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(54) **HEARING INSTRUMENT**

(57) The invention relates to a hearing instrument (1), comprising a shell (2) configured to be at least partially inserted into a human ear canal, and a sound tube (3) arranged in the shell (2), configured to guide sound emitted by a receiver (4) or loudspeaker, wherein a filter insert (9) is arranged to cover a sound outlet opening of the sound tube (3) and is held against the sound outlet opening by at least one elastic element attached to the shell (2) allowing the filter insert (9) to be pulled away from the shell (2) against a retraction force of the elastic element..

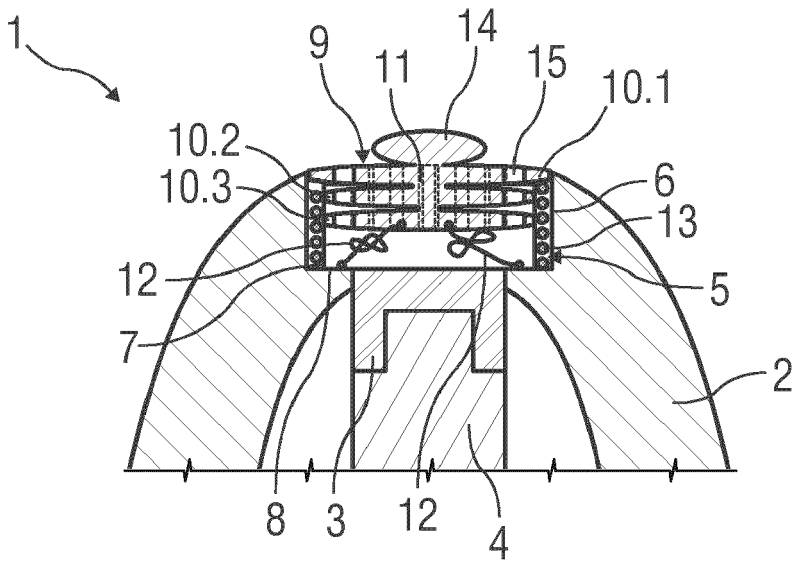

FIG 1

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Description

Technical Field

[0001] The invention relates to a hearing instrument having a filter insert.

Background of the Invention

[0002] A hearing instrument comprises a sound exit to deliver sound into a user's ear canal. The sound exit is one of the most vulnerable parts of a hearing instrument as it is prone to ingression of ear wax, sweat, and dander.

[0003] Wax guard systems for hearing instruments are designed to either inhibit ingressions of ear wax (cerumen), sweat, humidity and other particles into a sound tube or loudspeaker (also referred to as the receiver) of a hearing instrument with a filter or to lead the sound from the loudspeaker around a cap which serves as wax protection.

[0004] The filters of systems known in the art have to be exchanged with new ones regularly, the frequency of the exchange depending on the amount of ingressions. Users with reduced dexterity such as elderly people which are typical users of hearing instruments may be challenged by having to handle small items such as filters for hearing instruments. Moreover, new filters need to be purchased resulting in costs.

[0005] Systems with a cap leading the sound around this cap distort the straight sound flow. Also, due to the cap being attached on top of the device, there is a risk for the cap to fall off into the ear canal, causing risks for the user of the hearing instrument.

Summary of the Invention

[0006] It is an object of the present invention to provide a novel filter solution for a hearing instrument.

[0007] The object is achieved by a hearing instrument according to claim 1.

[0008] Preferred embodiments of the invention are given in the dependent claims.

[0009] The term medial as used herein refers to a direction and parts of a hearing instrument closer to the center of a user's body when the hearing instrument is at least partially inserted into a user's ear canal, while the term lateral refers to the opposite direction.

[0010] According to the invention, a hearing instrument comprises a shell configured to be at least partially inserted into a human ear canal, and a sound tube arranged in the shell, configured to guide sound emitted by a receiver or loudspeaker, wherein a filter insert is arranged to cover a sound outlet opening of the sound tube and held against the sound outlet opening by at least one elastic element attached to the shell allowing the filter insert to be pulled away from the shell. The filter insert is thus pulled against the sound outlet opening by the elastic element, e.g. to reposition the filter insert after cleaning.

[0011] In an exemplary embodiment, the elastic element may be a tension spring or an elastic cord.

[0012] In an exemplary embodiment, the sound tube ends in a hole in the shell, wherein the hole in the shell is configured as a bushing or has a bushing arranged therein, wherein the elastic element is attached to the bushing.

[0013] In an exemplary embodiment, the bushing comprises a medial opening and a lateral bottom with an opening toward the sound tube, wherein the filter insert is arranged in the bushing.

[0014] The tension spring may be arranged in the bushing, wherein a lateral end of the tension spring is fixed to the bushing and a medial end of the tension spring is fixed to the filter insert.

[0015] In an exemplary embodiment, the bushing has an outer wall and an inner wall.

[0016] In an exemplary embodiment, the tension spring is arranged in a space between the inner wall and the outer wall of the bushing. This may help protect the tension spring from being distained by ingressions.

[0017] In an exemplary embodiment, one, two, three, four or more security threads are provided to connect the filter insert to the shell or bushing to limit the movement of the filter insert away from the shell. This allows for preventing the filter insert to fall off the hearing instrument into the ear canal. If the at least one elastic element is at least one elastic cord, it may also assume the function of a security thread so separate security threads are not required. The elastic cord may be configured to be elastic until reaching a certain extension and be considerably less elastic beyond this point. This may for example be achieved by a configuration of a fabric of the cord arranged around an elastic core.

[0018] In an exemplary embodiment, the elastic element has a retraction force smaller than a weight of the hearing instrument when the filter insert is pulled away from the shell, so that just by holding the hearing instrument, e.g. by a handling knob, the filter insert will remain outside of the bushing or hole.

[0019] In an exemplary embodiment, the bushing is glued and/or press-fitted to the shell and/or the sound tube is glued and/or press-fitted to the bottom of the bushing.

[0020] In an exemplary embodiment, the filter insert comprises a series of two or more concentric discs, connected to each other through a hub, wherein each disc is provided with a multitude of through-holes. The discs may be arranged at a distance between each other. When the filter insert is removed from the hearing instrument, it may easily be cleaned from any ingressions brushing the spaces between the discs or using an air jet. The hub may be arranged about a longitudinal axis of the filter insert and the discs may protrude radially from the central axis beyond the hub.

[0021] In an exemplary embodiment, the through-holes of each disc are non-overlapping or misaligned with

the through-holes of one or more adjacent discs or all of the other discs, thus creating a wax labyrinth.

[0022] In an exemplary embodiment, the discs comprise a top disc at a medial end of the filter insert, wherein the top disc has a diameter greater than the diameters of the other discs. This allows for inserting the other discs into a hole in the hearing instrument while the top disc may cover said hole.

[0023] In an exemplary embodiment, the filter insert further comprises a handling knob arranged at the medial end of the hub or of the top disc to facilitate pulling the filter insert out of the hole in the hearing instrument.

[0024] In an exemplary embodiment, the diameter of the other discs corresponds to an inner diameter of the bushing or the inner wall thereof.

[0025] In an exemplary embodiment, the diameter of the top disc is greater than the diameter of the bushing or the inner wall thereof, in particular as great as or greater than the diameter of the outer wall thereof.

[0026] In an exemplary embodiment, the filter insert comprises or consists of or is coated with a repellent material, in particular PTFE to facilitate cleaning.

[0027] In an exemplary embodiment, the filter insert may be produced by 3D printing.

[0028] Further scope of applicability of the present invention will become apparent from the detailed description given hereinafter. However, it should be understood that the detailed description and specific examples, while indicating preferred embodiments of the invention, are given by way of illustration only, since various changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art from this detailed description.

Brief Description of the Drawings

[0029] The present invention will become more fully understood from the detailed description given hereinbelow and the accompanying drawings which are given by way of illustration only, and thus, are not limitative of the present invention, and wherein:

Figure 1 is a schematic detail view of a hearing instrument with a filter insert in place, and

Figure 2 is a schematic detail view of the hearing instrument with the filter insert pulled out.

[0030] Corresponding parts are marked with the same reference symbols in both figures.

Detailed Description of Preferred Embodiments

[0031] Hearing instruments or parts thereof (e.g. shells or molds) configured to be placed at least partially into a human ear canal are subject to ingression of organic material existing in or produced by the ear canal or its tissue or glands, like cerumen (ear wax), sweat, and dander.

[0032] The present invention provides a solution aiming at protecting the sound flow from hearing instruments towards the human ear drum (tympanic membrane) against the ingression of any solid, plastic or fluid substances.

[0033] **Figure 1** is a schematic detail view of a hearing instrument 1 comprising a shell 2 or mold configured to be at least partially inserted into a human ear canal and a sound tube 3 arranged in the shell 2, ending in a hole therein and configured to guide sound emitted by a receiver 4 or loudspeaker, which may also be arranged in the shell 2. In other embodiments, the receiver 4 may be located in an external device such as a behind-the-ear part of a hearing instrument 1, connected through a sound guide such as a tube or hose to the sound tube 3 in the shell 2.

[0034] The hole in the shell 2 may be configured as a bushing 5 or have a bushing 5 arranged therein. The bushing 5 may have an outer wall 6 and an inner wall 7 and a bottom 8 with an opening to allow sound from the sound tube 3 to enter. The bushing 5 may be glued and/or press-fitted to the shell 2, while the sound tube 3 may be fixed, e.g. glued and/or press-fitted, to the bottom 8 of the bushing 5.

[0035] A filter insert 9 is configured to be at least partially inserted into the bushing 5, in particular within the inner wall 7 thereof. The filter insert 9 comprises a series of concentric discs 10.1, 10.2, 10.3, connected to each other through a hub 11. The illustrated embodiment shows three discs 10.1, 10.2, 10.3. However, the skilled person readily understands that there may be more or less than three discs 10.1, 10.2, 10.3 in the filter insert 9. Each disc 10.1, 10.2, 10.3 is provided with a multitude of through-holes 15 to allow the sound to pass through. In an exemplary embodiment, the through-holes 15 of each disc 10.1, 10.2, 10.3 are non-overlapping or misaligned with the through-holes 15 of one or more adjacent discs 10.1, 10.2, 10.3 or all other discs 10.1, 10.2, 10.3 thus creating a wax labyrinth. The discs 10.1, 10.2, 10.3 comprise a top disc 10.1 at or near a medial end of the filter insert 9, wherein the top disc 10.1 has a diameter greater than the diameters of the other discs 10.2, 10.3. The diameter of the other discs 10.2, 10.3 may correspond to an inner diameter of the bushing 5 or the inner wall 7 thereof, in particular the diameter of the other discs 10.2, 10.3 may be nearly the same as the inner diameter of the bushing 5 or the inner wall 7 thereof such that the other discs 10.2, 10.3 may enter the bushing 5 easily. The diameter of the top disc 10.1 is for example greater than the diameter of the bushing 5 or the inner wall 7 thereof, in particular as great as or greater, e.g. slightly greater, than the diameter of the outer wall 6 thereof, so that the top disc 10.1 can cover a medial opening of the bushing 5, in particular completely.

[0036] One, two, three, four or more security threads 12 may be provided to connect the filter insert 9, in particular a lateral end thereof, to the bushing 5, in particular the bottom 8 thereof, to limit the movement of the filter

insert 9 out of the bushing 5.

[0037] A tension spring 13 or another elastic component, e.g. an elastic cord, may be arranged in the bushing 5, e.g. in a space between the inner wall 7 and the outer wall 6 of the bushing 5, wherein a lateral end of the tension spring 13 is fixed to the bushing 5, e.g. the bottom 8 thereof, and a medial end of the tension spring 13 is fixed to the filter insert 9, in particular the top disc 10.1 thereof. The filter insert 9 is thus pulled into the bushing 5 by the tension spring 13, e.g. to reposition the filter insert 9 after cleaning.

[0038] The filter insert 9 further may comprise a handling knob 14 arranged at the medial end of the hub 11 or of the top disc 10.1, allowing the filter insert 9 to be grabbed by a user and pulled out of the bushing 5, e.g. for cleaning the filter insert 9.

[0039] **Figure 2** is a schematic view of the hearing instrument 1 with the filter insert 9 being pulled out of the bushing 5.

[0040] The extension of the filter insert 9 from the bushing 5 may be limited by the security threads 12. Pulling the filter insert 9 out of the bushing 5 will tension the tension spring 13. The safety threads 12 will also protect the tension spring 13 from overextension.

[0041] In an exemplary embodiment, the tension spring 13 is dimensioned with a retraction force smaller than the weight of the hearing instrument 1 when the filter insert is pulled away from the shell, so that just by holding the hearing instrument 1 by the handling knob 14, the filter insert 9 will remain outside of the bushing 5. This allows for a reliable cleaning of the filter insert 9, e.g. using a brush or an air jet.

[0042] Releasing the handling knob 14 will allow the filter insert 9 to be pulled back into the bushing 5 by the force of the tension spring 13.

[0043] The combination of multiple stacked discs 10.1 to 10.3 with through-holes 15 provides a stack of filters which will prevent the receiver 4 and/or the sound tube 3 from being occluded and damaged by particle ingression.

[0044] The described solution allows for quick cleaning which eliminates the requirement for frequent filter replacement. This results in an easier handling of hearing instruments 1 worn in the ear and also in a cost reduction for the user of the hearing instrument 1.

[0045] The filter insert 9 may for example be produced by 3D printing.

[0046] The filter insert 9 may comprise or consist of or be coated with a repellent material such as PTFE.

[0047] The described configuration solves or mitigates the problems of ingression of ear wax (cerumen), sweat, humidity and other particles into the sound tube 3 or loudspeaker of the hearing instrument 1, and prevents or reduces the risk of loss of loose wax filters. Moreover, the present invention facilitates filter cleaning in hearing instruments 1, avoids the need to replace them and helps overcome dexterity issues with replacing tiny filters.

List of References

[0048]

1	hearing instrument
2	shell
3	sound tube
4	receiver
5	bushing
6	outer wall
7	inner wall
8	bottom
9	filter insert
10.1	disc, top disc
10.2, 10.3	disc, other disc
11	hub
12	security thread
13	tension spring
14	handling knob
15	through-hole

Claims

1. A hearing instrument (1), comprising a shell (2) configured to be at least partially inserted into a human ear canal, and a sound tube (3) arranged in the shell (2), configured to guide sound emitted by a receiver (4) or loudspeaker, wherein a filter insert (9) is arranged to cover a sound outlet opening of the sound tube (3) and is held against the sound outlet opening by at least one elastic element attached to the shell (2) allowing the filter insert (9) to be pulled away from the shell (2) against a retraction force of the elastic element.

2. The hearing instrument (1) according to claim 1, wherein the elastic element is a tension spring (13) or an elastic cord.

3. The hearing instrument (1) according to claim 1 or 2, wherein the sound tube (3) ends in a hole in the shell (2), wherein the hole in the shell (2) is configured as a bushing (5) or has a bushing (5) arranged therein, wherein the elastic element is preferably attached to the bushing (5).

4. The hearing instrument (1) according to claim 3, wherein the bushing (5) comprises a medial opening and a lateral bottom (8) with an opening toward the sound tube (3), wherein the filter insert (9) is arranged in the bushing (5).

5. The hearing instrument (1) according to claim 3 or 4, wherein the bushing (5) has an outer wall (6) and an inner wall (7).

6. The hearing instrument (1) according to claim 5,

wherein the tension spring (13) is arranged in a space between the inner wall (7) and the outer wall (6) of the bushing (5).

7. The hearing instrument (1) according to any one of the preceding claims, wherein one, two, three, four or more security threads (12) are provided to connect the filter insert (9) to the shell (2) or bushing (5) to limit the movement of the filter insert (9) away from the shell (2).

8. The hearing instrument (1) according to any one of the preceding claims, wherein the elastic element has a retraction force smaller than a weight of the hearing instrument (1) when the filter insert is pulled away from the shell.

9. The hearing instrument (1) according to any one of claims 3 to 8, wherein the bushing (5) is glued and/or press-fitted to the shell (2) and/or wherein the sound tube (3) is glued and/or press-fitted to the bottom (8) of the bushing (5).

10. The hearing instrument (1) according to any one of the preceding claims, wherein the filter insert (9) comprises a series of two or more concentric discs (10.1, 10.2, 10.3), connected to each other through a hub (11), wherein each disc (10.1, 10.2, 10.3) is provided with a multitude of through-holes (15).

11. The hearing instrument (1) according to claim 10, wherein the through-holes (15) of each disc (10.1, 10.2, 10.3) are non-overlapping or misaligned with the through-holes (15) of one or more adjacent discs (10.1, 10.2, 10.3).

12. The hearing instrument (1) according to claim 10 or 11, wherein the discs (10.1, 10.2, 10.3) comprise a top disc (10.1) at a medial end of the filter insert (9), wherein the top disc (10.1) has a diameter greater than the diameters of the other discs (10.2, 10.3).

13. The hearing instrument (1) according to any one of the claims 10 to 12, wherein the filter insert (9) further comprises a handling knob (14) arranged at the medial end of the hub (11) or of the top disc (10.1).

14. The hearing instrument (1) according to claim 12 or 13, wherein the diameter of the other discs (10.2, 10.3) corresponds to an inner diameter of the bushing (5) or the inner wall (7) thereof.

15. The hearing instrument (1) according to any one of claims 12 to 14, wherein the diameter of the top disc (10.1) is greater than the diameter of the bushing (5) or the inner wall (7) thereof, in particular as great as or greater than the diameter of the outer wall (6) thereof.

Amended claims in accordance with Rule 137(2) EPC.

1. A hearing instrument (1), comprising a shell (2) configured to be at least partially inserted into a human ear canal, and a sound tube (3) arranged in the shell (2), configured to guide sound emitted by a receiver (4) or loudspeaker, wherein a filter insert (9) is arranged to cover a sound outlet opening of the sound tube (3) and is held against the sound outlet opening by at least one elastic element attached to the shell (2) allowing the filter insert (9) to be pulled away from the shell (2) against a retraction force of the elastic element, **characterized in that** the elastic element is a tension spring (13) or an elastic cord.

2. The hearing instrument (1) according to claim 1, wherein the sound tube (3) ends in a hole in the shell (2), wherein the hole in the shell (2) is configured as a bushing (5) or has a bushing (5) arranged therein, wherein the elastic element is preferably attached to the bushing (5).

3. The hearing instrument (1) according to claim 2, wherein the bushing (5) comprises a medial opening and a lateral bottom (8) with an opening toward the sound tube (3), wherein the filter insert (9) is arranged in the bushing (5).

4. The hearing instrument (1) according to claim 2 or 3, wherein the bushing (5) has an outer wall (6) and an inner wall (7).

5. The hearing instrument (1) according to claim 4, wherein the tension spring (13) is arranged in a space between the inner wall (7) and the outer wall (6) of the bushing (5).

6. The hearing instrument (1) according to any one of the preceding claims, wherein one, two, three, four or more security threads (12) are provided to connect the filter insert (9) to the shell (2) or bushing (5) to limit the movement of the filter insert (9) away from the shell (2).

7. The hearing instrument (1) according to any one of the preceding claims, wherein the elastic element has a retraction force smaller than a weight of the hearing instrument (1) when the filter insert is pulled away from the shell.

8. The hearing instrument (1) according to any one of claims 2 to 7, wherein the bushing (5) is glued and/or press-fitted to the shell (2) and/or wherein the sound tube (3) is glued and/or press-fitted to the bottom (8) of the bushing (5).

9. The hearing instrument (1) according to any one of

the preceding claims, wherein the filter insert (9) comprises a series of two or more concentric discs (10.1, 10.2, 10.3), connected to each other through a hub (11), wherein each disc (10.1, 10.2, 10.3) is provided with a multitude of through-holes (15).

10. The hearing instrument (1) according to claim 9, wherein the through-holes (15) of each disc (10.1, 10.2, 10.3) are non-overlapping or misaligned with the through-holes (15) of one or more adjacent discs (10.1, 10.2, 10.3).

11. The hearing instrument (1) according to claim 9 or 10, wherein the discs (10.1, 10.2, 10.3) comprise a top disc (10.1) at a medial end of the filter insert (9), wherein the top disc (10.1) has a diameter greater than the diameters of the other discs (10.2, 10.3).

12. The hearing instrument (1) according to any one of the claims 9 to 11, wherein the filter insert (9) further comprises a handling knob (14) arranged at the medial end of the hub (11) or of the top disc (10.1).

13. The hearing instrument (1) according to claim 11 or 12, wherein the diameter of the other discs (10.2, 10.3) corresponds to an inner diameter of the bushing (5) or the inner wall (7) thereof.

14. The hearing instrument (1) according to any one of claims 11 to 13, wherein the diameter of the top disc (10.1) is greater than the diameter of the bushing (5) or the inner wall (7) thereof, in particular as great as or greater than the diameter of the outer wall (6) thereof.

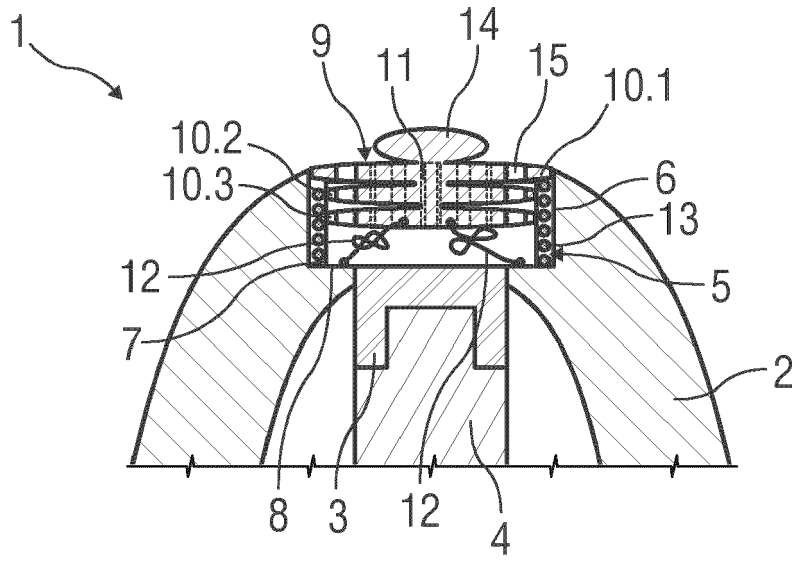
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FIG 1

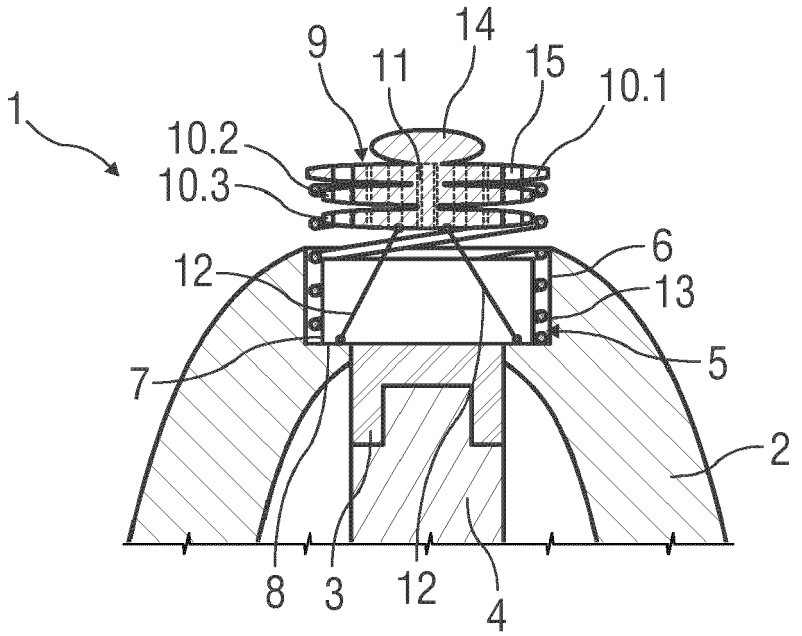
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FIG 2

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EUROPEAN SEARCH REPORT

Application Number
EP 22 17 0535

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	6 October 2022	Guillaume, Mathieu

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 22 17 0535

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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