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**Datasheet for the decision
of 17 June 2020**

Case Number: T 1879/16 - 3.5.03

Application Number: 09804590.9

Publication Number: 2311269

IPC: H04R1/22

Language of the proceedings: EN

Title of invention:

Apparatus incorporating an adsorbent material, and methods of making same

Applicant:

Nokia Technologies Oy

Headword:

Pressure compensation apparatus/NOKIA

Relevant legal provisions:

EPC Art. 116, 123(2)

Keyword:

Oral proceedings before the board - held by videoconference
Added subject-matter - all requests (yes)

Decisions cited:

T 1378/16



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Case Number: T 1879/16 - 3.5.03

D E C I S I O N
of Technical Board of Appeal 3.5.03
of 17 June 2020

Appellant: Nokia Technologies Oy
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Decision under appeal: **Decision of the Examining Division of the
European Patent Office posted on 8 March 2016
refusing European patent application
No. 09804590.9 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chair K. Bengi-Akyürek
Members: K. Peirs
J. Geschwind

Summary of Facts and Submissions

- I. The appeal is against the decision of the examining division refusing the present European patent application for added subject-matter (Article 123(2) EPC) and lack of novelty (Article 54 EPC).
- II. Oral proceedings before the board were held on 17 June 2020. The oral proceedings were initially scheduled as an in-person hearing and were - with the appellant's consent - converted into oral proceedings conducted by videoconference (see e.g. T 1378/16, Reasons, point 1).

The appellant requests that the decision under appeal be set aside and that a patent be granted according to the claims of one of

- a main request filed as "third auxiliary request" with the statement of grounds of appeal
- a first auxiliary request filed with the reply to the board's communication under Article 15(1) RPBA
- a second auxiliary request filed as "fifth auxiliary request" with the statement of grounds of appeal
- a third auxiliary request filed with the reply to the board's communication
- a fourth auxiliary request filed as "seventh auxiliary request" with the statement of grounds of appeal
- a fifth auxiliary request filed with the reply to the board's communication
- a sixth auxiliary request filed as "ninth auxiliary request" with the statement of grounds of appeal
- a seventh auxiliary request filed with the reply to the board's communication.

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

III. Claim 1 of the **main request** reads as follows:

"An acoustic transducer system comprising:
a cavity (22) having a substantially enclosed air volume;
an apparatus located within the cavity, the apparatus comprising:
a skeleton member (42, 62, 74, 92, 162) wherein the skeleton member (42, 62, 74, 92, 162) has a predetermined configuration comprising a plurality of hollows (50, 83, 98) formed within or a plurality of protuberances (170) formed thereon; and
adsorbent material supported at least on inner surfaces (52) of the plurality of hollows (50, 83, 98) or exterior surfaces (172) of the protuberances (170) of the skeleton member, wherein said adsorbent material provides a regular surface in such a way that a surface area of the material is known when dimensions of the material are known, and air in said substantially enclosed air volume flows through said skeleton member within said cavity, and
wherein the apparatus is arranged for compensating for pressure changes within said substantially enclosed air volume of said cavity by adsorbing gas molecules when the pressure increases and by releasing gas molecules when the pressure decreases within said substantially enclosed air volume."

IV. Claim 1 of the **first auxiliary request** reads as follows (amendments vis-à-vis claim 1 of the main request indicated by the board):

"An acoustic transducer system comprising:

a cavity (22) having a substantially enclosed air volume;

an apparatus located within the cavity, the apparatus comprising:

a skeleton member (42, 62, 74, 92, 162) wherein the skeleton member (42, 62, 74, 92, 162) has a predetermined configuration comprising a plurality of hollows (50, 83, 98) formed within or a plurality of protuberances (170) formed thereon; and

adsorbent material being one of: supported ~~at least on~~ within inner surfaces (52) of the plurality of hollows (50, 83, 98) or supported on exterior surfaces (172) of the protuberances (170) of the skeleton member, wherein said adsorbent material ~~provides~~ has a regular surface in such a way that a ~~surface area of the material is known when dimensions of the material are known,~~ and air in said substantially enclosed air volume flows through said skeleton member within said cavity, and

wherein the apparatus is arranged for compensating for pressure changes within said substantially enclosed air volume of said cavity by adsorbing gas molecules when the pressure increases and by releasing gas molecules when the pressure decreases within said substantially enclosed air volume."

V. Claim 1 of the **second auxiliary request** reads as follows (amendments vis-à-vis claim 1 of the main request indicated by the board):

"An acoustic transducer system comprising:

a cavity (22) having a substantially enclosed air volume;

an apparatus located within the cavity, the apparatus comprising:

a skeleton member (42, 62, 74, 92, 162) wherein the

skeleton member (42, 62, 74, 92, 162) has a predetermined configuration comprising a plurality of hollows (50, 83, 98) formed within or a plurality of protuberances (170) formed thereon; and

adsorbent material supported at least on inner surfaces (52) of the plurality of hollows (50, 83, 98) or exterior surfaces (172) of the protuberances (170) of the skeleton member, wherein said adsorbent material provides a regular surface in such a way that a surface area of the material is known when dimensions of the material are known, and air in said substantially enclosed air volume flows through said skeleton member within said cavity when said apparatus is located within said cavity (22), and

wherein the apparatus is arranged for compensating for pressure changes within said substantially enclosed air volume of said cavity by adsorbing gas molecules when the pressure increases and by releasing gas molecules when the pressure decreases within said substantially enclosed air volume, when said apparatus is located within said cavity (22)."

VI. Claim 1 of the **third auxiliary request** reads as follows (amendments vis-à-vis claim 1 of the main request indicated by the board):

"An acoustic transducer system comprising:
a cavity (22) having a substantially enclosed air volume;

an apparatus located within the cavity, the apparatus comprising:

a skeleton member (42, 62, 74, 92, 162) wherein the skeleton member (42, 62, 74, 92, 162) has a predetermined configuration comprising a plurality of hollows (50, 83, 98) formed within or a plurality of protuberances (170) formed thereon; and

adsorbent material being one of: supported at ~~least on~~ within inner surfaces (52) of the plurality of hollows (50, 83, 98) or supported on exterior surfaces (172) of the protuberances (170) of the skeleton member, wherein said adsorbent material ~~provides~~ has a regular surface ~~in such a way that a surface area of the material is known when dimensions of the material are known,~~ and air in said substantially enclosed air volume flows through said skeleton member within said cavity when said apparatus is located within said cavity (22), and

wherein the apparatus is arranged for compensating for pressure changes within said substantially enclosed air volume of said cavity by adsorbing gas molecules when the pressure increases and by releasing gas molecules when the pressure decreases within said substantially enclosed air volume, when said apparatus is located within said cavity (22)."

VII. Claim 1 of the **fourth auxiliary request** includes all the features of claim 1 of the second auxiliary request and further comprises the following phrase at the end:

"characterized wherein the adsorbent material is provided as a layer of surfaces of the skeleton member".

VIII. Claim 1 of the **fifth auxiliary request** reads as follows (amendments vis-à-vis claim 1 of the main request indicated by the board):

"An acoustic transducer system comprising:
a cavity (22) having a substantially enclosed air volume; and
an apparatus (12, 60, 70, 90, 160) located within the cavity, the apparatus comprising:

a skeleton member (42, 62, 74, 92, 162) wherein the skeleton member (42, 62, 74, 92, 162) has a predetermined configuration comprising a plurality of hollows (50, 83, 98) formed within or a plurality of protuberances (170) formed thereon; and

adsorbent material being one of: supported ~~at least on~~ within inner surfaces (52) of the plurality of hollows (50, 83, 98) or supported on exterior surfaces (172) of the protuberances (170) of the skeleton member, wherein said adsorbent material provides a regular surface ~~in such a way that a surface area of the material is known when dimensions of the material are known,~~ and air in said substantially enclosed air volume flows through said skeleton member within said cavity when said apparatus is located within said cavity (22), and

wherein the apparatus is arranged for compensating for pressure changes within said substantially enclosed air volume of said cavity by adsorbing gas molecules when the pressure increases and by releasing gas molecules when the pressure decreases within said substantially enclosed air volume, when said apparatus is located within said cavity (22); characterized wherein the adsorbent material is provided as a layer of surfaces of the skeleton member."

IX. Claim 1 of the **sixth auxiliary request** reads as follows (amendments vis-à-vis claim 1 of the main request indicated by the board):

"An acoustic transducer system comprising:
a cavity (22) having a substantially enclosed air volume; and
an apparatus (12, 60, 70, 90, 160) located within the cavity, the apparatus comprising:
a skeleton member (42, 62, 74, 92, 162) wherein the

skeleton member (42, 62, 74, 92, 162) has a predetermined configuration comprising a plurality of hollows ~~(50, 83, 98)~~ formed within or a plurality of protuberances (170) formed thereon; and

adsorbent material supported at least on ~~inner surfaces (52) of the plurality of hollows (50, 83, 98)~~ or exterior surfaces (172) of the protuberances (170) of the skeleton member, wherein said adsorbent material provides a regular surface in such a way that a surface area of the material is known when dimensions of the material are known, and air in said substantially enclosed air volume flows through said skeleton member within said cavity when said apparatus is located within said cavity (22), and

wherein the apparatus is arranged for compensating for pressure changes within said substantially enclosed air volume of said cavity by adsorbing gas molecules when the pressure increases and by releasing gas molecules when the pressure decreases within said substantially enclosed air volume, when said apparatus is located within said cavity (22); characterized wherein the adsorbent material is provided as a layer of surfaces of the skeleton member."

- X. Claim 1 of the **seventh auxiliary request** reads as follows (amendments vis-à-vis claim 1 of the main request indicated by the board):

"An acoustic transducer system comprising:

a cavity (22) having a substantially enclosed air volume; and

an apparatus (12, 60, 70, 90, 160) located within the cavity, the apparatus comprising:

a skeleton member (42, 62, 74, 92, 162) wherein the skeleton member (42, 62, 74, 92, 162) has a predetermined configuration comprising a plurality of

~~hollows (50, 83, 98) formed within or a plurality of protuberances (170) formed thereon; and~~

~~adsorbent material supported at least on inner surfaces (52) of the plurality of hollows (50, 83, 98) or exterior surfaces (172) of the protuberances (170) of the skeleton member, wherein said adsorbent material provides a regular surface in such a way that a surface area of the material is known when dimensions of the material are known, and air in said substantially enclosed air volume flows through said skeleton member within said cavity when said apparatus is located within said cavity (22), and~~

~~wherein the apparatus is arranged for compensating for pressure changes within said substantially enclosed air volume of said cavity by adsorbing gas molecules when the pressure increases and by releasing gas molecules when the pressure decreases within said substantially enclosed air volume, when said apparatus is located within said cavity (22); characterized wherein the adsorbent material is provided as a layer of surfaces of the skeleton member."~~

Reasons for the Decision

1. *The present application*

The application relates mainly to a loudspeaker in which the acoustic compliance is enhanced, i.e. in which the diaphragm's resistance to movement is reduced, by an adsorbent material disposed on a skeleton structure inside the loudspeaker's housing. This adsorbent material adsorbs or releases air molecules dependent on pressure increases or decreases inside the housing, which allows for an improved bass performance even in small devices. The application

proposes to use carbon nanotubes, graphite or a metal-organic material as the adsorbent material.

2. *Main request: claim 1 - features*

Claim 1 of the main request comprises the following limiting features (with the board's labelling):

- (a) An acoustic transducer system comprising:
 - a cavity having a substantially enclosed air volume;
 - an apparatus located within the cavity, the apparatus comprising:
- (b) a skeleton member wherein the skeleton member has a predetermined configuration comprising a plurality of hollows formed within or a plurality of protuberances formed thereon,
- (c) adsorbent material supported at least on inner surfaces of the plurality of hollows or exterior surfaces of the protuberances of the skeleton member,
- (d) wherein said adsorbent material provides a regular surface in such a way that a surface area of the material is known when dimensions of the material are known,
- (e) air in said substantially enclosed air volume flows through said skeleton member within said cavity,
- (f) wherein the apparatus is arranged for compensating for pressure changes within said substantially enclosed air volume of said cavity by adsorbing gas molecules when the pressure increases and by releasing gas molecules when the pressure decreases within said substantially enclosed air volume.

3. *Main request: claim 1 - added subject-matter*

- 3.1 The subject-matter of claim 1 of the main request has no direct and unambiguous basis in the application as filed in view of, at least, **features (e) and (f)**.
- 3.2 Concerning **feature (e)**, the appellant referred to page 13, lines 25-28 and page 17, lines 8 to 11 of the description as filed. The appellant emphasised, based on the original description as a whole, that the claimed cavity had a substantially enclosed air volume, which caused air to flow through the actual device, i.e. through its channels, and thereby inherently through the skeleton member.

The passages cited by the appellant only give two specific examples of how air can flow through an apparatus as claimed. The wording of feature (e) however represents an unallowable intermediate generalisation of those examples. In particular, the passage on page 13 of the description as filed concerns channels 58 formed between plates 42 in which air can easily flow. Likewise, the passage on page 17 of the description as filed relates to channels 88 formed by the arrangement of the members 74 in which air can easily flow. There is no indication for the skilled reader in the application as filed that the plates 42 and members 74 are compellingly to be seen as the skeleton member of the claim.

Even if were assumed, for the sake of argument, that this were the case, the skeleton member of the claim may, for instance, include arrangements where air cannot flow easily. Whilst the board acknowledges that there is no strict criterion to establish whether or not air can flow easily through an arrangement, the skilled reader would readily understand that arrangements involving, for instance, porous media

provide for a configuration where air is still able to flow, but cannot easily do so. The original description as a whole does not provide a direct and unambiguous basis for generalising the two specific examples referred to by the appellant to arrangements with a less easy air flow. Feature (e) therefore introduces subject-matter that extends beyond the content of the application as filed.

3.3 Regarding **feature (f)**, it may be referred to the passage of page 8, lines 7 to 25 of the description as filed, which describes how the pressure compensation apparatus 12 is arranged to compensate for pressure changes within a loudspeaker system. That passage reads as follows:

"... when the diaphragm 24 moves in the direction D2, and the gas pressure increases, an increased number of gas molecules are adsorbed by the apparatus 12 ... Conversely, when the diaphragm 24 moves in the direction D1 and the gas pressure within the loudspeaker unit 10 decreases, some of the gas molecules previously adsorbed by the apparatus 12 are released from the surface of the apparatus 12 into the surrounding volume ..."

As pointed out by the appellant, this loudspeaker system can be generalised to an acoustic transducer system as claimed by virtue of the reciprocity principle between loudspeakers and microphones, the more since the application as filed contains an explicit statement to this effect in lines 4 to 7 of page 28.

However, for the following reasons, feature (f) constitutes an unallowable intermediate generalisation

of the above teaching of the description as filed in terms of (i) *how* the apparatus is arranged for compensating pressure changes as well as in terms of (ii) the pressure changes themselves.

- 3.3.1 As regards the generalisation of *how* the apparatus is arranged for compensating pressure changes, the passage on page 8 of the application as filed implies that a *hysteresis* takes place in the adsorption and desorption process, such that, according to lines 10 to 12 of page 8, an *increased number* of gas molecules are adsorbed when the pressure increases and, according to lines 19-21 of page 8, such that, conversely, only *some* of the gas molecules previously adsorbed by the apparatus are released from the surface of the apparatus. The board notes that such a hysteresis occurs, for instance, in activated carbon with humid air. By contrast, feature (f) allows for a *symmetry* between the adsorption and desorption process by adsorbing gas molecules when the pressure increases and releasing (the same) gas molecules when the pressure decreases. Such a symmetric behaviour between adsorption and desorption has been observed, for instance, with dry nitrogen in activated carbon.

The appellant pointed out that the adsorption/release process was continuously ongoing when the loudspeaker was in operation. It was emphasised that the expression "some of the gas molecules" of the above passage ought to have been read in the sense that *more* gas molecules were released the further the pressure decreased. However, from the word "[c]onversely" in the above passage, the skilled reader would derive that the word "some" is bound to imply a difference between the released and adsorbed amount of gas molecules even when the decrease in pressure has completely negated the

increase. In any case, nothing in the application as filed would allow the skilled reader to derive, in a direct and unambiguous way, a *symmetric* adsorption and release process as covered by feature (f).

- 3.3.2 Regarding the generalisation of the pressure changes themselves, cavity 22 as shown in Figure 1 of the application as filed is enclosed by loudspeaker diaphragm 24 and the driving system that comprises magnet 16, pole-piece 18 and coil 20. The pressure changes within this cavity are due to the movement of diaphragm 24 in directions "D1" or "D2" shown in Figure 1. For a microphone, pressure changes within the cavity must be such as to cause diaphragm movement in those directions.

By contrast, the cavity of the claim is completely arbitrary, as long as it encloses an air volume in which an apparatus as claimed can be located. Moreover, the claim is totally silent as to the transducer diaphragm and its driving/detecting system, which could be, for instance, part of the "apparatus" claimed. The pressure changes of the claim could arise at *any* location within the cavity's enclosed air volume, *independently* of the diaphragm's movement. They could, for instance, be due to mere barometric influences caused by changing weather conditions or by a change in altitude of the acoustic transducer system. Even when restricting the cause of the pressure changes to sound waves, several examples of acoustic transducer systems can be considered in which an apparatus as claimed can be incorporated, but in which pressure changes in the cavity do not correspond to any diaphragm movement.

- 3.4 Consequently, claim 1 of the main request does not fulfil the provisions of Article 123(2) EPC.
4. *First to seventh auxiliary requests: claim 1 - added subject-matter*
- 4.1 Features (e) and (f) are also included in claim 1 of the **first to seventh auxiliary requests**. Thus, the objections raised for claim 1 of the main request apply equally to claim 1 of those auxiliary requests.
- 4.2 Consequently, claim 1 of the first to seventh auxiliary requests does not comply with the provisions of Article 123(2) EPC either.
5. Given that there is no allowable claim request on file, the appeal is to be dismissed.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:

The Chair:



B. Brückner

K. Bengi-Akyürek

Decision electronically authenticated