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Acoustic valve and ear plug for hearing protection.

(57)

The present disclosure concerns an acoustic valve (10) for hearing protection. The valve (10) comprises a housing (1) that is placeable or integrated in an ear plug (100). The housing (1) comprises a sound passage (2) extending through the housing (1) for allowing at least partial transmission of sound from the external surroundings (11) into the auditory canal (13). The housing comprises an impulse filter (3) comprising a rigid plate (4). The rigid plate (4) forms an enclosed volume (12) within the sound passage (2) of the valve. The rigid plate (4) comprises at least one perforation (5) for passing part of the sound from the external surroundings (11) via the perforation (5) into the enclosed volume (12). The housing further comprises an acoustic filter (6) comprising a mesh (7) arranged in the sound passage (2) between the rigid plate (4) and the auditory canal (13).

Title: ACOUSTIC VALVE AND EAR PLUG FOR HEARING
PROTECTION

TECHNICAL FIELD AND BACKGROUND

5 The present disclosure relates to an acoustic valve for hearing protection. The disclosure further relates to an ear plug for hearing protection comprising the acoustic valve.

 It is recognized that people can be exposed in their daily life to unwanted sounds and sound levels. Excessive sound levels may even cause
10 temporary or permanent damage to a person's hearing. To protect against unwanted or excessive sound, various devices exist that form a barrier or filter between the ear canal and the external surroundings. For example, an ear plug for hearing protection may comprise a universal or customized tip with an outer contour for sealingly fitting into an auditory canal of a user.
15 The earplug may provide a general blocking of all environmental sound. However, this may also prevent the user from hearing any other sound, e.g. speech, which can be undesired in some circumstance. For example, military or law enforcement officers may desire to have a good sense of hearing for regular environmental sound while at the same time being protected
20 against excessive sound levels, e.g. from gunshots. Accordingly, a non-linear filtering of different sound levels can be desired, wherein excessive sound levels are more attenuated than lower sound levels.

 U.S. Patent Number 6,068,079 describes an acoustic valve capable of selective and non-linear filtering of sound and placeable in a perforated
25 ear plug. The acoustic valve consists of a tube enclosing two rigid disks axially spaced opposite each other, each of the disks containing at least one perforation. The total perforated surface of at least one disk is between 0.03 and 0.5 mm² (square millimetre). It is appreciated that the prior art device may provide a simple design to protect against excessive (impulse) sound
30 levels while at the same time allowing at least a perception of regular sound

levels. However, it is found that the overall hearing perception of the environment can feel artificial to a user of the device.

Accordingly there is a desire for a simple design hearing protection device that provides a more natural hearing perception of the environment.

SUMMARY

According to one aspect, the present disclosure provides an acoustic valve for hearing protection, the valve comprising a housing placeable or integrated in an ear plug to form a seal between an auditory canal of an ear and an external surroundings, the housing comprising a sound passage extending through the housing for allowing at least partial transmission of sound from the external surroundings into the auditory canal; an impulse filter comprising a rigid plate forming an enclosed volume within the sound passage, wherein the rigid plate comprises at least one perforation for passing part of the sound from the external surroundings via the perforation into the enclosed volume; and an acoustic filter comprising a mesh arranged in the sound passage between the rigid plate and the auditory canal. According to another or further aspect, the present disclosure provides an ear plug for hearing protection comprising a tip with an outer contour for sealingly fitting into an auditory canal of a user, wherein the tip comprises a channel through the tip, and wherein an acoustic as described herein is arranged in the channel.

Without wishing to be bound by theory, it is appreciated that the synergetic combination of a rigid perforated plate or disc, a mesh, and an enclosed volume, can provide a more natural hearing perception in a simple hearing protection device. The mesh, which is typically woven, can provide a attenuation in particular at relatively low sound levels while the impulse filter, formed by the rigid perforated plate and the enclosed volume therein between, can provide attenuation in particular at relatively high sound

levels. The combined arrangement can provide a relatively flat acoustic transfer function, which is found to be associated with a more natural perception of environmental sound.

The inventors find that a single perforated rigid disc can be used to form an enclosed volume in combination with the acoustic filter and thereby used as an impulse filter. By forming the enclosed volume between the rigid plate and the acoustic filter, in particular the mesh, a more compact arrangement can be provided than e.g. by a combination of an acoustic filter with two perforated discs. The compact arrangement can be of particular benefit in an ear plug where spacing is limited.

To provide a barrier for impulse sound while at the same time allowing transfer of naturally occurring sound levels, it is found advantageous to provide a total perforated cross-section in the rigid plate between 0.01 and 0.10 square millimetre, preferably between 0.025 and 0.035 square millimetre. Alternatively, or in addition, the impulse filter is found to provide improved performance, i.e. sufficient protection while allowing natural audio perception, when a specific size is provided for the enclosed volume. Accordingly, the enclosed volume, e.g. between the rigid plate and the mesh, is preferably selected in a range between 5 and 20 cubic millimetre, more preferably between 10 and 15 cubic millimetre. Also a thickness of the rigid plate at a position of the perforation is found to influence the sound transfer function. To provide improved performance, this thickness is preferably chosen in a range between 0.05 and 0.5 millimetre, more preferably between 0.1 and 0.3 millimetre.

By providing the rigid plate as an integral part of the housing, production of the device can be simplified. For example, the housing and /or perforated rigid plate can be made from plastic, e.g. by a moulding technique. The rigid disc or plate may also comprise a metal part, e.g. produced by an etch technique. The metal part may provide improved rigidity to the plate which can be beneficial for blocking excessive sound. In

any case, the impulse filter is preferably arranged for attenuating impulse sound, e.g. above 130 dB, from the external surroundings into the auditory canal.

5 The mesh is preferably a woven mesh, e.g. precision woven. It is found that the sound filtering characteristics of a mesh can be particularly beneficial for attenuating relatively low to midrange sound pressure levels, e.g. below 100 dB. The characteristics of the mesh can be determined e.g. by the many openings formed between a woven grid of the mesh. Typically, several hundred openings can be formed which however provide a relatively
10 low total cross-section. To provide adequate attenuation, the cross-section surface of the openings is preferably between 1 to 20 percent of the total cross-section surface of the mesh, more preferably between 12 and 15 percent.

As described above, the combination of the rigid disc and mesh
15 can provide a simple yet effective means for improving natural perception, in particular for a combination of relatively low and relatively high sound levels. The perception may be even further enhanced by the provision of further acoustic filtering elements. In this regard it is found that a flexible membrane can be provided between the perforated disc and the mesh to
20 enhance filtering of sounds traversing the perforation of the rigid plate. For example, the flexible membrane may flex towards the mesh at elevated sound pressure levels in the enclosed volume. By placing the flexible membrane relatively close to the mesh, e.g. closer than 0.15 millimetre in equilibrium (without sound), the flexible membrane may abutting against
25 the mesh at elevated sound pressure levels, e.g. at sound pressure levels in the enclosed volume above 120 dB. Overall, the flexible membrane may thus provide a further flattening effect on the acoustic transfer function and improve natural perception.

BRIEF DESCRIPTION OF DRAWINGS

These and other features, aspects, and advantages of the apparatus, systems and methods of the present disclosure will become better understood from the following description, appended claims, and
5 accompanying drawing wherein:

FIG 1 shows a schematic cross section view of an embodiment of an acoustic valve;

FIG 2 shows a schematic cross section view of an embodiment of an acoustic valve comprising a flexible membrane;

10 FIG 3 shows a schematic cross section view of an embodiment of an acoustic valve wherein the rigid perforated plate is part of the housing;

FIG 4 shows a schematic cross section view of an embodiment of an acoustic valve comprising a switchable cap;

15 FIGs 5A-5D show schematic views of an acoustic valve design according to one embodiment;

FIG 6A shows schematic views of a perforated plate design according to one embodiment;

FIG 6B shows a graph with an example attenuation measurement of an earplug according to one embodiment;

20 FIG 7A shows a schematic cross section view of an embodiment of an earplug and how this can be inserted into an ear canal;

FIG 7B shows an exploded view of an embodiment of an earplug.

DESCRIPTION OF EMBODIMENTS

25 Unless otherwise defined, all terms (including technical and scientific terms) used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs as read in the context of the description and drawings. It will be further understood that terms, such as those defined in commonly used dictionaries,
30 should be interpreted as having a meaning that is consistent with their

meaning in the context of the relevant art and will not be interpreted in an idealized or overly formal sense unless expressly so defined herein. In some instances, detailed descriptions of well-known devices and methods may be omitted so as not to obscure the description of the present systems and methods. Terminology used for describing particular embodiments is not intended to be limiting of the invention. As used herein, the singular forms "a", "an" and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. The term "and/or" includes any and all combinations of one or more of the associated listed items. It will be understood that the terms "comprises" and/or "comprising" specify the presence of stated features but do not preclude the presence or addition of one or more other features. It will be further understood that when a particular step of a method is referred to as subsequent to another step, it can directly follow said other step or one or more intermediate steps may be carried out before carrying out the particular step, unless specified otherwise. Likewise it will be understood that when a connection between structures or components is described, this connection may be established directly or through intermediate structures or components unless specified otherwise. All publications, patent applications, patents, and other references mentioned herein are incorporated by reference in their entirety. In case of conflict, the present specification, including definitions, will control.

The invention is described more fully hereinafter with reference to the accompanying drawings, in which embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. The description of the exemplary embodiments is intended to be read in connection with the accompanying drawings, which

are to be considered part of the entire written description. In the drawings, the absolute and relative sizes of systems, components, layers, and regions may be exaggerated for clarity. Embodiments may be described with reference to schematic and/or cross-section illustrations of possibly idealized
5 embodiments and intermediate structures of the invention. In the description and drawings, like numbers refer to like elements throughout. Relative terms as well as derivatives thereof should be construed to refer to the orientation as then described or as shown in the drawing under discussion. These relative terms are for convenience of description and do
10 not require that the system be constructed or operated in a particular orientation unless stated otherwise.

FIG 1 shows a schematic cross section view of an embodiment of an acoustic valve 10 that can be used for hearing protection.

15 In one embodiment, as shown, the valve 10 comprises a housing 1. The housing can be placeable or integrated in an ear plug 100. The combined ear plug with acoustic valve may form a seal or filter between an auditory canal 13 of an ear and an external surroundings 11. The housing 1 comprises a sound passage 2 extending through the housing 1. The sound
20 passage 2 is arranged for allowing at least partial, e.g. filtered or ,damped, transmission of sound from the external surroundings 11 into the auditory canal 13 via the acoustic elements placed therein.

 In one embodiment, the sound passage 2 comprises an impulse filter 3. The impulse filter 3 comprises a rigid plate 4 forming an enclosed
25 volume 12 within the sound passage 2. The rigid plate 4 comprises at least one perforation 5 for passing part of the sound from the external surroundings 11 via the perforation 5 into the enclosed volume 12. The rigidity of the plate 4 is preferably such as to provide minimal or no transmission of sound waves via the plate structure 4 itself, and
30 substantially exclusively via the perforation 5.

In one embodiment, the sound passage 2 comprises an acoustic filter 6. The acoustic filter 6 comprises a mesh 7. In the embodiment shown, the mesh 7 is arranged in the sound passage 2 between the rigid plate 4 and the auditory canal 13. This arrangement provides an advantageous
 5 sequence of filtering the relatively loud noises before passing the sound to the mesh. Overall, the combination of the rigid plate 4 and mesh 7 can provide a relatively flat and/or smooth acoustic transfer function compared e.g. to a combination of perforated rigid plates.

In use, sound S1 from the external surroundings 11 enters the
 10 sound passage 2 of the valve 10. The sound S2 that passes the rigid plate 4 via perforation 5, enters into the enclosed volume 12. The sound S3 that passes the acoustic filter 6, in this case mesh 7, enters into the auditory canal 13 of a user.

In one embodiment, a cross-section of the perforation 5 in the
 15 rigid plate 4 is between 0.01 and 0.10 square millimetre. In one embodiment, a plurality of perforations is provided having a total perforated cross-section within the said range. For example, two, three, or more perforations can be provided in the rigid plate 4. However, an increased number of perforations can affect the acoustic transfer function.
 20 Accordingly, it is found desirable to keep the number of perforations in the rigid disc at fifty or below, preferably at twenty or below, more preferably at ten or below, most preferable at five or below. The less the number of perforations in the rigid disc, the higher can be the individual cross section of the perforations. A higher cross-section of a perforation, may be
 25 associated with a lower capillary resistance, which may affect the acoustic transfer function. Similarly, a lower thickness 14 of the rigid plate 4 may be associated with a lower capillary resistance. For example, in one embodiment, a thickness 14 of the rigid plate 4 at the at least one perforation 5 is between 0.05 and 0.5 millimetre.

In one embodiment, the enclosed or at least substantially enclosed volume 12 is formed between the rigid plate 4 and the acoustic filter 6. In the embodiment shown, the enclosed volume 12 is formed or defined between the rigid plate 4, the mesh 7 and the inner walls of the housing 1.

5 The enclosed volume 12 may act as a buffer to receive sound waves traversing the perforation 5. Together with the rigid plate 4, the enclosed volume 12 may act as an impulse filter 3. In one embodiment, the enclosed volume 12 is between 5 and 20 cubic millimetre. In one embodiment, the impulse filter 3 is arranged for attenuating impulse sound above 130 dB
10 from the external surroundings 11 into the auditory canal 13.

It is noted that the mesh 7 is substantially different from the rigid plate 4 in structure and function. In one embodiment, the mesh 7 comprises a woven structure. For example, a plastic mesh may be extruded, oriented, expanded, woven or tubular. In one embodiment, it comprises a wire mesh.
15 In one embodiment, the mesh 7 comprises a grid forming a plurality of openings through the grid, wherein a cross-section surface of the openings is between 1 to 20 percent of the total cross-section surface of the mesh 7. The structure of the mesh typically provides a relatively low rigidity.

In the embodiment shown, the acoustic filter 6 is formed by the mesh 7. In one embodiment, the acoustic filter 6, e.g. mesh 7, is arranged for flattening an acoustic transfer function of sound from the external
20 surroundings 11 into the auditory canal 13.

FIG 2 shows a schematic cross section view of an embodiment of an acoustic valve 10, similar to FIG 1, but additionally comprising a flexible
25 membrane 8. In one embodiment, as shown the flexible membrane 8 is arranged between the rigid plate 4 and the mesh 7. In one embodiment, the flexible membrane 8 is arranged for flexing towards the mesh 7 at elevated sound pressure levels in the enclosed volume 12. In one embodiment, the
30 flexible membrane 8 is arranged for abutting the mesh at elevated sound

pressure levels in the enclosed volume 12, e.g. above 120 dB. In one embodiment, the flexible membrane 8 is relatively close to the mesh 7. For example, in one embodiment, a distance 18 between the flexible membrane 8 and the mesh 7 (at equilibrium, not flexed) is less than 0.1 millimetre.

5 The flexible membrane 8 may be considered part of the acoustic filter 6, together with the mesh 7. Together, they may provide a desired acoustic transfer function, in particular for low to mid range sound levels, e.g. up to 120 dB. In combination with the impulse filter 3, an overall relatively flat or smooth transfer function may be obtained. It may be
10 considered that the enclosed volume 12 in one embodiment, is formed between the rigid plate 4 and flexible membrane 8, which may be considered part of the acoustic filter 6. Preferably, the rigid plate 4, flexible membrane 8, and/or mesh 7 are arranged in series and with their respective surfaces transverse to a length of the sound passage 2.

15 In one embodiment (not shown), the flexible membrane is disposed between a first mesh and a second mesh. In a further embodiment, the flexible membrane is configured for abutting the first mesh at an elevated pressure of the environment relative to the auditory canal, and configured for abutting the second mesh at a lowered pressure of the
20 environment relative to the auditory canal. It will be appreciated that an impulse sound wave may comprise an oscillating pressure level, wherein the flexible membrane configured between two meshes can filter both the over pressure and under pressure regions of the sound wave. In this way, even further improvement to the acoustic transfer function may be obtained.

25

FIG 3 shows a schematic cross section view of an embodiment of an acoustic valve similar to FIG 1, except wherein the rigid perforated plate 2 is part of the housing 1, i.e. an integral part of the housing 1. For example, the housing 1 and rigid plate 4 may be produced by a single moulding step,

e.g. injection moulding. The perforation 5 may be produced at the time of moulding or applied later.

FIG 4 shows a schematic cross section view of an embodiment of an acoustic valve similar to FIG 1, but further comprising a switchable cap 9. The cap 9 may be used for fully or partially closing an entrance to the sound passage 2. Accordingly, the cap 9 may act as an additional filter, in case a user wants to further block any sounds from the environment.

FIGs 5A-5D show schematic views of a design for an acoustic valve 10 according to one embodiment. FIG 5A shows a cross section view of section A-A, as viewed along the arrows A, indicated in the top view of FIG 5C. FIG 5B shows a perspective view of the embodiment and FIG 5B shows a side view of the embodiment.

In the embodiment shown, the mesh 7 is spanned by a washer or ring 7r that is placed in the housing 1. Alternatively, the mesh may also be attached directly to the housing. The rigid plate 4 in the embodiment is placed with its perforation 5 in line with an opening in the housing 1, e.g. a decorative figure or logo cut from the housing 1. The shown measures are given in millimetres, and may vary for different designs. In the embodiment shown, the valve 10, in particular, the housing 1 has an overall round shape. This may advantageously fit to a typical ear plug. However, also other shapes may be used.

FIG 6A shows a schematic top and side view of a design according to one embodiment of a rigid plate 4 with perforation 5. Also shown are example measurements for the plate 4, in this case a round disc having a diameter of 4.50 millimetre. The perforation 5, in this example, has a diameter of 0.20 millimetres. The thickness (not indicated here) is for example 0.15 millimetres. Also other measure and shapes are possible.

FIG 6B show an example graph of a measurements for an earplugs having an impulse filter as described herein. In the graph, the attenuation “F” (in decibels, “dB”) is plotted as a function of a provided sound pressure level “SPL” at an entrance of the respective ear plug. The SPL indicates an integrated value over a range of frequencies.

In one embodiment, the impulse filter is configured to attenuate impulse sound with an SPL between 140 and 160 dB at the entrance of the earplug to an output SPL below 140 dB at the other end of the earplug. Preferably the sound is attenuated below 130 dB. For example, in the graph, an input SPL of 150 dB is attenuated by 30 dB, to provide an output SPL of 120 dB. An input SPL of 165 dB is attenuated by 35 dB, to provide an output SPL of 130 dB. Accordingly, it is demonstrated that the ear plug can provide an increased attenuation for increased sound pressure levels.

FIG 7 shows two embodiments for an earplug 100 for hearing protection comprising an acoustic valve 10, as described herein. The ear plug 100 comprises a tip 101 with an outer contour for sealingly fitting into an auditory canal 13 of a user. FIG 7A shows a cross section view of an embodiment for an earplug 100 with a user customized tip 101 (e.g. otoplastics) while FIG 7B shows an exploded view of an embodiment with a more universal tip 101, e.g. comprising ridges. The tip 101 comprises a channel 102 through the tip 101. The acoustic valve 10 can be arranged in the channel 102. The channel 102 with the valve 10 arranged therein may in use form an acoustic passage between the external surroundings 11 and the auditory canal 13. For example, in FIG 7A, right side, the earplug 100 is shown inserted into an ear 23 of a user. As shown in FIG 7B, the earplug 100 and/or valve 10 may comprise an optional cap (formed in this case by hinging parts 9a, 9b) to manually close off the ear plug passage

It is noted that hearing protection can be defined for example in accordance with a minimum attenuation provided by an ear plug or acoustic

valve. In one embodiment, when tested in accordance with EN 13819-2:2002, 4.2, the values (Mf - sf) of the ear-plugs are not less than the values given in Table 1 of this standard (reproduced below), wherein Mf are the mean attenuation data and sf the standard deviations as measured in accordance with EN 13819-2:2002, 4.2. Alternatively, or in addition, also other definitions of hearing protection can be used.

Frequency in Hz	125	250	500	1000	2000	4000	8000
(Mf - sf) in dB	5	8	10	12	12	12	12

The sound pressure level (SPL) typically refers to a logarithmic measure of the effective sound pressure of a sound relative to a reference value. It may be measured e.g. in decibels (dB) above a standard reference level, e.g. 20 μ Pa root mean square in air or 1 μ Pa under water. These and other reference levels may be defined e.g. in a standard such as ANSI S1.1-1994. For example, a measurement can be done directly in front of and/or directly behind the ear plug. Measurements can be compared to determine a attenuation level of the ear plug, e.g. expressed as the relative sound pressure levels in decibels. It is noted that the amount of attenuation can be vary as a function of the sound pressure level and/or as function of sound frequency. In some measurements, the sound pressure level and/or the amount of attenuation can be integrated, e.g. over a range of frequencies. The individual or total sound pressure level can also be weighted depending on a typical sensitivity curve of human hearing.

For the purpose of clarity and a concise description, features are described herein as part of the same or separate embodiments, however, it will be appreciated that the scope of the invention may include embodiments having combinations of all or some of the features described. In one aspect, the present disclosure provides a passive acoustic filter with in series a single disc. The single disc consist of a thin element positioned in series with an other acoustic element providing a desired acoustic

characteristic at sound levels below 130 dBA, in particular in combination with universal tip or custom mould. The disc provides a strong increase in attenuation for higher sound levels as a result of a small hole. This hole can be tuned to provide more or less non-linear behaviour having limited effect on the attenuation at lower sound-levels. For example, while embodiments were shown for acoustic valves comprising passive elements, also alternative ways may be envisaged by those skilled in the art having the benefit of the present disclosure for achieving a similar function and result. For example, alternative sequences of the rigid plate, flexible membrane and/or mesh may provide alternative or additional advantages.

Acoustic elements may be combined or split up into one or more alternative components. For example, variable passive filters and/or active elements such as one or more controllable valves may be combined with the rigid disc in addition to, or instead of, the mesh and/or flexible membrane. The various elements of the embodiments as discussed and shown offer certain advantages, such as providing a simple design hearing protection providing a more natural sensation of the environment. Of course, it is to be appreciated that any one of the above embodiments or processes may be combined with one or more other embodiments or processes to provide even further improvements in finding and matching designs and advantages. It is appreciated that this disclosure offers particular advantages to hearing protection and in general can be applied for any application wherein it is desired to improve an acoustic transfer function of a hearing device.

While the present systems and methods have been described in particular detail with reference to specific exemplary embodiments thereof, it should also be appreciated that numerous modifications and alternative embodiments may be devised by those having ordinary skill in the art without departing from the scope of the present disclosure. For example, embodiments wherein devices or systems are disclosed to be arranged and/or constructed for performing a specified method or function inherently

disclose the method or function as such and/or in combination with other disclosed embodiments of methods or systems. Furthermore, embodiments of methods are considered to inherently disclose their implementation in respective hardware, where possible, in combination with other disclosed
5 embodiments of methods or systems. Furthermore, methods that can be embodied as program instructions, e.g. on a non-transient computer-readable storage medium, are considered inherently disclosed as such embodiment.

Finally, the above-discussion is intended to be merely illustrative
10 of the present systems and/or methods and should not be construed as limiting the appended claims to any particular embodiment or group of embodiments. The specification and drawings are accordingly to be regarded in an illustrative manner and are not intended to limit the scope of the appended claims. In interpreting the appended claims, it should be
15 understood that the word "comprising" does not exclude the presence of other elements or acts than those listed in a given claim; the word "a" or "an" preceding an element does not exclude the presence of a plurality of such elements; any reference signs in the claims do not limit their scope; several "means" may be represented by the same or different item(s) or
20 implemented structure or function; any of the disclosed devices or portions thereof may be combined together or separated into further portions unless specifically stated otherwise. The mere fact that certain measures are recited in mutually different claims does not indicate that a combination of these measures cannot be used to advantage. In particular, all working
25 combinations of the claims are considered inherently disclosed.

Conclusies

1. Akoestisch ventiel (10) voor gehoorbescherming, het ventiel (10) omvattende een behuizing (1) plaatsbaar of geïntegreerd in een oordop (100) om een afsluiting te vormen tussen een auditorisch kanaal (13) van een oor en een externe omgeving (11), de behuizing (1) omvattende
 - 5 – een geluidsdoorgang (2) die zich uitstrekt door de behuizing (1) voor het toestaan van tenminste gedeeltelijke transmissie van geluid van de externe omgeving (11) in het auditorisch kanaal (13);
 - een impulsfilter (3) omvattende een rigide plaat (4) welke een omsloten volume (12) vormt binnen de geluidsdoorgang (2), waarbij de
 - 10 rigide plaat (4) tenminste een perforatie (5) omvat voor het doorgeven van een deel van het geluid van de externe omgeving (11) via de perforatie (5) in het omsloten volume (12); en
 - een akoestisch filter (6) omvattende een gaas (7) ingericht in de geluidsdoorgang (2) tussen de rigide plaat (4) en het auditorisch kanaal (13).
- 15 2. Akoestisch ventiel (10) volgens conclusie 1, waarbij een totale geperforeerde dwarsdoorsnede van de tenminste een perforatie (5) in de rigide plaat (4) tussen 0.01 en 0.10 vierkante millimeter is.
3. Akoestisch ventiel (10) volgens een der voorgaande conclusies, waarbij het omsloten volume (12) is gevormd tussen de rigide plaat (4) en
- 20 het akoestische filter (6).
4. Akoestisch ventiel (10) volgens een der voorgaande conclusies, waarbij het omsloten volume (12) tussen 5 en 20 kubieke millimeter is.
5. Akoestisch ventiel (10) volgens een der voorgaande conclusies, waarbij een dikte (14) van de rigide plaat (4) bij de tenminste een perforatie
- 25 (5) tussen 0.05 en 0.5 millimeter is.

6. Akoestisch ventiel (10) volgens een der voorgaande conclusies, waarbij de rigide plaat (4) een integraal deel is van de behuizing (1).
7. Akoestisch ventiel (10) volgens een der voorgaande conclusies, waarbij het impulsfilter (3) is ingericht voor het verzachten van
5 impulsgeluid boven 130 dB van de externe omgeving (11) in het auditorisch kanaal (13), waarbij het impulsfilter (3) is geconfigureerd om impulsgeluid met een input-geluidsdrukniveau tussen 140 en 160 dB te verzachten bij een ingang van de geluidsdoorgang (2) tot een output-geluidsdrukniveau onder 140 dB bij een ander einde van de geluidsdoorgang (2).
- 10 8. Akoestisch ventiel (10) volgens een der voorgaande conclusies, waarbij het gaas (7) een geweven gaas is.
9. Akoestisch ventiel (10) volgens een der voorgaande conclusies, waarbij het gaas (7) een raster omvat waarbij een veelheid openingen door het raster worden gevormd, waarbij een dwarsdoorsnede oppervlak van de
15 openingen tussen 0.5 tot 20 procent is van het totale dwarsdoorsnede-oppervlak van het gaas (7).
10. Akoestisch ventiel (10) volgens een der voorgaande conclusies, waarbij het akoestische filter (6) een flexibel membraan (8) omvat tussen de rigide plaat (4) en het gaas (7).
- 20 11. Akoestisch ventiel (10) volgens conclusie 10, waarbij het flexibele membraan (8) is ingericht om te buigen naar het gaas (7) bij verhoogde geluidsdrukniveaus in het omsloten volume (12).
12. Akoestisch ventiel (10) volgens conclusie 11, waarbij het flexibele membraan (8) is ingericht om tegen het gaas te komen bij
25 geluidsdrukniveaus in het omsloten volume (12) boven 120 dB.
13. Akoestisch ventiel (10) volgens conclusie 11 of 12, waarbij een afstand (18) tussen het flexibele membraan (8) en het gaas (7) in evenwicht minder dan 0.15 millimeter is.

14. Akoestisch ventiel (10) volgens een der voorgaande conclusies, waarbij het akoestische filter (6) is ingericht voor het vlakmaken van een akoestische overdrachtsfunctie van geluid van de externe omgeving (11) in het auditorisch kanaal (13).
- 5 15. Oordop (100) voor gehoorbescherming omvattende een tip (101) met een buitencontour voor het afsluitend passen in een auditorisch kanaal (13) van een gebruiker, waarbij de tip (101) een kanaal (102) omvat door de tip (101), en waarbij een akoestisch ventiel (10) volgens een der voorgaande conclusies is ingericht in het kanaal (102).

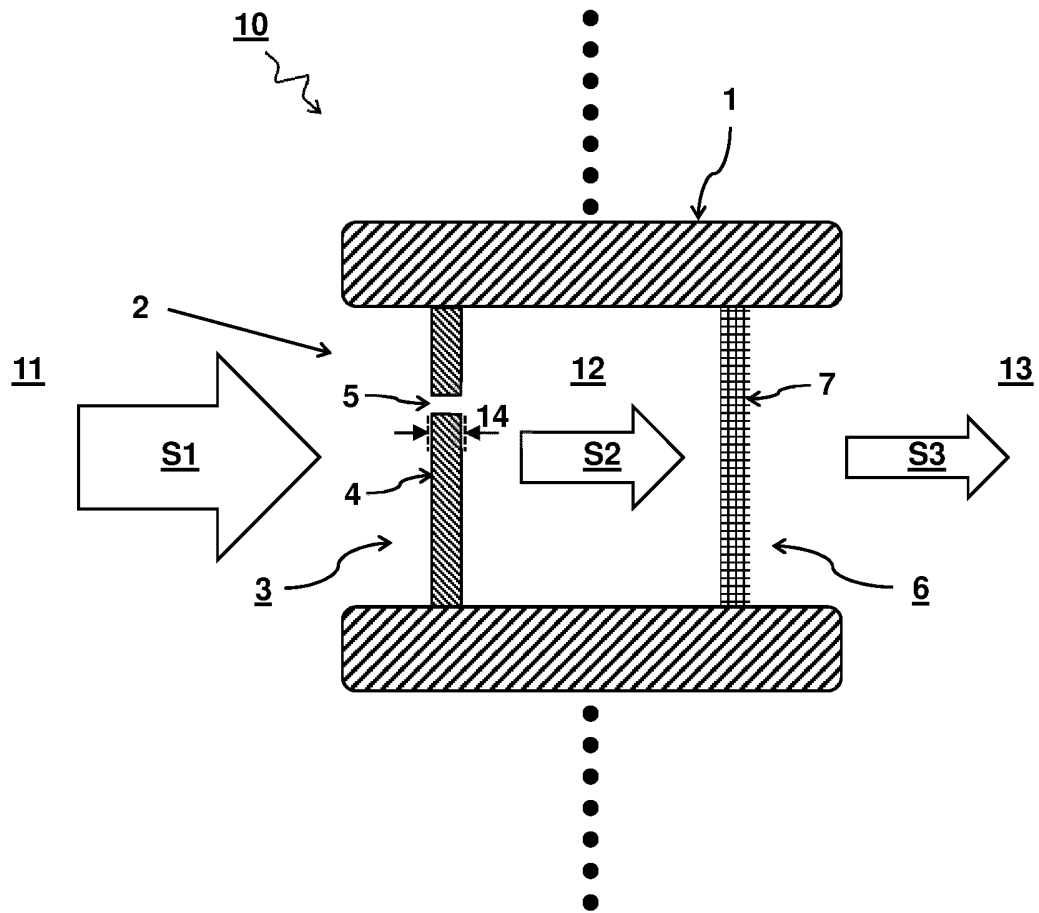


FIG 1

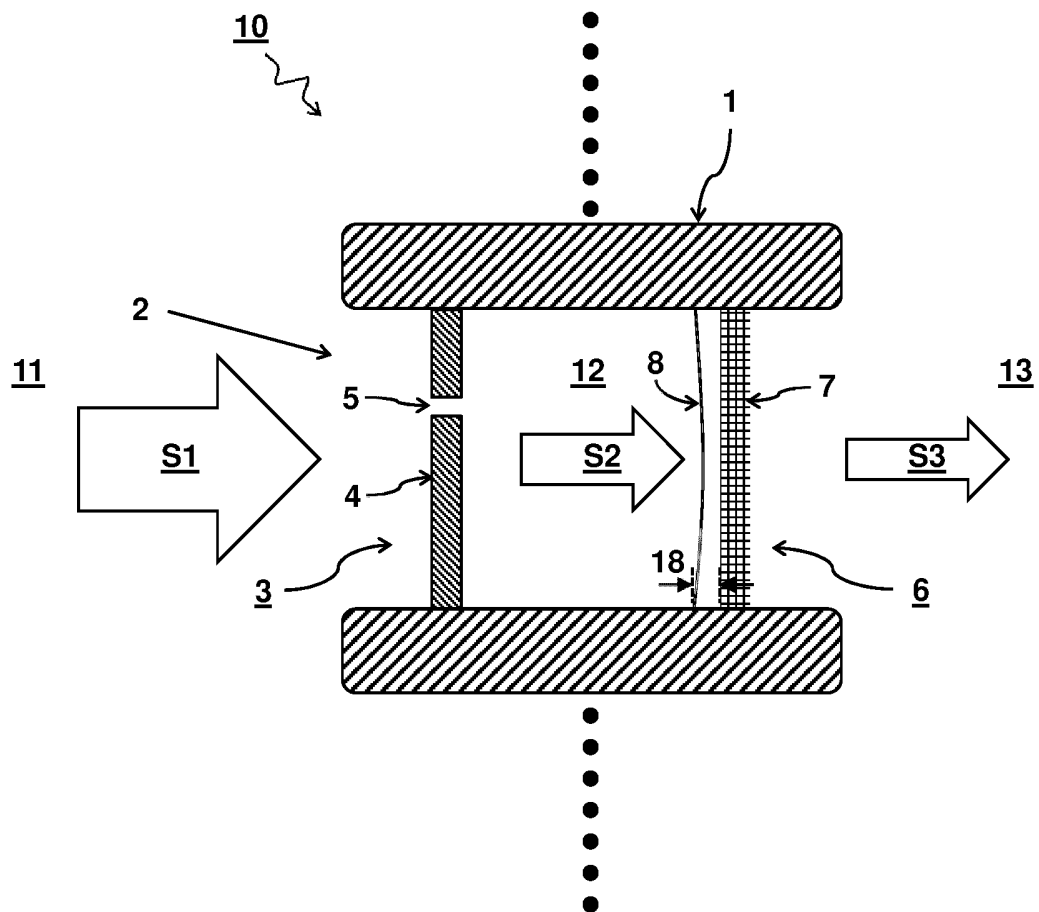


FIG 2

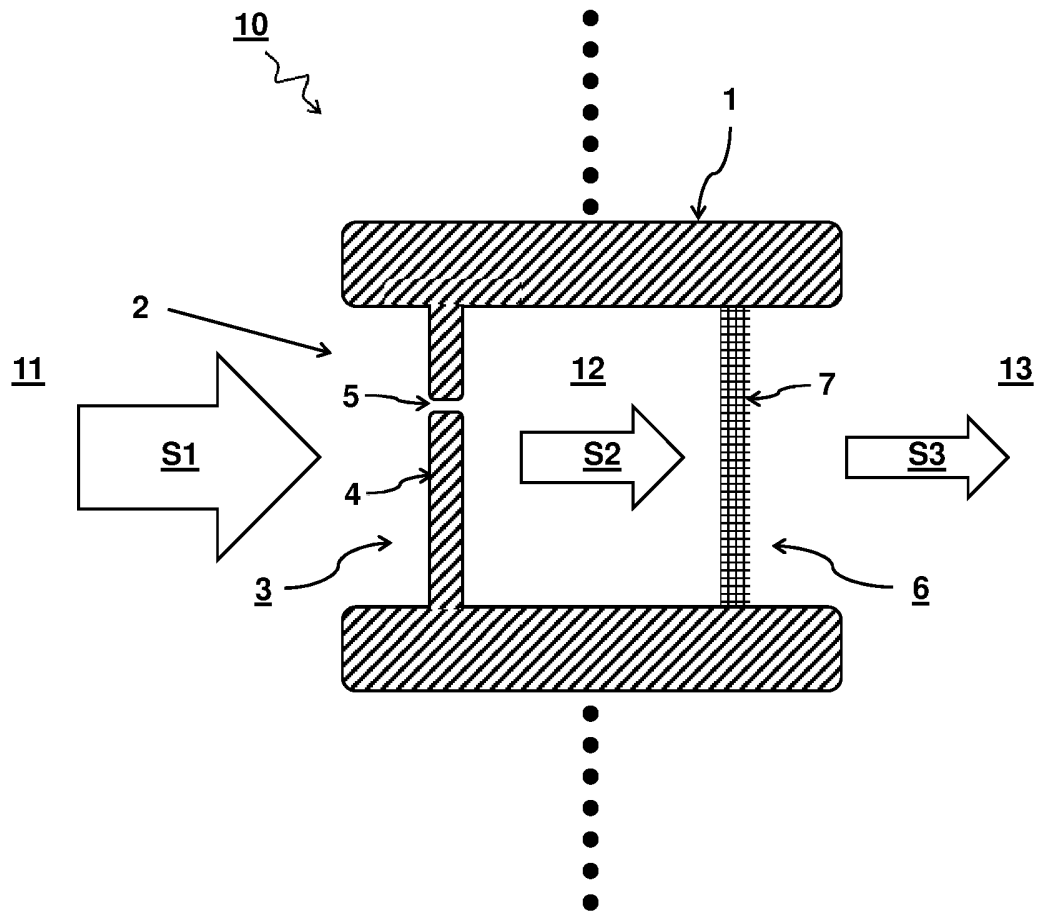


FIG 3

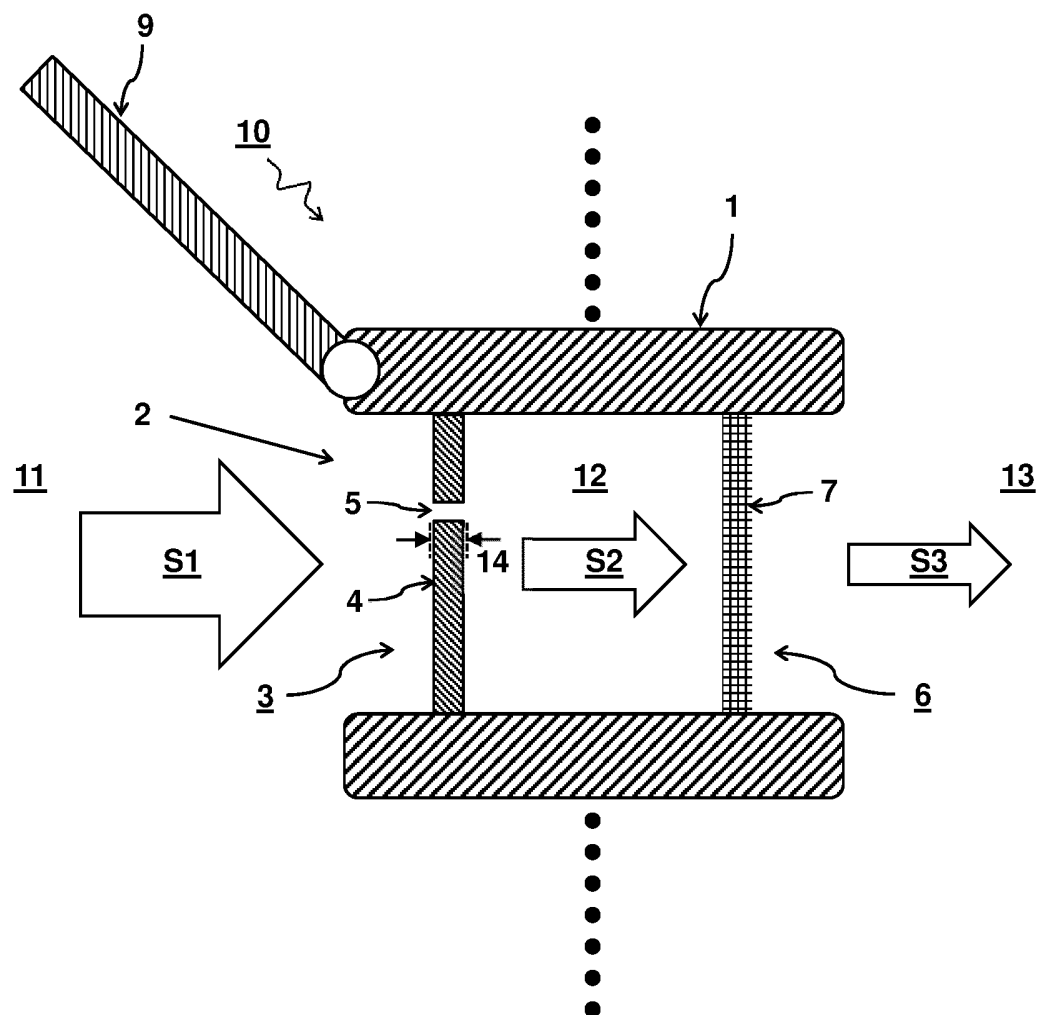


FIG 4

10

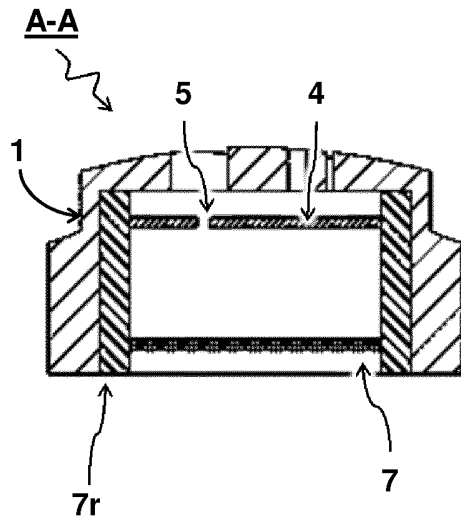


FIG 5A

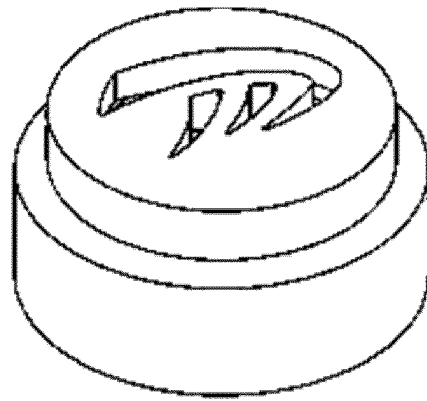


FIG 5B

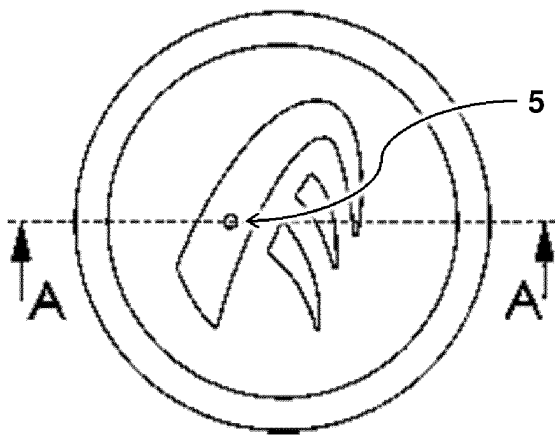


FIG 5C

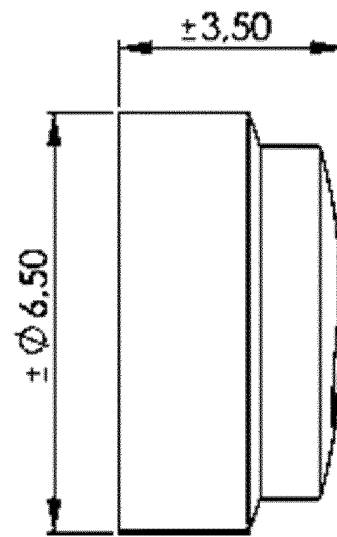


FIG 5D

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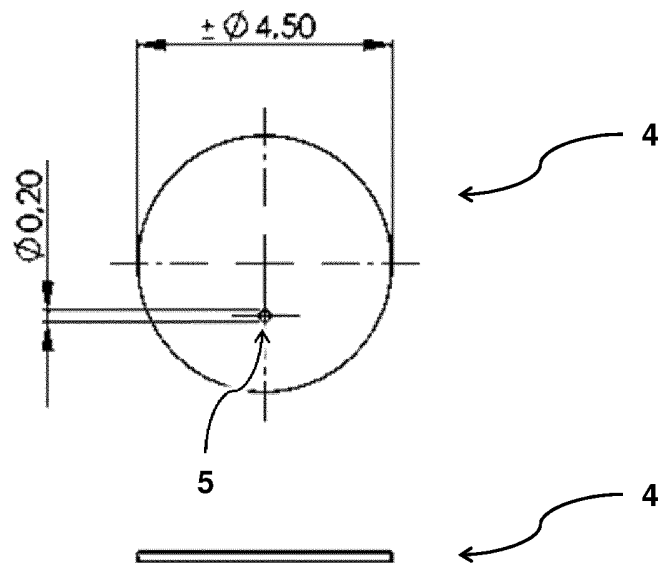


FIG 6A

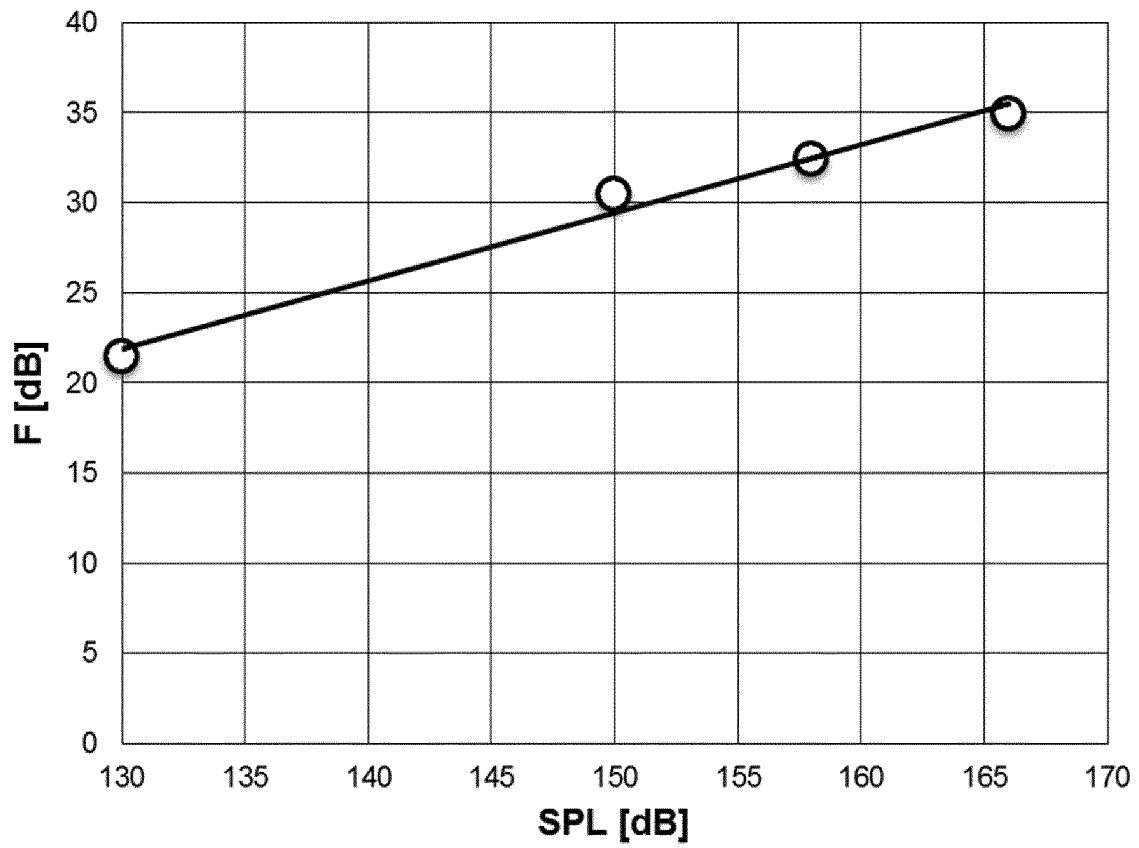


FIG 6B

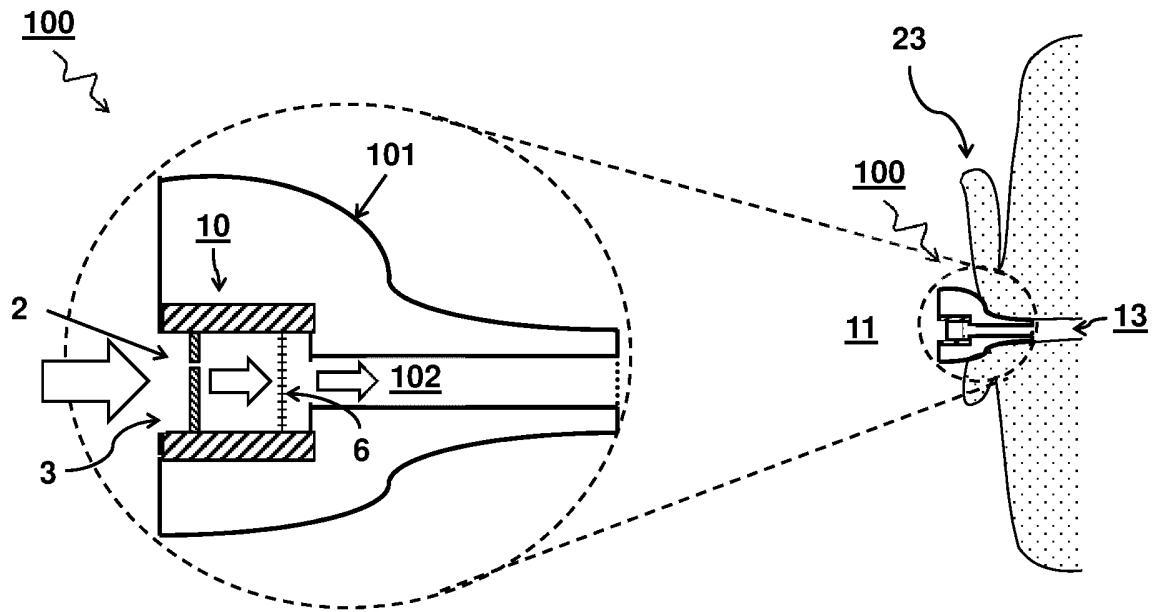


FIG 7A

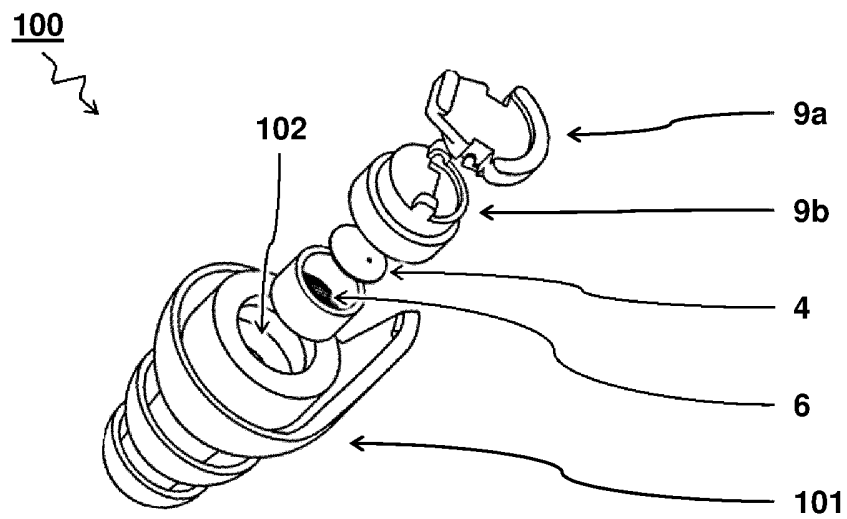


FIG 7B

Title: ACOUSTIC VALVE AND EAR PLUG FOR HEARING
 PROTECTION

ABSTRACT

The present disclosure concerns an acoustic valve (10) for hearing protection. The valve (10) comprises a housing (1) that is placeable or integrated in an ear plug (100). The housing (1) comprises a sound passage (2) extending through the housing (1) for allowing at least partial transmission of sound from the external surroundings (11) into the auditory canal (13). The housing comprises an impulse filter (3) comprising a rigid plate (4). The rigid plate (4) forms an enclosed volume (12) within the sound passage (2) of the valve. The rigid plate (4) comprises at least one perforation (5) for passing part of the sound from the external surroundings (11) via the perforation (5) into the enclosed volume (12). The housing further comprises an acoustic filter (6) comprising a mesh (7) arranged in the sound passage (2) between the rigid plate (4) and the auditory canal (13).

[FIG 1]



ONDERZOEKS RAPPORT

BETREFFENDE HET RESULTAAT VAN HET ONDERZOEK NAAR DE STAND VAN DE TECHNIEK

RELEVANTE LITERATUUR			
Categorie ¹	Literatuur met, voor zover nodig, aanduiding van speciaal van belang zijnde tekstgedeelten of figuren.	Van belang voor conclusie(s) nr.	Classificatie (IPC)
X	GB 2 458 538 A (ISORINNE JUKKA [GB]) 30 september 2009 (2009-09-30) * bladzijde 11, laatste alinea - bladzijde 12, alinea 1; figuur 9 *	1-7,14, 15	INV. A61F11/08
X	WO 2011/078659 A1 (DYNAMIC EAR COMPANY B V [NL]; WILMINK ENGBERT [NL]) 30 juni 2011 (2011-06-30) * bladzijde 5, regel 14 - regel 27; figuren *	1-15	
A	US 2007/183606 A1 (DOTY MARC L [US]) 9 augustus 2007 (2007-08-09) * alinea's [0042], [0051]; figuren *	1-15	
Indien gewijzigde conclusies zijn ingediend, heeft dit rapport betrekking op de conclusies ingediend op:			Onderzochte gebieden van de techniek
Plaats van onderzoek: 's-Gravenhage			Bevoegd ambtenaar: Neumann, Elisabeth
Datum waarop het onderzoek werd voltooid: 4 maart 2015			
¹ CATEGORIE VAN DE VERMELDE LITERATUUR			
X: de conclusie wordt als niet nieuw of niet inventief beschouwd ten opzichte van deze literatuur Y: de conclusie wordt als niet inventief beschouwd ten opzichte van de combinatie van deze literatuur met andere geciteerde literatuur van dezelfde categorie, waarbij de combinatie voor de vakman voor de hand liggend wordt geacht A: niet tot de categorie X of Y behorende literatuur die de stand van de techniek beschrijft O: niet-schriftelijke stand van de techniek P: tussen de voorrangsdatum en de indieningsdatum gepubliceerde literatuur T: na de indieningsdatum of de voorrangsdatum gepubliceerde literatuur die niet bezwarend is voor de octrooiaanvraag, maar wordt vermeld ter verheldering van de theorie of het principe dat ten grondslag ligt aan de uitvinding E: eerdere octrooi(aanvraag), gepubliceerd op of na de indieningsdatum, waarin dezelfde uitvinding wordt beschreven D: in de octrooiaanvraag vermeld L: om andere redenen vermelde literatuur &: lid van dezelfde octrooifamilie of overeenkomstige octrooipublicatie			

**AANHANGSEL BEHORENDE BIJ HET RAPPORT BETREFFENDE
HET ONDERZOEK NAAR DE STAND VAN DE TECHNIEK,
UITGEVOERD IN DE OCTROOIAANVRAGE NR.**

NO 139092
NL 2013208

Het aanhangsel bevat een opgave van elders gepubliceerde octrooiaanvragen of octrooien (zogenaamde leden van dezelfde octrooifamilie), die overeenkomen met octrooischriften genoemd in het rapport.

De opgave is samengesteld aan de hand van gegevens uit het computerbestand van het Europees Octrooibureau per

De juistheid en volledigheid van deze opgave wordt noch door het Europees Octrooibureau, noch door het Bureau voor de Industriële eigendom gegarandeerd; de gegevens worden verstrekt voor informatiedoeleinden.

04-03-2015

In het rapport genoemd octrooigeschrift		Datum van publicatie	Overeenkomend(e) geschrift(en)		Datum van publicatie
GB 2458538	A	30-09-2009	GEEN		
WO 2011078659	A1	30-06-2011	EP	2515810 A1	31-10-2012
			NL	2004004 C	23-06-2011
			US	2013126262 A1	23-05-2013
			WO	2011078659 A1	30-06-2011
US 2007183606	A1	09-08-2007	BR	PI0806441 A2	06-09-2011
			CN	101626745 A	13-01-2010
			EP	2112916 A2	04-11-2009
			US	2007183606 A1	09-08-2007
			WO	2008100407 A2	21-08-2008

SCHRIFTELIJKE OPINIE

DOSSIER NUMMER NO139092	INDIENINGSDATUM 17.07.2014	VOORRANGSDATUM	AANVRAAGNUMMER NL2013208
CLASSIFICATIE INV. A61F11/08			
AANVRAGER Dynamic Ear Company B.V.			

Deze schriftelijke opinie bevat een toelichting op de volgende onderdelen:

- ☒ Onderdeel I Basis van de schriftelijke opinie
- ☐ Onderdeel II Voorrang
- ☐ Onderdeel III Vaststelling nieuwheid, inventiviteit en industriële toepasbaarheid niet mogelijk
- ☐ Onderdeel IV De aanvraag heeft betrekking op meer dan één uitvinding
- ☒ Onderdeel V Gemotiveerde verklaring ten aanzien van nieuwheid, inventiviteit en industriële toepasbaarheid
- ☐ Onderdeel VI Andere geciteerde documenten
- ☒ Onderdeel VII Overige gebreken
- ☐ Onderdeel VIII Overige opmerkingen

	DE BEVOEGDE AMBTENAAR
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SCHRIFTELIJKE OPINIE

Aanvraag nr.:

NL2013208

Onderdeel I Basis van de Schriftelijke Opinie

1. Deze schriftelijke opinie is opgesteld op basis van de meest recente conclusies ingediend voor aanvang van het onderzoek.
2. Met betrekking tot **nucleotide en/of aminozuur sequenties** die genoemd worden in de aanvraag en relevant zijn voor de uitvinding zoals beschreven in de conclusies, is dit onderzoek gedaan op basis van:
 - a. type materiaal:
 - ☐ sequentie opsomming
 - ☐ tabel met betrekking tot de sequentie lijst
 - b. vorm van het materiaal:
 - ☐ op papier
 - ☐ in elektronische vorm
 - c. moment van indiening/aanlevering:
 - ☐ opgenomen in de aanvraag zoals ingediend
 - ☐ samen met de aanvraag elektronisch ingediend
 - ☐ later aangeleverd voor het onderzoek
3. ☐ In geval er meer dan één versie of kopie van een sequentie opsomming of tabel met betrekking op een sequentie is ingediend of aangeleverd, zijn de benodigde verklaringen ingediend dat de informatie in de latere of additionele kopieën identiek is aan de aanvraag zoals ingediend of niet meer informatie bevatten dan de aanvraag zoals oorspronkelijk werd ingediend.
4. Overige opmerkingen:

SCHRIFTELIJKE OPINIE

Aanvraag nr.:
NL2013208

Onderdeel V Gemotiveerde verklaring ten aanzien van nieuwheid, inventiviteit en industriële toepasbaarheid

1. Verklaring

Nieuwheid	Ja: Conclusies 1-15 Nee: Conclusies
Inventiviteit	Ja: Conclusies Nee: Conclusies 1-15
Industriële toepasbaarheid	Ja: Conclusies 1-15 Nee: Conclusies

2. Citaties en toelichting:

Zie aparte bladzijde

Onderdeel VII Overige gebreken

De volgende gebreken in de vorm of inhoud van de aanvraag zijn opgemerkt:

Zie aparte bladzijde

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

Reference is made to the following documents:

- D1 GB 2 458 538 A (ISORINNE JUKKA [GB]) 30 september 2009 (2009-09-30)
- D2 WO 2011/078659 A1 (DYNAMIC EAR COMPANY B V [NL]; WILMINK ENGBERT [NL]) 30 juni 2011 (2011-06-30)

1.1 The present application does not meet the criteria of patentability, because the subject-matter of claim 1 does not involve an inventive step.

D1 is regarded as being the prior art closest to the subject-matter of claim 1, and discloses (zie bladzijde 11, laatste alinea - bladzijde 12, alinea 1; figuur 9) een akoestisch ventiel voor gehoorbescherming, het ventiel omvattende een behuizing (22) plaatsbaar of geïntegreerd in een oordop om een afsluiting te vormen tussen een auditorisch kanaal van een oor en een externe omgeving, de behuizing (22) omvattende

- een geluidsdoorgang die zich uitstrekt door de behuizing (22) voor het toestaan van tenminste gedeeltelijke transmissie van geluid van de externe omgeving in het auditorisch kanaal;
- een impulsfilter omvattende een rigide plaat (33) welke een omsloten volume vormt binnen de geluidsdoorgang, waarbij de rigide plaat (33) tenminste een perforatie (34) omvat voor het doorgeven van een deel van het geluid van de externe omgeving via de perforatie (34) in het omsloten volume; en
- een akoestisch filter (25) ingericht in de geluidsdoorgang tussen de rigide plaat (33) en het auditorisch kanaal.

Filter (25) does not explicitly disclose "omvattende een gaas" although figure 9 implies a mesh on that filter.

1.2 The subject-matter of claim 1 also does not involve an inventive step in view of D2, see bladzijde 5, regel 14 - regel 27; figuren.

2 The present application does not meet the criteria of patentability, because the subject-matter of claim 1 does not involve an inventive step.

D1 further discloses an ear plug comprising the filter of claim 1.

3 Dependent claims 2-14 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of inventive step, see D1, bladzijde 11, laatste alinea - bladzijde 12, alinea 1; figuur 9.

Re Item VII

Certain defects in the application

1 Independent claim 1 is not in the two-part form, which in the present case would be appropriate, with those features known in combination from the prior art being placed in the preamble and the remaining features being included in the characterising part.

2 The relevant background art disclosed in document D1 is not mentioned in the description, nor is this document identified therein.