) and the relevant acoustic transfer functions (G_{sd}, N_{so}) which are combined in a specific mathematical formula (i.e. "Equation (1)"; see the formula mentioned in feature (q) of auxiliary request 8 in point X above) to predict the "driver output signal" (*d*), which the board will understand to refer to the signal fed into "driver 106".

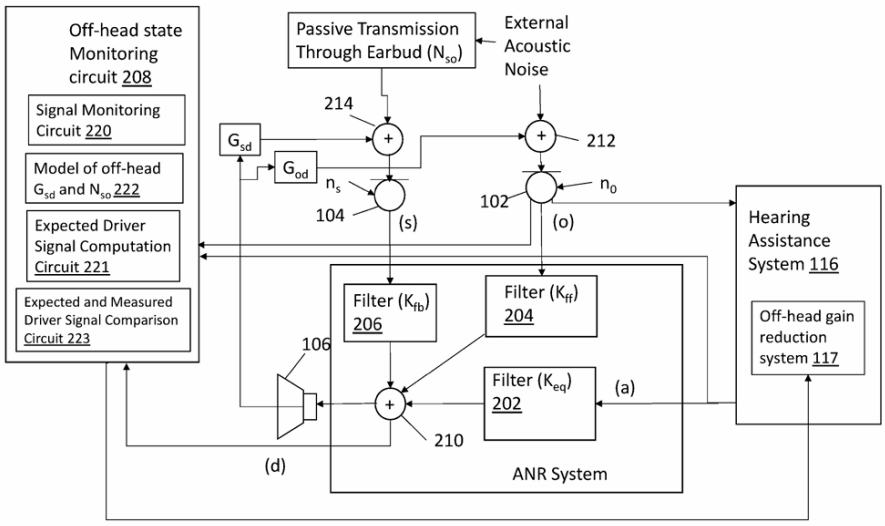

FIG. 2

2. *Auxiliary request 1: claim 1 - sufficiency of disclosure*

2.1 Concerning **auxiliary request 1**, the board finds that the opposition division's reasoning regarding insufficiency of disclosure under Article 83 EPC in Reasons 5.1 and 5.2 of the appealed decision has merit.

2.2 The board concurs with the opposition division that the terms "audio signal" and "feed-forward microphone signal" used in features (b) and (c), "driver output

signal" in features (b) to (d) and "off-head data" in feature (c) are quite broad. Given this breadth, it would present an undue burden for the skilled person to implement the claimed invention over the whole scope claimed based solely on the patent's teaching and the skilled person's common general knowledge.

2.3 In general, the proprietor's arguments concerning sufficiency of disclosure are unconvincing as they rely on functional interpretations derived from the patent specification to narrow the meaning of the terms mentioned in point 2.1 above, in particular the terms "driver output signal" and "off-head data". The opponent correctly argued in this regard that the proprietor's approach amounts to an unallowable attempt to read limitations into claim 1 that are only present in embodiments disclosed in the patent's description and drawings (see e.g. **T 2027/23**).

For the assessment of sufficiency of disclosure, the claimed subject-matter must indeed *first* be construed by taking all technically sensible interpretations of the claim into account. It must *then* be assessed whether the patent as a whole provides a sufficient disclosure for the claimed subject-matter so construed. Furthermore, the disclosure of a *single* way to carry out the claimed invention is only sufficient if it allows the skilled person to perform the invention over the whole scope claimed (see e.g. **T 149/21** and **T 867/21**).

Given the breadth of the above terms in the present case, the single embodiment disclosed in paragraphs [0033] to [0042] and Figure 2 of the opposed patent does not provide sufficient information to enable the invention over the whole scope claimed

without undue burden.

2.4 In this regard, the proprietor argued that the claim features should be analysed as a whole. When doing so, their combined relationship provided concrete limitations.

However, this is merely an unsubstantiated assertion. The proprietor failed to explain how this "holistic" analysis limits the broad terms of claim 1. The board agrees with the opponent that the mere presence of an "audio signal" and a "feed-forward microphone signal" does not provide any further information on how the broad features "driver output signal" or "off-head data" are to be interpreted or implemented.

To assess this in more detail, the board notes the following:

2.4.1 Regarding the specific *breadth* of the term "off-head data", the proprietor argued that the skilled person, reading claim 1 as a whole and with a view to making technical sense of it, would implicitly restrict this data to values that are necessary to make the respective prediction of the target signal successful, citing paragraph [0042] of the opposed patent.

However, the board finds the proprietor's argument to be circular because it uses the result to be achieved (i.e. a successful prediction of the target signal) to artificially limit the claimed subject-matter. In that regard, the board must evaluate the objective breadth of claim 1. As the opponent correctly pointed out, the claim wording regarding the term "off-head data" is such that this term could well relate to a simple binary flag or a temperature reading possibly combined

with a predefined threshold to indicate whether there is an off-head state, neither of which the patent enables the skilled person to mathematically integrate into the "expected-output computation circuit" in accordance with feature (c). Because the associated claim wording also covers data types for the "off-head data" that are not suitable for "off-head detection" within the meaning of features (a) and (d) and the patent provides only one specific embodiment for that purpose without a generic teaching to identify others, the invention defined by claim 1 fails to comply with Article 83 EPC.

2.4.2 A similar deficiency applies to the *determination* of the "off-head state" as per feature (d). The proprietor argued that the skilled reader, reading claim 1 as a whole, would implicitly understand how to perform this determination because this off-head state was effectively encoded in the predicted value of the "driver output signal" resulting from the step underlying feature (c). According to the proprietor, if the actually measured "driver output signal" is sufficiently similar to this predicted value, the system is supposed to successfully detect the *off-head* state, whereas a substantial difference indicates an *on-head* state.

However, the board notes that because achieving the technical effect of detecting or determining an off-head state is a functional limitation of claim 1 as per features (a) and (d), the patent must enable the skilled person to reliably achieve this effect across the entire scope claimed. The objective physical reality of an "off-head state" encompasses vastly different acoustic environments, such as the in-ear headset lying on a desk, dangling from a cable or

simply having a loose seal in the ear (as acknowledged in, for instance, paragraph [0053] of the patent specification). Each of these acoustic environments presents completely different acoustic characteristics, such as varying levels of acoustic impedance and different leakage paths, causing the underlying acoustic transfer functions to fluctuate drastically depending on the specific off-head scenario. Because claim 1 broadly requires the "off-head detection system" to determine this state, but the opposed patent provides no generic teaching on how the "off-head data" or the comparison thresholds required for the determination as per feature (d) must be adapted to account for these drastically varying acoustic conditions, the skilled person would have been forced to undertake a research programme to implement the invention across the whole scope claimed at the relevant date.

2.5 During the oral proceedings before the board, the proprietor acknowledged that claim 1 does not specify how the "audio signal", the "feed-forward microphone signal" and the "off-head data" are combined to arrive at the expected value of the "driver output signal". Nevertheless, the proprietor argued that the off-head state determination was achieved by the comparison mentioned in feature (d) and that the "driver output signal" could be predicted in accordance with feature (c) based on those inputs. Moreover, the proprietor considered claim 1 to be sufficiently disclosed because the description contained general statements applicable to broader configurations, pointing specifically to paragraph [0010] of the opposed patent. It also argued that this paragraph disclosed that acoustic transfer functions "*change in magnitude*" when the device is removed from the user's

ear. In the proprietor's view, this constituted a generic teaching that enabled the skilled person, using standard engineering modelling, to formulate a mathematical relationship predicting the "driver output signal" without being restricted to the specific Equation (1) of the patent's preferred embodiment.

The board is not convinced. Knowing that a physical variable changes in magnitude does not instruct the skilled person how to combine the claimed signals and data to eventually predict the "driver output signal" as per feature (c). Deriving a reliable prediction requires constructing a specific mathematical relationship. Paragraph [0010] of the patent specification provides only a high-level functional summary of the physical behaviour exploited by the claimed invention (cf. point 1.3 above), namely that the relevant acoustic transfer functions change in magnitude upon removal of the headset. It does not, however, provide an enabling technical teaching on how to mathematically harness this change to calculate the predicted target signal as required in feature (c). Consequently, the undue burden on the skilled person remains. In other words, the determination of the claimed "off-head state" on the basis of a not further defined signal prediction depending on three not further defined signals or data items according to feature (c) could not be reproduced by the skilled person in the field of headsets without undue burden over the whole scope claimed.

2.6 The proprietor further relied on paragraphs [0021], [0033], [0037] and [0042] of the opposed patent, arguing that these paragraphs provide a sufficient generic teaching to generalise the claimed invention beyond the single embodiment covered by Equation (1)

and Figure 2. Specifically, it argued that because paragraphs [0021] and [0037] of the opposed patent disclosed that the acoustic transfer function (G_{od}) between the acoustic driver (i.e. signal (d)) and the external (feed-forward) microphone (i.e. signal (o)) also changes upon headset removal, the skilled person could dispense with the internal feedback microphone (involving signal (s)) altogether and instead design an alternative prediction system relying solely on this external leakage path.

The board cannot accept this argument. In fact, paragraphs [0021] and [0037] of the opposed patent merely describe the underlying physical problem, namely that breaking the acoustic seal causes sound to leak from the headset's driver to its external (feed-forward) microphone. The resulting leak increases the magnitude and alters the phase of the transfer function G_{od}, typically causing oscillation. Those paragraphs, however, do not provide any mathematical framework or block diagram indicating how to build an "expected-output computation circuit" in accordance with feature (c) based solely on this external leakage path. Furthermore, the proprietor's argument contradicts the mathematics of the patent's own sole embodiment. Equation (1) relies entirely on the *internal* feedback loop (i.e. G_{sd}) and mathematically neglects the driver-to-external-microphone leakage path (i.e. G_{od}). This omission is intuitively plausible for a properly sealed earplug, where the physical barrier heavily attenuates sound escaping to the outside, allowing the underlying model to treat this external leakage as negligible. Instructing, however, the skilled person to discard the only provided mathematical model and invent a novel prediction scheme based on a variable (i.e. G_{od}) that the inventors chose

to ignore in the context of the present patent requires extensive trial-and-error and inventive insight, which in turn amounts to an undue burden for the skilled person.

Similarly, paragraphs [0033] and [0042] of the opposed patent merely describe the high-level functional goal of comparing expected and current states and summarise the specific variables used in Equation (1) of the patent. However, *formulating* a functional goal does not equate to *enabling* it. These paragraphs lack any generic teaching that would allow the skilled person to generalise the "expected-output computation circuit" according to feature (c) to architectures lacking the specific acoustic-feedback loop required by Equation (1).

2.7 Thus, there is no reason for the board to disagree with the opposition division's finding in Reasons 5.1 and 5.2 of the appealed decision that auxiliary request 1 is not allowable under Article 83 EPC.

3. *Auxiliary requests 2 to 4: claim 1 - sufficiency of disclosure*

3.1 The board considers that **auxiliary requests 2 to 4** do not resolve the deficiencies of claim 1 of auxiliary request 1 mentioned in point 2 above.

3.2 The proprietor argued that the amendments introduced by **features (e) to (l)** — which explicitly include the "feedback microphone signal" (s) (as a fourth signal) into the claimed subject-matter and, in the case of auxiliary request 2 by virtue of feature (e), introduce a negative limitation — overcomes the opposition

division's objections by excluding embodiments lacking a feedback microphone.

3.3 The board is not persuaded that these amendments render the associated auxiliary requests 2 to 4 allowable under Article 83 EPC.

3.3.1 While the board acknowledges that the explicit inclusion of the "feedback-microphone signal" addresses the issue that the claimed system entirely lacks such a feedback microphone, it fails to cure the overarching deficiency identified for auxiliary request 1 in its entirety. This is because claim 1 still utilises the objectionably broad terms "off-head data" and "driver output signal" according to features (e) to (i). Crucially, the mere presence of a "feedback-microphone signal" in claim 1 does not provide the skilled person with the missing mathematical framework (such as Equation (1) of the patent) or the structural and acoustic constraints required to reliably combine these signals and properly predict the "driver output signal" in accordance with features (e), (h) and (k).

3.3.2 Consequently, the board finds that significant issues remain for auxiliary requests 2 to 4 with respect to insufficiency of disclosure over the whole scope claimed. The skilled person is still faced with an undue burden and a research programme to implement the "off-head detection system" across the entire breadth of claim 1.

3.4 Thus, there is no reason for the board to disagree with the opposition division's finding in Reasons 17 of the appealed decision that auxiliary requests 2 to 4 are not allowable under Article 83 EPC, either.

4. *Auxiliary requests 5 to 7: admittance*

4.1 As acknowledged by the proprietor, **auxiliary requests 5 to 7** constitute an "amendment" within the meaning of Article 12(4), first sentence, RPBA. Consequently, these requests may only be admitted into the proceedings at the board's discretion (Article 12(4), second sentence, RPBA).

4.2 As a justification for filing these claim requests only at the appeal stage, the proprietor relied primarily on an alleged violation of its right to be heard during the opposition proceedings. Specifically, the proprietor cited an allegedly incorrect exercise of discretion by the opposition division regarding the admittance of auxiliary requests filed during the first-instance oral proceedings, a failure to adhere to the Guidelines for Examination and an alleged shift in the opposition division's reasoning between the oral proceedings and the written decision. The opponent contested this, arguing that the claim requests could and should have been filed earlier.

4.3 The board is not convinced by the proprietor's procedural complaints.

4.3.1 Regarding the alleged refusal to grant an adjournment of the first-instance hearing, the minutes of the oral proceedings before the opposition division (see point 6.2) confirm that the proprietor was granted considerable time (i.e. more than 1.5 hours) to prepare a response once the opposition division's position on Article 83 EPC had become apparent. The board considers this to be fair and ample.

4.3.2 Furthermore, the board discerns no substantial procedural violation. In the appealed decision, the opposition division provided reasoned grounds for its discretionary decision not to admit the late-filed claim requests (auxiliary requests 1a, 1b and 1e), correctly applying the principle of *prima facie* allowability. The opposition division's reasoning regarding Article 83 EPC in the appealed decision was also firmly rooted in issues that were already apparent from the written proceedings. Therefore, the proprietor's primary justification for admittance fails.

4.4 With regard to **auxiliary request 5** specifically, the proprietor argued that it contained only a "minor amendment" (compared to auxiliary request 5 underlying the appealed decision; see point VII above) and that it was filed as a precautionary response to an objection raised against auxiliary request 1e underlying the appealed decision, which it could not have been anticipated prior to the first-instance oral proceedings.

The board notes that any amendment, however minor, remains an "amendment" subject to the provisions of Article 12(4) RPBA. Furthermore, since auxiliary request 1e was filed only during the oral proceedings before the opposition division, the proprietor cannot reasonably claim to have been taken by surprise by the lack of prior objections against it.

4.5 During the oral proceedings before the board, the opponent emphasised that the crucial question for admittance in this regard was whether the amendments were suitable for addressing the objections that had led to the appealed decision. The board agrees and

places this criterion at the forefront of its assessment. The board, however, finds that none of auxiliary requests 5 to 7 satisfy this requirement:

4.5.1 Regarding **auxiliary request 5**, this claim request attempts to overcome the objection under Article 83 EPC by introducing the specific acoustic transfer functions (i.e. N_{so} and G_{sd}) into **feature (m)**. However, as the opponent correctly pointed out, auxiliary request 5 still omits the relevant digital filters (i.e. K_{eq}, K_{ff} and K_{fb}) through which the claimed signals must pass. Extracting the transfer functions without the accompanying digital filters represents an unallowable intermediate generalisation (Article 123(2) EPC), an issue that was clearly raised in the appealed decision regarding auxiliary request 1a (see Reasons 7). Since auxiliary request 5 *prima facie* fails to address this known deficiency, it was not admitted into the appeal proceedings.

4.5.2 Concerning **auxiliary requests 6 and 7**, the board acknowledges the opponent's argument that these requests are *prima facie* not allowable because they fail to specify the exact location of the "feedback microphone". The board considers this to be a substantial flaw, which will be analysed in detail concerning auxiliary request 8 in point 5.3.1 below. Yet, the board's decision not to admit auxiliary requests 6 and 7 rests on a more immediate, *prima facie* formal deficiency regarding algorithmic completeness.

As the board noted during the oral proceedings, while **auxiliary request 6** introduces the digital filters and transfer functions depicted in Figure 2 by virtue of **feature (n)**, it entirely omits the mathematical formula (Equation (1) of the patent) that dictates how these

variables are precisely combined to predict the "driver output signal".

The same applies to **auxiliary request 7**, where **features (o) and (p)** do not address this omission. Claiming the specific inputs, filters and variables of Figure 2 without the specific mathematical equation connecting them leaves the "expected-output computation circuit" mentioned in features (c) and (o) functionally obscure (Article 83 EPC) and constitutes a further unallowable intermediate generalisation of the architecture shown in Figure 2 (Article 123(2) EPC). On top of that, in feature (p), it has been added that the claimed "input device" includes an "active noise reduction (ANR) circuit". Moreover, according to feature (b), the "input device" is supposed to receive the "driver output signal". However, according to the relevant embodiment illustrated by Figure 2, only "driver 106" and the "off-head state monitoring circuit 208" are supposed to receive the "driver output signal" and not the "ANR system" (Article 123(2) EPC).

4.6 Because auxiliary requests 5 to 7 fail to address all of the issues which led to the decision under appeal, the board exercised its discretion not to admit them into the appeal proceedings (Article 12(4) RPBA).

5. *Auxiliary request 8: claim 1 - added matter*

5.1 Concerning **auxiliary request 8**, the board notes that **feature (q)**, and in particular Equation (1), is based on page 7, lines 30 to 33 of the description as filed. However, extracting Equation (1) and the transfer functions from this specific embodiment without including the necessary structural and acoustic constraints results in an unallowable intermediate

generalisation, thereby adding subject-matter. The board agrees with the opponent in this regard that the limitations disclosed at page 5, lines 25 to 28 of the application as filed, namely that

> "*[t]he feedback microphone 104 is positioned in front of the acoustic driver 106, or more specifically, in a shared acoustic volume with the acoustic driver 106 and the ear drum of the wearer when worn*",

are inextricably linked to the validity and function of Equation (1) of the patent.

5.2 To illustrate this in more detail, the board notes that the inextricable link between these limitations and the extracted mathematical model can be demonstrated by the following two technically sensible configurations. These configurations are encompassed by claim 1, but Equation (1) completely breaks down in these cases:

5.2.1 The open-fit or highly vented design (no "shared" acoustic volume):

As established in point 1.3 above, the entire "off-head detection system" disclosed in the opposed patent relies on the premise that the acoustic transfer functions change substantially when the claimed "in-ear headset" is removed due to the loss of a "closed acoustic-pressure chamber". During the oral proceedings before the board, the parties did indeed agree that the claimed effect of determining "an off-head state" (i.e. feature (d)) relies fundamentally on acoustic transfer functions that change in magnitude when the in-ear headset is removed from the user's ear. In a vented or open-fit in-ear headset, this "closed acoustic-pressure

chamber" is intentionally never formed. Instead, the user's ear canal remains acoustically open to the environment even when the in-ear headset is properly worn. Because the acoustic impedance is exceptionally low in both the *on-head* and *off-head* states, the transfer function G_{sd} between signals (*d*) and (*s*) remains virtually static. Furthermore, because the lack of a seal provides effectively no passive acoustic isolation, the external-to-internal transfer function N_{so} similarly experiences no substantial change. If the physical variables G_{sd} and N_{so} do not experience a substantial change upon removal, the mathematical output of Equation (1) must remain effectively identical. The associated "comparison circuit" is thus completely blind to the fact that the in-ear headset has been taken off. This however demonstrates that the "shared acoustic volume" as mentioned in line 26 of page 5 of the application as filed is an indispensable prerequisite for Equation (1).

5.2.2 The "behind-the-driver" or "side-cavity" placement (*acoustic-tube design*):

In many compact wireless earbuds, the front nozzle entering the user's ear canal is too small to house both the acoustic driver and a microphone. A standard solution in the context of active noise reduction (ANR) is to mount the associated feedback microphone deep inside the chassis, *behind* or *parallel to* the acoustic driver, connecting the feedback microphone to the ear canal via a narrow acoustic tube. Although such an arrangement may be entirely adequate if ANR were the sole objective, the claimed system additionally requires the reliable "detection of an off-head state". However, routing the sound through a narrow tube introduces complex acoustic phase delays and resonant

peaks into the transfer function G_{sd}, which the only disclosed mathematical model according to Equation (1) is fundamentally unequipped to handle. Equation (1), which assumes a simple and direct shared volume, fails to account for these specific tube dynamics and cannot predict the "driver output signal" accurately in such a case. This demonstrates that acoustically positioning the feedback microphone "*in front of the acoustic driver*" as set out in lines 25 and 26 of page 5 of the application as filed is likewise inextricably linked to the mathematical model defined by Equation (1).

5.3 The proprietor's arguments to the contrary, provided during the oral proceedings before the board, are not convincing.

5.3.1 The proprietor argued that it was unnecessary to explicitly claim the location of the feedback microphone because a skilled reader would understand that a "feedback microphone" inherently must be positioned in the specific manner described in the opposed patent; otherwise, it would be technically meaningless and could not calculate the "driver output signal".

The board cannot accept this argument. In the context of control circuitry such as the kind underlying the claimed "off-head detection system", a "feedback microphone" is simply a sensor, the output of which is fed back into a closed-loop control circuit to calculate an "error signal". It merely defines a signal-processing topology, not a set of precise spatial coordinates. As illustrated by the "side-cavity" acoustic-tube example referred to in point 5.2.2 above, a microphone can function perfectly well as a feedback microphone for ANR (thus falling

within the claimed subject-matter) without being physically "*in front of*" the acoustic driver or sharing the immediate acoustic volume in the manner described in the application as filed. Therefore, the functional label "feedback microphone" does not implicitly restrict claim 1 to the specific structural arrangement required by Equation (1). In response to the board's example of a vented earpiece where Equation (1) would fail (cf. point 5.2.1 above), the proprietor argued that such a configuration would be technically nonsensical. The proprietor contended that in a vented arrangement or in the presence of a leak, the *feed-forward* and *feedback* microphones would detect the same signal, rendering one of the two microphones redundant.

This argument is factually incorrect from an acoustic perspective. Even in a completely open-fit or highly vented earbud, the *feed-forward* and *feedback* microphones typically sit in entirely different acoustic near-field environments. The *feedback* microphone is mounted internally, directly adjacent to the acoustic driver's output. Therefore, the driver's output (i.e. "$d \cdot G_{sd}$") dominates the feedback microphone's signal. The *feed-forward* microphone, on the other hand, sits on the outer shell, where the driver's leakage (i.e. G_{od}) is much weaker and the "external acoustic noise" referred to in Figure 2 of the opposed patent dominates the captured signal (i.e. signal (o)). As a result, the two microphones physically capture different primary sound sources and serve entirely different purposes (measuring the internal residual error versus measuring the external-noise reference), even if the earbud is heavily vented. As apparent from point 5.2.1 above, the fundamental technical deficiency of applying Equation (1) to a

vented earbud does not consist in that one of the microphones becomes redundant. Rather, the deficiency is that the transfer function G_{sd} remains relatively static due to the lack of a pressure-chamber seal. Because of the broad way in which it has been drafted, claim 1 covers such vented in-ear headsets, yet the mathematical model defined by Equation (1) fundamentally relies on the omitted pressure-chamber dynamics of a closed earplug to function.

5.4 Therefore, by extracting Equation (1) without the inextricably linked structural limitations of the feedback microphone, the amendment introduced in claim 1 of auxiliary request 8 presents the skilled person with new technical information that was not disclosed in the application as filed and not derivable from the skilled person's common general knowledge.

5.5 Auxiliary request 8 is thus not allowable under Article 123(2) EPC.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chair:

B. Brückner K. Bengi-Akyürek

Decision electronically authenticated