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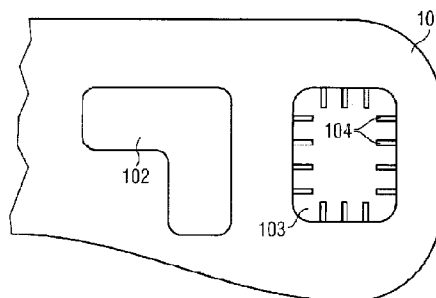
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FIG 1



(57) Abstract: Various embodiments pertain to a hearing aid with an outer housing which contains components positioned in mounting enclosures (102, 103), which components are suitable for detecting, amplifying and transmitting sound to the wearer, and also contains a formed piece (101) including resilient material and which defines the mounting enclosures for a plurality of the components. Various embodiments also pertain to the formed piece, which is insertable into the outer housing, and methods of manufacture of the formed piece using injection moulding, e.g. single and double injection moulding. Various embodiments are suitable for hearing aids which include a portion arranged to be worn behind the ear.



HEARING AID WITH INSERT

[0001] The invention relates to a hearing aid.

[0002] A hearing aid allows a hearing impaired wearer to hear a greater range of audio frequencies and to hear them at a greater volume than would be the case without the additional aid. Many hearing aids feature a formed piece which sits inside the ear and a small casing arranged to sit behind the ear. The small casing contains, for example, a receiver, microphone, SMD (surface mount technology) amplifier, and other electronic apparatus suitable for the operation of the hearing aid and via which the hearing aid is suitable for receiving sound from the environment and transmitting it into the ear of the wearer. Such hearing aids are often known as 'behind the ear' (BTE) hearing aids, or 'over the ear' (OTE) hearing aids. Typically, an arrangement is provided which allows transfer of the detected sound from the section situated behind the ear into the piece which sits in the ear and which transmits sound into the ear of the wearer. A common solution to achieve this is an acoustic tube which runs along a connecting structure between the small casing behind the ear and the transmitting section placed in the ear. An alternative arrangement is to include a small receiver in an ear piece which broadcasts detected sound directly into the ear and in this case is connected to the casing behind the ear using wires.

[0003] The small casing which is worn behind the ear is conventionally constructed from molded plastic and includes an internal network of spaces which accommodate the various electronic components needed for operation. The electronic components in a

conventional hearing aid are prone to vibration and to damage due to accelerative movement against the interior sides of the casing. Typically these problems are reduced by the addition of an inner formed piece, in the form of a small rubber frame, around each component to provide a degree of cushioning. Each small rubber frame typically includes protrusions orientated outwards from the encapsulated component which cushion the component against the inner sides of the internal network of spaces of the casing.

[0004] US 2008/0112584 discloses an alternative arrangement. This document describes a support mount for an electronic component, suitable for use in a hearing aid, and in the form of a small, regularly shaped frame which exhibits inner protrusions and which fits around the outer surface of the electronic component and positions it in a regularly shaped mounting enclosure inside the outer casing of the hearing aid. The protrusions are directed inwards from the inner side of the rubber frame, in the direction of the electronic component, and grip its outer surface. The protrusions take various forms including a conical form, a form with a substantially triangular cross section, a gently curving dome-like cross sectional form with an inner air space or, when situated in a corner of the inner surface of the frame, a quarter moon cross section. The outer sides of the small rubber frame are smooth and are regularly shaped to fit the size and shape of the mounting enclosure into which the electronic component is placed. The electronic component is thereby both secured into position in the mounting enclosure and is also protected from damage by use of the inner frame. An additional rubber frame is required for each extra component to be incorporated into the hearing aid and each frame must be accurately sized to fit both the electronic component and the inner dimensions of the

mounting enclosure which corresponds to that particular component. Each electronic component must be inserted into its corresponding frame before placement in the outer casing of the hearing aid and these additional steps must therefore be incorporated into the manufacture of the hearing aid for every additional component which is included in the hearing aid.

[0005] The use of a formed piece to define multiple mounting enclosures may simplify production of the hearing aid because it allows multiple electronic components to be inserted or slotted directly into corresponding receiving spaces within the outer casing without the need to first apply an individual outer frame to each component.

[0006] Assembly of the hearing aid is therefore considerably simplified because manufacture can either be accomplished by the insertion into the outer casing of a single formed piece into which the individual electronic components can be directly inserted, or, by the insertion of the electronic components individually into the formed piece followed by insertion of the formed piece into the outer casing. The need for, and the manufacture of, multiple rubber frames, one for each electronic component, is obviated. Additionally however, since the formed piece is constructed from a resilient material the electronic components can still be positioned within the outer casing while remaining cushioned and protected from shock caused by sudden deceleration. The single formed piece, by containing multiple mounting enclosures, ensures a simple and effective solution for the problem of how to place the electronic components into the hearing aid casing in such a way that they retain their position while remaining protected from vibration and damage. The formed piece thereby provides a dual function, that of both ensuring positional stability of the enclosed electronic components and also of ensuring that the components

are cushioned. The components are often connected by wires and these can be disrupted by relative movement between the components caused by shocks to the outer casing caused during routine use of the hearing aid. The cushioning provided by the single formed piece to multiple components simultaneously reduces relative movement between the components and greatly reduces the possibility that electrical connection between components will be disrupted.

[0007] Additionally, the damping offered by the formed piece is greater than in the conventional devices because the electronic components are no longer protected by a thin layer of rubber. They are instead supported by a thicker, more substantial body of resilient material through which any forces of vibration or shock can be spread or dissipated.

[0008] The creation of multiple mounting enclosures within a resilient formed piece may also improve positional stability within the hearing aid. Sudden decelerative shock, caused for example by dropping, may cause damage to the plastic casing of a traditionally formed hearing aid and may cause physical damage and possibly disruption to the network of internal spaces. This potentially causes permanent displacement of the inner components and may result in dislocation of their connections and therefore permanent damage to the function of the hearing aid. With use of the resilient formed piece, however, sudden decelerative shock is far less likely to cause permanent disruption to the relative position of the inner electronic components and therefore is far less likely to result in permanent damage to the function of the hearing aid.

[0009] In one embodiment, at least one mounting enclosure in the formed piece includes a protrusion arrangement. The protrusion arrangement includes at least one

protrusion but in some embodiments includes two protrusions or more. Several protrusions may be included in any one mounting enclosure but the effects of the various embodiments can still be achieved using only one protrusion in a single mounting enclosure. Each protrusion is arranged to protrude from the formed piece into the space defined by the mounting enclosure and is arranged to be of a size suitable to provide a structure sufficiently resilient and supporting to hold the electronic component in place within the mounting enclosure.

[0010] When there are multiple protrusions in any one mounting enclosure they may be arranged to be spaced evenly around the sides of the mounting enclosure and may be arranged to be generally of a height suitable to span the gap between the sides of the mounting enclosure and the sides of the electronic component when the component is placed in the mounting enclosure. Alternatively, and since the material of the formed piece is resilient, the protrusions may be arranged to be of a height that is slightly longer than the height needed to span the gap between the sides of the mounting enclosure and the sides of the electronic component. In this case, the height of the protrusions are slightly longer than would be predicted by the size of the corresponding electronic component and the size of the accommodating mounting enclosure in which the protrusions are arranged. Insertion of the electronic component into the available space in the mounting enclosure therefore may compress the protrusions slightly and since they are resilient the protrusions are placed under tension and thereby may provide a more secure cushion for the electronic component.

[0011] Further, and regardless of whether the protrusions are of a height that will or will not place them under tension when the component is inserted, when the protrusions

are situated on several sides of the mounting enclosure they may be arranged to be of substantially similar size so that the electronic component is held at a position approximately in the middle of the mounting enclosure where it is equidistant from the surrounding side walls. This reduces potential damage from a sudden decelerative shock, such as would occur for example if the hearing aid fell off the ear of the wearer and dropped onto the floor.

[0012] The protrusions are formed to protrude from the inner surface of the mounting enclosure and may take several forms including ridges, rectangles, nubs, cones, cylinders and points. In one embodiment the protrusions are substantially rectangular in shape and with a height, as measured from the base of the protrusion where it meets the side of the mounting enclosure to the side of the protrusion furthest away from the base, of generally between 0.2 mm to 10 mm, and of a length, measured perpendicular to the measurement of height, in the range of 0.2 mm to 1 mm, and of a width, also measured perpendicular to the measurement of height, in the range of 0.2 mm to 1 mm.

[0013] The actual dimensions of the protrusions, but also the spacing between individual protrusions may vary according to the weight and size of the component to be supported in the corresponding mounting enclosure. Generally it is found that for the typical size and weight of components used in a hearing aid a suitable support can be provided by a protrusion every 0.5 to 2 mm. Generally, about the number of protrusions suitable for any one side of the mounting enclosure varies in the range between 2 and 20, depending on the length of the side but it is found that between 2 and 5 protrusions along a short side is often adequate and between, say, 5 and 10 protrusions distributed on longer sides.

[0014] The formed piece can be made from any resilient material but it is usually made from rubber, and particularly synthetic rubber and more particularly silicone rubber. Rubber is relatively easy to cast and mould in an irregular form and the techniques for doing so are well known as such. In addition, an entire, irregular formed piece with protrusions can be moulded in one step using single injection moulding and this allows the manufacturing of the hearing aid to be simplified. One effect of using a formed piece manufactured using single injection moulding may be that it may obviate the need to manufacture multiple rubber frames of varying sizes, one for each type of component and this thereby reduces the number of moulds that must be made and used in order to produce a single type of hearing aid. Instead of the need to use a different mould to produce the rubber frames for each type of electronic component, only one mould need be used, which casts a formed piece comprising multiple mounting enclosures.

[0015] As an alternative to rubber, any other soft material can be used that provides sufficient cushioning and damping while carrying the electronic components, and which provides a sufficient acoustic barrier to obviate acoustic coupling between the microphones and the receiver. Generally an alternative to rubber would normally be some other resilient material.

[0016] The preferred qualities of the material used for the formed piece can be described in terms of Shore hardness. The quantity of Shore hardness provides a measure of the extent to which a material allows rebound from its surface. It offers, in effect, a measure of the degree of elasticity of the material. In some embodiments, the resilient material of which the formed piece is formed should have a shore hardness in the range from about 15 to about 40 shore hardness (for damping/cushioning purpose). A material

with shore hardness in this range should offer sufficient cushioning of the electronic components. In some embodiments, the value of shore hardness is more specifically in a range from about 15 to about 30 shore hardness. Values in this range provide excellent cushioning for components of the size typically found in a hearing aid. The material used for positioning/structural purpose may have a value of shore hardness in the range from about 40 to about 70 shore hardness. However, in some embodiments the shore hardness may be in a range from about 40 to about 70 and these embodiments may offer good positioning of components and good structural support.

[0017] Embodiments which may offer sufficient cushioning of the electronic components without sacrificing the stability of their relative positions may be made from material with a shore hardness in a range from about 30 to about 50 and e.g. in a range from about 35 to about 45.

[0018] It is not necessary for the protrusions to be made from material with the same Shore hardness as the material from which the rest of the formed piece is made and in fact some embodiments include a formed piece with protrusions in which the value of the shore hardness of the protrusions differs from the value of the shore hardness of the rest of the formed piece. The difference in Shore hardness produces a difference in resilience and this can be used to allow, for example, greater damping of vibration of the component within the mounting enclosure while the material of the surrounding formed piece restrains the position of the component to the position of the mounting enclosure. In general, use of different shore hardness within the formed piece may allow production of a formed piece offering greater variation in cushioning and positional stability for the electronic components intended to be inserted within it. Therefore, in some embodiments

the shore hardness of the material from which the at least one protrusion is comprised has a lower value than the shore hardness of the resilient material from which the remainder of the formed piece is comprised. In other words, the protrusions of the formed piece are more resilient than the body of the formed piece, which means that the protrusions can resiliently provide cushioning to the component and the mounting enclosure can provide the overall positioning of the component within the casing. In some embodiments the shore hardness of the resilient material from which at least one protrusion is comprised lies in the range from about 15 to about 40 shore hardness and more specifically may be in the range from about 15 to about 30 shore hardness. Furthermore, the shore hardness of the remainder of the formed piece in which the mounting enclosures are formed may lie in the range from about 40 to about 70.

[0019] A different shore hardness could be arranged for only one protrusion, or for several protrusions out of a group arranged within one mounting enclosure, but normally the same value of shore hardness would be arranged for all protrusions positioned in any particular mounting enclosure. However, it may be arranged that all the protrusions in one particular mounting enclosure have one particular value of shore hardness, while all the protrusions in another, and different, mounting enclosure have a different value of shore hardness. This might be arranged, for example, when electronic components of different weights are to be inserted into the different mounting enclosures, in which case a shore hardness of greater value may be arranged for the protrusions in the mounting enclosure arranged to receive the heavier component.

[0020] In some embodiments, the formed piece may include a smooth surface arranged to fit a portion of the inner surface of the outer housing. This may ensure that

the formed piece rests efficiently, and with minimal movement, against the inner surface of the outer housing and thereby may also reduce the overall movement that individual components will suffer during general use of the hearing aid.

[0021] During manufacture the formed piece is typically inserted directly into the inner space in the outer casing. The formed piece may be arranged to be completely space filling within the inner volume created inside the plastic casing of the hearing aid. This may improve the manufacturing process because since, during manufacture, the formed piece is typically inserted directly into the inner space in the outer casing, the outer casing can be formed as an outer shell and a formed piece inserted inside this shell. The formed piece thereby provides resilient support not only for the individual components inside the hearing aid but also for the outer shell itself. The smooth outer surface of the formed piece arranged to fit the form of the inner surface of the outer housing facilitates correct insertion of the formed piece during manufacture of the hearing aid, particularly in the case where the space defined by the shape of the outer casing, and therefore the form defined by the formed piece, is irregular. In this case it is relatively easy to insert the formed piece into the outer casing of the hearing aid with the correct orientation and this typically optimizes the time taken for construction of the hearing aid body during its manufacture.

[0022] In particular, in some embodiments, two formed pieces may be used. Each formed piece has a smooth surface arranged to fit a portion of the inner surface of the outer housing, and each formed piece further includes a substantially level second surface opposite the smooth surface. The level surface is essentially flat so that both formed pieces may be easily brought towards each other and placed together with their level

surfaces touching or flat against each other. When the hearing aid is assembled, the two flat, level, second surfaces fit next to each other so that the two formed pieces constitute a formed body which fits simply within the outer casing. Insertion of the electronic components during manufacture of the hearing aid is better facilitated when the mounting enclosures which are designed into each formed piece are arranged to be formed inwards from each second surface into the body of the respective formed piece. The mounting enclosures sunk into the flat surface are easily visible in the level surface of the formed piece but also are easily accessible so that components can be easily inserted into each respective mounting enclosure. Further, the mounting enclosures for larger components can be distributed across both formed pieces so that when both pieces are pressed together along the flat surfaces of the formed pieces the entire respective mounting enclosure is formed inside the formed body from the two separate enclosures which are placed together when the two formed pieces are joined along their level surfaces. A component can then be inserted during manufacture initially into the mounting enclosure in one formed piece and be covered by the further mounting enclosure in the other formed piece when this is placed on top. This method may be used when there are several large components to be inserted into the hearing aid, because the components can be placed serially into their respective part mounting enclosures in one formed piece and then all be instantaneously covered as the other formed piece is placed on top and pressed together along the flat surface.

[0023] The formed piece as described in embodiments of the invention is particularly well suited for use in hearing aids in which a portion of the hearing aid is arranged to be worn behind the ear. The portion of the hearing aid worn behind the ear is typically

formed with an outer casing with rounded outer surfaces designed to more comfortably fit the shape of the wearer. A problem that typically arises is how to fit the inner electronic components into such an irregularly shaped outer casing. Previous solutions allow for a moulded plastic casing with an array of regularly sized inner spaces and an unevenly shaped outer surface. The difference between the two forms is filled by moulded plastic. Embodiments of the invention, however, allow the production of a moulded insert piece which can be arranged to include mounting enclosures to receive electronic components and to have an irregularly shaped surface which corresponds to the inner surface of the casing which is itself corresponding to the irregularly shaped outer surface.

[0024] Embodiments of the invention further allow sealing of the components against moisture, and this functionality is possible particularly when the formed piece is made from rubber.

[0025] By way of example, good protection of the inner electronic components against moisture may be offered by an embodiment in which there are two formed pieces, each with a level surface, placed together within the outer casing of the hearing aid along the flat surfaces. Because the surfaces are flat and fit together, the two formed pieces, placed together, may effectively seal the inner components against moisture.

[0026] Because the inclusion of the single formed piece obviates the need for the rubber frames in the conventional devices, embodiments of the invention further allow the construction of a hearing aid without the fixing mechanisms of a conventional device. This saves space within the outer casing, permitting the casing to be reduced in size and therefore making the hearing aid smaller in volume and therefore less noticeable.

[0027] A further embodiment of the invention provides for that no further fixing arrangement is required to secure the electronic components into the mounting enclosures. The conventional devices propose further fixing in the form of screw arrangements, adhesive or interlocks etc to further secure the small, regularly shaped rubber frames into the mounting enclosure. Because in embodiments of the invention as herein described the mounting enclosure, in a form that encloses the electronic component, is itself made of a sufficiently resilient material, the component can be inserted directly into the resilient mounting enclosure and held in place without any further fixation. This allows savings in the number of components.

[0028] Moulding, and in particular, injection moulding, may provide an easy and cost efficient way of manufacturing the formed piece. By way of example, single injection moulding can be used to create the piece from a material with a suitable shore hardness. The use of injection moulding allows the construction of the more complicated arrangements of the formed piece, including mounting enclosures and various protrusions, and further allows the manufacture of a formed piece from material of differing shore hardness. Specifically, the use of double injection moulding allows the formation of a formed piece in which the protrusions are made from a material with a first shore hardness which has a value different from the shore hardness of the material from which the remainder of the piece is made. In various embodiments, this could mean that the positional and structural parts could be moulded with a material of greater value of shore hardness while the cushioning support for the transducer, for example, is constructed during the second moulding with a lower value of Shore hardness. Double injection moulding also allows parts with different colors to be moulded. Higher injection

moulding counts are also possible, for example if the cushioning part for the transducer is required to have itself parts of different Shore hardness, and in this case triple injection moulding might be preferred to produce a formed piece comprising three areas each with a different value of Shore hardness. The construction of even more complicated formed pieces is possible. For example, triple injection moulding allows the formation of a formed piece in which one set of protrusions, for example to support a particular component, are constructed with a first shore hardness, a second set of protrusions, for example to support a second component, are constructed with a second shore hardness, while the body of the formed piece is constructed with a third shore hardness. In this case the first, second and third values of shore hardness are different from each other. By way of example, double injection moulding allows parts with different materials or different color materials to be mounted into a single part. Thus in this case, the positional / structural support could be moulded via a higher shore hardness material first, followed by the second moulding for the cushioning support for the transducer (i.e. lower higher shore hardness material). In some embodiments, the cushioning support for the transducer (i.e. receiver and microphone) may need different shore hardness, thus the third moulding could be used, if desired.

[0029] These and other embodiments of the invention will be shown in the following diagrams.

[0030] In the drawings, like reference characters generally refer to the same parts throughout the different views. The drawings are not necessarily to scale, emphasis instead generally being placed upon illustrating the principles of various embodiments of

the invention. In the following description, various embodiments of the invention are described with reference to the following drawings, in which:

FIG. 1 shows a general embodiment of the invention.

FIG. 2 shows a general embodiment of the invention.

FIG. 3 shows an exploded view of an embodiment of the invention.

FIG. 4 illustrates a method of putting together the hearing aid of Figure 3.

FIG. 5 shows embodiments of the protrusions possible within the invention.

FIG. 6 shows embodiments of the protrusions possible within the invention.

[0031] The following detailed description refers to the accompanying drawings that show, by way of illustration, specific details and embodiments in which the invention may be practiced. These embodiments are described in sufficient detail to enable those skilled in the art to practice the invention. Other embodiments may be utilized and structural, logical, and electrical changes may be made without departing from the scope of the invention. The various embodiments are not necessarily mutually exclusive, as some embodiments can be combined with one or more other embodiments to form new embodiments.

[0032] FIGS. 1 and 2 show a general embodiment of the invention. A section of formed piece 101 is visible in which mounting enclosures 102 and 103 are formed. Mounting enclosures 102 and 103 are sunk into the surface of formed piece 101 and are shaped to accommodate suitable electronic components intended for the hearing aid. In this example mounting enclosure 102 may be L-shaped and mounting enclosure 103 may be rectangular in shape but they may be of any shape suitable to accommodate the intended corresponding component. Generally, rectangular mounting enclosure 103

has 5 sides. Mounting enclosure 103 features protrusions 104 distributed on four of the five sides of the mounting enclosure 103. In this example protrusions are not shown on the fifth side of the mounting enclosure 103, seen as a base side in this figure, but this would be possible. Protrusions 104 are substantially rectangular in shape in this embodiment, but they may also be of any suitable shape to support the electronic component.

[0033] FIG. 3 shows an embodiment of the invention. Two formed pieces, 201 and 202, include mounting enclosures 203 into which various components, for example microphones 204, receiver 205, SMD amplifier 206 or receiver connector 207, or combinations thereof, can be placed. In general, formed piece 201 may include corresponding mounting enclosures to formed piece 202. Formed pieces 201 and 202 are arranged to fit into two outer plastic casing pieces, 208 and 209, which are irregular in shape and lock together to form a typical 'behind the ear' section of a hearing aid. Smooth surfaces on the formed pieces 201 and 202 correspond to smooth inner surfaces on the casing pieces 208 and 209. The formed pieces 201 and 202 can be pressed together to form a formed piece assembly 210 and the corresponding mounting enclosures in each formed piece, 201 and 202, form spaces within the body 210 in which the components, 204, 205, 206, 207, are held. Protrusions 212 are formed in a mounting enclosure to support the corresponding electronic component.

[0034] A method of assembly based on the embodiment of FIG. 3 is shown in FIG. 4. Firstly the outer housing piece 308 is laid flat with inner cavity facing upwards. The formed piece 302 corresponding to the outer housing piece 308 is inserted into the outer housing piece 308. Electrical components to be included in the hearing aid, for example

microphone 304, receiver 305 and receiver connector 307, SMD amplifier 306 are placed or inserted, with connecting wires already attached, into the corresponding mounting enclosures of the formed piece 302. The formed piece 301 is placed on top of the formed piece 302 so that corresponding mounting enclosures align and the electronic components are enclosed. Both pieces now form the formed piece assembly 310 mounted in outer housing piece 308. Outer housing piece 309 is placed over formed piece 301 and locked into place with outer housing piece 308 to form a casing which encloses formed piece assembly 310 and the encased components.

[0035] Connecting wires attached to the electronic components may be soldered on.

[0036] FIG. 5 shows examples of possible protrusions in accordance with embodiments of the invention. Protrusions are mounted on side wall 401 at their base 402 and in general have a height, h , measured from the base 402 to the distal surface 403, a width, w , measured between planar sides 404, and a length, l , measured between end surfaces 405.

[0037] A first protrusion form 406 is substantially rectangular in form with essentially regularly cuboid shaped rectangular planar surfaces 404, end surfaces 405 and distal surfaces 403. Although the length of the planar sides 404 are shown as being the same as the width of the side wall 401 of the mounting enclosure, this feature is not necessary and the length of the protrusion may be any suitable length to perform the function of positioning or supporting the electronic component.

[0038] A second protrusion form 407 has a substantially oval form in cross section with essentially regularly shaped curved surfaces 404, minimal end surfaces 405 and oval shaped distal surfaces 403.

[0039] A third protrusion form 408 is substantially ridge-like in form with essentially regularly shaped rectangular planar surfaces 404 which are angled to meet each other at a minimal distal surface 403. The end surfaces 405 are essentially triangular in shape with one side of the triangular shape at the base 402. Other possible shapes in alternative embodiments are cylindrical, squarish, rectangular.

[0040] A fourth protrusion form 409 is substantially conical in form with minimal distal surface 403 and a single conical surface 410.

[0041] A fifth protrusion form 411, as shown in FIG. 6, may be substantially cylindrical in form, including cylinder 412 with essentially circular distal surface 403 with essentially the same size as circular base 402.

[0042] A sixth protrusion form 413, as also shown in FIG. 6, related to 411, may be a cylinder-like form in which essentially circular distal surface 403 is smaller in size than circular base 402. Protrusion form 413, in essence, may be similar to conical form 409 but with the apex removed to leave a flat cut surface.

[0043] A seventh protrusion form 414 may be essentially a cuboid in shape in which all sides have the same size. Protrusion 414 may include a cubic form with square shaped base 402, square shaped distal surface 403, square shaped planar surfaces 404 and square shaped end surfaces 405, all essentially the same size.

[0044] The first protrusion form 406 shows the rectangular cuboid protrusion orientated relative to a side wall 401 of a mounting enclosure in such a way that the long length of the rectangular cuboid form spans the width of the side wall 401. In a related eighth protrusion form 415 the form of the protrusion is again a rectangular cuboid form but in this instance is arranged to be orientate relative to the side wall 401 of the

mounting enclosure in such a way that the short length of the rectangular cuboid form spans the width of the side wall 401.

[0045] Protrusion form 415 may be similar to protrusion form 406 upon rotation through 90 degrees relative to the side wall 401 of the mounting enclosure. The length of planar side 404 may or may not be equal to the width of side wall 401 of the mounting enclosure.

[0046] Other forms of protrusion are possible and may be provided in alternative embodiments.

[0047] While the invention has been particularly shown and described with reference to specific embodiments, it should be understood by those skilled in the art that various changes in form and detail may be made therein without departing from the spirit and scope of the invention as defined by the appended claims. The scope of the invention is thus indicated by the appended claims and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced.

Claims

What is claimed is:

1. A hearing aid, comprising:

an outer housing which contains components positioned in mounting enclosures, which components are suitable for detecting, amplifying and transmitting sound to the wearer; and

a formed piece comprising resilient material and which defines the mounting enclosures for a plurality of the components.
2. The hearing aid as claimed in claim 1,

wherein at least one mounting enclosure defined by the formed piece comprises a protrusion arrangement, which protrusion arrangement comprises at least one protrusion which protrudes from the formed piece into the mounting enclosure.
3. The hearing aid as claimed in claim 2,

wherein the protrusion arrangement comprises more than one protrusion.
4. The hearing aid as claimed in claim 2 or 3,

wherein the at least one protrusion is substantially rectangular in shape and comprises a length in the range from 0.2 mm to 10 mm, a height in the range from 0.2 mm to 1 mm and a width in the range from 0.2 mm to 1 mm.
5. The hearing aid as claimed in any of claim 1 to 4,

- wherein the formed piece comprises a smooth surface arranged to fit a portion of the inner surface of the outer housing.
6. The hearing aid as claimed in claim 5,
wherein there is a second formed piece comprising a smooth surface arranged to fit a portion of the inner surface of the outer housing and wherein each formed piece comprises a second surface opposite the smooth surface, which second surface is substantially level so that when assembled the two second surfaces fit next to each other.
 7. The hearing aid as claimed in claim 6,
wherein the mounting enclosures are formed inwards from second surfaces into the body of each respective formed piece.
 8. The hearing aid as claimed in any of claims 1 to 7,
wherein the resilient material is rubber.
 9. The hearing aid as claimed in any of claims 1 to 8,
wherein the resilient material of which the formed piece is comprised has a shore hardness in the range from 15 to 40 shore hardness.
 10. The hearing aid as claimed in any of claims 2 to 9,

- wherein at least one protrusion is comprised of resilient material with a different shore hardness than the resilient material from which the remainder of the formed piece is comprised.
11. The hearing aid as claimed in claim 10,
wherein the shore hardness of the material from which the at least one protrusion is comprised has a lower value than the shore hardness of the resilient material from which the remainder of the formed piece is comprised.
12. The hearing aid as claimed in claim 10,
wherein the shore hardness of the resilient material from which at least one protrusion is comprised lies in the range from 15 to 70 shore hardness; and/or
wherein the shore hardness of the resilient material from which the remainder of the formed piece is comprised lies in the range from 15 to 70 shore hardness.
13. The hearing aid according to any previous claim,
in which the hearing aid comprises a portion arranged to be worn behind the ear
and in which the inner formed piece is situated in the portion worn behind the ear.
14. Method of manufacture of a formed piece for a hearing aid comprising an outer housing and components suitable for providing the functionality of the hearing aid,
in which the formed piece comprises a plurality of mounting enclosures suitable

to receive the components, and is formed using single injection moulding from a material with a shore hardness in the range 15 to 70.

15. Method of manufacture to create a formed piece for a hearing aid comprising an outer housing and components suitable for providing the functionality of the hearing aid, in which the formed piece comprises resilient material and further comprises a plurality of mounting enclosures suitable to receive the components, and in which at least one mounting enclosure comprises protrusions, wherein the formed piece is constructed using double injection moulding and in which the formed pieces is formed from a material with a first shore hardness while the protrusions are formed from a second shore hardness.
16. A formed piece for a hearing aid comprising an outer housing and components suitable for providing the functionality of the hearing aid, in which the formed piece comprises resilient material and further comprises a plurality of mounting enclosures suitable to receive the components.

FIG 1

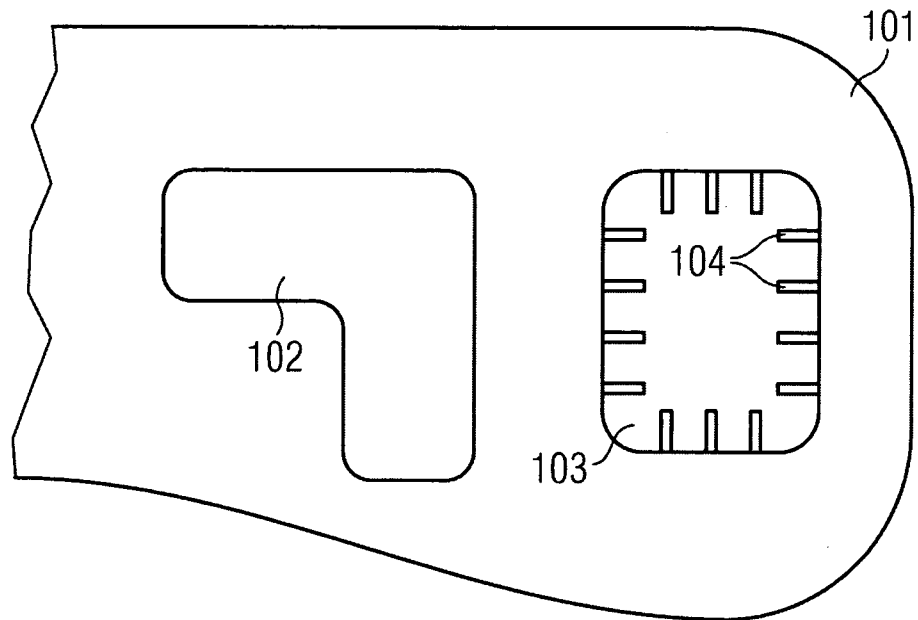


FIG 2

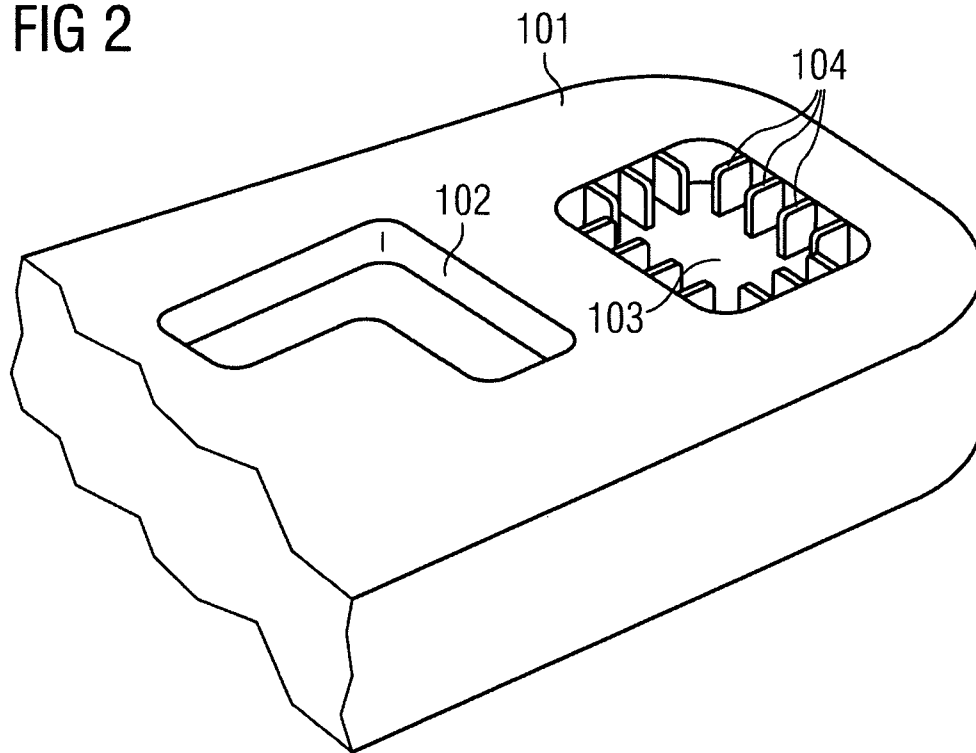
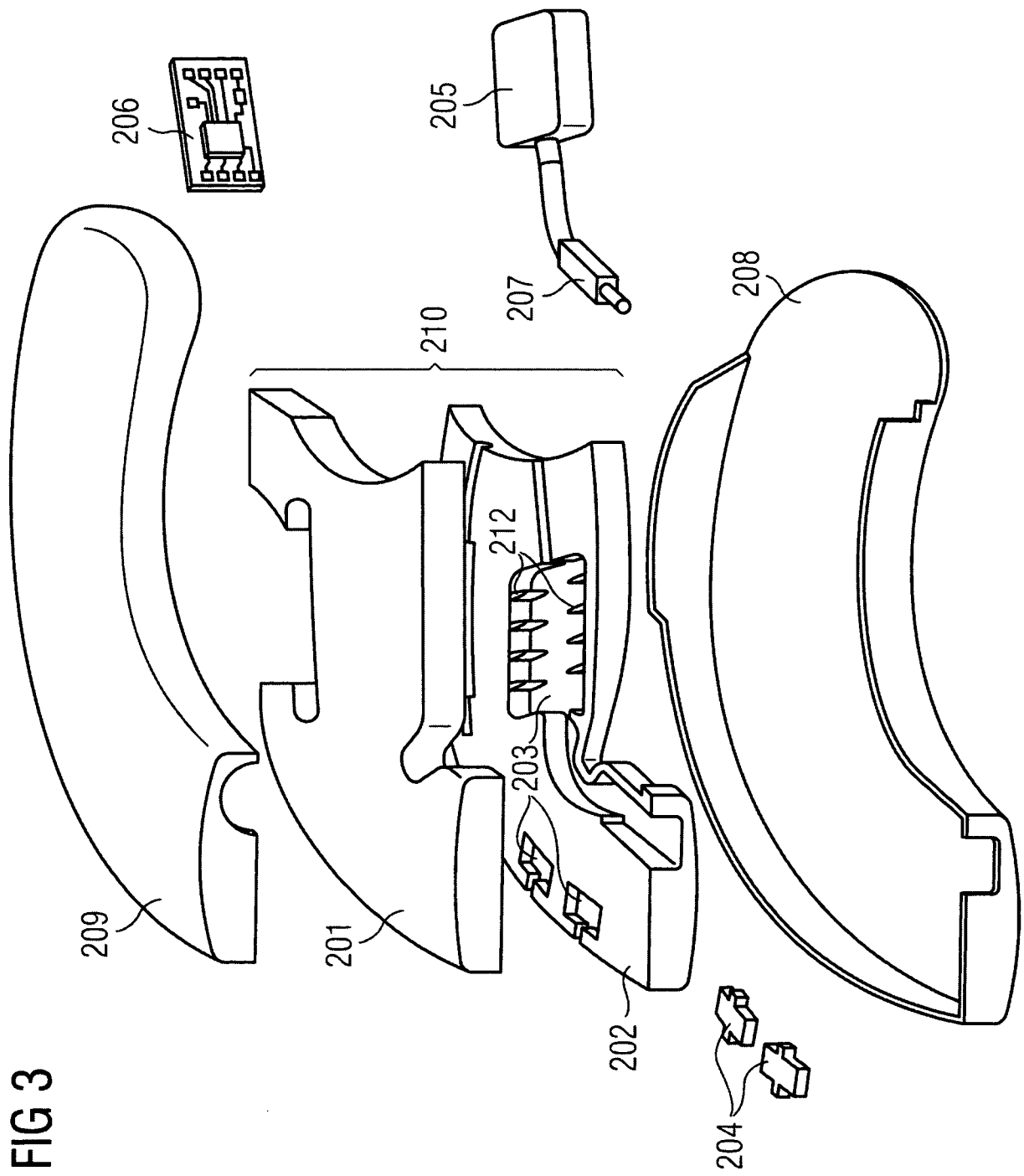
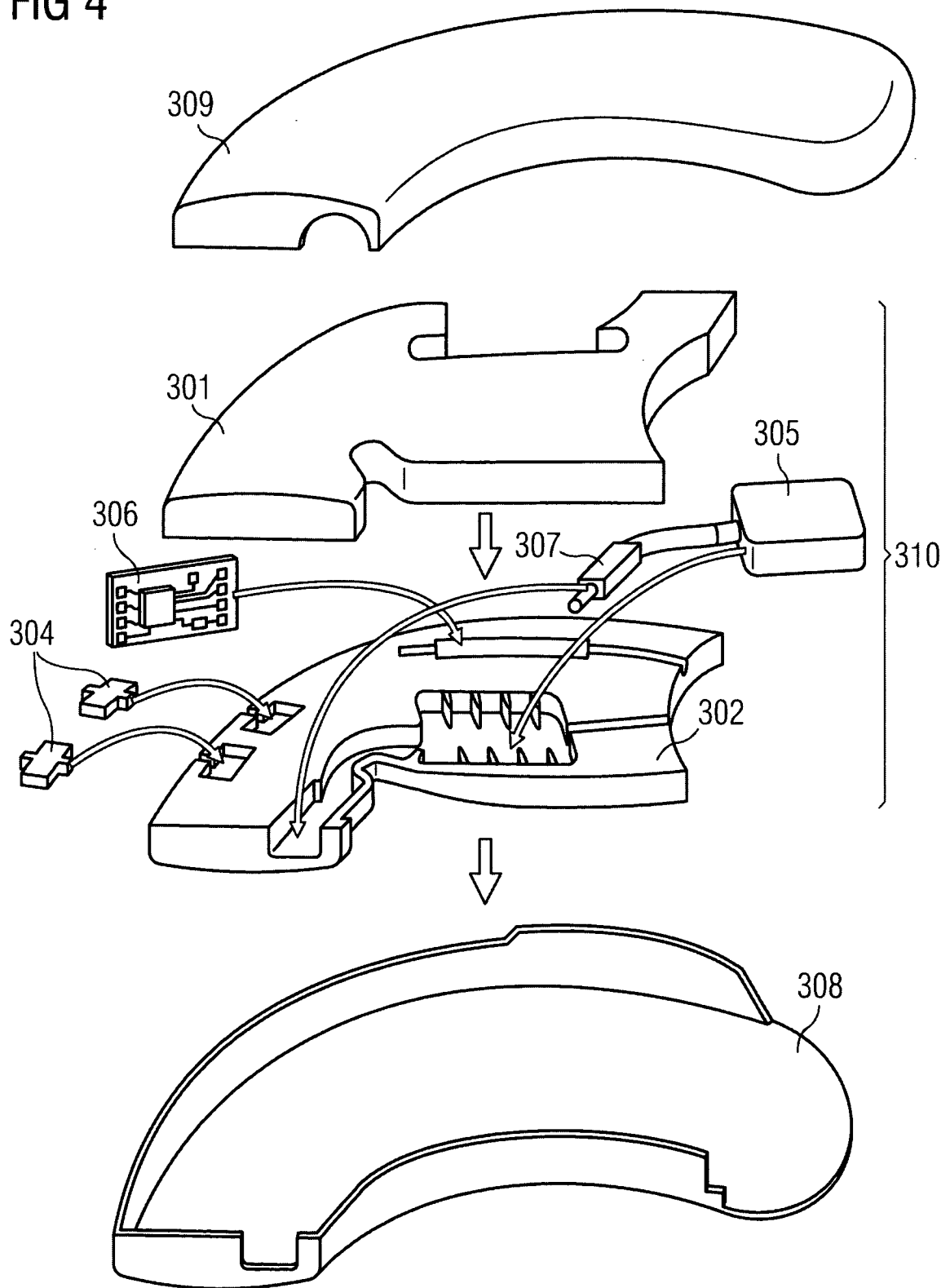


FIG 3



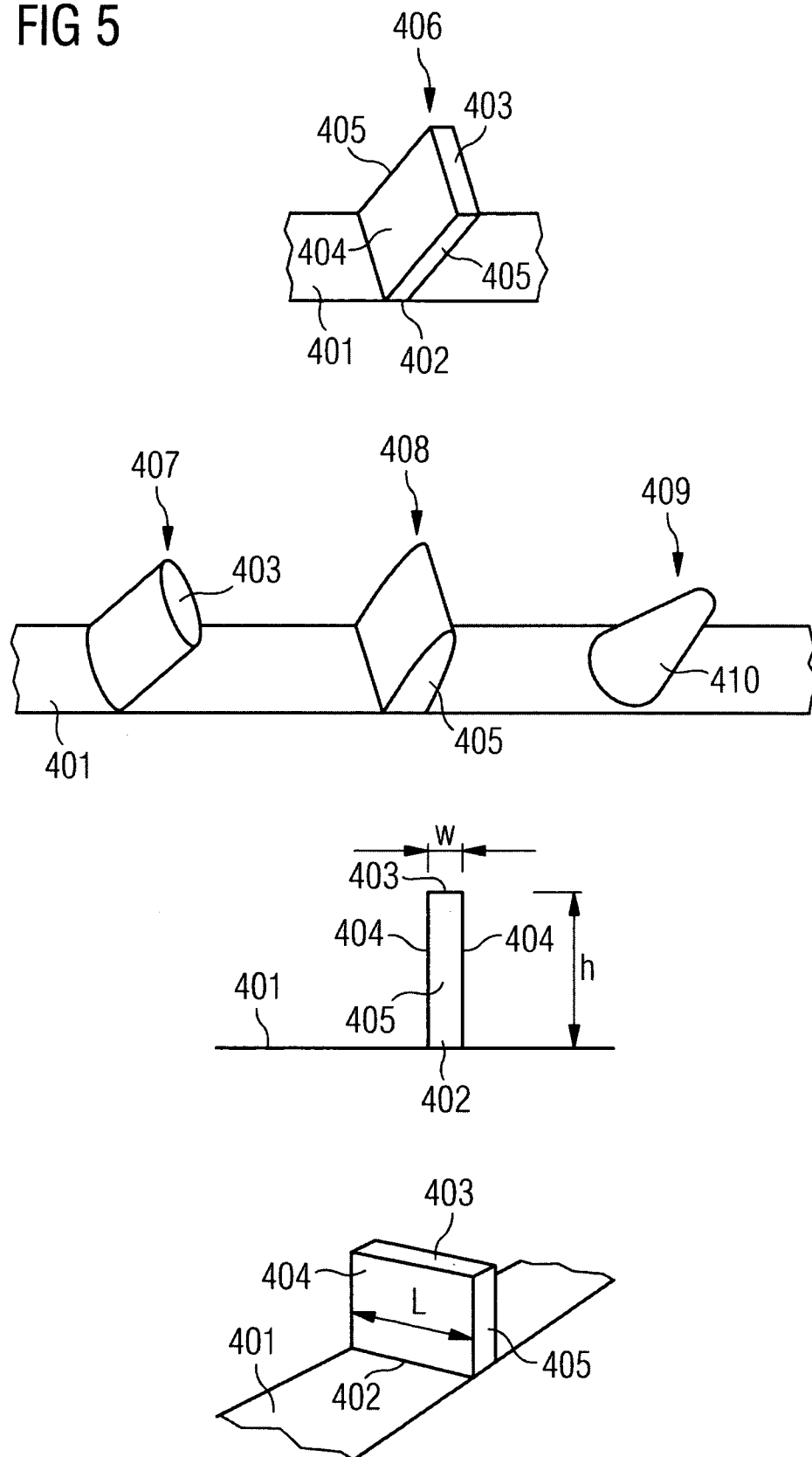
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FIG 4



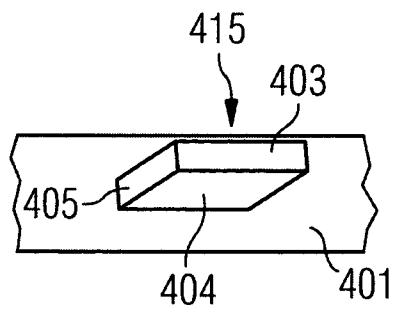
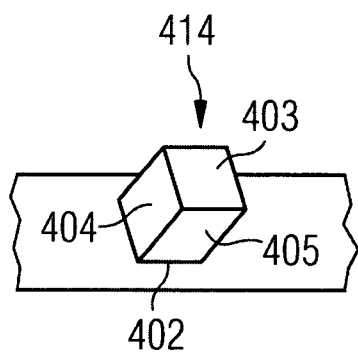
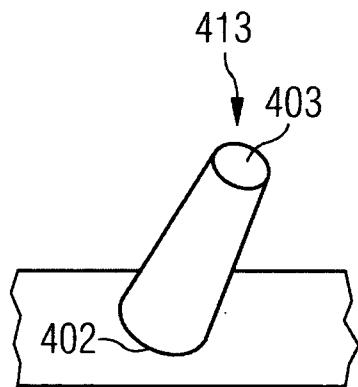
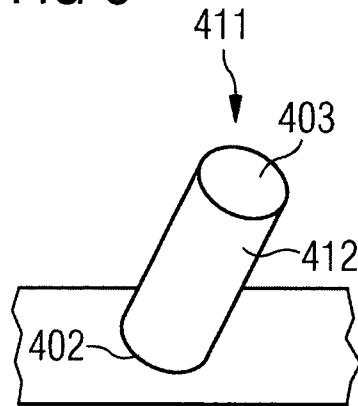
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FIG 5



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FIG 6



INTERNATIONAL SEARCH REPORT

International application No.
PCT/SG 2009/000128

A. CLASSIFICATION OF SUBJECT MATTER

IPC⁸: **H04R 25/00** (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC⁸: H04R 25/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI, EPODOC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 1915029 A2 (Nikles et al.) 23 April 2008 (23.04.2008) <i>Abstract; claim 1, Fig. 4</i> --	1
A	EP 1626612 A (Van Halteren) 15 February 2006 (15.02.2006) <i>Abstract; claim 1</i> --	1
A	EP 1349425 A2 (Gebert et al.) 1 October 2003 (01.10.2003) <i>Abstract; claim 1</i> ----	1

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

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Date of the actual completion of the international search
21 September 2009 (21.09.2009)Date of mailing of the international search report
28 September 2009 (28.09.2009)Name and mailing address of the ISA/ AT
Austrian Patent Office
Dresdner Straße 87, A-1200 Vienna

Facsimile No. +43 / 1 / 534 24 / 535

Authorized officer

GRÖSSING G.

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/SG 2009/000128

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